

# This document is discoverable and free to researchers across the globe due to the work of AgEcon Search. 

## Help ensure our sustainability. Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

Papers downloaded from AgEcon Search may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.


GIANNINI FOUNDATION OF<br>AGRICULTUTEM ECONOMICS<br>Lintro<br>Ahnt.<br>4HK 171990

## WORKING PAPER

Canadä'


Working papers are (1) interim reports completed by the staff of the Policy Branch, and (2) research reports completed under contract. The former reports have received limited review, and are circulated in the language of preparation for discussion and comment. Views expressed in these papers are those of the author(s) and do not necessarily represent those of Agriculture Canada.

AN ANALYSIS OF WHEAT SUPPLY RESPONSE
UNDER RISK AND UNCERTAINTY
(Working Paper 1/90)
R.A. Schoney

Department of Agricultural Economics
University of Saskatchewan Saskatoon, Saskatchewan S7N OWO

March 1990

## ACKNOWLEDGEMENTS

R. Chikwana contributed much of the theory of stochastic dominance, $p p$ 9-10, the measurement of risk attitudes $p p 35-47$, and contributed data used to build the soil and crop modules.
D. L. Cameron worked on pp 47 to 50 and contributed to data development.

## EXECUTIVE SUMMARY

The primary objective of this study is to appraise typical Saskatchewan grain producer supply response to price induced risk. A secondary objective is to quantify the major sources of farm income risk, price and yield, faced by typical wheat farmers on the brown soils. In general, risk does not aggregate well. Analysis of risk in the aggregate lacks the rigorous foundation underlying neoclassical economics. Moreover, when individuals are non neutral in risk attitudes, the traditional measures of producer welfare are meaningless and must be replaced by concepts such as the utility certainty equivalent price. Individual farmers are confronted with local weather variability. However, measurements of yield variability based on provincial or national yield averages tend to mask true yield risk faced by an individual due to the pooling effect associated with aggregation of data. In addition, the distribution effects associated with price stabilizing policies are important. Thus, a representative study approach is used to evaluate producer response to alternative generic price stabilization polices. Producer response to risk is evaluated at the whole farm level, not at the enterprise level; that is producers respond to variations in net cash income in planning seeded acres. Thus, posited supply response to stochastic prices becomes a function of the nature of the price distribution, risk attitudes, production costs and financial structure. In this model, supply response is based on the fallow/seed FLEXCROP decision rule. The FLEXCROP decision rule is based on a critical soil moisture threshold, $M_{c}$ and actual spring soil moistures $M_{t}$; if $M_{t} \geq M_{c}$, then the producer would seed and if $M_{t}<M_{c}$, then the producer would fallow. A bio-economic simulator is constructed incorporating stochastic May soil moisture, $M_{t}$, and yield relationships and deterministic farm costs. By parametrically varying $M_{c}$, the optimal FLEXCROP decision rule can be found. Supply response, then, is based on adjustment of optimal cropping intensity to varying prices and risk.

If each producer were perfectly risk neutral, then each producer would choose the expected profit maximizing strategy. Consequently, the actuarially sound stabilization programs would have no production effect. However, producers were found to possess differing risk attitudes-at least at lower income levels. Three wheat producer clusters are identified: Cluster A-relatively risk loving (10\%), Cluster B-relatively risk neutral (40\%) and Cluster Crelatively risk adverse (50\%).

Three price scenarios and four price policies are examined. The three price scenarios include 1) a middle price scenario with an expected wheat price of $\$ 181.23$, the historical mean adjusted for inflation and technology; 2) a low expected wheat price of $\$ 141.93 / t$ (historical mean - one standard deviation) and 3) a high expected price of $\$ 224.76$ (historical mean + one standard deviation). Four alternative price stabilization programs are chosen, representing the free market with no government restrictions (no-price stabilization policy), upper and lower bounded prices (price truncation), and lower bounded prices (price insurance) and perfect price stabilization (fixed price). In each scenario the price coefficient of variation is held constant at $31 \%$ of the mean, historical average.

The net worth cdf of farm risk cluster is simulated for each FLEXCROP $M_{c}$ strategy, price level and price policy. A total of 3 clusters $x 9 M_{c}$
risk averse. ${ }^{2}$
5. The constant risk aversion coefficient is not constant over income but declines. This implies that the absolute risk premium declines with wealth and wealthier producers would be willing to pay less for a given reduction in the standard deviation of income.
6. The relative risk aversion coefficient is also not constant over income. Farmers are far more likely to be risk neutral at higher prices than at lower prices. This implies that the proportional risk premium these producers would be willing to pay also declines in more favorable economic environments.
7. The implication of 3,4 , and 5 is that government programs which are based on risk-neutral behavior may seem to work well during times of high commodity prices, may not work nearly so well during times of low expected prices.
8. A general conclusion from varying risk attitudes is that risk lovers produce more and risk averters produce less than perfectly risk neutral producers under free market prices.

Acreage Response to Price Stabilization. General findings with respect to risk attitudes and supply response are the following.
9. Regardless of risk attitude, so long as risk attitudes are not perfectly risk neutral, farmers react to any mandatory stabilizing programs by producing more. Risk lovers increase output more than risk averters because of the slope of the tradeoff between expected income-risk. At low prices, impact of price stabilization programs is to expand production of risk averters to approximately the same level as PMAX (perfect risk neutrality).
10. Price stabilization programs only have impact on acreage response at low commodity prices. Wheat acreage supply response based on cropping intensity is very inelastic with respect to changes in risk; the maximum acreage response occurs at the lowest expected price scenario and is $3.1 \%$ to $9.1 \%$ over free market prices if all price variability were removed. However, more typical acreage response is 2 to $3 \%$. The latter translates into optimal total farm production increases of 1 to $2 \%$.

Risk Attitudes and Responsiveness to Price Changes Under No Price Stabilization. Using perfect risk neutrality or the profit maximizing model as the benchmark, the benchmark price elasticities of acreage response are 0.31 and 0.12 , respectively, between low-mid and mid-high price intervals. This compares very favorably to other research findings. The corresponding

[^0]price elasticity of wheat production is 0.14 and 0.05 , respectively. General findings with respect to risk attitudes and supply response and no price stabilization policies are the following.
11. Using the low prices and PMAX (perfect risk neutrality), the benchmark price elasticity is 0.31 , the corresponding price elasticities of relative risk lovers and relative risk neutral producers are 0.19 and 0.18 , respectively; thus they are somewhat less price responsive than PMAX. Risk averters are somewhat more price responsive (0.35) than PMAX at low prices.
12. All risk lovers are less responsive than PMAX to price changes at high prices because they are operating at a relatively high production level and have rapidly diminishing total production.
13. If each cluster is weighted by its corresponding sample proportion and summed to give the aggregate response then the acreage responsive to price is 0.15 or about $50 \%$ of the PMAX of 0.31 . Production response is about one-half of acreage response due to diminishing average yields.

Risk Attitudes and Responsiveness to Price Changes Under Price Stabilization. General findings with respect to risk attitudes and supply response and price stabilization policies are the following.
14. With respect to relatively risk neutral and risk averse producers, most price stabilization programs had little impact on acreage response to price even under lower prices. Risk loving producers became less responsive to price with price truncation, price insurance and fixed price (ranked in order of diminishing acreage responsiveness) primarily because they are operating at a higher production level.
15. In the aggregate, price stabilization programs tend to make producers less responsive to price, primarily because they are operating at a higher production level; with price truncation, price insurance and fixed price ranked in order of diminishing acreage responsiveness. At high prices, there is no significant aggregate acreage response to price.

Preferences towards Stabilization Programs, General findings with respect to producer preferences towards price stabilization programs are following.
16. If given a choice, risk lovers prefer a no price stabilization policy while risk averters would tend to prefer a symmetrical lower and upper price truncation program over the price insurance program.

## Limitations

This study focuses solely on adjustment of wheat cropping intensity to expected prices on the brown soils of Saskatchewan; neither cross price effects, changes in input intensity nor changes in land base are allowed. The
problem of a single product is potentially acute with the dark brown and black soils of Saskatchewan. However, inclusion of alternative competing crops complicates considerably supply response under risk because all the various price-price, price-yield and yield-yield correlations must be considered.

## Generalization to Other Saskatchewan Soils

It has been shown that risk averse producers are less responsive to price changes. It is posited that wheat acreage is likely to be more responsive to changes to wheat price and wheat price risk on the dark brown soil zone because there are more crop substitution possibilities than the brown soils. It is also posited that wheat producers will be less responsive to wheat price or price risk changes on the black soil zone even though there are other greater crop substitution possibilities because 1) canola which is the major alternative tends to be planted at the maximum and thus will be relatively unresponsive to cross price effects and 2) current cropping patterns include very little fallow leaving little room for expansion of wheat through greater cropping intensity.

TABLE OF CONTENTS
EXECUTIVE SUMMARY ..... ii
Acreage Response to Price Stabilization. ..... iv
Limitations ..... v
CHAPTER I: INTRODUCTION ..... 1
Objectives ..... 2
Research Procedure and Methodology ..... 3
Organization ..... 7
CHAPTER II: ALTERNATIVE MODELS OF CROPPING DECISIONS UNDER RISK ..... 9
Introduction ..... 9
Expected Utility Maximization ..... 9
Crop Portfolio Analysis ..... 10
E-V Portfolio Analysis ..... 10
The MOTAD/MAD Model ..... 12
Stochastically Efficient Criteria ..... 14
First and Second Degree Stochastic Dominance ..... 15
Risk Interval Approach ..... 16
Stochastic Dominance with Respect to a Function ..... 17
Limitations of Risk Interval Approach/ SDRF ..... 19
Summary ..... 19
CHAPTER III: THE BIO-ECONOMIC SIMULATOR ..... 21
Introduction ..... 21
The Management Module ..... 21
The Soil Module: May Soil Moisture ..... 23
The Agronomic Module: Wheat Yields ..... 28
Error Term ..... 31
Income CDF's ..... 31
Stochastically Efficient Sets ..... 31
Summary ..... 32
CHAPTER IV: REPRESENTATIVE FARMS AND RISK PREFERENCES ..... 35
Introduction ..... 35
Risk Attitudes of Saskatchewan Farmers ..... 35
Risk Interval Results ..... 38
Absolute Risk Aversion ..... 38
Relative Risk Aversion Coefficient ..... 39
Representative Farm Risk Clusters ..... 40
Cluster A--Relatively Risk Loving ..... 40
Cluster B--Relatively Risk Neutral ..... 41
Cluster C--Relatively Risk Adverse ..... 42
Representative Farm Risk Coefficients ..... 45
Representative Farms Costs and Size ..... 47
Cropping Rotation Strategies ..... 49
Summary ..... 49
CHAPTER V: SELECTION OF PRICE STABILIZATION PROGRAMS ..... 51
Choice of Wheat Prices ..... 51
Historical Wheat Prices ..... 52
Opportunity Cost of Production (COP) ..... 53
Price Scenarios ..... 53
Price Stabilization Programs ..... 55
Impact of Yield and Price Variability on Gross Income Variability ..... 62
Summary ..... 63
CHAPTER VI: RESULTS ..... 65
Introduction ..... 65
The Relationship Between $M_{c}$ and Cropping Intensity ..... 66
Cropping Intensity and Yields ..... 67
Expected Net Income and Variability of Net Income ..... 69
Supply Response Under Perfect Risk Neutrality ..... 72
Risk Efficient $M_{c}$ Strategies ..... 74
Cluster A ..... 76
Cluster B ..... 78
Supply Response Under Risk ..... 85
Risk Lovers ..... 86
Risk Neutrality ..... 86
Risk Averting ..... 86
Aggregate Response ..... 87
An E-V Analysis of Response ..... 89
Producer Price Stabilization Policy Preferences ..... 92
CHAPTER VII: SUMMARY AND CONCLUSIONS ..... 98
Research Objectives ..... 98
Research Findings and Conclusions ..... 99
Preferences ..... 99
Stabilization Programs and Expected Prices ..... 100
Acreage Response to Price Under Risk. ..... 101
Acreage Response to Price Stabilization. ..... 102
Risk Attitudes and Responsiveness to Price Changes ..... 103
Price Stabilization and Responsiveness to Price Changes ..... 104
Stabilization Program Preferences ..... 104
Limitations ..... 104
Normative vs Positive ..... 105
Single Crop-Brown Soils ..... 105
Single Crop-Black Soils ..... 105
Single Crop-Dark Brown Soils ..... 106
REFERENCES ..... 107
APPENDIX•A: Simulated Soil Moisture and Wheat Yield ..... 114
APPENDIX B: Risk Survey and Results ..... 116
Risk Interval Results ..... 117
APPENDIX C: Simulated Income Distributions ..... 122

## LIST OF TABLES

Table 4.0: Income Distribution Parameters, Risk Attitude Questionnaire, 1987 ..... 36
Table 4.1: Definition of Questionaire Absolute Risk Intervals (RIA) ..... 37 ..... 37
Table 4.2: Summary of Farm and Sociological Statistics, by Cluster Group ..... 43
Table 4.3: Summary of Mean, Lower and Upper $\tau$ Ranges, by Cluster Group ..... 43
Table 4.4: Number of Respondents by Risk Classification ..... 44
Table 4.5: Summary of Commonly Used Risk Aversion Coefficients ..... 45
Table 4.6: Income Intervals, by Cluster ..... 47
Table 4.7: Risk Intervals and Absolute Risk Coefficients ..... 47
Table 4.8: Representative Farm Size, Assets and Debt, Saskatchewan, Brown Soils ..... 48
Table 4.9: Costs of Production, Saskatchewan, Brown Soils ..... 48
Table 4.10: Annual Overhead Costs and Family Living Withdrawals, Brown Soils ..... 49
Table 5.1: Long Run, Real-Indexed Saskatchewan Wheat Prices, and 1987 Top Management Costs of Production ..... 55
Table 5.2: Wheat Price Scenarios ..... 55
Table 5.3: Simulated Statistics of Stabilization Programs ..... 57
Table 5.4: Estimated Variability in Gross Income ..... 63
Table 6.0: Simulated Mean Cropping Intensity and Mean Yield By $M_{c}$, Brown Soils, Saskatchewan ..... 69
Table 6.1: Mean and Standard Deviation of Simulated Income, by $M_{c}$, Cluster, Price Policy and Price Level, Brown Soils of Saskatchewan
Table 6.2: Summary of Selected Studies of Wheat Acreage Supply Price Elasticities ..... 74
Table 6.3a: Risk Efficient $M_{c}$ Strategies, by Cluster and Wheat Price ..... 82
Table 6.3b: Mean Risk Efficient $M_{c}$ Strategies, by Price Level and Cluster ..... 82
Table 6.4: Mean Risk Efficient Cropping Intensity* by Cluster and Wheat Price ..... 83
Table 6.5: Risk Efficient Acreage Decisions, by Cluster and Price Level, Brown Soils ..... 83
Table 6.6: Impact of Stabilization Programs on Risk Efficient Acreage Decisions, Brown Soils ..... 84
Table 6.7: Impact of Stabilization Programs on Risk Efficient Production ..... 84
Table 6.9: Weighted Acreage Supply Response ..... 88
Table 6.10: Estimated Interval Price Elasticity of Production Response by Cluster and Wheat Price, Brown Soil Zone ..... 89
Table 6.11: Expected Value-Standard Deviation of Annualized Income Frontier, Cluster B, Base Price Scenario ..... 91
Table 6.12: Risk Efficient Pricing Policy Strategies, All Pricing Policy Policies Considered ..... 94
Table 6.13: Risk Efficient Pricing Policy Strategies, No Fixed Pricing Policy ..... 95
Table 6.14 : Summary of Simulated Annualized Income CDFs, 90 mm Low Price Scenario, Cluster C, Brown Soils, Saskatchewan ..... 97
Appendix Table A-1: Real-Time, Simulated Wheat Yields and Field Moisture, Brown Soils ..... 115
Appendix Table B-1: Financial and Sociological Characteristics of Clusters ..... 117
Appendix Table B-2: Mean, Lower and Upper $\tau$ Ranges-Cluster A ..... 117
Appendix Table B-3: Mean, Lower and Upper $\tau$ Ranges--Cluster B ..... 118
Appendix Table B-4: Mean, Lower and Upper $\tau$ Ranges--Cluster C ..... 119
Appendix Table B-5: Mean, Lower and Upper $\theta$ Ranges--Cluster A ..... 120
Appendix Table B-6: Mean, Lower and Upper $\theta$ Ranges-Cluster $B$ ..... 120
Appendix Table $B-7$ : Mean, Lower and Upper $\theta$ Ranges-Cluster C ..... 121
Appendix Table B-8: Profile of Sample Farmers According to Net Worth, 1987 ..... 121
Appendix Table C-1: Simulated Annualized Income CDFs, Cluster A, No Price Intervention, Low Price Scenario, Brown Soils, Saskatchewan . ..... 123
Appendix Table C-2: Simulated Annualized Income CDFs, Cluster A, No Price Intervention, Base Price Scenario, Brown Soils, Saskatchewan ..... 124
Appendix Table C-3: Simulated Annualized Income CDFs, Cluster A, NoPrice Intervention, High Price Scenario, Brown Soils, Saskatchewan125
Appendix Table C-4: Simulated Annualized Income CDFs, Cluster A, Truncated Prices, Low Price Scenario, Brown Soils, Saskatchewan ..... 126
Appendix Table C-5: Simulated Annualized Income CDFs, Cluster A, Truncated Prices, Base Price Scenario, Brown Soils, Saskatchewan ..... 127
Appendix Table C-6: Simulated Annualized Income CDFs, Cluster A, Truncated Prices, High Price Scenario, Brown Solls, Saskatchewan ..... 128
Appendix Table C-7: Simulated Annualized Income CDFs, Cluster A, Price Insurance Policy, Low Price Scenario, Brown Soils, Saskatchewan ..... 129
Appendix Table C-8: Simulated Annualized Income CDFs, Cluster A, Price Insurance Policy, Base Price Scenario, Brown Soils, Saskatchewan ..... 130
Appendix Table C-9: Simulated Annualized Income CDFs, Cluster A, Price Insurance Policy, High Price Scenario, Brown Soils, Saskatchewan ..... 131
Appendix Table C-10: Simulated Annualized Income CDFs, Cluster A, Fixed Price Policy, Low Price Scenario, Brown Soils, Saskatchewan ..... 132
Appendix Table C-10: Simulated Annualized Income CDFs, Cluster A, Fixed Price Policy, Base Price Scenario, Brown Soils, Saskatchewan ..... 133
Appendix Table C-12: Simulated Annualized Income CDFs, Cluster A, Fixed Price Policy, High Price Scenario, Brown Soils, Saskatchewan ..... 134
Appendix Table C-13: Simulated Annualized Income CDFs, Cluster B, No Price Intervention, Low Price Scenario, Brown Soils, Saskatchewan ..... 135
Appendix Table C-14: Simulated Annualized Income CDFs, Cluster B, No Price Intervention, Base Price Scenario, Brown Soils, Saskatchewan ..... 136
Appendix Table C-15: Simulated Annualized Income CDFs, Cluster B, No Price Intervention, High Price Scenario, Brown Soils, Saskatchewan ..... 137
Appendix Table C-16: Simulated Annualized Income CDFs, Cluster B, Truncated Prices, Low Price Scenario, Brown Soils, Saskatchewan ..... 138
Appendix Table C-17: Simulated Annualized Income CDFs, Cluster B, Truncated Prices, Base Price Scenario, Brown Soils, Saskatchewan ..... 139
Appendix Table C-18: Simulated Annualized Income CDFs, Cluster B,

Truncated Prices, High Price Scenario, Brown Soils, Saskatchewan . 140
Appendix Table C-19: Simulated Annualized Income CDFs, Cluster B, Price
Insurance Policy, Low Price Scenario, Brown Soils, Saskatchewan . . 141
Appendix Table C-20: Simulated Annualized Income CDFs, Cluster B, Price
Insurance Policy, Base Price Scenario, Brown Soils, Saskatchewan . 142
Appendix Table C-21: Simulated Annualized Income CDFs, Cluster B, Price
Insurance Policy, High Price Scenario, Brown Soils, Saskatchewan . 143
Appendix Table C-22: Simulated Annualized Income CDFs, Cluster B, Fixed
Price Policy, Low Price Scenario, Brown Soils, Saskatchewan . . . . 144
Appendix Table C-23: Simulated Annualized Income CDFs, Cluster B, Fixed
Price Policy, Base Price Scenario, Brown Soils, Saskatchewan . . . 145
Appendix Table C-24: Simulated Annualized Income CDFs, Cluster B, Fixed
Price Policy, High Price Scenario, Brown Soils, Saskatchewan . . 146
Appendix Table C-25: Simulated Annualized Income CDFs, Cluster C, No
Price Intervention, Low Price Scenario, Brown Soils, Saskatchewan . 147
Appendix Table C-26: Simulated Annualized Income CDFs, Cluster C, No
Price Intervention, Base Price Scenario, Brown Soils, Saskatchewan148
Appendix Table C-27: Simulated Annualized Income CDFs, Cluster C, No
Price Intervention, High Price Scenario, Brown Soils, Saskatchewan ..... 149
Appendix Table C-28: Simulated Annualized Income CDFs, Cluster C, Truncated Prices, Low Price Scenario, Brown Soils, Saskatchewan . . 150

Appendix Table C-29: Simulated Annualized Income CDFs, Cluster C, Truncated Prices, Base Price Scenario, Brown Soils, Saskatchewan . 151
Appendix Table C-30: Simulated Annualized Income CDFs, Cluster C, Truncated Prices, High Price Scenario, Brown Soils, Saskatchewan . 152
Appendix Table C-31: Simulated Annualized Income CDFs, Cluster C, Price
Insurance Policy, Low Price Scenario, Brown Soils, Saskatchewan . . 153
Appendix Table C-32: Simulated Annualized Income CDFs, Cluster C, Price
Insurance Policy, Base Price Scenario, Brown Soils, Saskatchewan . 154
Appendix Table C-33: Simulated Annualized Income CDFs, Cluster C, Price
Insurance Policy, High Price Scenario, Brown Soils, Saskatchewan 155
Appendix Table C-34: Simulated Annualized Income CDFs, Cluster C, Fixed
Price Policy, Low Price Scenario, Brown Soils, Saskatchewan . . . . 156
Appendix Table C-35: Simulated Annualized Income CDFs, Cluster C, Fixed
Price Policy, Base Price Scenario, Brown Soils, Saskatchewan . . . 157
Appendix Table C-36: Simulated Annualized Income CDFs, Cluster C, Fixed
Price Policy, High Price Scenario, Brown Soils, Saskatchewan . . 158
Figure 1 : Steps in Determining the Risk Efficient Supply Response Acreages ..... 8
Figure 2: Efficient Crop Portfolio ..... 12
Figure 3: Second Degree Stochastic Dominance ..... 16
Figure 4: CDF of May Soil Moisture by Fixed Rotation ..... 27
Figure 5: CDF of Simulated Yields, Fixed Rotations, Brown Soil Zone of Saskatchewan ..... 30
Figure 6: Nominal, Real and Indexed Spring Wheat Prices ..... 52
Figure 7: Estimated Wheat Price Distributions, by Policy, Medium Price Scenario ..... 59
Figure 8: Estimated Wheat Price Distribution, by Policy, Low Price Scenario ..... 60
Figure 9: Estimated Wheat Price Distributions, by Policy, High Price Scenario ..... 61
Figure 10: Simulated Mean Cropping Intensity, by $M_{c}$, Brown Soil Zones ..... 66
Figure 11: Simulated Mean and Standard Deviation of Wheat Yields, by $M_{c}$, Brown Soil Zone ..... 68
Figure 12: Cropping Strategies Dominance Matrix, No Price Policy, Brown Soils, Saskatchewan ..... 75
Figure 13: Risk Efficient Cropping Intensity, Cluster A--Risk Lovers ..... 77
Figure 14: Risk Efficient Cropping Intensity, Cluster B-Relatively Risk Neutral ..... 79
Figure 15:Risk Efficient Cropping Intensity, Cluster C--Risk Averters ..... 80
Figure 16: Expected Income-Variance Frontier, Base Price Scenario,
Cluster B ..... 92

## AN ANALYSIS OF WHEAT SUPPLY RESPONSE UNDER RISK AND UNCERTAINTY

## CHAPTER I: INTRODUCTION

Most farm production and investment decisions are made under uncertain commodity prices, crop yields, interest rates, and government farm policies. According to Wilson and Eidman (1983), fundamental production decisions cannot be isolated from risk management considerations. Hazell (1982) argues that if risk is omitted from farm management models, 1) production response will be over-estimated, 2) optimal cropping patterns will be overly specialized and supply elasticities estimates will be biased. Yet, most policy recommendations are based on single-period, static models or assume risk neutrality. While there has long been considerable interest in the impact of risk on farm production and organization at the farm level, interest in the aggregate farm level has been comparatively recent. Just (1975) was perhaps one of the first to incorporate the effects of risk in assessing alternative agricultural policies. While the problem of measuring risk is a problem with both farm level and aggregate models, it has been a much greater problem at the aggregate level. Thus, a major concern in aggregate supply analysis lies in selecting an appropriate risk measure to be included in the analysis. Historically, aggregate models have included some type of variance measure of commodity prices or crop gross revenues as a proxy variable for risk. ${ }^{3}$ But, these aggregate supply response models lack micro linkages in terms of individual risk attitudes: most farm level risk models are based on individual response to their own distributions of net farm income, given their unique

[^1]risk attitudes. Moreover, aggregate models have severe problems when extended to policy analysis in that even if the underlying prices are normally distributed, often the central policy focus is to alter the shape of the price distribution. Furthermore, even if both commodity prices and yields are normal, their product will not be normal. Also, as is well known, risk does not aggregate well do the "pooling" effect and thus, aggregate price and income variance are not satisfactory risk proxy variables. Finally, if producers are allowed to possess non-neutral risk attitudes, then aggregate measures of producer welfare are no longer valid; an individual's utility (welfare) is no longer a linear function of revenue.

Even though there are numerous methodological problems, supply response under risk is of considerable interest to policy makers because many fundamental Canadian farm programs are currently being examined for efficiency, distributional impacts and production neutrality. Programs such as stabilization and crop insurance, which are designed to modify the distribution of potential price, yield or income outcomes faced by the producer are coming under particular scrutiny. Key considerations in examining supply response under risk are that production decisions are made under ex-ante expectations and that many producers are risk averters over at least a portion of the range of possible incomes. While there are numerous studies on supply response under risk, there are few studies which examine supply response under both risky outcomes and risk aversion.

## Objectives

The primary objective is to assess typical Saskatchewan producer supply response to price induced risk at the whole farm level, not at the enterprise
level. A secondary objective is to quantify the price and yield risk faced by typical wheat farmers on the brown soils of Saskatchewan.

Research Procedure and Methodology
This study is organized into three major sections. The first section of the study examines production and price risks faced by a typical Saskatchewan wheat farmer. Yield risk is based on simulated crop yields and historical weather patterns while price risk is based on historical price patterns adjusted for inflation and changing technologies. The next major section, section 2, identifies risk clusters of farms. The third section examines the supply response of individual risk clusters under risky prices and yields using representative farms.

In general, an acreage response function is of the form:

$$
\begin{equation*}
a=f(P) \tag{1.1}
\end{equation*}
$$

where $\mathrm{a}=$ acreage, and
$\mathrm{P}=$ vector of commodity prices.
Acreage is a function of all commodity prices, including its own price, and the prices of its complements and substitutes. Note that equation 1.1 varies between the humid and semi-arid portions of North America. In the humid areas, land is continuously cropped and acreage response is the result of the substitution of one crop for another; thus, the acreage response function typically includes the prices of all crop substitutes. In the semi-arid regions, and in particular, the western Canadian prairies, substantial portions of farmland are summerfallowed. Wheat is the dominant crop and acreage response is derived primarily from a change in cropping intensity or the amount of summerfallow. While much research has been devoted to optimal crop rotations, recent research suggests that farmers should consider variable
cropping patterns or FLEXCROPPING, according to available spring soil
moisture. Experience with the Top Management Workshop farmers, suggests that many farmers already informally incorporate spring soil moisture into their cropping decisions. FLEXCROPPING incorporates the concept of critical spring soil moisture thresholds--a farmer will crop land if its available soil moisture exceeds a predetermined critical soil level. While Weisensel (1988) examined optimal soil moisture thresholds using a dynamic programming framework, it did not examine the risk-profit tradeoff. In a later paper, Weisensel, Schoney and Van Kooten (1988) examine the risk efficiency of the FLEXCROP and alternative cropping strategies, including the traditional breakeven decision rules and fixed cropping rotations. In addition to stochastic yields, they incorporate a soil moisture measurement error. In her dissertation, Chikwana examines the tradeoff between critical soil moisture thresholds and corresponding cropping intensities and income variability. Like Weisensel, she examines alternative cropping rules including the flexcropping but unlike Weisensel et al, she examines the production decision at the whole farm level and tests for stochastic efficiency using stochastic dominance with respect to a function. Her study features a bio-economic simulation model which incorporates a number of stochastic weather variables and error terms as well as timeliness penalties or yield reductions as a function of acres planted to generate cumulative density functions (cdf's) of future net worths. These cdf's form the basis of risk dominance comparisons. While this study incorporates much of the work by Chikwana; Weisensel et al, and Schoney, it also adds price variability in addition to weather variability. In the following analysis, it is assumed that acreage response is determined by an individual producer's selection of risk-efficient cropping
strategies in reaction to expected price distributions, individual farm cost and financial structure and soil type. The basic model of supply response for an individual farmer becomes

$$
\begin{equation*}
A, q=f(P \mid r, S, C) \tag{1.2}
\end{equation*}
$$

where $A=$ distribution of acreages,
$q=$ distribution of quantities,
$\mathrm{P}=$ distribution of prices,
$r=$ risk attitude,
$S=$ soil zone and
$C=$ farm business cost and financial structure.

Note that the traditional price, acreage and quantity or yield variables in equation 1.2 are no longer single-valued, but probability distributions of values. The various risk-efficient cropping strategies are based on FLEXCROP spring soil moisture thresholds and the corresponding cropping intensity. Thus, given price probability distributions, soil zone and risk preferences, acreage response can be generated by perturbing either expected prices or modifying the shape of the price probability distribution through the various government price stabilization/insurance programs.

The procedure used to find the schedule of $A, q, P$ and $r$ combinations is shown in figure 1. Given a distribution of commodity prices, a bio-economic simulator is used to estimate the cumulative density function of annualized returns for each critical soil moisture threshold (FLEXCROP decision rule), $M_{c}$. For a given price distribution, each $M_{c}$ is examined for first degree stochastic efficiency (FSD). Where the efficient FSD set, $M_{c}{ }^{*}$, consists of a single $M_{c}$, then this value is optimal over all risk attitudes(r). Since the decision rules are based on very small stepped values of a continuous variable, $M_{c}$, the $M_{c}{ }^{*}$ efficient set is likely to contain several efficient $M_{c}$ and thus, additional information as to risk attitudes must be incorporated in
order to further discriminate among the various risk efficient decision rules. In this study, risk attitudes are measured by the Pratt-Arrow risk aversion coefficient. Because risk measurements are relatively imprecise, a risk interval with upper and lower bounds is defined. While little is known as to the exact distribution of $r$ among Saskatchewan farmers, a recent study by Chikwana using the Top Management Workshop participants, provides potential distributions of $r$. Three risk clusters of farmers will be identified: risk neutral, risk loving and risk averse. Given the risk interval for a given risk grouping, stochastic dominance with respect to a function (SDRF) is used to further narrow the set of $M_{c}{ }^{*}$ choices. Associated with each $M_{c}{ }^{*}$, is a corresponding distribution of $A^{*}$ and $q^{*}$. Because yield and acreage response now vary according to at least two parameters, price and risk, the response surface also becomes at least three dimensional and the number of points required to map a surface explodes. Accordingly, the ratio of the standard deviation to the mean or the coefficient of variation is fixed so that as price varies so then does the variance. After $M_{c}{ }^{*}$ is found, the parameters of the price distribution are perturbed and the procedure repeated.

The procedure is also repeated for each price policy program. In addition to the benchmark of normally distributed prices, three potential government programs altering the distribution of commodity prices are defined: lower and upper price truncation; price insurance; and perfectly price stabilizing or fixed prices. In each program the mean price is preserved, so that supply response is a function of differing higher moments of the price distribution and risk attitudes.

## Organization

The remainder of this study is organized in the following fashion: the various methods of supply response and supply response under risk are briefly reviewed in Chapter 2 ; the bio-economic simulation model is reviewed in Chapter 3; representative farm cost data and summary of risk preferences are presented in Chapter 4 ; the selection of price stabilization programs is presented in Chapter 5 ; and the results are presented in Chapter 6.


Figure 1 : Steps in Determining the Risk Efficient Supply Response Acreages

## CHAPTER II: ALTERNATIVE MODELS OF CROPPING DECISIONS UNDER RISK

## Introduction

Knight defines a risky situation as that situation where all possible outcomes and their joint probability density functions are known. Uncertainty is created when either or both conditions cannot be fulfilled: either all possible outcomes cannot be delineated and/or their probability density functions cannot be specified. In more recent times, most researchers tend to lump risk and uncertainty into one general category. In general, modern treatment of risk behavior is based on utility maximization (EUM) behavior.

## Expected Utility Maximization

Risk aversion behavior can be derived from the maximization of expected utility hypothesis (EUM). Economists find the EUM hypothesis attractive not only for its mathematical simplicity but also because it integrates well into existing economic theory, particularly consumer theory. As in consumer theory, the decision maker is assumed to maximize except utility--except the choices are risky. In order for a utility function to exist, certain restrictions as to rationality and consistency in choices among several risky alternatives must be placed on human behavior. These properties can be stated as the axioms of ordering, transitivity, substitution among choices and certainty equivalent among choices (Barry, 1984). If these axioms hold, it follows that an optimal risky choice can be based on the maximization of expected utility and that an individual will always choose the prospect which yields the highest expected value of utility, usually expressed as a function of income or wealth.

Note that risk behavior is a result, not an explicit parameter: a decision maker's attitude towards risk is inferred from the shape of his
utility function. A concave function implies risk aversion, a convex function implies risk preferring and a linear function implies risk neutrality. A decision maker may also have a utility function with both convex and concave segments indicating changes in attitudes for monetary outcomes. In the following sections, two basic approaches to micro supply response under risk are examined--crop portfolio analysis and stochastic efficiency criteria.

## Crop Portfolio Analysis

Farm cropping decisions can also be considered in a fashion similar to a stock portfolio: the proportion of land devoted to any particular crop is similar to a decision to buy a particular stock. The net returns from an acre of crop is gross return less variable costs. Key to this analysis is the correlations between the various net returns. There are two basic models of crop portfolios based on the expected income / variance of income (E-V) stock investment model used by Markowitz and Hazell's MOTAD.

## E-V Portfolio Analysis

In the E-V crop portfolio model, the expected utility of the investor is a function of expected income and variance of income:

$$
\begin{aligned}
\operatorname{Max} U= & R X+\lambda X^{t} \sigma X \\
\text { st } & A X \leq b \\
& X \geq 0
\end{aligned}
$$

where: $R=$ Expected Return,
$\lambda=$ Scaler and
$\sigma=$ variance-covariance matrix of returns

The assumptions of the E-V model can be briefly stated as the following:

1. There is functional linear trade off between income and variance.
a. The utility function can adequately be described by the first and second moments which implies an underlying normal distribution,
or
b. The utility function is quadratic.
2. The decision maker is a price taker.

The first assumption is perhaps the most controversial in its implications. The existence of a linear trade off between income and variance involves a number of subtle but important assumptions. Variance as a measure of risk implies that the decision maker's utility function is quadratic or the income distribution is normally distributed. Thus, either the decision maker must be indifferent to higher moments such as the third or fourth or the distribution must be normal; in which case the higher moments are identical. The quadratic utility assumption is largely unacceptable because decision makers are unlikely to be indifferent to skewness or peakedness and so the burden is placed on the normality assumption. ${ }^{4}$

The last assumption guarantees that returns are independent of the level of output; $R$ is fixed per unit. This may be a problem in a crop portfolio if either yield timeliness penalties or economies of size exist.

In crop portfolio analysis, decision makers are generally assumed to be risk averters, or $\lambda<0$. Because $\lambda$ is generally not precisely known, $\lambda$ is parametrically varied until the EV curve turns down, mapping an efficient frontier. Thus, the efficient frontier is defined as the locus of points where for any given income, the variance is at a minimum and conversely, for

4 Some researchers also question the notion that positive deviations be weighted the same as negative deviations and suggest that risk could be defined in other ways such as semi-variance (MOTAD) or that risk be measured as a deviation from a "target" income (Target MOTAD).
any given variance, the expected income is at a maximum. Graphically, an $E-V$ efficient frontier is shown in figure 3. The indifference curve, $I$, is shown as a linear line and the optimal point is the point of tangency between the $I$ and the E-V


Figure 2: Efficient Crop Portfolio frontier.

The quadratic utility function is an unrealistic assumption so that if the distributions are non-normal, then the resulting choices or portfolios may be unrealistic. In addition, a quadratic objective function means that it can be difficult to solve computationally unless the problem size is restricted. Nevertheless, the $E-V$ method of analysis is a very appealing tool both theoretically and operationally.

The MOTAD/MAD Model
In recent years, Hazell and others have proposed another model, the MOTAD (minimization of total absolute derivations) or E-A (expected value absolute value) model to circumvent the computational difficulties and size limitations imposed by most L.P. solution algorithms. In the MOTAD model, risk is measured in a different manner. In the $E-V$ model, risk is measured by variance but in the MOTAD model the risk (A) is measured as the sum of
deviations from the mean

$$
\begin{equation*}
\left.A=\frac{1}{S} \quad \sum^{n} \underset{h=1}{\sum} \underset{\substack{n=1 \\ j}}{\left(R_{h j}\right.} \cdots \overline{R_{j}}\right) X_{j} \tag{2.8}
\end{equation*}
$$

$\begin{array}{ll}\text { where: } & R_{j}=\text { mean net margin of returns }, \\ R_{h j}=\text { annual net margin in period } j \text { and } \\ S & =\text { number of sample observations (years). }\end{array}$
The MOTAD model incorporates similar assumptions to the $E-V$ model but the MOTAD criterion loses some precision in that semivariance ${ }^{5}$ only approximates variance. ${ }^{6}$ Hazell (pp. 60-61) tests his model through a Monte Carlo simulation and concludes that the E-A sample mean absolute deviation is 88 percent efficient in terms of estimating variance when the population is normally distributed. Furthermore, given the assumptions of normality, nonstochastic and fixed $R_{j}$ 's, probabilistic statements can be made about the likelihood of various income levels through the use of Herry's $H$ statistic (1971, p 6).

The MOTAD method does not explicitly consider the activity risk interrelationships in the same fashion as the covariances of the E-V model. In the process of minimizing the sum of mean absolute deviations, the interrelationships are implicitly considered through the linear income constraints. Thus, the enterprise interrelationships are not as open to examination and interpretation as the variance-covariance matrix. In summary, the MAD model trades precision and explicitness for computational and operational simplicity and low cost solution techniques. ${ }^{7}$ Since the model is

[^2]linear in both criterion and constraints, it can be solved by existing L.P. codes. Moreover, it is not extremely expensive in terms of matrix size. The MOTAD/E-A model can be easily set up to incorporate the semi-variance criteria of Markowitz. In this popular formulation, risk is measured by $S$, the sum of the negative deviations from the mean. Another variation measures risk as negative deviations from a "target" return which is higher than the mean return.

## Stochastically Efficient Criteria

An alterative approach to the crop portfolio analysis which relies on more general assumptions as to the nature of the decision maker's utility surface is the stochastically efficient approach. Given specified restrictions on the decision maker's preferences and in some cases, on the probability distributions of feasible alternatives, an efficiency criterion provides a partial ordering of choices. As Levy and Sarnat (1972) note, an efficiency criterion divides the decision alternatives into two mutually exclusive sets consisting of an efficient set and an inefficient set. The efficient set contains the preferred choices of every individual whose preferences conform to the restrictions associated with the criterion.

Stochastic dominance criteria divide risky choices into efficient and inefficient sets based on independent pair-wise comparisons of all alternative choices. In identifying the stochastically efficient set, each pair of risky outcomes is compared for dominance based on their corresponding cumulative density functions (CDF). Five stochastic dominance selection criteria are First Degree Stochastic Dominance (FSD), Second Degree Stochastic Dominance (SSD), Third Degree Stochastic Dominance (TSD), Stochastic Dominance with

Respect to a Function (SDRF) and Convex Set Stochastic Dominance (CSSD). The following sections review the most popular criteria First Degree and Second Degree Stochastic Dominance and Stochastic Dominance with Respect to a Function.

## First and Second Degree Stochastic Dominance

First Degree Stochastic Dominance (FSD) incorporates the least restrictive set of underlying assumptions of any of the stochastic choice criteria: the FSD criterion requires only that decision makers prefer more to less. Under FSD, an alternative with an outcome distribution defined by cumulative distribution $F(Y)$ is preferred to a second alternative with cumulative distribution $G(y)$ if

$$
\begin{equation*}
F(y)<=G(y) \tag{2.0}
\end{equation*}
$$

for all possible values of $y$ and the inequality is strict for some values of y. While FSD rules are based on the weakest possible assumptions that can be made about the underlying utility functions, they can not discriminate between risky prospects whose cumulative density functions intersect. While FSD is extremely robust, it generally is not a very discriminating criterion, and the resulting stochastically efficient sets can be quite large.

Unlike FSD, SSD allows discrimination between risky prospects whose cumulative density functions intersect. The SSD criterion compares the intersecting areas under the cdf's. A distribution function F1 dominates another $G 1$ if it lies more to the right in terms of differences in area between the CDF curves cumulated from the lower values of uncertain quantity (Anderson et al, 1977). This is depicted in figure 2 where the area marked $A$ exceeds the area marked B. SSD also holds for all decision makers whose
utility functions have positive but decreasing marginal utility.

Even though the concept of stochastic dominance is attractive because of the relatively unrestrictive nature of the underlying assumptions as to the nature and the shape of the utility


Figure 3: Second Degree Stochastic Dominance function, FSD and SSD have not been very successful in eliminating alternatives from the efficient sets. Accordingly, additional information as to risk attitudes usually must be incorporated. The following section briefly outlines the risk interval approach of eliciting general attributes of a producer's utility function and then proceeds to establish the use of that information to discriminate between risky alternatives in stochastic dominance with respect to a function.

## Risk Interval Approach

The problems associated with eliciting an uniquely defined utility function led to the Risk Interval Approach formulated by Meyer (1977b) and later propounded by King and Robison (1981a, 1981b), which explicitly accounts for possible errors in the utility measurement. King and Robison (1982) have shown that individuals can be grouped according to specific intervals of the Arrow-Pratt measure of absolute risk aversion. The Arrow-Pratt absolute risk aversion coefficient is

$$
\begin{equation*}
\tau=-\left(U^{\prime \prime}(y) / U^{\prime}(y)\right) \tag{2.1}
\end{equation*}
$$

where $U^{\prime \prime}(y)=$ second derivative of utility of income, and
$U^{\prime}(y)=f i r s t$ derivative of utility of income.
A related measure of risk preferences, the coefficient of relative risk aversion, is defined as

$$
\begin{equation*}
R(y)=-Y U^{\prime \prime}(y) / U^{\prime}(y) \tag{2.2}
\end{equation*}
$$

```
where R(y) = Relative risk aversion,
    Y = Average net income,
    U''(y) = Second derivative of utility of income and
    U'(y) = First derivative of utility of income.
```

The relative risk aversion coefficient is also referred to as the elasticity of marginal utility. As an elasticity, it is dimensionless and related to absolute risk aversion by

$$
\begin{equation*}
R(y)=Y A(Y) \tag{2.3}
\end{equation*}
$$

The $\tau$ interval is estimated by asking decision makers to choose between carefully chosen pairs of discrete probability density functions. Each pair of distributions is defined over a relatively narrow range, so that the absolute risk aversion space is divided into two regions: one distribution consistent with the predetermined risk interval and the other inconsistent with it. By confronting the decision maker with a series of choices between carefully selected pairs of distributions, the risk aversion interval for the decision makers' preferences can be established.

## Stochastic Dominance with Respect to a Function

While the knowledge of $\tau$ or the range of $\tau$ can be used to estimate risk premiums under certain conditions, it is more useful when it is combined with stochastic dominance with respect to a function (SDRF). SDRF was introduced by Meyer (1977) as a more discriminating function than the SSD efficiency criterion. $\operatorname{SDRF}$ is a more discriminating efficiency criterion because it
incorporates more information as to individual preferences. By incorporating additional information over a limited range of the utility function, the SDRF can order choices for decision makers whose absolute risk aversion function lies within specified lower and upper bounds, or a risk interval, A. Given the values of " $\tau$ " at the lower bound $\left(A_{i}\right)$ and the upper bound ( $A_{2}$ ), it can be determined whether an individual would prefer one cumulative distribution of net income, $F(y)$, to another $G(y)$ or if he/she is indifferent. The solution procedure finds the utility function $U(y)$ which minimizes

$$
\begin{equation*}
[G(y)-F(y)] U^{\prime}(y) d y \tag{2.5}
\end{equation*}
$$

subject to

$$
\begin{equation*}
A_{1}(y)<\tau<=A_{2}(y) \tag{2.6}
\end{equation*}
$$

where $A_{1}(y)=$ the lower bound of the risk aversion interval, $A_{2}(y)=$ the upper bound of the risk aversion interval and $y=$ income level.

The expression in equation 2.5 is the difference between the expected utilities of outcome distributions $F(y)$ and $G(y)$. If for a given class of decision makers, the minimum of this difference is positive, $F(y)$ is unanimously preferred to $G(y)$. If the minimum is zero, it is possible for an agent in the relevant class of decision makers to be indifferent between the two alternatives and thus they cannot be ordered. If the minimum is negative, then the particular set of decision makers does not unanimously prefer $G(y)$ to $F(y)$. In this case, the expression

$$
\begin{equation*}
[F(y)-G(y)] U^{\prime}(y) d y \tag{2.7}
\end{equation*}
$$

must be minimized subject to equation 2.6. Note that this procedure does not ensure complete ordering, as it is possible for both equations 2.5 and 2.7 to be negative. Meyer (1977) uses optimal control techniques to derive the solution to this problem. The exponential utility function consistent with
this problems is

$$
\begin{equation*}
u(y)=-e^{-A i(y) y} \quad i=1,2 \tag{2.8}
\end{equation*}
$$

where $A i(y)$ is the lower or upper bound of the absolute risk aversion level.

## Limitations of Risk Interval Approach/ SDRF

SDRF may allow ranking of farm plans that can not be ranked by either first or second degree stochastic rules but the efficient set may still consist of multiple alternatives. SDRF also requires specific information as to the lower and upper bounds of the decision maker's absolute aversion function. This information is generally not available nor can it necessarily be estimated for broad groups of individuals. In general, $\tau$ must be elicited for each individual and there is a relatively high cost of eliciting individual preferences. This is particularly true as the risk aversion interval narrows, and the number of pairwise choices increase by $2^{N}$ where $N$ is the number of intervals. In addition, the value of $\tau$ may change over time. However, Love and Robison (1984) conclude that risk preferences are rather stable over the income ranges that are typically experienced by farmers. Nevertheless, risk preferences may be intertemporally unstable over wide ranges of income or longer time periods.

## Summary

While the crop portfolio models have much appeal in farm level decision models, they present particular difficulty in that the income distributions will be altered by the various price insurance and stabilization programs and that income is dynamic. In addition, they require unrealistic assumptions as to the nature of the underlying risk attitudes. Thus, neither E-V nor MOTAD
analysis is appropriate. Stochastic efficiency analysis is also attractive and commonly used in firm level models. While FSD and SSD can provide very robust conclusions, they are unlikely to result in efficient sets consisting of a single strategy. Accordingly, stochastic dominance with respect to a function (SDRF) was chosen to identify the risk efficient strategies in that it can incorporate additional information as to risk attitudes to further discriminate among risk efficient alternatives. Nevertheless, the resulting set of efficient alternatives need not be singular. The Risk Interval Approach is used to assess farmers' risk attitudes.

## CHAPTER III: THE BIO-ECONOMIC SIMULATOR

## . Introduction

The primary purpose of the bio-economic simulator is to generate the cumulative density functions of annualized ending net worth for each combination of crop selection strategy $\left(M_{c}\right)$, price policy distribution and representative farm. The bio-economic simulator incorporates three major modules: a soil, an agronomic and a management module. The soil module models the climate-soil moisture interaction to simulate spring soil moisture, $M_{t}$. $M_{t}$ is a function of real-time weather variables and a stochastic error term. The agronomic module simulates crop yield based on $M_{t}$, real-time summer precipitation and a stochastic error term. The management module incorporates the FLEXCROP decision making criterion and the various return, cost and financial relationships. The following section reviews each of the modules and their corresponding data requirements.

## The Management Module

It is assumed that the farmer's objective is to maximize ending net worth subject to fixed family living removals. In the following equation, all variables are in the current year ( $t=1$ ) except where indicated and all prices, costs, family living expenses, value of equipment, machinery and buildings and land are expressed in nominal values.

$$
\begin{align*}
& I N T_{t}=\text { Rate } * \text { BAL }_{t-1}  \tag{3.0}\\
& \text { MARGIN }_{t}=\sum_{c=1}^{3}\left(\left(P_{t}-C_{t}^{k}\right) * Y_{c t}-C^{h} t-C R C_{c t}^{d}\right) * H_{c t}  \tag{3.1}\\
& C F_{t}=\text { MARGIN }_{t}-P_{t}-I N T_{t}-O H_{t}-F L-C R C_{t}^{i}-T X_{t}  \tag{3.2}\\
& \text { BAL }_{t}=\text { BAL }_{t-1}+C F_{t}  \tag{3.3}\\
& N W_{t}=A \operatorname{set} s_{t}-B A L_{t} \tag{3.4}
\end{align*}
$$

where $t=$ time period, 1..15,
$\mathrm{f}=\mathrm{fallow}$,
s = stubble,
$\mathrm{CF}=$ Cash Flow,
FL = Family Living Expenses, MARGIN $_{t}=$ Total farm operating margin
PT = Property Taxes,
INT = Interest Paid (or received),
$\mathrm{OH}=$ Overhead Expenses,
Rate $=$ Interest Rate,
P = Price,
$Y=$ Yield per Hectare (kg/ha),
$C_{k}=$ Variable/Fixed Cost per Kilogram ( $\$ / \mathrm{kg}$ ),
$C_{h}=$ Variable/Fixed Cost per Hectare (\$/ha),
$\mathrm{H}=$ Hectares $1=$ fallow, $2=$ crop on fallow and $3=$ crop on stubble,
$\mathrm{NW}_{\mathrm{t}}$ = ending net worth in time period t ,
Assets $_{t}=$ intermediate and long run assets and, BAL $_{t}=$ beginning balance,

Additional key assumptions are:

1. the farmer's objective is to maximize terminal net worth, 2. fixed machine ownership costs vary according to cropped acreage
2. cash flow constraints are not binding - capital is perfectly available,
3. yield quotas are not binding,
4. there are no government payments, and
5. income tax rates are constant.

The farm is assumed to consist of four fields, each a separate decisionmaking unit with its own crop/fallow choice. Summer and winter precipitation are based on the random selection of one of the 44 years of the Kindersley actual weather years. Each weather year is assumed to be independent of all other weather years. Actual spring soil moisture is calculated based on the previous fallow/crop state, a random weather year and an error term. The actual spring soil moisture provides the basis for the crop/fallow decision. Each spring the simulated spring soil moisture, Mt, is compared to a prespecified critical threshold soil moisture (FLEXCROP decision rule), $M_{c}$, on a field by field basis. If $M_{t} \geq M_{c}$, then the field is seeded. If the field has been previously cropped, then costs are based on stubble cropping,
otherwise cropping costs are based on fallow cropping. If $M_{t}<M_{c}$, then the field is fallowed. Another summer weather year is drawn and yields are determined. Farm returns and expenses are calculated according to equations (3.0) to (3.4) and the net balances forward are calculated. The next year starts with the redrawing of another winter weather year and the determination of the new spring soil moisture. The entire set of income distributions for $M_{c}$ is found by parametrically ranging $M_{c}$ and repeating the simulation.

Both commodity prices and yields are stochastic and are assumed to be independent of each other. Accordingly, gross revenues are also stochastic. In addition, annual costs are indirectly stochastic insomuch as seeded acres on fallow or stubble are a function of the product of $M_{t}$, a stochastic variable. CDF's for the stochastic dominance analysis based on each strategy are simulated 1000 times.

The major biological components in the bio-economic simulation model are May soil moisture and the wheat yield.

The Soil Module: May Soil Moisture
The May soil moisture level is a key relationship in that it provides the threshold values used to make the crop/fallow decision. May soil moisture is assumed to be a function of the previous May soil moisture, summer and winter precipitation and an error term.

$$
\begin{equation*}
M_{j t}=f\left(M_{t-1}, S_{t-1}, W_{t-1}\right)+e_{j t} \tag{3.5}
\end{equation*}
$$

```
where j = previously fallowed or cropped,
    Mjt = May moisture at period t,
    St = summer (growing season) precipitation in period t,
    Wt = winter precipitation for period t and
```

$e_{j t}=$ May moisture error in period $t$.

A second order polynomial functional form is used to estimate the relationship between May soil moisture, lagged May soil moisture, summer precipitation and winter precipitation. Spring soil moisture is estimated for both fallow years and stubble years because of the impact of differing summer ET rates and differing abilities to trap and absorb winter precipitation. The data include 161 observations from the Innovative Acres Project conducted by the Soils Department at the University of Saskatchewan over the years of 1983-1986. The data are both cross sectional and time series. The four years of data are reduced to 3 years because of the lagged soil moisture and summer precipitation variables. Thus, only three weather years can be actually used. In addition, winter precipitation data were not collected and thus winter precipitation is estimated based on the nearest weather observation point. The estimated equations are:

Fallow Year:

$$
\begin{align*}
& M_{t}=\underset{(0.01)}{0.001}+\underset{(0.049)}{0.463 M_{t-1}}+\underset{(0.609)}{0.082} \mathrm{~S}_{t-1}+\underset{(0.237)}{0.261 \mathrm{~W}_{t-1}}+\underset{(0.035)^{* \hbar}}{0.126\left(\mathrm{~S}_{t-1}\right)^{2}} \\
& \begin{array}{r}
+0.052\left(W_{t-1}\right)^{2}-0.160(0.009)\left(S_{t-1}\right)\left(W_{t-1}\right)
\end{array}  \tag{3.6}\\
& n=152 \\
& R^{2}=0.58 \\
& S E E=2.54 \\
& \text { standard error values in parentheses, and } \\
& \text { ** indicates } t \text { test significance from zero at a probability of } 95 \% \text {. }
\end{align*}
$$

## Crop Year:

$$
n=152
$$

$$
R^{2}=0.24
$$

$$
S E E=4.00
$$

standard error values in parentheses, and
$* *$ indicates $t$ test significance from zero at a probability of $95 \%$.
The $R^{2}$ values are 0.58 and 0.24 , respectively for the fallow and the crop equations, respectively, indicating a much higher degree of predictability of soil moisture following fallow than crop. The associated standard error of the estimate (SEE) is important in that it specifies the relative riskiness associated with fallow/crop. The higher SEE associated with the crop equation will translate into more variable May soil moistures. Not all of the estimated $S_{t-1}$ and $W_{t-1}$ coefficients are significantly different from zero at the 90 or $95 \%$ level as indicated by the test. However, these coefficients have been retained because upon further investigation, equations based on reduced parameter sets tended to be unstable when applied to 44 years of actual weather data. ${ }^{8}$ The spring soil moisture coefficient, $M_{t-1}$, is nearly identical between the two equations, at approximately 0.463 to 0.465 . This indicates that approximately $46 \%$ of the spring soil moisture is conserved for use in the following year. However, note that the remaining estimated parameters differ considerably between fallow and stubble years. The intercept of the fallow equation is extremely close to zero while the intercept of the crop year is negative and significantly different from zero. Likewise, the parameters associated with

[^3]\[

$$
\begin{aligned}
& \begin{array}{r}
+0.023\left(W_{t-1}\right)^{2}-0.054\left(S_{t-1}\right)\left(W_{t-1}\right) \\
(0.005)^{\star \pi}
\end{array}
\end{aligned}
$$
\]

summer $\left(S_{t-1}\right)$ and winter $\left(W_{t-1}\right)$ precipitation are also considerably different between the two equations. The fallow equation tends to be convex with respect to summer and winter precipitation in some portions of the function, indicating that carryover increases at an increasing rate as seasonal precipitation increases. This is due to the positive $\left(S_{t-1}\right)^{2}$ and $\left(W_{t-1}\right)^{2}$ terms Nonetheless, the negative $\left(S_{t-1} \times W_{t-1}\right)$ interaction term induces concavity when precipitation from both seasons and in particular, winter, is high.

In sharp contrast to the fallow equation, the net impact of summer precipitation on stubble soil moisture is relatively small. The estimated coefficients of $S_{t-1}$ associated with the stubble equation are strongly concave--as would be expected from the evapo-transpiration (ET) rates associated with a growing wheat crop. In addition, strong concavity could also be induced by precipitation runoff losses. Winter precipitation, $W_{t-1}$, is far less concave but contributes far more to spring soil moisture in the stubble equation than it does in the fallow equation. This possibly indicates that stubble land is better able to trap and absorb snow than fallow land.

In order to better explore the contributions of $M_{t-1}, S_{t-1}$ and $W_{t-1}$ on the following spring moisture, $M_{t}$, a simple sensitivity analysis is conducted using average coefficient values for both fallowed and stubble equations. 9 The differences become quite apparent. On fallowed land, spring moisture $\left(M_{t-1}\right)$, and summer precipitation $\left(S_{t-1}\right)$ contribute approximately $27.4 \%$ and 72.6\%, respectively, of the following spring soil moisture; but winter precipitation $\left(W_{t-1}\right)$ contributes little towards spring soil moisture. On stubble land the major contributing variables are spring moisture ( $M_{t-1}$ ) and

[^4]

Figure 4: CDF of May Soil Moisture by Fixed Rotation
winter precipitation (Wt-1), which contribute approximately $30.2 \%$ and $69.8 \%$, respectively, to the following spring soil moisture; summer precipitation (St1) contributes little towards spring soil moisture.

In order to further demonstrate the potential differences associated with the fallow/cropping decisions, a simple spreadsheet was constructed assuming a 2 year wheat/fallow rotation and a continuous rotation. Note that the 2 year rotation is based on two fields so that the lumpiness is averaged out. The estimated equations are applied to 44 years of actual weather data for Kindersley, Saskatchewan which is located in the brown soil zone, over the years of 1942-1986. The results are shown in Appendix Table A-1. The resulting spring soil moisture levels are used to construct probability
cumulative density functions (CDF's) displayed in figure 4. Surprisingly, spring moisture following fallow is somewhat more variable and less regular in shape than soil moisture following crop. This may be due to the skewness in the data and the truncation associated with minimum and maximum soil moisture levels. ${ }^{10}$ These results will be used as a benchmark in later comparisons in order to compare direct weather variability versus simulated total variability.

## The Agronomic Module: Wheat Yields

Yield is assumed to be a function of May soil moisture, (equation 3.8), summer precipitation and an error term.
$Y_{t}=f\left(M_{j t}, S_{t}\right)+e_{y t}$
where $Y_{t}=$ wheat yield in time period $t$ and
$e_{y t}=y i e l d$ error term in period $t$.

Yield estimates are also based on the Innovative Acres Project Data which includes both time series and cross sectional observations of May soil moisture, growing season (summer) precipitation and yield; a total of 556 observations are included over the period of 1983 to 1986. ${ }^{11}$ While only a quadratic form is presented, several functional forms, including the translog, were used to estimate the relationship between yield and moisture. The quadratic form is chosen because the negative intercept is appealing in that it requires moisture levels exceed a critical level before any crop can

[^5]be produced. All of the estimated coefficients are significantly different from zero at the $95 \%$ level as indicated by their t-statistics.
\[

$$
\begin{align*}
& \mathrm{n}=550  \tag{3.9}\\
& R^{2}=0.44 \\
& S E E=702 \\
& \text { standard error values in parentheses, and } \\
& * * \text { indicates } t \text { test significance from zero at a probability of } 95 \% \text {. }
\end{align*}
$$
\]

Using equation (3.9), approximately $6-7 \mathrm{~cm}$ of spring soil moisture and another $6-7 \mathrm{~cm}$ of summer precipitation are required to produce a crop sufficiently large enough to justify harvesting. Equation (3.9) is sufficiently concave to have a stage 3 ; however, stage three of production requires either a fully recharged soil moisture at seeding time ( 25 cm ) and a near normal summer precipitation of 15 cm or a normal seeding moisture of 12 cm and almost double the average summer precipitation ( 28 cm ).

Using spring soil moisture estimates in Appendix Table A-1 and equation (3.9), yields are also estimated and the corresponding yield CDF constructed, and are presented in figure 5. Note that while the spring soil moisture associated with fallow is more highly variable than that associated with cropping, the subsequent wheat yields follow different patterns due to the concavity of the yield function. Estimated yields are 2060 and $1606 \mathrm{~kg} / \mathrm{h}$ respectively for the 2 year wheat-fallow and continuous rotations respectively. The corresponding standard deviations are $386 \mathrm{~kg} / \mathrm{h}$ (2 yr) and $474 \mathrm{~kg} / \mathrm{h}$ (continuous) and coefficients of variation are $18.7 \%$ and $29.5 \%$.

Thus, the continuous rotation generates about twice as much relative risk as the 2 year fallow rotation. However, the C.V. is a poor measure of relative


Figure 5: CDF of Simulated Yields, Fixed Rotations, Brown Soil Zone of Saskatchewan
risk; risk is perhaps best evaluated through the yield CDF. For much of the distribution, the 2-year fallow wheat rotation is a constant 400 to $500 \mathrm{~kg} / \mathrm{h}$ greater than the continuous rotation. In addition, a crop failure is very unlikely with a 2 -year fallow wheat rotation, but it is approximately a 1 in 10 year event with a continuous rotation. However, these comparisons should be used with extreme caution in that they are not true simulations in that they omit the error terms associated with both equations (3.6) and (3.9) and they are not based on the FLEXCROP model.

## Error Term

An important component in eq. $3.6,3.7$ and 3.9 is the error term because it influences the relative riskiness of fallow and stubble cropping.

The OLS procedures assume that error terms are normally distributed and this same assumption is continued in the simulation of soil moisture and yields.

The following procedure is used to estimate the error term:
$e=\operatorname{Sqrt}\left(-2 \ln \left(u_{1}\right)\right) \cos \left(2 \pi\left(u_{2}\right)\right) \sigma+\mu$

```
where e = error term,
        sqrt = square root,
        ln = natural log,
    u
        Cos = cosine,
            \sigma= standard deviation of the error terms, and,
            \mu = mean of the error terms,
```

The mean error is assumed to be 0 , from the OLS procedure and the corresponding and standard deviation is the SEE of the corresponding equation.

## Income CDF's

The ending net worth is simulated over a 15 year period for each $M_{c}$ strategy. Because the cdf of ending net worth is inconsistent with the income intervals used in the elicitation of risk attitudes, these distributions must be annualized using the following formula:

$$
\begin{equation*}
A=\left[W_{n} /(1+i)^{n}-W_{0}\right] * i /\left(1-(1+i)^{-n}\right) \tag{3.11}
\end{equation*}
$$

where $A=$ annualized income,
$W_{n}=$ terminal net worth,
i = discount rate,
$\mathrm{n}=$ years and
$W_{0}=$ initial net worth

## Stochastically Efficient Sets

The various $M_{c}$ strategies form the basic choice set for given risk
clusters, price levels and price stabilization policies. Because producers may differ in their preferences for differing price stabilization policies, an expanded choices set includes a combination of $M_{c}$ strategies and the various price stabilization policies. Each choice set is evaluated for stochastic dominance and stochastic dominance with respect to a function (SDRF) in order to identify the set of risk efficient $M_{c}{ }^{*}$, given risk attitudes. In brief review, $S D R F$ is required when first and second degree stochastic dominance fails to identify a single risk efficient alternative. SDRF incorporates further information as to risk attitudes by allowing the absolute risk coefficient, $\tau$ to vary between $\tau_{l}$ and $\tau_{u}$ or a risk interval. The risk interval may vary by income level. Given, a set of risk intervals, SDRF compares each pair of distributions over various income levels and identifies dominant and dominated alternatives. ${ }^{12}$ The dominant distributions are the set of risk efficient strategies, $M_{c}{ }^{*}$.

Summary

A bio-economic stochastic simulator is constructed to generate cumulative density functions for alternative crop selection strategies, $M_{c}$. The simulation model has three major modules: a soil, an agronomic and a management module. There are four primary stochastic elements, weather, a spring soil moisture error term, a yield error term and commodity prices. Both the soil and agronomic modules are critical components. The spring soil moisture, $M_{t}$, is a particularly critical component because it forms the basis for comparison with $M_{c}$; if $M_{t} \geq M_{c}$, then the field is seeded and if $M_{t}<M_{c}$,

[^6]then the field is fallowed. Both fallow and stubble spring moisture relationships are based on Innovative Acres data for the years of 1983 to 1986. The $R^{2}$ values are 0.58 and 0.24 respectively for the fallow and stubble $M_{t}$. There are several important points to note about the fallow and stubble $M_{t}$. First, the spring moisture relationships differ; summer precipitation is more important in determining fallow $M_{t}$ and winter precipitation is more important in determining stubble $M_{t}$. Secondly, the stubble $M_{t}$, is more variable and has a much higher error term. This means that it will be intrinsically riskier. In addition, $M_{t}$ is a major variable in determining yields. The yield module is also critical in that not only must the relationship between fallow and stubble yields be accurately estimated but their relative variability must also be properly captured. The yield equation is based on a second order polynomial with an estimated $R^{2}$ of 0.44 . When fallow and continuous cropping yields are compared, the fallow yield tends to exceed the continuous yield by a constant 400 to $500 \mathrm{~kg} / \mathrm{h}$ over much of the yield cdf. However, it remains to be seen how this yield dominance will translate into income dominance under the FLEXCROP decision rule.

In order to reduce annual income fluctuations associated with the lumpiness of the seed/fallow decision, soil moisture and yields, the biosimulator incorporates four fields, each separate decision making entities and differing in initial soil moisture. The management module incorporates traditional cash flow and net worth accounting equations which form the linkages between annual income and growth in net worth. The ending net worth is annualized and the resulting cdf of annualized income is the basis of comparison of alternative $M_{c}$. Stochastic dominance with respect to a function is used to select the risk efficient farm plans for specific risk aversionSupply Response Under Riskpage 34intervals. The following chapters define the three farms representingalternative risk attitudes and the various price scenarios and price stabilization policies.

## CHAPTER IV: REPRESENTATIVE FARMS AND RISK PREFERENCES

## Introduction

This study is limited to the farmers on the brown soils of Saskatchewan. The brown soil zone covers 8.5 million hectares and lies in Southwestern Saskatchewan. Lack of moisture in this soil zone limits crops to small grains and pasture. The dark-brown soil zone has somewhat cooler temperatures and more moisture than the brown soil zone which covers 7.4 million hectares and lies to the north and east of the brown soil zone. The black soil zone covers 10.7 million hectares and lies to the north and east of the dark-brown soil zone. It has more moisture but cooler temperatures than either the brown or dark brown soil zone (Saskatchewan Agriculture, 1986).

Representative farms are delineated based on the cluster analysis of 1987 Top Management producers. Three clusters are identified: relatively risk loving; relatively risk neutral and relatively risk averse. From these three clusters, three corresponding representative farms are defined. The following sections report the original survey, the clusters and the corresponding representative farms used to simulate producer supply response to alternative price stabilization programs.

## Risk Attitudes of Saskatchewan Farmers

Top Management Workshops participants were surveyed in 1987 as to their risk attitudes using techniques developed by King and Robison (1981a, b). In the following analysis, net income is defined as income available for family living and machine and building purchases. Each farmer participant was asked to order 12 pair-wise distributions of net farm income for three different income intervals. Key to the development of the questionnaire is the income
distribution parameters, presented in Table 4.0. The income distributions underlying the pairwise comparisons must contain sufficient dispersion to represent real-world relevance to the respondents but not so broadly defined to encompass too vast an income interval. ${ }^{13}$ Note that mean income level I (low net income levels) is set at a relatively low level of $\$ 10,000$, while II, (middle net income level) is set at $\$ 20,000$, also a relatively low income level but III (high income level) is set at $\$ 40,000$ is still a relatively modest income; this is because our interest lies primarily in the low end of the income distribution.

Table 4.0: Income Distribution Parameters, Risk Attitude Questionnaire, 1987

| Statistic | Net-Income Level |  |  |
| :---: | :---: | :---: | :---: |
|  | I | II | III |
|  |  | -. - \$ |  |
| Mean Net Income | 10,000 | 20,000 | 40,000 |
| Std Deviation | 1,500 | 3,000 | 5,000 |
| Minimum value | 5;200 | 14,400 | 25,800 |
| Maximum value | 13,400 | 26,200 | 55,000 |
| Source: Chikwana | 1989) |  |  |

[^7]Table 4.1: Definition of Questionaire Absolute Risk Intervals (RIA)

| Interval |
| :--- |
| Nonge |
|  |
|  |
|  |
| [Low $\tau$ High $\tau$ ] |

$\left.\begin{array}{ll}1 \\ 2 & {\left[\begin{array}{cc}-\infty & -0.0001] \\ 3 & -0.005,\end{array}\right]} \\ 4 & {\left[\begin{array}{c}-0.0001,0.0001\end{array}\right]} \\ 5 & 0 \\ 6 & {\left[\begin{array}{c}0.0003\end{array}\right]} \\ 7 & {\left[\begin{array}{c}0.0001,0.0006\end{array}\right]} \\ 8 & {\left[\begin{array}{l}0.0003,0.001\end{array}\right]} \\ 0.0006,0.005\end{array}\right]$

While only the income interval corresponding to the producer's actual income possibilities is strictly appropriate, the same questionnaire encompassing all three income levels was administered to all participants, in order to facilitate administration of the survey. Risk coefficients are estimated for each farmer over all three income intervals and tested for their uniqueness and consistency. ${ }^{14}$

The Top Management Workshop participants are not a random sample of farmers. There are no formal selection criteria; the Workshops are publicly advertised and open to all farmers, regardless of size. However, the input forms are a formidable obstacle, implying a detailed knowledge of both the production and financial aspects of the farm. Accordingly, it would be expected that the participants would be better than average managers. Nevertheless, while this group is not truly representative of the entire population of Saskatchewan farmers, they are more representative of the commercial farms which produce the majority of Saskatchewan farm output.

14 The study questionnaire can be found in Chikwana, Appendix 1.

The questionnaire was distributed at Top Management Workshop meetings when farmers were planning and evaluating changes in their 5 -year farm plans. During this time, survey respondents were in a sense a "captive" audience as they were waiting for individual "what if" sessions. Not all Top Management participants stayed for the ensuing "what if" sessions and a few correspond by mail; out of a total of 130 farmers, 100 farmers completed the survey. A total of 79 of the 100 questionnaires were utilized for the following analysis. The other questionnaires were discarded because instructions were not followed or there were errors in the data.

## Risk Interval Results

Risk aversion can be measured by the coefficients of 1) Absolute Risk Aversion and 2) Relative Risk Aversion. The Absolute Risk Aversion coefficient, $\tau$, has already been defined in Chapter 2 . While $\tau$, is the most commonly used measure, it is not independent of income level, although it is independent of scaling. Thus, a second measure is included, the relative risk aversion coefficient, which is unitless and be can interpreted as an elasticity.

## Absolute Risk Aversion

Note that $\tau<0$ indicates pure risk loving, $r=0$ indicates pure risk neutrality and $r>0$ indicates pure risk aversion. Thus, Interval 1 [-m,0.0001 ], Table 4.1, clearly indicates risk loving and Intervals 5 $[0.0001,0.0006]$ to $8[0.001, \infty]$ clearly indicate risk aversion. However, the RIA results in overlapping risk intervals and therefore, intervals which are somewhat ambiguous. Interval 2 is relatively risk loving because it spans the 0 to $-0.005 \tau$ interval; and thus, risk neutrality is not excluded.

Likewise, Interval 3 is defined as relatively risk neutral as it covers the 0.0001 to $0.0001 \tau$ interval; it encompasses both risk loving and risk averse behavior.

Many of the values of $\tau$ found in the literature have been assumed (Table 4.5.) In general, the values of [-.00001 to . 00001] or [ -.0001 to . 0001] have been considered almost risk neutral. However, the values of $\tau$ indicating strong risk aversion are highly variable, as would be expected given the nature of the $\tau$ coefficient; values of $\tau$ have ranged from [.000042 to 0.0035] to [. 02 to .04 ]. This is because $\tau$ is not invariant with respect to income level (Fleisher, 1986) and must be converted to the relative risk aversion coefficient in order to make inter-income comparisons.

## Relative Risk Aversion Coefficient

In addition to $\tau$, the relative risk aversion coefficients, $\theta$, were also calculated for each of the study respondents. ${ }^{15}$ The relative risk aversion coefficient, $\theta$, is unitless and can thus be compared across income levels. As with $\tau$, a pure risk lover is defined as $0<\theta$, a pure risk averter is defined as $\theta>0$ and pure risk neutrality is defined as $\theta=0$. Note that RIA blurs these definitions by allowing $\tau$ or $\theta$ to assume a range of values $\left[\tau_{l}, \tau_{u}\right]$ and $\left[\theta_{l}, \theta_{u}\right]$. Hence, some intervals may clearly denote either pure risk loving or pure risk averse behavior by having both upper and values values negative (purely risk loving) or positive (purely risk averse). But in many cases, the range may

[^8]also include 0. In these cases, relative risk lovers are defined as $\theta_{l}<0$ and $\theta_{u}<0$ and relative risk averters are defined as $\theta_{l} \geq$ and $\theta_{u}>0$.

## Representative Farm Risk Clusters

One of the problems in delineating representative farms is that each parameter tends to add another dimension and hence, the total farms are a multiple of the number of variations in each dimension. For example, a farm profile specifying 3 soil zones, 3 farm sizes, 3 debt levels and 3 risk attitudes would require $3 \times 3 \times 3 \times 3$ or 81 representative farms--clearly an intractable number. One way around this problem is to use cluster analysis to identify clusters of relatively homogenous farms. Chikwana (1989) used cluster analysis to identify clusters of relatively homogenous farmers. In brief summary, she parametrically ranged the number of clusters from 3 to 8 . The best results were 3 clusters listed in Appendix B. The summary characteristics are found in Tables 4.10 to 4.12 . Three representative farm types are delineated by farm size according to the risk clusters defined by Chikwana (1989). The risk clusters are

Cluster A: relatively risk loving: low debt, large;
Cluster B: relatively risk neutral: experienced, moderate debt, large and,
Cluster C: relatively risk averse: young, high debt and smaller.

## Cluster A--Relatively Risk Loving

Of the total 79 valid surveys, 10 respondents formed Cluster A. This cluster is relatively large, averaging 2090 acres, but featuring relatively low financial leverage- with a debt-asset ratio of $14.9 \%$ (Table 4.2). The mean net worth was $\$ 1,009,762$ and net farm income was $\$ 62,327$. Using the
lower income level, all of the lower $\tau$ levels are negative or less than 0 . However, only 2 of the upper $\tau$ levels are negative. Again, using the lower income level, 7 or $70 \%$ of cluster $A$ can be classified as relative risk lovers (Table 4.4), but only half are pure risk lovers; there 5 relative risk lovers (ie. possessing a $\tau_{u}$ or $\theta_{u}=0$ ). ${ }^{16}$ Interestingly, as income level is raised, 70\% of Cluster A migrates towards risk neutrality; either becoming neutral (50\%) or becoming less loving/adverse (2).

## Cluster B--Relatively Risk Neutral

A total 29 respondents form Cluster B. This cluster tends to establish the middle ground between the other two clusters. Cluster $B$ features a moderate net farm income of $\$ 33,875$, a net worth of $\$ 649,192$ and tends to span risk loving to risk adverse. While farm size remains relatively large at 1,814 acres, financial leverage is considerably higher than $A$, the mean debt to asset ratio is $22.72 \%$. This group is far more risk neutral than the other two groups; the mean $\tau$ range tends to span 0 , including a negative lower value and a positive upper value (Table 4.3). However, the mean $r$ values mask the true character of this cluster. Using Table 4.4 , Cluster $B$ is characterized by approximately one-half are purely risk neutral or mixed, one-third are purely risk averters and one-fifth are purely risk lovers. However, if relative behavior is used as the criterion $(\theta=0$ is included), then approximately half fall within the relatively neutral category.

[^9]
## Cluster C-Relatively Risk Adverse

Cluster $C$ is the largest group encompassing approximately one-half of the total respondents. Cluster $C$ features the smallest farm size at 1,311 acres and the greatest financial leverage--a $37.90 \%$ debt to asset ratio. The corresponding mean net worth is relatively low at $\$ 234,938$. While it is difficult to assess the exact financial status without further information and statistical means of debt-asset ratios can be misleading, it would be expected that many of these farms are in a potentially precarious financial position; many are likely to experience moderate to severe cash flow problems unless there is off-farm family income. Given their relatively precarious financial position, it is not surprising that this cluster is relatively risk averse. Mean $\tau$ values are positive and much higher than the other clusters (Table 4.3). While the mean $r_{l}$ associated with the lower income level is -0.00001 , this is very close to 0.0 . Again using the low income level, very few respondents are pure risk lovers-only $10 \%$ but $50 \%$ are pure risk averters (Table 4.4). The remaining $40 \%$ have $\tau, \theta$ values spanning from slightly negative to very positive (Appendix B). What is surprising, however, is that almost all--98\% of the farmers $\theta$ values move towards 0 when income levels are increased. Using income level III, $50 \%$ of the farmers are relatively neutral and $88 \%$ are pure neutral or mixed.

Table 4.2: Summary of Farm and Sociological Statistics, by Cluster Group

| Net <br> Income | Debt/ <br> Asset <br> Ratio | Net <br> Worth | Age Educ | Farm Farm <br> Size Experience |
| :---: | :---: | :---: | :---: | :---: |
| $(\$ /$ year $)$ | $(\$)$ | (years) | (acres) (yrs) |  |

## Cluster A:

$\mathrm{n}=10$

|  |  |  |  |  |  |  |  |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| Mean | $\$ 62,327$ | $14.90 \%$ | $\$ 1,009,762$ | 36.1 | 5.6 | 2,090 | 15.4 |
| StDev | $\$ 33,013$ | $12.43 \%$ | $\$ 69,546$ | 6.36 | 1.95 | 939 | 6.02 |
| Min | $\$ 15,567$ | $0.00 \%$ | $\$ 914,131$ | 25 | 2 | 955 | 6 |
| Max | $\$ 111,266$ | $43.00 \%$ | $\$ 1,114,552$ | 46 | 8 | 3,760 | 25 |

Cluster B:
$\mathrm{n}=29$

| Mean | $\$ 33,875$ | $22.72 \%$ | $\$ 649,192$ | 41.6 | 5.72 | 1,814 | 21.3 |
| :--- | :--- | ---: | ---: | ---: | ---: | ---: | ---: |
| StDev | $\$ 44,119$ | $11.96 \%$ | $\$ 94,853$ | 8.71 | 4.36 | 798 | 9.63 |
| Min | $(\$ 78,426)$ | $3.00 \%$ | $\$ 426,830$ | 30 | 0 | 750 | 9 |
| Max | $\$ 144,473$ | $54.00 \%$ | $\$ 834,814$ | 63 | 23 | 3,980 | 43 |

Cluster C:
$\mathrm{n}=40$

| Mean | $\$ 4,080$ | $37.90 \%$ | $\$ 234,938$ | 36.2 | 5.95 | 1,311 | 13.2 |
| :--- | :---: | ---: | ---: | ---: | ---: | ---: | ---: |
| StDev | $\$ 20,454$ | $20.65 \%$ | $\$ 94,604$ | 6.27 | 1.96 | 599 | 5.29 |
| Min | $(\$ 62,796)$ | $5.00 \%$ | $\$ 53,563$ | 24 | 1 | 311 | 4 |
| Max | $\$ 38,438$ | $83.00 \%$ | $\$ 390,124$ | 57 | 11 | 2,860 | 29 |

Table 4.3: Summary of Mean, Lower and Upper $\tau$ Ranges, by Cluster Group

| Mean $\tau$ <br> Income Level |  |  | Lower $\tau$ Income Level |  | Upper $\tau$ Income Level |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1 | 3 | 1 | 3 | 1 | 3 |
| Cluster A: |  |  |  |  |  |  |
| Mean | 0.0001 | -0.0001 | -0.0004 | -0.0004 | 0.0005 | 0.0001 |
| StDev | 0.0009 | 0.0002 | 0.0005 | 0.0004 | 0.0015 | 0.0001 |
| Cluster B: |  |  |  |  |  |  |
| Mean | 0.0007 | 0.00041 | -0.00014 | -0.00026 | 0.0015 | 0.00107 |
| StDev | 0.0018 | 0.00174 | 0.00061 | 0.00055 | 0.0031 | 0.00303 |
| Cluster C: |  |  |  |  |  |  |
| Mean | 0.00095 | 0.000162 | -0.00001 | -0.00016 | 0.00192 | 0.000485 |
| StDev | 0.00173 | 0.000981 | 0.00056 | 0.00035 | 0.00298 | 0.001707 |

Table 4.4: Number of Respondents by Risk Classification

| Risk Classification | Risk Cluster $\theta$ |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | A <br> Income Level |  | $\begin{gathered} \text { B } \\ \text { Income Level } \\ \hline \end{gathered}$ |  | C <br> Income Level |  |
|  | 1 | 3 | 1 | 3 | 1 | 3 |
| Relative: ${ }^{\text {a }}$ |  |  |  |  |  |  |
| Risk Lovers | 7 | 4 | 12 | 13 | 15 | 9 |
|  | 70\% | 40\% | 41\% | 45\% | 38\% | 238 |
| Risk Averters | 3 | 1 | 15 | 5 | 25 | 11 |
|  | 30\% | 10\% | 52\% | 17\% | 63\% | 28\% |
| Mixed/Neutral | 0 | 5 | 2 | 11 | 0 | 20 |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| Risk Lovers | 2 | 2 | 6 | 6 | 4 | 3 |
|  | 20\% | 20\% | 21\% | 21\% | 10\% | $8 \%$ |
| Risk Averters | 1 | 0 | 10 | 3 | 20 | 2 |
|  | 10\% | 0\% | 34\% | 10\% | 50\% | 5\% |
| Mixed/Neutral | 7 | 8 | 13 | 20 | 16 | 35 |
|  | 70\% | 80\% | 45\% | 69\% | 40\% | 88\% |
| Move Towards Neutrality |  | 7 |  | 20 |  | 39 |
| From Level I |  | 70\% |  | 69\% |  | 98\% |

${ }^{a}$ Relative Risk Behavior: given a risk interval: $\left[\tau_{l}, \tau_{u}\right]$ and $\left[\theta_{l}, \theta_{u}\right]$ Risk Lovers: $\tau_{l}<0$ and $\tau_{u} \leq 0$ and Risk Averter: $\tau_{l} \geq 0$ and $\tau_{u}>0$.
b Pure Risk Behavior: given a risk interval: [ $\left.\tau_{l}, \tau_{u}\right]$ and $\left[\theta_{l}, \theta_{u}\right]$ Risk Lovers: $\tau_{l}<0$ and $\tau_{u}<0$ and Risk Averter: $\tau_{l}>0$ and $\tau_{u}>0$.

Table 4.5: Sumary of Commonly Used Risk Aversion Coefficients

| Study | Almost Risk Neutral | Strongly Risk Averse | Outcome Variable | Source of (r)x |
| :---: | :---: | :---: | :---: | :---: |
| 1) Holt and Brandt | . 005 to. | . 02 to. 04 | Hog prices (R/cwt) | Assumed based on Kramer and Pope |
| 2) Meyer 1977b |  | 6.0 | \% Annual return on mutual funds | Assumed based on C.E. |
| 3) Cochran, Robison, and Lodwick |  | . 0015 | Annual income from 10-acre block | Elicited |
| 4) Lemieux, | -. 00001 to . 00001 | . 000015 | After-tax NPV (10 year) | As sumed |
| 5) Tauer, 1985 |  | .0002 to . 0003 | \$100,000 farm purchase | Assumed based on King and Robison |
| 6) Love and Robison | -. 00001 to. 0002 | .0025 to m | After-tax annual income | Elicited |
| 7) Rister, Skees, and Black | -. 00001 to. 00001 | . 00004 to . 00008 | Annual returns to grain storage | Assumed based on C.E. |
| 8) Wilson and Eidman 1983 | -.0001 to . 0001 | . 0002 to . 001 | After-tax annual farm income | Elicited |
| 9) Zacharias and Grube | -. 0000001 to . 000001 | . 000042 to . 0035 | Annual farm income | Assumed threshold |
| 10) King and Oamek | -. 00001 to . 00001 | . 00005 to . 0001 | Annual farm income | Elicited |
| 11) Danok, McCarl, and White |  | . 1 | Annual farm income | As sumed |
| 12) King and Lybecker | -. 0001 to . 0001 | . 0003 to . 0006 | Annual income from 1,000 cwt dry beans | As sumed |
| 13) Kramer and Pope | . 000 to . 00125 | . 02 to . 03 | Annual farm income | Assumed based on C.E. |
| 14) King and Robison | -. 0001 to . 0001 | . 001 | Annual income | Elicited |
| 15) Cochran et al. | -. 0001 to . 0001 | . 001 | Annual income | Assumed based on Love, and Robison: Cochran Robison, and Lodwick |
| 16) Tauer 1986 | -. 0001 to . 001 | .001 to $\infty$ | Annual farm income | Elicited |
| 17) Green et 21. | . 0 to . 00125 | . 005 to . 0075 | Annual farm income | As sumed |

Source: As cited in Raskin, Rob and M.J. Cocharan. (1986). Interpretations and Transofrmations of Scale for the Pratt-Arrow Absoulute Risk Aversion Coefficient Implications for Generalized Stochastic Dominace. American Journal of Agricultural Economics. 68:204-210.

## Representative Farm Risk Coefficients

Fundamental to RIA is the definition of the $\tau$ intervals. The income
distribution is divided into two intervals roughly according to the RIA questionnaire. Note that in the questionnaire that family living and taxes were not deducted. However, in order to properly define cash flows and their linkages with firm growth, family living and tax expenditures must be deducted from cash flows. Thus, the point separating the two segments of the income CDF must take into consideration farm differences. Fortunately, the estimate need only approximate the $\$ 40,000$ of income used in the study to separate net income levels I and III. The income intervals are defined in Table 4.6. The corresponding risk intervals defined in Table 4.7 are closely based on the risk clusters' mean $\tau$ values. Cluster A, the relative risk lovers has a lower income $\tau$ ranging from -0.00040 to 0.00000 ; allowing this group to vary from moderately risk loving to risk neutral. At higher income levels, the interval is further broadened by maintaining the lower $\tau$ limit of -0.00040 and expanding the upper $\tau$ limit to include 0.00010. Nevertheless, at the upper income level, this cluster still is far less risk averse than the other two clusters. Cluster $B$, the relatively risk neutral group has a lower income level risk interval spanning a very broad $\tau$ interval of -0.00014 to 0.00155 . Curiously, this cluster has upper income, upper $\tau$ value which is moderately risk adverse. Thus, the upper income risk intervals associated with this cluster will tend not to discriminate as well as those of the other two clusters. The last cluster is the relatively risk averse cluster. At the lower income level the $\tau$ interval lies entirely within the risk averse range. However, the upper range encompasses both moderate risk loving and aversion $r$ values.

Supply Response Under Risk
Table 4.6: Income Intervals, by Cluster

| Cluster | Income |  |  |  |  | Interval |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Lower | Upper |  |  |  |
|  |  |  |  |  |  |  |
|  | 0 | 18,000 | 18,000 | 150,000 |  |  |
| B | 0 | 15,000 | 15,000 | 150,000 |  |  |
| C | 0 | 12,000 | 12,000 | 150,000 |  |  |

Table 4.7: Risk Intervals and Absolute Risk Coefficients

|  | Income Level |  |  |  |  |
| :---: | ---: | ---: | ---: | ---: | ---: |
| Cluster | Lower |  |  |  |  |
|  |  |  | Upper |  |  |
| A | 0 | -0.00040 | 0.00000 | -0.00040 | 0.00010 |
| B | 0 | -0.00014 | 0.00155 | -0.00026 | 0.00107 |
| C | 0 | 0.00001 | 0.00192 | -0.00016 | 0.00049 |

## Representative Farms Costs and Size

The farm size and debt are based on the previously defined risk clusters; cluster farm size and debt to asset ratios set the general financial parameters. Total farm assets, asset composition, and the various production and technical coefficients are based on the 1987 Top Management Workshop participants. Farm costs are divided into three components according to the production/use units: direct cash costs and fixed per kilogram, direct cash and costs per hectare and general farm overhead cash costs. Direct cash costs per kilogram consist of expenses which are incurred on a unit yield basis such as combining, trucking and storage (Table 4.9). Direct cash costs per hectare are those expenses which are incurred on, a unit hectare basis such as fuel and repairs associated with tillage operations and swathing; material costs
including seed, fertilizer, herbicide, insecticide; and other costs including custom work and crop insurance. Direct cash costs are the same for all representative farms. General farm overhead cash costs include property taxes and overhead expenses. The latter includes fuel and repairs of pickup trucks and transportation of chemicals and fertilizer; farmstead power and repairs, legal and accounting fees; and general costs of operating a farm business (Table 4.10). Family living withdrawals are based on an opportunity wage rate of $\$ 10$ per hour and a flat management fee of $\$ 6,000 .{ }^{17}$

| Cluster | $\begin{aligned} & \text { Farm } \\ & \text { Size } \end{aligned}$ | Total Land Value | Total Machines Buildings | Total Assets | Total Debt | Net Worth | Debt Asset Ratio |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| (hectares) |  |  |  | (dollars) |  |  |  |
| A | 948 | 763,319 | 162,949 | 926,269 | 185,254 | 741,015 | 0.20 |
| B | 823 | 662,565 | 146,181 | 808,746 | 121,312 | 687,434 | 0.15 |
| C | 594 | 478,338 | 115,522 | 593,860 | 195,974 | 397,886 | 0.33 |

Table 4.9: Costs of Production, Saskatchewan, Brown Soils

| Production/ Cost Item | Wheat |  | $\begin{aligned} & \text { Sumner } \\ & \text { Fallow } \end{aligned}$ |
| :---: | :---: | :---: | :---: |
|  | Fallow | Stubble |  |
| Costs per kilogram: |  |  |  |
| Fuel and repair | 0.0055 | 0.0055 | 0.0000 |
| Capital Recovery Charge | 0.0183 | 0.0183 | 0.0000 |
| Costs per hectare: |  |  |  |
| Direct Costs | 61.16 | 77.14 | 11.88 |
| Capital Recovery Charge | 66.05 | 64.99 | 16.63 |

[^10]

## Cropping Rotation Strategies

Flexible rotations are based on the available May soil moisture, for farmers decide to crop or fallow based on the amount of soil moisture at planting. Farmers may also have different May soil moisture thresholds levels. May moisture threshold levels chosen for this study are parametrically varied from 70 to 110 mm by 5 mm increments. ${ }^{18}$

## Summary

Cluster analysis was used to identify relatively homogeneous clusters of the 1987 Top Management participants based on their risk attitudes, farm size, debt levels and sociological characteristics. Here, relative risk attitudes encompass a range of risk attitudes. Relatively risk loving attitudes includes risk neutrality as well as strong risk loving. Relatively risk neutral attitudes spans moderately risk loving to moderately risk averting attitudes. Likewise, relatively risk averting attitudes encompasses risk neutrality to strong risk aversion. Three risk clusters of representative farms are delineated Cluster A--relatively risk loving; Cluster B-relatively risk neutral and Cluster C--relatively risk averse. Of the total 79 valid

[^11]surveys, 10 respondents formed Cluster A. Cluster A features relatively large farms with low debt and a correspondingly high net worth. A total 29 respondents form Cluster B. Cluster B farmers are almost as large as Cluster A but are more typical in terms of net worth and debt leverage. Cluster $C$ is the largest group encompassing approximately one-half of the total respondents. Cluster $C$ farmers are the smallest but possess the greatest financial leverage and the lowest net worths. All of the risk clusters tended to become more risk neutral at high income. This is particularly true of Cluster C--98\% of the farmers $\theta$ values moved towards 0 when income is increased.

## CHAPTER V: SELECTION OF PRICE STABILIZATION PROGRAMS

Key to the investigation are the price policies and the expected price scenarios. Four alternative price stabilization programs are chosen, representing the free market with no government restrictions, perfect stabilization (fixed price), upper and lower bounded prices (price truncation), and lower bounded prices (price insurance). The following sections review 1) the price levels selected for the measuring production response and 2) the definition of the various price stabilization programs.

Choice of Wheat Prices
Two approaches were selected for mapping out three points on the demand curve: historical price patterns and current opportunity costs of production. ${ }^{19}$ These values represent a lower price, a middle price and a higher price. In order to facilitate the evaluation of producer response, the middle approach should conform to a long run equilibrium price where zero economic profits are generated at the farm level. The historical wheat prices are used to generate not only the mean but the variance. These are compared to opportunity costs of production.

[^12]Historical Wheat Prices


Figure 6: Nominal, Real and Indexed Spring Wheat Prices

In figure 6, nominal Saskatchewan farmgate wheat prices are presented for the years 1960 to 1986. Next, commodity prices are converted to real 1986 prices using the consumer price index and are labelled "real" prices. Finally, real prices are indexed downwards for a two percent increase in cost efficiency; this price is labelled the "real-indexed" price. The two percent increase in cost efficiency is primarily based on increases in technical efficiency and is interpreted as acting like a shift in the supply curve. The mean, real-indexed price of wheat is $\$ 180.41 /$ tonne.

Opportunity Cost of Production (COP)
Data from the 1987 Top Management Workshops is used to construct typical costs of wheat for the brown soil zone of Saskatchewan. The COP represents an equilibrium price where each resource just recovers its "opportunity cost" or reservation price. Thus, this price represents an important economic benchmark. Based on 13,49 and 27 farms, in the brown, dark-brown and black soils, the costs of production are $\$ 175.27, \$ 179.31$ and $\$ 170.86$ per tonne, respectively (Table 5.1). Note that these costs are extremely close to the provincial long-run real-indexed wheat prices. ${ }^{20}$ The $\$ 179.31$ per tonne COP can be regarded as an equilibrium where all factors of production would remain stable, there would be no migration of resources and land prices would remain constant.

## Price Scenarios

The mean real-indexed wheat price of $\$ 180.41$ per tonne not only represents a continuation of long run prices, but also represents a nearly equilibrium COP as it is very close to the 1987 COP. While the other two price points are important only in that they facilitate price mapping, it would be convenient if they also represent known values. Consequently, the low price should represent a continuation of current prices (spring, 1988) with government transfer payments. Initial Saskatchewan farmgate wheat prices in 1988 are about $\$ 95.53$ per tonne. Government transfer payments, including WGSA and the Special Grains payments, add approximately $\$ 43.36$ per tonne to

[^13]give a total combined price of $\$ 138.89$ per tonne-which is conveniently close to the mean less the standard deviation of $\$ 56.22 /$ tonne or $\$ 138.16 /$ tonne. ${ }^{21}$ Accordingly, the low wheat price scenario is set at $\$ 138.16$ per tonne, the mean less one standard deviation. In order to maintain symmetry, the high commodity price scenario is based on the mean + the standard deviation of $\$ 56.22 /$ tonne or $\$ 222.67$ per tonne.

In addition to mapping the traditional supply response surface with respect to price, a further dimension of price variability must also be considered. While this dimension is continuous, some combinations of expected prices and variability are obviously unlikely. Moreover, each additional combination of expected price and variability adds considerably to overall problem tractability. Hence, the standard deviation of each price scenario is set at a constant coefficient of variation of $31.2 \%$, which is the coefficient of variation of the long run, real-indexed wheat prices. Thus, the standard deviation corresponding to the three price scenarios are $\$ 43.05, \$ 56.22$, and \$69.38 per tonne for the low, medium and high price scenarios, respectively (Table 5.2).

21 Note, this assumes that the maximum payouts, of $\$ 25,000$ and $\$ 28,000$, respectively for the WGSA program and the Special Grains Program are not reached.

Table 5.1: Long Run, Real-Indexed Saskatchewan Wheat Prices, and 1987 Top Management Costs of Production

|  | (\$/Tonne) |  |
| :---: | :---: | :---: |
| 1987 Real and Indexed Prices: ${ }^{1}$ |  |  |
| Mean | 180.41 |  |
| S.d. | 56.22 |  |
| C.V. | $31.2 \%$ |  |

1987 Costs of Production: ${ }^{2}$ Soils:

Brown 175.27
Dark Brown 179.31
Black $\quad 170.86$

1 Based on nominal prices inflated to 1987 dollars and indexed downwards for a $2 \%$ increase in cost efficiency.
2 Based on 1987 Top Management truncated mean costs.

Table 5.2: Wheat Price Scenarios ${ }^{\text {a }}$

| Price <br> Scenario | Expected <br> Price | Standard <br> Deviation | Price <br> Floor | Price <br> Ceiling |  |
| :--- | ---: | :--- | ---: | :--- | :---: |
|  |  | $(\$ /$ tonne) |  |  |  |
| Low | $\$ 180.47$ | $\$ 56.22$ | $\$ 124.25$ | $\$ 236.69$ |  |
| Medium | $\$ 138.16$ | $\$ 43.04$ | $\$ 95.12$ | $\$ 181.20$ |  |
| High | $\$ 222.67$ | $\$ 69.37$ | $\$ 153.30$ | $\$ 292.04$ |  |

[^14]
## Price Stabilization Programs

Four price policies are constructed: one of no price intervention and three alternative price stabilization programs are constructed. In Table 5.2, the price expectations of the various price scenarios are defined. While the standard deviation of the middle price scenario is set at the historical
level, the other two standard deviations are based on a coefficient of variation of $31.2 \%$. Price floors (truncated and insurance) and ceilings (truncated) are defined as the following. The price floor is set at the expected price minus one standard deviation while the price ceiling is set at the expected price plus one standard deviation.

The first price policy, Policy A, assumes no price intervention or no stabilization program and serves as a benchmark for comparing other programs. The second case, Case B--Truncated Price Policy, assumes a price floor and a price ceiling. Accordingly, 68 percent of the price variability remains under the Truncated Price Policy. Because of the symmetry associated with the truncation process, the mean remains unaltered. The third case, Case D-Price Insurance, incorporates a price floor and retains 84 percent of the price variability. In order to adjust for the accompanying bias of Case $D$, prices are adjusted downwards by the lower truncation area. The last policy, Policy B--Fixed Price Policy, assumes complete price stabilization, with prices fixed at the expected scenario price.

Table 5.3: Simulated Statistics of Stabilization Programs, by Price Level

| Program Policy | Expected Price Scenario |  |  |
| :---: | :---: | :---: | :---: |
|  | Low | High | Medium |
| No Stabilization: |  |  |  |
| Mean | 138.16 | 180.41 | 222.67 |
| StdDev | 44.11 | 55.14 | 68.41 |
| Min | 13.72 | 1.60 | 16.20 |
| Max | 348.02 | 263.38 | 428.46 |

B) Upper \& Lower Bounded Stabilization (Truncated) :

| Mean | 138.16 | 180.41 | 222.67 |
| :--- | ---: | ---: | ---: |
| StdDev | 30.75 | 40.36 | 49.66 |
| Min | 94.48 | 126.40 | 155.16 |
| Max | 180.48 | 238.68 | 293.74 |
|  |  |  |  |
| C) Lowed | Bounded | Stabilization |  |
| (Insured) : |  |  |  |
| Mean | 138.16 | 180.41 | 222.67 |
| StdDev | 37.25 | 46.65 | 58.08 |
| Min | 93.95 | 125.43 | 151.41 |
| Max | 262.88 | 350.00 | 428.58 |

D) Complete Stabilization (Fixed)
Fixed $138.16 \quad 180.47 \quad 222.67$

While the statistics in Table 5.3 reveal some of the characteristics of the alternative stabilization policies, they mask much of the impact born by the producer. While the standard deviations are reduced by approximately 30 to $40 \%$ by stabilizing prices, this does not adequately measure the true impact of the price insurance or price truncation. The simulated price distributions for each of the four alternative policies are shown in figures 7, 8 and 9 for the three alternative expected price scenarios, respectively. It should be noted that the histogram intervals are broadly defined so that the histograms
are only approximate. The no stabilization prices are normally distributed and the histograms generally display the required normal shape. The truncated price policy is created by truncating the distribution for those points which lie beyond $\pm$ one standard deviation from the mean. Thus, the corresponding truncated distributions should display two equally sized blips at each of the truncation points. Because of the errors in the histogram techniques, the differences between the two blips are exaggerated--they are much closer than actually shown. The price insurance policy incorporates the same price floors as the truncated price policy less the insurance premium which is 0.0884 times the standard deviation. Thus, the price insurance policy should display a "blip" the same size as the price truncation policy but slightly below the lower price floor.


Figure 7: Estimated Wheat Price Distributions, by Policy, Medium Price Scenario


Figure 8: Estimated Wheat Price Distribution, by Policy, Low Price Scenario


Figure 9: Estimated Wheat Price Distributions, by Policy, High Price Scenario

Impact of Yield and Price Variability on Gross Income Variability
Thus far, it has been maintained that risk is manifested as variability in net farm income. In Chapter 4, the weather-induced variability on wheat/fallow and continuous cropping yields is estimated. Likewise, price variability has been estimated in the previous section. This section reviews how yield and price variability generate total gross income variability and demonstrates the impact of a total reduction in either yield or price variability on total income variability, assuming independence of price and yields. Gross income in Table 5.4, is the simple product of price and yield. The variability of gross income is far more complex and must take into account all the various squared interaction terms. Mean yields from Chapter 3 are 2060 and $1606 \mathrm{~kg} / \mathrm{h}$, with corresponding standard deviations of 386 and $474 \mathrm{~kg} / \mathrm{h}$ respectively. It is also assumed that mean wheat prices are $\$ 0.18 / \mathrm{kg}$ with a standard deviation of $\$ 0.06 / \mathrm{kg}$. Gross incomes are $\$ 379.93$ and $\$ 296.28 / \mathrm{h}$ respectively, for $\mathrm{W}-\mathrm{F}$ and Continuous rotations. The corresponding standard deviations are $\$ 136$ and $\$ 126 / \mathrm{h}$ with CV's of $36 \%$ and $42 \%$. There are several important relationships to note between individual price, yield and gross income variability. First, gross income variability rises but not nearly as much as would be intuitively expected. Given individual CV's of $31 \%$ and $19 \%$, respectively for price and W-F yield, the CV of gross income is $36 \%$, not a great deal larger than the CV of price. The individual CV's for price and continuous wheat yields are $31 \%$ and $33 \%$ respectively and the corresponding CV of gross income is $42 \%$. Thus, while the CV of continuous yield is considerably higher than the CV of W-F ( $30 \% \mathrm{v} 19 \%$ ), the gross income CV is only marginally higher ( $42 \% \mathrm{v} 36 \%$ ). Secondly, the elimination of price variability still leaves yield variability--and the overall reduction in the

CV is relatively small. The latter has particularly important implications for stabilization programs which address only price or yield variability; these policies will not be nearly as effective in reducing income variability as programs which directly address income.

Table 5.4: Estimated Variability in Gross Income

|  | Price | Yield |  |
| :---: | :---: | :---: | :---: |
|  |  | W-F | Continuous |
|  | (\$/k) |  | k/h) |
| Mean | \$0.18 | 2060 | 1606 |
| Var | 0.003160 | 149169 | 224821 |
| StDev | \$0.06 | 386 | 474 |
| CV | 31\% | 19\% | 30\% |
| $E(P * Y)$ |  | \$379.93 | \$296. 28 |
| $\operatorname{Var}(\mathrm{P} * \mathrm{Y})$ |  | \$18,486 | \$15,804 |
| StDev |  | \$136 | \$126 |
| CV |  | 36\% | 42\% |

Summary
Three price scenarios and four price policies are delineated. The three price scenarios include 1) a middle price scenario which represents an historical mean adjusted for inflation and technology; this price scenario is also very close to a COP equilibrium price; 2) a low expected price based on one standard deviation below the mean and 3) a high expected price based on one standard deviation above the historical mean. In each scenario the coefficient of variation is held constant at $31 \%$ of the mean, the historical average. Four alternative price stabilization programs are chosen, representing the free market with no government restrictions, upper and lower
bounded prices (price truncation), and lower bounded prices (price insurance) and perfect price stabilization (fixed price).

Chapter 3 estimates of yield variability are combined with wheat price variability. Estimated gross income variability is $36 \%$ and $42 \%$ respectively, for the wheat-fallow rotation and continuous wheat, respectively. Since both price and yield variability are more or less equally important in determining gross income variability, the elimination of one without a corresponding reduction in the other will generate only modest decreases in gross income variability. The obvious implication is that government programs must address both income and yield variability simultaneously before any progress can be made in reducing farm income risk.

## CHAPTER VI: RESULTS

## Introduction

In brief summary, a real time, bio-economic simulator is constructed incorporating stochastic May soil moisture and yield relationships and deterministic farm costs. The seeding decision for each of the four fields is based on whether the May soil moisture, $M_{t}$, is above or below $M_{c}$, the critical soil moisture threshold. If $M_{t} \geq M_{c}$, then the field is seeded, if $M_{t}<M_{c}$, then the field is fallowed. If each producer cluster were perfectly risk neutral, then no further analysis would be needed; each producer would choose the expected profit maximizing strategy. Likewise, actuarially sound stabilization programs would have no long-run production effect. However, producers were found to possess differing and distinct risk attitudes--at least at lower income levels. Three clusters were identified: Cluster Arelatively risk loving, Cluster B-relatively risk neutral and Cluster Crelatively risk adverse. Four stabilization policies are formulated: no policy, price truncation, price insurance and a fixed price. The cdf of annualized returns of each strategy and farm cluster are re-simulated for each $M_{c}$ strategy. A total of 3 clusters $x 3$ price levels $\times 4$ price policies $x 9 M_{c}$ strategies generates a total of 324 simulations for one soil zone. Given price level, and stabilization price policy, each pair of the nine $M_{c}$ strategies are examined for stochastic efficiency according to the cluster risk attitudes. In the case of multiple stochastic efficient $M_{c}{ }^{*}$ strategies, each efficient strategy is assigned the same weight and averaged. The impact of alternative risk attitudes on acreage and production decisions is assessed by comparing each $M_{c}^{*}$ strategy of each risk cluster with the perfectly risk neutral attitude or the profit maximizing strategy. By parametrically varying
wheat prices, production response can be mapped and the percentage difference over the benchmark profit maximization response determined. Next, the corresponding price elasticities of acreage and production response are estimated. Finally, producer preferences as to price stabilization programs are assessed.

The Relationship Between $M_{c}$ and Cropping Intensity By parametrically varying $M_{c}$ from 40 to 120 cm , the relationship between


Figure 10: Simulated Mean Cropping Intensity, by $M_{c}$, Brown Soil Zones
$M_{c}$ and cropping intensity can be mapped (figure 10). As expected, increasing $M_{c}$ results in decreased cropping intensity but somewhat surprisingly, the simulated relationship between $M_{c}$ and cropping intensity appears to be nearly
linear. Since cropping intensity depends upon the number of years $M_{t} \geq M_{c}$, a normal distribution of rainfall should result in a curvilinear relationship as the chances of $M_{t}$ exceeding $M c$ should diminish rapidly as Mc increases. Apparently, the fallowed years build up sufficient moisture, increasing the probability of $M_{t} \geq M_{c}$ and preserving the appearance of linearity.

## Cropping Intensity and Yields

Another important relationship is the relationship between $M_{c}$ and wheat yields. In validating the yield module, a convenient yield benchmark is the $50 \%$ cropping intensity which allows approximate comparisons with the wheat on fallow. ${ }^{22}$ The mean yield associated with a mean $53.0 \%$ cropping intensity is $1,976 \mathrm{~kg} / \mathrm{h}$ with a standard deviation of $600 \mathrm{~kg} / \mathrm{h}$ (Table 6.0 ). This compares very favorably with the 1988 Top Management Workshop results of $1991 \mathrm{~kg} / \mathrm{h}$ of wheat on fallow for the same soil zone (Schoney et al, 1988, p 37).

In addition, the sources of yield variability can be decomposed into 1) direct precipitation effects on May soil moisture and yield, 2) the combined effects of the May precipitation and, 3) yield error terms. In the simple spreadsheet simulation in Chapter 4, yields are simulated based on actual real time precipitation and without error terms: the mean wheat yield associated with a $50 \%$ rotation is approximately $2060 \mathrm{~kg} / \mathrm{h}$ with a standard deviation of $386 \mathrm{~kg} / \mathrm{h}$. In the bio-economic simulations, a $53.0 \%$ cropping intensity results in a yield standard deviation of $600 \mathrm{~kg} / \mathrm{h}$ (Table 6.0 ). Hence, the direct weather effects contribute roughly $64 \%$ of the total variation in yield and the

[^15]

Figure 11: Simulated Mean and Standard Deviation of Wheat Yields, by $M_{c}$, Brown Soil Zone
error terms associated with May soil moisture and yield contribute the remaining $36 \%$.

In figure 11, the relationship between mean yield and $M_{c}$ also appears to be nearly linear. This is not surprising in that mean yields are a convex combination of fallow and stubble yields. Likewise, the standard deviation of yields increases in a nearly linear fashion with $M_{c}$.

Table 6.0: Simulated Mean Cropping Intensity and Mean Yield By $M_{c}$, Brown Soils, Saskatchewan

|  |  | Yield |  |
| ---: | :---: | :---: | :---: |
| $M_{c}$ <br> Level | Mean <br> Cropping <br> Intensity | Mean. | StDev |
| 40 | $88.4 \%$ | 1,501 | 715 |
| 45 | $86.6 \%$ | 1,527 | 710 |
| 50 | $84.9 \%$ | 1,553 | 705 |
| 55 | $83.1 \%$ | 1,582 | 700 |
| 60 | $81.3 \%$ | 1,611 | 694 |
| 65 | $78.3 \%$ | 1,653 | 682 |
| 70 | $76.3 \%$ | 1,682 | 676 |
| 75 | $73.4 \%$ | 1,722 | 664 |
| 80 | $71.5 \%$ | 1,750 | 658 |
| 85 | $68.4 \%$ | 1,792 | 650 |
| 90 | $66.3 \%$ | 1,820 | 640 |
| 95 | $64.3 \%$ | 1,844 | 635 |
| 100 | $62.3 \%$ | 1,867 | 628 |
| 105 | $60.1 \%$ | 1,890 | 624 |
| 110 | $58.0 \%$ | 1,910 | 618 |
| 115 | $55.5 \%$ | 1,943 | 609 |
| 120 | $53.0 \%$ | 1,976 | 600 |

## Expected Net Income and Variability of Net Income

The cdf's of net income are displayed in Appendix Table $C$ and the summary statistics are presented in Table 6.1 In brief review, farm net worth is simulated over a 15 -year period assuming that assets are periodically replaced and labor and management charges are removed as family living withdrawals. Net farm growth is measured by increased net worth over the period. Increased net worth is annualized to an annual return to equity capital and thus, is a return to entrepreneurship. As can be expected, the low price scenarios generate an expected erosion in net worth and annualized incomes are accordingly negative. When prices are set at their expected and high price scenarios, there is growth and annualized incomes are accordingly
positive.
The price policies are designed to be actuarially sound so that the price policy and the corresponding premium should not influence the mean annualized return. In addition, no asymmetry between borrowing and lending rates is allowed (ie they are set at the same rate) and tax rates are held constant. Thus, the mean annualized incomes should be virtually identical between price policies; the only variation should be from the randomness associated with the simulation process. In general, the mean annualized incomes are very close--generally, within $\pm \$ 150$ of each other (Table 6.1). This is important because the $M_{c}$ intervals are very small-only 5 mm , and the corresponding differences in mean annualized incomes are also very small, about $\pm \$ 500$.

Income variability is a complex combination of yield variability, seeded acreage variability and price variability. Using Cluster $B$ and the $90 \mathrm{~mm} \mathrm{M}_{\mathrm{c}}$ threshold, the coefficient of variation is $69 \%, 74 \%$ and $76 \%$, respectively for the low, medium and high price levels. The contribution of yield variability to annualized net income can be established by comparing the standard deviation of net income generated by no price policy with the standard deviation associated with a fixed price (no variability in price) policy. This can be readily evaluated using Table 6.1. For example, using the $90 \mathrm{~mm} M_{c}$ level, Cluster B and the base price scenario, the no price stabilization policy results in a standard deviation of $\$ 14,459$; the fixed price scenario results in a standard deviation $\$ 10,690$. Hence, removing all price variability results in a reduction in the coefficient of variation in net farm

```
income of 25%.}\mp@subsup{}{}{23
```

\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|c|c|}
\hline civater \& Poticy \& \& tistic \& 65 \& 70 \& 75 \& 10 \& \(\underset{35}{\text { Mc }}\) \& \({ }_{\infty}\) \& 95 \& 100 \& 105 \\
\hline \multirow[t]{6}{*}{} \& no price \& tow \& nem \& (11,988) \& , \& 10, \& (10, 159) \& ( 9.856 \& (9,812) \& (9,950) \& (10, 1 \& 13) \\
\hline \& \& \& sto \& 12,833 \& 12,723 \& 12,545 \& 12,622 \& 12,202 \& 12,01 \& 11,895 \& 11,521 \& 11,466 \\
\hline \& no Price \& tase \& mea \& 16,009 \& 16,869 \& 17,211 \& 17,233 \& 16.901 \& 16,483 \& 15,835 \& 15.081 \& 16, 132 \\
\hline \& n Prico \& dos \& stom \& \& 17,901 \& 17,482 \& 17,210 \& 16.891 \& 16,655 \& 16, 617 \& 15,908 \& 15, 805 \\
\hline \& no price \& Wigh \& mam \&  \& 4.939
22,583 \& 45, 081
22,172 \& 41,947
21.890 \& 4,014
21,726 \& 4,1182
21,466 \& \({ }^{42}, 117\) \& 60,763 \& \({ }^{39,262}\) \\
\hline \& \& \& stod \& 22,805 \& 22,53 \& 22,172 \& \& \& 21,456 \& 21,2\% \& 20,859 \& 20,691 \\
\hline \(\wedge\) \& Truncatod \& tow \& Mam \& (11, 10898\()\) \& \((11.150)\) \& (10,256) \& \((9,878)\)
10,
1785 \& (9,590) \& (9,566) \& (9,653) \& (9,890) \& (10,327) \\
\hline \& \& 18. \& Stoer \& 10,928
16,556 \& 10,767
16,507 \& -10,570 \& 10, 17.408 \& 10,232 \& 10,013 \& 16,128 \& 19,609 \& 14,389 \\
\hline a \& Truncatos \& -8. \& stour \& 15,966 \& 15,676 \& 15,209 \& 15,153 \& 16;55 \& 14,65 \& 16,26 \& 16,313 \& 14,165 \\
\hline \(\wedge\) \& trunca \& M1gh \& memon \& \$4,97913 \& 40, 4.89 \& \({ }^{40}{ }^{40} 838\) \& 4,9\%00 \& 43,735
19,674 \& 49,819
19 \& 419,922 \& 40,595 \& 38,417 \\
\hline \multirow{5}{*}{\(\stackrel{ }{*}\)} \& \multicolumn{2}{|l|}{\multirow[t]{2}{*}{Insurence 2}} \& \multirow[t]{5}{*}{men stom men storv stDer} \& (11,677) \& \((11,121)\) \& \((10,288)\) \& ( 9.87 \& (9, 585 ) \& (9,556) \& (9,631) \& \((9,903)\) \& \multirow[t]{2}{*}{\((10,303)\)
10,500} \\
\hline \& \& \& \& \& \& \& 11,52 \& \& \& 10,912 \& \& \\
\hline \& \multirow[t]{2}{*}{Imauranee} \& \multirow[t]{2}{*}{Bse} \& \& \({ }^{16,523}\) \& 16,860 \& 17,322 \& 17.399 \& 17.147 \& 16,784 \& 15, 137 \& \& \({ }^{16,409}\) \\
\hline \& \& \& \& 16.706 \& 16,557 \& 16,7\% \& \({ }^{16.076}\) \& 15,43 \& 15,692 \& 15,518 \& 15.146 \& 15.086 \\
\hline \& \multicolumn{2}{|l|}{Insurance wigh} \& \& 21,988 \& 41, \({ }^{41,451}\) \& \({ }_{\text {2 }}^{41,050}\) \& \({ }^{40,457}\) \& 43,459 \& 42,782
20,191 \& 41,902 \& 60,367
19,655 \& \\
\hline \multirow[t]{2}{*}{} \& \multirow[t]{2}{*}{flxad} \& \multirow[t]{2}{*}{Low} \& \multirow[t]{2}{*}{} \& \multirow[t]{2}{*}{\[
(11,9,7)
\]} \& \multirow[t]{2}{*}{\[
\binom{11,412}{9,163}
\]} \& \multirow[t]{2}{*}{(10,515)} \& \multirow[t]{2}{*}{(10, 131 )} \& \multirow[t]{2}{*}{(9,816)} \& \multirow[t]{2}{*}{\((0,735)\)
8,327} \& \multirow[t]{2}{*}{(9,850)} \& \multirow[t]{2}{*}{(10,082)} \& \multirow[t]{2}{*}{(10,461)} \\
\hline \& \& \& \& \& \& \& \& \& \& \& \& \\
\hline \multirow[t]{3}{*}{\(\stackrel{\wedge}{ }\)} \& \(F_{1}\) \& Bsese \& \({ }_{\substack{\text { mam, } \\ \text { stoer }}}\) \& \& \& 117.173 \& 17,24 \& 16,906 \& 16,569 \& 16,013 \& 15,265 \& 16,251
11.826 \\
\hline \& \multirow[t]{2}{*}{Hixad} \& \multirow[t]{2}{*}{nion} \& \multirow[t]{2}{*}{\[
\begin{aligned}
\& \text { stoon } \\
\& \text { Men. } \\
\& \text { stoov }
\end{aligned}
\]} \& 13,488 \&  \& 迷 \& 12,748
4.67 \& 12,31
63.176 \& 12,316
62,930 \& \({ }^{12}\) \& 11.9 \& 11,826 \\
\hline \& \& \& \& 17,741 \& 17,498 \& 17,176 \& 16,466 \& 16,630 \& 16,398 \& 16,307 \& 15,953 \& 15,202 \\
\hline 2 \& no price \& tor \& Nom, \& (7,350) \& ( 6,858 ) \& \((6,078)\) \& (5,762) \& (5,488) \& (5.461) \& ( 5.581\()\) \& (5.780) \& (6,069) \\
\hline \multirow{4}{*}{\({ }^{8}\)} \& \multirow[t]{2}{*}{Mo Price} \& \multirow[t]{4}{*}{Bme} \& stour \& 11, 1161 \& 11,065 \& 17,899 \& lic,78 \& 10,593 \&  \& 10, \({ }_{16}\) \& 10.002
16,150 \& 15,956 \\
\hline \& \& \& \multirow[t]{3}{*}{\[
\begin{aligned}
\& \text { Mem } \\
\& \text { stoon } \\
\& \text { Men } \\
\& \text { stooer }
\end{aligned}
\]} \& 15,677 \& 15,576 \& 15, 177 \& 15,019 \& 16,663 \& 16,459 \& 16,265 \& 13, 889 \& 13,721 \\
\hline \& no Price \& \& \& 42, \({ }^{196}\) \& 42,071 \& \({ }^{2} 2.196\) \& 41
4
19 \& 18,287
18.260 \&  \& 39, \({ }^{2181}\) \& 38,455 \& 77, 7125 \\
\hline \& \& \& \& 19,798 \& 19,605 \& 19,269 \& 19,006 \& 18,860 \& 18,553 \& 13,486 \& 18,109 \& 17.789 \\
\hline 8 \& \multicolumn{2}{|l|}{Truncatod tow} \& \multirow[t]{5}{*}{Mean StOev 4en Stow stder} \& (7,090) \& \((6,616)\) \& \((5,872)\) \& ( 5.518\()\) \& ( 5,268\()\) \& ( 5,265\()\) \& (5,323) \& (5,529) \& ( 5,908\()\) \\
\hline \& \& \multicolumn{2}{|l|}{\multirow[b]{4}{*}{Pruncated sace iruncatod Migh}} \& \& 17,487 \& 9,347 \& 18,071 \& 8,997
18,170 \& 17.883 \& 17,592 \& \({ }^{8,5059}\) \& -8.352 \&  \\
\hline \& \& \& \& 13,616 \& 13,636 \& 13, 278 \& 13,15s \& 12,038 \& 12,722 \& 12,620 \& 12,626 \& 12,297 \\
\hline - \& \& \& \& 41,93 \& 41.980 \& 41,982 \& 61.79 \& 61,026 \& 40,230 \& 39,478 \& \& 36,866 \\
\hline \& \& \& \& 17,261 \& 17,621 \& 17,387 \& 17,166 \& 16,906 \& 16,711 \& 16,035 \& 16,186 \& 16,015 \\
\hline ! \& \multicolumn{2}{|l|}{Insurance tow} \& \multirow[t]{4}{*}{\[
\begin{aligned}
\& \text { Mem } \\
\& \text { Stoev } \\
\& \text { Mamn } \\
\& \text { stoev } \\
\& \text { Memn } \\
\& \text { stoev }
\end{aligned}
\]} \& (7,080) \& \((6,597)\) \& \((5.839)\) \& ( 5,516 ) \& (5,263) \& \((5,236)\) \& (5,306) \& (5,56) \& (5,887) \\
\hline - \& \multicolumn{2}{|l|}{\multirow[t]{2}{*}{imurence tase}} \& \& 10.603 \& 10.475
17.677 \& 10.237
18.295 \& (10.002 \& 9,789
179 \& 17,556 \& 17,073 \& 16,382 \& \\
\hline \& \& \& \& 16,503 \& 16,976 \& 14.167 \& \({ }^{13,955}\) \& 13,75 \& 13, 7178 \& 13,472 \& \({ }^{13} 18.15\) \& 13,097 \\
\hline 8 \& \multicolumn{2}{|l|}{insurance nion} \& \& 41, \({ }^{18,487}\) \& 41,916
18,631 \&  \& \({ }^{16,465}\) \& co, 880
17.749 \& \begin{tabular}{l} 
+0, 172 \\
17.58 \\
\hline
\end{tabular} \& 9,

17,176 \& 38,102
17.064 \& 36,818
16,860 <br>
\hline \multirow[t]{4}{*}{$:$} \& fixed \& Low \& \& (7.316) \& (6,450) \& (6,071) \& (5.735) \& (5.466) \& ( 5,436$)$ \& ( 5.501$)$ \& (5,695) \& (6,025) <br>
\hline \& \multirow[t]{2}{*}{F1xad} \& \multirow[t]{2}{*}{Base} \& \multirow[t]{2}{*}{Stoer} \& \%,100 \& 7,955 \& 7,765 \& 7,5050 \& 7,405 \& 7,239 \& 7.1459 \& 6,959 \& \% 6.892 <br>
\hline \& \& \& \& 11,710 \& 11,550 \& 11,295 \& 11,067 \& 10,479 \& 10,000 \& 10,610 \& 10,365 \& 10, 267 <br>

\hline \& \multirow[t]{2}{*}{fixad} \& \multirow[t]{2}{*}{Migh} \& \multirow[t]{2}{*}{$$
\begin{aligned}
& \text { Mean } \\
& \text { stoer }
\end{aligned}
$$} \& 41.957 \& 61,961 \& 42,099 \& 41.462 \& 41,096 \& ${ }_{4}^{4}, 237$ \& 39,425 \& 38, 28. \& 36,888 <br>

\hline \& \& \& \& ,02 \& 15, 191 \& 16,910 \& 16,60 \& 16,457 \& 14,236 \& 16,1 \& 13, \& 13,718 <br>

\hline $c$ \& no Price \& \multirow[t]{2}{*}{Low} \& \multirow[t]{5}{*}{$$
\begin{aligned}
& \text { Mean } \\
& \text { stoev } \\
& \text { hean } \\
& \text { stoer } \\
& \text { mean } \\
& \text { stoer }
\end{aligned}
$$} \& (9.030) \& $(8,675)$ \& (8.112) \& (7.80) \& (7,687) \& (7.667) \& (7,756) \& $(7,897)$ \& (8,106) <br>

\hline \& \& \& \& 8.01 \& 7,972 \& 7,360 \& 7.783 \& 7,005 \& 7.526 \& 7,456 \& 7,219 \& 7.185 <br>
\hline c \& \& \& \& - ${ }^{8,888}$ \& ${ }^{11} 1262$ \&  \& 99,839 \& 10,583 \& \% ${ }^{3.808}$ \& 8, 802 \& 7.931 \& ?,936 <br>
\hline \multirow[t]{2}{*}{c} \& \multirow[t]{2}{*}{no Price} \& \multirow[t]{2}{*}{Nigh} \& \& 26, 591 \& 27,639 \& 26,728 \& 26;801 \& 26,059 \& 25,'s13 \& 26,871 \& 26,022 \& 23,069 <br>
\hline \& \& \& \& 16,289 \& 16,150 \& 13,893 \& 13,716 \& 13,612 \& 13,463 \& 13,362 \& 13,070 \& 12,399 <br>

\hline c \& \multicolumn{2}{|l|}{Truncatod low} \& \multirow[t]{5}{*}{$$
\begin{aligned}
& \text { Mem } \\
& \text { Stoer } \\
& \text { Mean } \\
& \text { Stoer } \\
& \text { mam } \\
& \text { stoper }
\end{aligned}
$$} \& \& (8.499) \& (7,964) \& (7,708) \& (7,528) \& (7,511) \& (7.548) \& (7,716) \& (7.990) <br>

\hline c \& Truncatod \& \& \& 6,45 \& 6.767 \& 6, 623 \& 6.493 \& 6.611 \& 6.276 \& 6.180 \& 6.021 \& 5,966 <br>
\hline \& Trucatod \& 8.0 \& \& 8,820 \& 9,697 \& \%; 84 \& 9,438 \& ;,302 \& +1821 \& - \& 8.1 \& 8,875 <br>
\hline \multirow[t]{2}{*}{c} \& \multirow[t]{2}{*}{Truncated} \& \multirow[t]{2}{*}{Migh} \& \& 26.587 \& 26,573 \& 26,575 \& 26,639 \& 25,485 \& 25.311 \& 2,767 \& 23,917 \& 22,881 <br>
\hline \& \& \& \& 12,891 \& 12,718 \& 12,549 \& 12,374 \& 12,202 \& 12,061 \& 12,007 \& 11,682 \& 11,559 <br>
\hline \multirow[t]{2}{*}{$c$} \& \multicolumn{2}{|l|}{Insur mice} \& \multirow[t]{5}{*}{Mean storv Stoen Mstan} \& $(8,836)$ \& \& (7,90) \& (7.705) \& (7.526) \& $(7,505)$ \& (7,556) \& (7.726) \& (7,976) <br>
\hline \& Insurance \& \& \& 7.653 \& 7.560 \& 7,388 \& 7,219 \& 7.065 \& 6,903 \& 6,837 \& 6.707 \& 6,579 <br>
\hline \& \& \& \&  \& 10, ${ }^{3} 76$ \& 10,211 \& 10, ${ }^{1}$ \& :285 \& \%,832 \& -7,726 \& $\stackrel{8,098}{815}$ \&  <br>
\hline \multirow[t]{2}{*}{c} \& \multirow[t]{2}{*}{Insurance} \& \multirow[t]{2}{*}{W1gh} \& \& 26,692 \& 26,526 \& 26,513 \& 26,364 \& 25,758 \& 25, 269 \& 26,588 \& 23,774 \& 22,467 <br>
\hline \& \& \& \& 13,571 \& 13,467 \& 13, 100 \& 13,006 \& 12,611 \& 12,652 \& 12,520 \& 12,316 \& 12,169 <br>
\hline \multirow[t]{2}{*}{$c$} \& $81 \times 04$ \& 10. \& Mean stovy \& (9,005) \& $(8,670)$ \& $(8,108)$ \& (7,867) \& (7,671) \& (7,050) \& $(7,696)$ \& $(7,836)$ \& (8,074) <br>

\hline \& \multirow[t]{2}{*}{flxed} \& \multirow[t]{2}{*}{Bsee} \& $$
\begin{aligned}
& \text { stoon } \\
& \text { nem }
\end{aligned}
$$ \& 5,46 \& 5,761 \& 5, ${ }^{\text {c/25 }}$ \& 5,456 \& 5,315 \& \& 3,154 \& 5,023 \& 6i,976 <br>

\hline \& \& \& \multirow[t]{2}{*}{$$
\begin{aligned}
& \text { Memn } \\
& \text { Stoper } \\
& \text { Mean }
\end{aligned}
$$} \& 3. 452 \& 8,322 \& 8, 152 \& 7,968 \& 7.352 \& 7,716 \& 7,658 \& 7,481 \& 7,610 <br>

\hline \& Fixed \& Migh \& \& ${ }_{11,116}^{26,543}$ \& 26,960 \& 28, ${ }^{26,965}$ \&  \& 23,935
10,420 \& 25,300 \& 26,730
10,218 \& 23,906 \& 22,890 <br>
\hline
\end{tabular}

23 Note that gross income variability is a complex function of yield and price variability. Accordingly, if yield variability were eliminated, the result would be much less than $75 \%$ of the total variability.

## Supply Response Under Perfect Risk Neutrality

Before appraising the estimated supply response elasticities under risk neutrality, a note of caution is in order: this analysis focuses solely on the adjustment of cropping intensity to varying expected prices, neither cross price substitution effects nor changes in land base are allowed. The latter includes conversion of land not in cereal production to cereal production. In addition, this analysis is normative in nature, unlike most supply response studies based on econometric models which are positive in nature. In general, it would be expected that a normative model would generate more elastic supply responses. However, since land is fixed and other cropping possibilities are excluded, the estimated supply response elasticities should be less elastic than they would be otherwise. Thus, the inherent limitations associated with a positive model and the more limiting underlying assumptions as to a diminished set of production opportunities should be offsetting, with the net bias unknown.

One of the most important aspects in reviewing supply response is the underlying length of run. While a long-run dynamic model is used to capture the full dynamic effects of changes in cropping patterns, the supply price elasticities are essentially short to intermediate run in nature because land is fixed and technology is held constant, but fixed costs of machine ownership are treated as variable. In addition, there are no lags in price expectations--which would tend to support an intermediate length of run.

In Chapter 4, average variable costs are nearly constant per unit over farm size. Thus, marginal costs are also nearly constant across farm size and representative farms will respond in the same fashion under risk neutrality.

This is the case. Under perfect risk neutrality or unrestricted profit maximization, all clusters would choose the 90,80 and $75 \mathrm{~mm} M_{c}$ strategies for the $\$ 141.93$, $\$ 181.23$ and $\$ 224.76$ per tonne wheat prices, respectively (Table 6.3a). Based on mean acreages and the two price intervals, this corresponds to elasticities of acreage response to a price of 0.31 and 0.12 , respectively (Table 6.8). Decreasing acreage response to increasing price would be expected because as cropping intensity is increased, there is less and less likelihood of fallow ground remaining. Because of the decreasing yields with respect to cropping intensity, the corresponding yield response elasticities are considerably less--0.14 and 0.05 respectively. These estimates compare reasonably well with recent estimates by Siemans and Clark (1989) and earlier estimates by Meilke (1976): Siemans and Clark (1989) estimate the short supply elasticity as 0.15 while Meilke (1976) estimated the acreage supply elasticity to final price as $0: 35$. All of these studies are based on models which intrinsically assume an underlying producer attitude of perfect risk neutrality. However, as was shown, most producers tend to posses non-neutral attitudes towards risk, many having risk attitudes which span a range of possibilities--that is varying from risk adverse to risk loving, according to their income level.

While all farms have similar variable costs, average total costs deline because of some "lumpy" fixed costs. ${ }^{24}$ This combined with differing risk

[^16]attitudes means that each representative farm will respond differently because of differing attitudes and differing income cdf's. The following sections review individual risk efficient cropping strategies for each risk cluster in response to varying prices and price stabilization policies. Associated with each risk efficient cropping strategy is a distribution of efficient mean cropping intensities, acreages and yields. These will be used to map acreage and yield response to price and price stabilization programs.

Table 6.2: Summary of Selected Studies of Wheat Acreage Supply Price Elasticities

| Researchers | Area | Length of Run <br> Short Run |  |
| :--- | :--- | :---: | :---: |
| Meilke (1976)  <br> Jolly \& Abel <br> Colman (1979) Western Canada <br> .  | Western Canada <br> Western Canada | 0.35 | 0.69 |
| Morzuch et al (1980) | North Dakota <br> Montana | 1.16 |  |
| Siemens \& Clark (1989) | Saskatchewan | 0.15 | 0.89 |

Sources:
For those under ${ }^{a}$ :
Glenn, Marcia and Ralph Lattimore. 1983. "Canadian Acreage Response to Grain Storage Subsidies," Canadian Journal of Agricultural Economics 31:245-248.

Morzuch, B.J., R.d. Weaver, and P.G. Helmberger, (1980). "Wheat Acreage Supply Response under Changing Farm Programs." American Journal of Agricultural Economics 62:29-37.

Siemens \& Clark (1989). Personal communication with Steve Clark.

## Risk Efficient $M_{c}$ Strategies

In order to find risk efficient $M_{c}$ strategies, each of the nine income
cdf functions is compared, one pair at a time, for stochastic dominance with respect to a function. Each risk cluster has its own unique income cdf's due to differing farm size and financial structure and differing risk attitudes. The pairwise comparisons for the no-price stabilization policy are presented in figure 12. Using the row as the "defender" and the columns as the "challenger," and moving along a defending row, a "1" indicates that the challenger is dominated by the defender, while a "-1" indicates that the challenger dominates the defender. ${ }^{25}$ A zero indicates that neither one dominates. In figure 12 , the risk efficient $M_{c}$ strategy is the $80 \mathrm{~mm} M_{c}$ level.


Figure 12: Cropping Strategies Dominance Matrix, No Price Policy, Brown Soils, Saskatchewan

The risk efficient $M_{c}$ strategies are presented in Table 6.3 by cluster and wheat price level. The unrestricted profit maximizing case represents those

[^17]farmers who were perfectly risk neutral and would use maximization of profits as their sole choice criterion. This is used as the benchmark in the appraisal of the following risk efficient $M_{c}$ strategies. At low income levels, Cluster A represents relative risk lovers, Cluster B represents relatively risk neutral producers and Cluster C represents relatively risk adverse producers. At higher income levels, the relative risk preferences are more ambiguous, spanning risk loving to risk aversion but tending towards relative risk neutrality.

## Cluster A

Low Prices. Under the low price scenario most $M_{c}{ }^{*}$ 's consist of a unique $M_{c}$, with the sole exception being the no price stabilization scenario. Cluster A, as relative risk lovers, prefer more intensive and riskier cropping intensities at lower price levels; at the low wheat price scenarios of $\$ 141.93 / t$, this risk cluster prefers $M_{c}$ 's which are 5 to 20 mm less than the unrestricted profit maximizing $M_{c}$ (Table 6.3a). For example, using the low price scenario, the mean profit maximizing crop acreage is 629 hectares (Table 6.5). Due to their risk preferences, this group would seed approximately 34 hectares more on the average, or about a $5 \%$ increase in acreage (Table 6.6).

The various price stabilization policies result in increasing crop intensity as shifts in price policies move from no-price policy, to price truncation, to fixed prices (figure 12). This is as expected in that when price risk is reduced, the risk lover will compensate by choosing risk increasing strategies, even if they are less profitable. Increased cropping intensity translates into relatively modest acreage increases (Table 6.5). Not all price stabilization policies result in the same acreage response. A risk lover would tend to avoid strategies affecting the upper end of an income


Figure 13: Risk Efficient Cropping Intensity, Cluster A--Risk Lovers
distribution. Thus, risk lovers would tend to particularly dislike a truncation policy which truncates both tails of the distribution: this type of program allows the risk lover the least freedom to compensate for reduced risk by expanding acreage because potentially high incomes are also excluded. This is the case. Because of the truncation effect, there is little acreage effect: using the no-price policy as the benchmark and the low price interval, a price truncation program results in only a $2.2 \%$ increase in mean acreage (Table 6.6) and a corresponding 18 increase in mean annual wheat production
(Table 6.7). ${ }^{26}$ In sharp contrast, both the risk insurance and the fixed price policies allow the producer to compensate. Thus, as price risk is reduced, the producer responds by expanding acreage over the same interval by $4.9 \%$ and $9.1 \%$, respectively.

Mid and High Prices. While there is a small and significant production response over the perfectly risk neutral attitude, there is no significant acreage or production response due to changing price policy in response to increasing wheat expected price levels to $\$ 181.23 / t$. When the expected price is increased to $\$ 224.76 / t$, there are multiple $M_{c}$ 's in the optimal risk efficient set. Thus, without more information, ie. narrower risk intervals, the stochastic dominance with respect to a function technique can not sufficiently discriminate between the various $M_{c}$ strategies. Hence, there is no significant price response either over risk neutrality or with respect to price policy. ${ }^{27}$ This is as expected in that at higher income levels, Cluster A becomes relatively risk neutral. Moreover, because the $\tau$ interval encompasses both risk loving and risk averting attitudes, multiple $M_{c}$ would be expected in the efficient set.

## Cluster B

Low Price. Cluster $B$ is the relatively risk neutral cluster, with $r$ intervals spanning both risk loving and risk averting $\tau$ values. The lower income $\tau$ interval was set at $[-0.00014,0.00155]$ (Table 4.15). Apparently,

[^18]

Figure 14: Risk Efficient Cropping Intensity, Cluster B-Relatively Risk Neutral
the lower income level is sufficiently low enough to give the lower interval of -0.00014 more weight; the $\tau_{l}$ values take on greater importance as the absolute value of income rises. Hence, Cluster B at the lower income levels tends towards very moderate risk loving attitudes when compared to the risk neutral or profit maximizing criterion. However, this attitude is moderate enough that price policies have no significant effect on production; while there may be some production response associated with price insurance programs, this occurs because $M_{c}{ }^{*}$ consists of multiple $M_{c}{ }^{\prime} s$ and can not be claimed as significant because the $M_{c}{ }^{*}$ overlap.

Mid and High Prices. At the middle price level, Cluster $B$ is risk
neutral and therefore maintains the same $M_{c}$, regardless of price policy. At the high price level, the upper $r$ of 0.00155 takes on more importance and the Cluster $B$ tends to act as a risk averter, contracting production by $4.2 \%$ to $7.2 \%$

## Cluster C



Figure 15:Risk Efficient Cropping Intensity, Cluster C--Risk Averters

Low Prices. Cluster $C$ is the relative risk averting cluster. At lower prices, the risk efficient $M_{c}{ }^{*}$ of this cluster results in mean seeded acreage falling to 382 h from the profit maximizing acreage of 394 h or about a $3 \%$ reduction. Interestingly, the various stabilization policies enable Cluster $C$ to expand by the same amount, regaining the same levels associated with profit maximization.

Mid Prices. At higher income levels, the $\tau$ interval is [-00016, 0.00049 ], so that at higher price levels (and thus, income levels), Cluster B will tend to act in a more risk-neutral fashion with only moderate tendencies towards risk aversion. At the middle price scenario, the no price stabilization policy results in slightly lower risk efficient acreages than the profit maximizing acreage--acreage is cut by $2.2 \%$. As in the lower price scenario, price insurance and fixed price policies result in regaining the same 2.28 so that production is at the same level as the profit maximizing level.

High Prices. At the highest price level, acreage averages about 2.5\% below profit maximizing acreages under all price policies (Table 6.5). In general, the various price polices do not have a significant impact on production, although there may be a slight but insignificant tendency for the fixed price to cause a slight decrease in acreage over the no-price stabilization policy. This may be due to the "fuzziness" of the RIA/SDWF approach. ${ }^{28}$

[^19]Table 6.3a: Risk Efficient $M_{c}$ Strategies, by Cluster and Wheat Price


Table 6.3b: Mean Risk Efficient $M_{c}$ Strategies, by Price Level and Cluster

| Cluster/ <br> Price <br> Level | Risk Preferences |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Unrestricted Profit Max | d Risk Efficient Criteria |  |  |  |
|  |  | Price Policy |  |  |  |
|  |  | None | Truncate | Insure | Fixed |
| (mm of May Moisture) |  |  |  |  |  |
| Cluster A |  |  |  |  |  |
| \$141.93 | 90.0 | 82.5 | 80.0 | 75.0 | 70.0 |
| \$181.23 | 80.0 | 75.0 | 75.0 | 75.0 | 75.0 |
| \$224.76 | 75.0 | 77.5 | 72.5 | 72.5 | 77.5 |
| Cluster B |  |  |  |  |  |
| 141.93 | 90.0 | 85.0 | 85.0 | 82.5 | 85.0 |
| 181.23 | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 |
| 224.76 | 75.0 | 80.0 | 80.0 | 90.0 | 85.0 |
| Cluster C |  |  |  |  |  |
| 141.93 | 90.0 | 95.0 | 90.0 | 90.0 | 90.0 |
| 181.23 | 80.0 | 82.5 | 82.5 | 80.0 | 80.0 |
| 224.76 | 75.0 | 80.0 | 80.0 | 80.0 | 82.5 |

Table 6.4: Mean Risk Efficient Cropping Intensity* by Cluster and Wheat Price

| Price | Risk Preferences |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Unrestricted Profit Max | Risk Efficient Choices |  |  |  |
|  |  |  | Price P | licy |  |
|  |  | None | Truncate | Insure | Fixed |


| Cluster A |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| $\$ 141.93$ | 0.66 | 0.70 | 0.71 | 0.73 | 0.76 |
| $\$ 181.23$ | 0.71 | 0.73 | 0.73 | 0.73 | 0.73 |
| $\$ 224.76$ | 0.73 | 0.72 | 0.75 | 0.75 | 0.72 |
|  |  |  |  |  |  |
| Cluster B |  |  |  |  |  |
| $\$ 141.93$ | 0.66 | 0.68 | 0.68 | 0.70 | 0.68 |
| $\$ 181.23$ | 0.71 | 0.71 | 0.71 | 0.71 | 0.71 |
| $\$ 224.76$ | 0.73 | 0.71 | 0.71 | 0.66 | 0.68 |
|  |  |  |  |  |  |
| Cluster C |  |  |  |  |  |
| $\$ 141.93$ | 0.66 | 0.64 | 0.66 | 0.66 | 0.66 |
| $\$ 181.23$ | 0.71 | 0.70 | 0.70 | 0.71 | 0.71 |
| $\$ 224.76$ | 0.73 | 0.71 | 0.71 | 0.71 | 0.70 |

* Mean cropping intensity is defined as the mean seeded acres/total acres.

Table 6.5: Risk Efficient Acreage Decisions, by Cluster and Price Level, Brown Soils

| Price | Risk Preferences |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Unrestricted Profit Max | Risk Efficient Choices |  |  |  |
|  |  | Price Policy |  |  |  |
|  |  | None | Truncate | Insure | Fixed |
| Cluster A |  |  |  |  |  |
| \$141.93 | 629 | 663 | 678 | 695 | 724 |
| \$181. 23 | 678 | 695 | 695 | 695 | 695 |
| \$224.76 | 695 | 686* | 709* | 709* | 686* |
| Cluster B |  |  |  |  |  |
| \$141.93 | 546 | 563 | 563 | 576 | 563 |
| \$181. 23 | 588 | 588 | 588 | 588 | 588 |
| \$224.76 | 604 | 588 | 588 | 546 | 563 |
| Cluster C |  |  |  |  |  |
| \$141.93 | 394 | 382 | 394 | 394 | 394 |
| \$181. 23 | 425 | 416* | 416* | 425 | 425 |
| \$224.76 | 436 | 425 | 425 | 425 | 416 |

* Not significantly different from the profit maximization strategy (ie. the efficient set includes the profit maximization strategy $M_{c}$ ).

Table 6.6: Impact of Stabilization Programs on Risk Efficient Acreage Decisions, Brown Soils

| Expected |
| :--- | :--- | :--- |
| Price |$\quad$ None Truncate Insure Fixed

(Percent Change Over No-Price Stabilization Program)

| Cluster A |  |  |  |  |
| :--- | :--- | :--- | :--- | ---: |
| $\$ 141.93$ | $0.0 \%$ | $2.2 \% *$ | $4.9 \%$ | $9.1 \%$ |
| $\$ 181.23$ | $0.0 \%$ | $0.0 \%$ | $0.0 \%$ | $0.0 \%$ |
| $\$ 224.76$ | $0.0 \%$ | $3.3 \% *$ | $3.3 \% *$ | $0.0 \%$ |
|  |  |  |  |  |
| Cluster B |  |  |  |  |
| $\$ 141.93$ | $0.0 \%$ | $0.0 \%$ | $2.2 \% *$ | $0.0 \%$ |
| $\$ 181.23$ | $0.0 \%$ | $0.0 \%$ | $0.0 \%$ | $0.0 \%$ |
| $\$ 224.76$ | $0.0 \%$ | $0.0 \%$ | $-7.2 \%$ | $-4.2 \%$ |
|  |  |  |  |  |
| Cluster C |  |  |  |  |
| $\$ 141.93$ | $0.0 \%$ | $3.1 \%$ | $3.1 \%$ | $3.1 \%$ |
| $\$ 181.23$ | $0.0 \%$ | $0.0 \%$ | $2.2 \% *$ | $2.2 \% *$ |
| $\$ 224.76$ | $0.0 \%$ | $0.0 \%$ | $0.0 \%$ | $-2.1 \% *$ |

* Not significantly different from the no stabilization policy (ie. the efficient set includes the optimum no stabilization policy $M_{c}$ ).

Table 6.7: Impact of Stabilization Programs on Risk Efficient Production

|  | Price Policy |  |  |  |
| :--- | :---: | :---: | :---: | :---: |
| Price | None | Truncate | Insure Fixed |  |
|  |  | (Percent Change Over No Price Policy) |  |  |
| Cluster A |  |  |  |  |
| $\$ 141.93$ | $0.0 \%$ | $1.0 \% *$ | $2.0 \%$ | $3.6 \%$ |
| $\$ 181.23$ | $0.0 \%$ | $0.0 \%$ | $0.0 \%$ | $0.0 \%$ |
| $\$ 224.76$ | $0.0 \%$ | $1.3 \% *$ | $1.3 \% *$ | $0.0 \%$ |
|  |  |  |  |  |
| Cluster B |  |  |  |  |
| $\$ 141.93$ | $0.0 \%$ | $0.0 \%$ | $1.0 \% *$ | $0.0 \%$ |
| $\$ 181.23$ | $0.0 \%$ | $0.0 \%$ | $0.0 \%$ | $0.0 \%$ |
| $\$ 224.76$ | $0.0 \%$ | $0.0 \%$ | $-3.4 \%$ | $-1.9 \%$ |
|  |  |  |  |  |
| C1uster C | $0.0 \%$ | $1.8 \%$ | $1.8 \%$ | $1.8 \%$ |
| $\$ 141.93$ | $0.0 \%$ | $0.0 \%$ | $1.0 \% *$ | $1.0 \% *$ |
| $\$ 181.23$ | $0.0 \%$ | $0.0 \%$ | $0.0 \%$ | $-1.0 \% *$ |
| $\$ 224.76$ | $0.0 \%$ |  |  |  |
|  |  |  |  |  |

$\bar{*}$ Not significantly different from the no stabilization policy (ie. the efficient set includes the optimum no stabilization policy $M_{c}$ ).

## Supply Response Under Risk

Associated with each risk efficient cropping strategy is a distribution of efficient mean cropping intensities, acreages and yields. These are used to map acreage and yield response to price and price stabilization programs. In some cases, the efficient set consists of more than one $M_{c}$; in this case the corresponding acreage and production response are averaged. However, when the efficient set includes the same $M_{c}$ as the previous price, then these elasticities are marked as being insignificantly different from zero. Also note that unrestricted profit maximization (PMAX) is the perfect neutrality case and is included under each cluster as a benchmark of comparison. In addition, recall that Cluster $B$ is relatively risk neutral in that it includes both risk loving, neutral and aversion tendencies. Also recall that all price stabilization programs are mandatory. In the previous section, it was shown that risk lovers produce more and risk averters produce less; but the questions addressed in this section are the following.

1) How does risk attitude affect production responsiveness to price changes?
2) Given risk attitude, how does a mandatory price stabilization program affect production responsiveness to price changes?
3) If each cluster is weighted by its corresponding sample proportion, what is the aggregate response?

The interval price elasticity of acreage response by cluster and wheat price are presented in Table 6.8 and the interval price elasticity of production (total yield) response by cluster and wheat price are presented in Table 6.10. Note that production response is about one-half of acreage response due to diminishing average yields.

Risk Lovers. Risk lovers crop more intensively than perfect risk neutrality (PMAX) and have correspondingly less freedom to respond with still more intensity; thus, risk lovers respond with fewer acres to increased prices than (PMAX), even under low prices. Recall that mandatory fixed prices cause risk loving producers to search out more risk so that production is very intensive even at low prices. In addition, there may also be a "utility effect" similar to the "income effect" associated with consumer behavior. By raising utility through increased incomes, risk lovers are less likely to search for more utility through increased risk. Using the low price interval, the result is that mandatory price stabilization programs make risk lovers less price responsive or in the case of fixed prices, even cause them to act "perversely" by decreasing acreage with increased wheat prices. ${ }^{29}$

Risk Neutrality. This cluster also is less price responsive than the PMAX benchmark, primarily due to the broad latitude in risk attitudes attached to this group. At low prices, price stabilization programs have little effect on price responsiveness, as expected. At the higher price scenario, there is no response to prices except for price insurance and fixed price programs; the latter two programs induce a negative production response; production at the high price level is roughly at the same level as the low price. Again, the reason for the negatively sloped supply curve is apparently due to the relatively broad $\tau$ values. From Table 4.8, the interval range is $[-0.00026,0.00107]$ with the upper $\tau$ value being higher than the corresponding risk lovers' value.

Risk Averting. At lower prices, risk averters are more responsive than

[^20]the perfectly risk neutral benchmark; the price elasticity of acreage is 0.35 v 0.31 associated with risk neutrality. Most price stabilization programs increase production intensity to roughly the same level as that of PMAX and price responsiveness is similar. At higher prices and no price stabilization, Cluster C producers become more risk neutral and response under no price stabilization is similar to PMAX. At higher prices, price stabilization programs tend to dampen price responsiveness due to higher levels of production intensity and broader risk attitude intervals, including a greater tendency towards risk loving.

Aggregate Response. In Table 6.9, each cluster is weighted by its corresponding sample proportion and summed to give the aggregate response. Using the low price as a base, acreage responsiveness to price is 0.15 or about $50 \%$ of the PMAX of 0.31 . In the aggregate and at lower price intervals, price stabilization programs tend to make producers less responsive to price, primarily because they are operating at a higher production level; with price truncation, price insurance and fixed price ranked in order of diminishing acreage responsiveness. At high expected prices, there is no significant acreage response to price under price stabilization.

Table 6.8: Estimated Interval Price Elasticity of Acreage Response by Cluster and Wheat Price, Brown Soil Zone

| Price | Risk Preferences |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Unrestricted Profit Max | d Risk Efficient Choices |  |  |  |
|  |  |  | Price Po | licy |  |
|  |  | None | Truncate | Insure | Fixed |
| Cluster A |  |  |  |  |  |
| \$141.93 |  |  |  |  |  |
| \$181.23 | 0.31 | 0.19 | 0.11 | 0.00 | -0.16 |
| \$224.76 | 0.12 | -0.06* | 0.09* | 0.09* | -0.06* |
| Cluster B |  |  |  |  |  |
| \$141.93 |  |  |  |  |  |
| \$181.23 | 0.31 | 0.18 | 0.18 | 0.09* | 0.18 |
| \$224.76 | 0.12 | 0.00 | 0.00 | -0.35 | -0.20 |
| Cluster C |  |  |  |  |  |
| \$141.93 |  |  |  |  |  |
| \$181.23 | 0.31 | 0.35 | 0.22 | 0.31 | 0.31 |
| \$224.76 | 0.12 | 0.10* | 0.10* | 0.00 | -0.10* |

* Not significantly different from zero (ie. the efficient set includes the same acreage).

Table 6.9: Weighted Acreage Supply Response

| Price | Risk Preferences |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Unrestricted Profit Max | Risk Efficient Choices |  |  |  |
|  |  |  | Price | licy |  |
|  |  | None | Truncate | Insure | Fixed |


| $\$ 141.93$ |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: |
| $\$ 181.23$ | 0.31 | 0.15 | 0.13 | 0.04 | 0.01 |
| $\$ 224.76$ | 0.12 | $-0.01 *$ | $0.02 *$ | $-0.13 *$ | $-0.10 *$ |
|  |  |  |  |  |  |
| Mean | 0.21 | $0.07 *$ | $0.07 *$ | $-0.05 *$ | $-0.04 *$ |
|  |  |  |  |  |  |

* Includes estimates which are not significantly different
from zero (ie. the efficient set includes the same acreage).

Table 6.10: Estimated Interval Price Elasticity of Production Response by Cluster and Wheat Price, Brown Soil Zone

| Price | Risk Preferences |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Unrestricted Profit Max | Risk Efficient Choices |  |  |  |
|  |  |  | Price | Policy |  |
|  |  | None | Truncate | Insure | Fixed |
| Cluster A |  |  |  |  |  |
| \$141.93 |  |  |  |  |  |
| \$181.23 | 0.14 | 0.08 | 0.04 | 0.00 | -0.07 |
| \$224.76 | 0.05 | -0.02* | 0.04* | 0.04* | -0.02* |
| Cluster B |  |  |  |  |  |
| \$141.93 |  |  |  |  |  |
| \$181.23 | 0.14 | 0.08 | 0.08 | 0.04* | 0.08 |
| \$224.76 | 0.05 | 0.00 | 0.00 | -0.16 | -0.09 |

Cluster C \$141.93

| $\$ 181.23$ | 0.14 | 0.18 | 0.10 | 0.14 | 0.14 |
| :--- | :--- | :--- | :--- | :--- | :--- |

\$224.76 0.05 0.04* 0.04* 0.00 -0.04*

* Not significantly different from zero (ie. the efficient set includes the same production).


## An E-V Analysis of Response

In the previous section, each risk cluster is treated separately. In brief summary, relative risk lovers produce more and respond more positively to price stabilization policies than relative risk averters. While relative risk averters produce less than relatively risk neutral producers, they also respond more to price stabilization policies. This section shows how these results must follow from their differences in risk attitudes and the shape of the E-V frontier. In the following section the E-V efficiency frontier is based on choices faced by Cluster $B$ under the middle or base price scenario for the base price and fixed price policies (Table 6.11). The resulting E-V
efficiency frontier is presented in figure $16 .{ }^{30}$
Risk Averters. In brief review, an efficiency frontier for risk averters is the locus of points where for a given variance, expected income is maximized and likewise, for a given expected income, variance is minimized. Thus, relevant risk efficient points must lie below and to the left of the point of maximum expected income. The optimum production is the point of tangency between the indifference surface and the E-V frontier. The indifference surface for a given level of utility must be positively sloped, indicating that more risk must be also accompanied by more expected income. Likewise a reduction in risk caused by elimination of price risk must also result in a slight to a higher indifference surface. This is shown in figure 16 by a shift from the stochastic price E-V frontier to the lower E-V frontier of fixed prices.

Risk Lovers. In sharp contrast to the risk averters, the relevant section of the E-V frontier to the risk lover is the section also lying to the left but lying above the profit maximizing point. The slope of the indifference curve is negatively sloped. Utility increases with upward and outward shifts. Thus, the stochastic price E-V curve represents a higher level of utility than the fixed price E-V curve.

Risk Neutral. Of course, the risk neutral point is the point of maximum income and any movement to the right represents increased utility.

Comparisons. Several important comparisons can be made. First, note the efficient risk averse section of both E-V curves is relatively flat as compared to the efficient risk loving sections. This means that a small change in risk must be accompanied by a much larger and inversely proportional

30 Note the axes have been reversed from chapter 2 for computational ease.
change in expected income. Thus, risk averters' efficient $M_{c}{ }^{*}$ will be less affected by small changes in. attitude, than those of risk lovers.

A price reduction is represented by a shift to the left and downwards. Assuming constant expected returns - variance trade off, $\Phi$, risk lovers will be more price responsive under no price stabilization programs because their efficient portion has far greater absolute slope than that of risk averters.

Price stabilization programs result ina downward shift and a compression. Maintaining a constant $\Phi$, when price stabilization programs such as the fixed price policy, reduce the variance, they also reduce price responsiveness of both risk lovers and risk averse groups because the $E-V$ surface becomes flatter. However, risk lovers remain relatively more price responsive than risk averters.

Table 6.11: Expected Value-Standard Deviation of Annualized Income Frontier, Cluster B, Base Price Scenario

| $\begin{gathered} M_{c} \\ \text { Strategy } \end{gathered}$ | Price Policy |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | None |  | Fixed |  |
|  | Mean | andard iation | Mean | Standard viation |
| (mm) | (dollars/year) |  |  |  |
| 65 | 17,477 | 15,677 | 17,308 | 11,710 |
| 70 | 17,703 | 15,576 | 17,553 | 11,530 |
| 75 | 17,999 | 15,177 | 17,966 | 11,295 |
| 80 | 18,035 | 15,011 | 18,050 | 11,067 |
| 85 | 17,765 | 14,663 | 17,812 | 10,879 |
| 90 | 17,366 | 14,459 | 17,442 | 10,690 |
| 95 | 16,803 | 14,265 | 16,959 | 10,610 |
| 100 | 16,150 | 13,889 | 16,292 | 10,365 |
| 105 | 15,326 | 13,721 | 15,429 | 10,267 |



Figure 16: Expected Income-Variance Frontier, Base Price Scenario, Cluster B

## Producer Price Stabilization Policy Preferences

In the previous section, each price policy is evaluated separately for dominant cropping strategies. In this section, the four price policy alternatives and the nine cropping strategies are simultaneously assessed for stochastic dominance; thus, each cluster has a total 36 alternative
strategies. ${ }^{31}$ The results are shown in Table 6.12. Because the fixed price policy may not be a feasible price policy, a reduced set of alternatives is formed by omitting the fixed price alternatives and testing the remaining alternatives for dominance. These results are shown in Table 6.13.

As can be expected, the no price policy is uniquely dominant at the low and base price scenarios for Cluster $A$, the relatively risk loving group. Since the shape of the $E-V$ frontier is similar between all three clusters, this can easily be verified from figure 16; a risk lover can reach a higher indifference curve by shifting from fixed price policies to no price or a free market price policy. However, the results of the high price scenario and Cluster $A$ are somewhat surprising--all pricing policies and the no price policy are dominant. This is the result of the extremely broad or "fuzzy" upper income level risk coefficients of $[-0.00040,0.00010]$.

Cluster $B$ is relatively risk neutral but not perfectly so. At the lowest price scenario, Cluster $B$ would be expected to choose the no price policy--this is the stochastically dominant set. At higher price scenarios, the fixed price policy is dominant (Table 6.12), indicating that the [-0.00026, 0.00107] risk coefficient interval leads Cluster $B$ to act in a mildly risk averse fashion. When fixed prices are omitted from the opportunity set, Cluster $B$ would prefer price truncation policies over price insurance policies. This follows because risk aversion implies concavity of the utility function and thus, stabilization programs will be in general

[^21]preferred over insurance programs. ${ }^{32}$

Table 6.12: Risk Efficient Pricing Policy Strategies, All Pricing Policy Policies Considered

| Price | Price Policy |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | None | Truncate | Insure | Fixed |
| Cluster A |  |  |  |  |
| \$141.93 | X |  |  |  |
| \$181.23 | X |  |  |  |
| \$224.76 | X | X | X | X |
| Cluster B |  |  |  |  |
| \$141.93 | X |  |  |  |
| \$181.23 |  |  |  | X |
| \$224.76 |  |  |  | X |
| Cluster C |  |  |  |  |
| \$141.93 |  | X | X | X |
| \$181.23 |  |  |  | X |
| \$224.76 |  |  |  | X |

32 Concavity of the utility function gives the result of diminishing marginal utility. Hence, any program which reduces low income extremes with a corresponding reduction in high income extremes will result in higher expected utility than one which reduces low income extremes with a corresponding constant payment reduction (risk premium) of the remaining distribution.

Table 6.13: Risk Efficient Pricing Policy Strategies, No Fixed Pricing Policy

|  | Price Policy |  |  |
| :--- | :--- | :---: | :--- |
| Price | None | Truncate | Insure |
|  |  |  |  |
| Cluster A |  |  |  |
| \$141.93 | X |  |  |
| $\$ 181.23$ | X |  |  |
| $\$ 224.76$ | X | X | X |
|  |  |  |  |
| C1uster B |  |  |  |
| $\$ 141.93$ | X | X |  |
| $\$ 181.23$ |  | X |  |
| $\$ 224.76$ |  |  |  |
|  |  | X | X |
| Cluster C |  | X |  |
| $\$ 141.93$ | X |  |  |
| $\$ 181.23$ |  |  |  |
| $\$ 224.76$ |  |  |  |

Cluster $C$ is the relatively risk averse cluster. Thus, it should choose the fixed price alternative. Curiously, this cluster would unambiguously choose the fixed price scenario only under the base and high price scenarios; under the low price scenario, the stochastically dominant set consists of all three price risk reduction alternatives. The reason for multiple efficient alternatives may lie in the nature of the dominance tests and its potential ambiguity. In order to explore this further, the annualized income cdf is summarized for the risk efficient strategies, 90 mm in Table 6.14 . The income levels associated with the 1 percentile of the risk efficient strategies are $-\$ 22,681,-\$ 22,398$ and $-\$ 20,348$ for the truncated, insurance and fixed price policies, respectively. At this probability level, the fixed price policy should dominate the truncated price which should dominate the insured price
policy. ${ }^{33}$ This is not the case between the truncated and insurance policies. At the $1 \%$ level the insurance policy slightly dominates the truncated policy; between the $2 \%$ and $52 \%$ level, the truncation policy dominates the insurance policy as it should. The crossover points--both the location and the number of crossovers are of next interest. The first CDF dominance crossover between the fixed and truncated price polices occurs at the $47 \%$ level followed by crossovers at $50 \%$ and $57 \%$ levels. The first and only CDF crossover between the fixed and insured price polices occurs at the $54 \%$ level. However, the probability of a positive annualized income is higher with the insurance price policy--87\% v 93\%. Thus, because of multiple crossovers and/or the negative incomes, the SDRF process can not sufficiently discriminate among the various price policies to choose a unique price stabilization policy. This also demonstrates the potential drawbacks of RIA and SDRF. .

[^22]


## CHAPTER VII: SUMMARY AND CONCLUSIONS

This section reviews study objectives, summarizes research procedure, reviews major research findings and outlines study limitations. Major research findings are indented and single spaced.

Research Objectives
In brief summary, the primary objective of this study is to appraise typical Saskatchewan grain producer supply response to price induced risk. A secondary but related objective is to quantify the major sources of farm income risk--price and yield risk faced by typical wheat farmers on the brown soils of Saskatchewan. In general, risk does not aggregate well. Analysis of risk in the aggregate lacks the rigorous foundation underlying neoclassical economics. Moreover, when individuals are non neutral in risk attitudes, the traditional measures of producer welfare are meaningless and must be replaced by concepts such as the utility certainty equivalent price. In addition, aggregate yield variables tend to understate true yield variability. Moreover, many aggregate models lack the the micro-foundations of risk analysis which can be based on more general concepts which do rely on normality assumptions. The following are major implications of supply response under risk at the firm level.

1. In general, individual farm income distributions are likely to be non-normal. Even if both yield and prices are likely to be normally distributed, which is also unlikely, their product is not normal.
2. While variance is commonly regarded as a measure of risk, it is an imperfect measure and misleading measure when incomes are nonnormally distributed. Moreover, the purpose of many government programs is to deliberately change the shape of the income distribution. This means that traditional mean-variance analysis
may be inappropriate.

In addition, the distribution effects associated with price stabilizing policies are important. Thus, a representative study approach is used to evaluate producer response to alternative generic price stabilization polices. Producer response to risk is evaluated at the whole farm level, not at the enterprise level; producers respond to variations in net cash income in planning seeded acres. Thus, posited supply response to stochastic prices becomes a function of the nature of the price distribution, risk attitudes, production costs and financial structure. In this model, supply response is based on the fallow/seed FLEXCROP decision rule. Accordingly, a bio-economic simulator is constructed incorporating stochastic May soil moisture and yield relationships and deterministic farm costs. The seeding decision for each of the four fields is based on whether the May soil moisture, $M_{t}$, is above or below $M_{c}$, the critical soil moisture threshold. This is the FLEXCROP decision rule: if $M_{t} \geq M_{c}$, then the field is seeded, if $M_{t}<M_{c}$, then the field is fallowed. By parametrically varying $M_{c}$ from 65 to 105 mm by 5 mm increments, the frontier of income-risk choices is mapped. Accompanying each $M_{c}$, are cdf's of income (converted from ending net worth), crop acreage and total wheat production. For example, a $M_{c}$ of 90 mm results in a mean cropping intensity of $66.3 \%$, a mean yield of $1,820 \mathrm{k} / \mathrm{h}$ and a standard deviation of 640 $k / h$.

## Research Findings and Conclusions

Risk Preferences. If each producer cluster were perfectly risk neutral, then no further analysis would be needed; each producer would choose the expected profit maximizing strategy. Likewise, the actuarially sound stabilization programs would have no long-run production effect. However,
producers were found to possess differing and distinct risk attitudes--at
least at lower income levels. Three clusters were identified: Cluster Arelatively risk loving (10\%), Cluster B-relatively risk neutral (40\%) and Cluster C-relatively risk adverse (50\%).
3. While the Top Management sample can not be regarded as representing the general farm population, the risk attitude survey does question the almost universal assumption employed by economists that farmers are risk neutral or, alternatively, if they possess risk attitudes, they are uniformly risk averse. ${ }^{34}$
4. The constant risk aversion coefficient is not constant over income but declines. This implies that the absolute risk premium declines with wealth. This means that wealthier producers would be willing to pay less for a given reduction in the standard deviation of income. ${ }^{35}$
5. The relative risk aversion coefficient is not constant over income but declines. Farmers are far more likely to be risk neutral at higher prices than at lower prices. Likewise, this implies that the proportional risk premium these producers would be willing to pay also declines with more favorable economic environments. ${ }^{36}$
6. Non-uniform risk attitudes which vary with income have important policy implications: government programs which are based on riskneutral behavior may seem to work well during times of high commodity prices but may not work nearly so well during times of low expected prices.

Stabilization Programs and Expected Prices Three price scenarios and four price policies are examined. The three price scenarios include 1) a middle price scenario with an expected wheat price of $\$ 181.23$ which represents

[^23]a historical mean adjusted for inflation and technology; this price scenario is also very close to a COP equilibrium price; 2) a low expected wheat price of $\$ 141.93 / t$ (historical mean - one standard deviation) and 3) a high expected price of $\$ 224.76$ (historical mean + one standard deviation). In each scenario the price coefficient of variation is held constant at $31 \%$ of the mean, historical average. Four alternative price stabilization programs are chosen, representing the free market with no government restrictions (no-price stabilization policy), upper and lower bounded prices (price truncation), lower bounded prices (price insurance), and perfect price stabilization (fixed price). In measuring response, the no-price stabilization policy is chosen as the benchmark and the alternative price risk reduction policies are lower and upper price truncation, price insurance and fixed prices. Response to price induced risk is mapped by perturbing both prices and price stabilization policies/risk.

Acreage Response to Price Under Risk. The net worth cdf of each strategy and farm cluster are simulated for each $M_{c}$ strategy, price level and price policy. A total of 3 clusters $x 3$ price levels $\times 4$ price policies $x 9$ $M_{c}$ strategies generates a total of 324 simulations. Given price level and stabilization price policy, each pair of the nine $M_{c}$ strategies are examined for stochastic efficiency according to the representative cluster risk attitudes. In the case of multiple stochastic efficient $M_{c}{ }^{*}$ strategies, the various efficient acreage and production response is assigned the same weight and averaged. By parametrically varying wheat prices, production response can be mapped and the percentage difference over the benchmark profit maximization response determined. Using perfect risk neutrality or the profit maximizing model as the benchmark, the price elasticities of acreage response are 0.31
and 0.12 , respectively, between low-mid and mid-high price intervals. The corresponding price elasticity of wheat production response is 0.14 and 0.05 , respectively. As expected, the risk lovers, Cluster A produce at a somewhat higher and riskier level; acreages are approximately 58 higher than the profit maximization benchmark. Cluster $B$, the relatively risk neutral cluster, produces at levels slightly differing from perfect risk neutrality because their risk attitudes span a relatively wide interval; they tend to act as slightly risk loving, perfectly risk neutral and slightly risk adverse at low, medium and high price levels, respectively. As expected, the risk averters, Cluster $C$, choose more conservative $M_{c}$ strategies; their risk efficient seeded acreages are approximately $3 \%$ less than the profit maximizing benchmark.
7. The conclusion is that risk lovers produce more and risk averters produce less than perfectly risk neutral producers under free market prices.

Acreage Response to Price Stabilization. When price stabilization polices are introduced under the low price scenario, Cluster A, risk lovers, is affected the most. The truncated, insured and fixed price polices cause acreage to expand by $2.28,4.9 \%$ 9.1\%, respectively over the no price stabilization policy. As expected, the risk efficient set of Cluster B, relatively risk neutral, is little altered--except at high prices. Also as expected, stabilizing prices results in a positive acreage response from Cluster $C$, the risk averse cluster. However, acreage response is relatively small--3.1\%. This is due to the relative flat surface of the E-V curve. In sharp contrast, the risk lovers operate on the section of the curve which has a much higher slope.
8. Regardless of risk attitude, so long as risk attitudes are not perfectly risk neutral, farmers react to any mandatory stabilizing program by producing more. Risk lovers increase output more than
risk averters because of the slope of the tradeoff between expected income-risk. At low prices, impact of price stabilization programs is to expand production of risk averters to approximately the same level as PMAX (perfect risk neutrality).
9. Price stabilization without a corresponding yield insurance component is not a very effective tool in reducing income variation. For example, given a simlar coefficient of variation between price and yield ( $30-35 \% \mathrm{v} 31 \%$ ), tThe coefficient of variation of their product (gross income) is approximately $45 \%$. Thus, if either price or yield variability is eliminated, gross income variability still remains at approximately $30 \%$.
10. Price stabilization programs only have impact on acreage response at low commodity prices. Wheat acreage supply response based on cropping intensity is very inelastic with respect to changes in risk; the maximum acreage response occurs at the lowest expected price scenario and is $3.1 \%$ to $9.1 \%$ over free market prices if all price variability were removed. However, more typical acreage response is 2 to 38 . The latter translates into optimal total farm production increases of 1 to $2 \%$.

Risk Attitudes and Responsiveness to Price Changes. Using perfect risk neutrality or the profit maximizing model as the benchmark, the benchmark price elasticities of acreage response are 0.31 and 0.12 , respectively, between low-mid and mid-high price intervals. The corresponding price elasticity of wheat production is 0.14 and 0.05 , respectively. General findings with respect to risk attitudes and supply response and no price stabilization policies are the following.
11. Using the low prices and PMAX (perfect risk neutrality), the benchmark price elasticity is 0.31 , the corresponding price elasticities of relative risk lovers and neutral producers are 0.19 and 0.18 , respectively; thus they are somewhat less price responsive than PMAX. Risk averters are somewhat more price responsive ( 0.35 ) than PMAX at low prices.
12. All risk lovers are less responsive than PMAX to price changes at high prices because they are operating at a production level and have rapidly diminishing total production.
13. If each cluster is weighted by its corresponding sample proportion and summed to give the aggregate response then the acreage responsive to price is 0.15 or about $50 \%$ of the PMAX of 0.31 . Production response is about one-half of acreage response due to diminishing average yields.

Price Stabilization and Responsiveness to Price Changes. General findings with respect to risk attitudes and supply response and price stabilization policies are the following.
14. With respect to relatively risk neutral and averting producers, most price stabilization programs had little impact on acreage response to price, at lower prices. Risk loving producers became less responsive to price with price truncation, price insurance and fixed price (ranked in order of diminishing acreage responsiveness) primarily because they are operating at a higher production level.
15. In the aggregate, price stabilization programs tend to make producers less responsive to price, primarily because they are operating at a higher production level; with price truncation, price insurance and fixed price ranked in order of diminishing acreage responsiveness. At high prices, there is no significant aggregate acreage response to price.

Stabilization Program Preferences. Finally, when preferences among programs are assessed, then relative risk lovers, Cluster A, prefer no price stabilization policy; risk neutral producers, Cluster $B$, prefer no program or a fixed price policy, depending upon the expected price level; risk averters, Cluster $C$, prefer a fixed price first and secondly, a lower and upper stabilization policy, depending upon the expected price level.
16. If given a choice, risk lovers prefer a no price stabilization policy while risk averters would tend to prefer a symmetrical lower and upper price truncation program over the price insurance program.

## Limitations

This study focuses solely on adjustment of cropping intensity to expected prices, neither cross price substitution effects nor changes in land base are allowed. In addition, this analysis is normative in nature, unlike most supply response studies based on econometric models which are positive in nature.

Normative vs Positive. In general, it would be expected that a normative model would generate more elastic supply responses than a positive model. However, since land expansion opportunities and other crop possibilities are excluded, the estimated supply response elasticities should be less elastic than they would be otherwise. Thus, the inherent limitations associated with a positive model and the more limiting underlying assumptions as to a diminished set of production opportunities should be offsetting, with the net bias unknown.

Single Crop-Brown Soils. Allowing alternative competing crops complicates considerably supply response under risk because all the various price-price, price-yield and yield-yield correlations must be considered. Moreover each crop may have its own optimal spring soil moisture threshold, $M_{c}$. However, several important factors tend to mitigate the omission errors associated with the assumption of single crop production. Wheat is the vastly dominant crop in the brown soil zone primarily due to its greater overall profitability over feed barley, the primary alternative crop. In addition, barley yields and prices are very highly correlated with wheat yield and price. This means that any stabilization program which affects both wheat and barley in a similar fashion will leave the optimum crop portfolio largely unchanged. Alternative crops are more of a potential problem in the other soil zones of Saskatchewan.

Single Crop-Black Soils. Nevertheless, canola has been more profitable than wheat in the black soil zone over the past few years and farmers tend to plant as much as possible up to a limit of 1 year in 4. The latter is a constraint imposed by plant disease. Thus, there is likely to be little cross price effect between canola and wheat. However, many cropping intensities are
far higher on the black soil zones, leaving little room for increased wheat acreages. Hence, if wheat/canola price ratios remain constant, then wheat acreages are likely to be less responsive to price or price changes than the brown soil zone.

Single Crop-Dark Brown Soils. There is likely to be far more of a cross price effect between canola and wheat on the dark brown soils. This is because canola is generally seeded on fallow ground. Hence, changes in spring soil moisture, past cropping intensity and wheat-canola price relationships influence canola seeding decisions. This may be offset by more intensive rotations leaving less room for acreage response. Thus, wheat acreage response on the dark brown soils is likely to be more responsive to changes to wheat price and wheat price risk than the brown soils.

## REFERENCES

Adams, R.M., D.J. Menkhaus, and K.A. Keith. 1981. An Investigation of Alternative Risk Supply Response Models for Selected U.S. Crops. \#RJ 161, University of Wyoming, Agricultural Experiment Station.

Anderson, Jock R. 1974. "Risk Efficiency in the Interpretation of Agricultural Production Research." Review of Marketing and Agricultural Economics, 4षо. 3: 131-309.

Anderson, J.R., J.L. Dillon and B. Hardaker. 1977. Agricultural Decision Analysis. Iowa State University Press. Ames, Iowa.

Antle, J.M. 1983. "Sequential Decision Making in Production Models." American Journal of Agricultural Economics. 65: 282-290.

Antle, J.M. 1983. "Incorporating Risk in Production Analysis." American Journal of Agricultural Economics 65: 1099-1106.

Antle, J.M. 1987. "Econometric Estimation of Producers' Risk Attitudes." American Journal of Agricultural Economics 69: 509-522.

Atkinsom, Scott E., R.M. Adams, and T.D. Crocker. 1985. "Optimal Measurement of Factors Affecting Crop Production: Maximum Likelihood Methods." American Journal of Agricultural Economics 67: 414-418.

Barry, P.J. (Editor). 1984. Risk Management in Agriculture. Iowa State University Press. Ames, Iowa.

Binswanger, Hans P., 1980. "Attitudes toward Risk: Experimental Measurement In Rural India." American Journal of Agricultural Economics 62: 395407.

Bond, Gary E. and S.R. Thompson. 1985. "Risk Aversion and the Recommended Hedging Ration." American Journal of Agricultural Economics 67: 870872.

Boussard, Jean-Marc. 1971. "Time Horizon, Objective Function, and Uncertainty in a Multiperiod Model of Firm Growth," American Journal of Agricultural Economics 53: 467-477.

Braverman, Avishay and J.E. Stiglitz. 1986. "Cost-Sharing Arrangements under Sharecropping: Moral Hazard, Incentive Flexibility, and Risk." American Journal of Agricultural Economics 68: 642-652.

Brorsen, B. Wade, Jean-Paul Chavas, and W.R. Grant. 1987. "A Market Equilibrium Analysis of the Impact of Risk in the U. S.Rice Industry." American Journal of Agricultural Economics 69: 733-739.

Brorsen, B. Wade, Jean-Paul Chavas, W.R. Grant and L.D. Schnake. 1985. "Marketing Margins and Price Uncertainty: The Case of the U.S. Wheat Market." American Journal of Agricultural Economics 67: 521-528.

Buccola, Steven T. 1983. "Risk Preferences and Short-Run Pricing Efficiency." American Journal of Agricultural Economic 65: 587-591.

Buccola, Steven T. 1981. "The Supply and Demand of Marketing Contracts under Risk." American Journal of Agricultural Economics 63: 503-509.

Chambers, Robert G. 1983. "Risk in Agricultural Production: Discussion." American Journal of Agricultural Economics 65: 1114-1115.

Chavas, Jean-Paul, J. Kliebenstein, and T.D. Crenshaw. 1985. "Modeling Dynamic Agricultural Production Response: The Case of Swine Production." American Journal of Agricultural Economics 67: 637-646.

Chavas, Jean-Paul and R.M. Klemme. 1986. "Aggregate Milk Supply Response and Investment Behavior on U,S, Dairy Farms." American Journal of Agricultural Economics 68: 55-66.

Chen, Joyce T. and C.B. Baker. 1974 "Marginal Risk Constraint Linear Programming for Activity Analysis," American Journal of Agricultural Economics 56, No. 3: 622-627.

Chen, Joyce T. 1971. "A Linear Alternative to Quadratic and Semivariance Programming for Farm Planning Under Uncertainty: Comment, " American Journal of Agricultural Economics 53, No. 4: 662-664.

Chen, Joyce T. and C.B. Baker. 1974. "Marginal Risk Constraint Linear Program for Activity Analysis," American Journal of Agricultural Economics 56: 622-627.

Cochran, M.J., L.J. Robison, and W. Lodwick. 1985. "Improving the Efficiency of Stochastic Dominance Techniques Using Convex Set Stochastic Dominance." American Journal of Agricultural Economics. 67: 289-295.

Collender, Robert Neil and J.A. Chalfant. 1986. "An Alternative Approach to Decisions under Uncertainty Using the Empirical Moment-Generating Function." American Journal of Agricultural Economics 68: 727-731.

Collins, Robert A. and P.J. Barry. 1986. "Risk Analysis with Single-Index Portfolio Models: An Application to Farm Planning." American Journal of Agricultural Economics 68: 152-161.

Cowling, Keith and T.W. Gardner. 1963. "Analytical Models for Estimating Supply Relations in the Agricultural Sector, A Survey and Critique," Journal of Farm Economics 15: 439-450.

Day, Richard H. 1965. "Probability Distributions of Field Crop Yields," Journal of Farm Economics 47, No. 3: 713-741.

Eckstein, Zvi. 1985. "The Dynamics of Agriculture Supply: A Reconsideration." American Journal of Agricultural Economics 67: 204214.

Egbert, A.C. and M.K. Hyung. 1975. "Analysis of Aggregation Errors in Linear Programming Planning Models," American Journal of Agricultural Economics 57, No. 2: 292-301.

Fishburn, P.C. 1964. Decision and Value Theory. John Wiley and Sons, New York.
Frick, G.T. and R.A. Andrews. 1965. "Aggregation Bias and Four Methods of Summing Farm Supply Functions," Journal of Farm Economics 47, No. 3:

Garcia, Philip, R.M. Leuthold, and M.E. Sarhan. 1984 "Basis Risk: Measurement and Analysis of Basis Fluctuations for Selected Livestock Markets." American Journal of Agricultural Economics 66: 499-503.

Glenn, Marcia and R. Lattimore. 1983 "Canadian Acreage Response to Grain Storage Subsidies," Canadian Journal of Agricultural Economics 31: 245-248.

Harling, Kenneth F. and T.F. Funk. 1987. "Competitive Strategy for Farm Supply and Grain Elevator Business." American Journal of Agricultural Economics 69: 1047-1055.

Hazell, P.B.R. 1971. "A Linear Alternative to Quadratic and Semivariance Programming for Farm Planning Under Uncertainty: Reply," American Journal of Agricultural Economics 53, No. 4: 662-663.

Hazell, P.B.R. 1971. "A Linear Alternative to Quadratic and Semivariance Programming for Farm Planning Under Uncertainty," American Journal of Agricultural Economics 53, No. 2: 53-62.

Hazell, P.B.R. and P.L. Scandizzo. 1974. "Competitive Demand Structures Under Risk in Agricultural Linear Programming Models," American Journal of Agricultural Economics 56, No. 2: 235-244.

Hazell, P.B.R. 1982. "Application of Risk Preference Estimates in Firmhousehold and Agricultural Sector Models." American Journal of Agricultural Economics 64: 384-390.

Heady, E.O., C.B. Baker, H.G. Diesslen, E. Kehrberg, and Sydney Staniforth, editors. 1961. Agricultural Supply Functions. Ames, Iowa: Iowa State University Press.

Helmberger, Peter G. and V. Akinyosoye. 1984. "Competitive Pricing and Storage under Uncertainty with an Application to the U.S. Soybean Market." American Journal of Agricultural Economics 66: 119-130.

Holt, John. 1983. "Risk in Agricultural Production: Discussion." American Journal of Agricultural Economics 65: 1116-1117.

Houck, J.P. and M.E. Ryan. 1972. "Supply Analysis for Corn in the United States: The Impact of Changing Government Programs." American Journal of Agricultural Economics 54: 184-191.

Irwin, G.D. 1968. "Whither Supply Elasticity," American Journal of Agricultural Economics 50, No. 3: 761-763.

Just, Richard E. 1974. "An Investigation of the Importance of Risk in Farmers' Decisions." American Journal of Agricultural Economics 56: 14-25.

Just, Richard E. 1975. "Risk Response Models and Their Use in Agricultural Policy Evaluation." American Journal of Agricultural Economics 57: 836843.

Just, Richard E. and D. Zilberman. 1985. "Risk Aversion, Technology Choice, and Equity Effects of Agricultural Policy." American Journal of Agricultural Economics 67: 435-440.

King, Robert P. and G.E. Oameck. 1983. "Risk Management by Colorado Dryland Wheat Farmers and the Elimination of the Disaster Assistance Program." American Journal of Agricultural Economics 65: 247-255.

King, R.P. and L.J. Robison. 1981a. "An Interval Approach to Measuring Decision Maker Preferences." American Journal of Agricultural Economics. 62: 510-520.

King, R.P. and L.J. Robison. 1981b. Implementation of the Interval Approach to the measurement of Decision Maker Preference. Department of Agricultural Economics, Michigan State University.

Klecka, W.R. 1980. Discriminant Analysis. Paper No. 19. Sage Publications, Beverly Hills.

Klemme, Richard M. 1985. "A Stochastic Dominance Comparison of Reduced Tillage Systems in Corn and Soybean Production under Risk." American Journal of Agricultural Economics 67: 550-557.

Lambert, David K. and B. A. McCarl. 1985. "Risk Modeling Using Direct Solution of Nonlinear Approximations of the Utility Function." American Journal of Agricultural Economics 67: 846-852.

Lazarus, William F. and E.R. Swanson. 1983. "Insecticide Use and Crop Rotation under Risk: Rootworm Control in Corn." American Journal of Agricultural Economics 65): 738-747.

Lee, David R. and P.G. Helmberger. 1985. "Estimating Supply Response in the Presence of Farm Programs." American Journal of Agricultural Economics 67: 193-203.

Lin, William, G.W. Dean and C.V. Moore. 1974. "An Empirical Test of Utility vs. Profit Maximization in Agricultural Production," American Journal of Agricultural Economics 56: 497-508.

Lin, W.W. and H.S. Chang. 1978. "Specification of Bernoulian Utility

Function in Decision Analysis." Agricultural Economic Research 30: 3036.

Lopez, Ramon E. 1985. "Supply Response and Investment in the Canadian Food Processing Industry." American Journal of Agricultural Economics 67: 40-48.

Love, R.O. and L.J. Robison. 1984. "An Empirical Analysis of the Intertemporal Stability of Risk Preference ." Southern Journal of Agricultural Economics. 16: 151-158.

Markowitz, Harry M. 1954. Portfolio Selection: Efficient Diversification of Investments. New York: John Wiley \& Sons.

Maruyama, Yoshihiro. 1972. "A Truncated Maximin Approach to Farm Planning Under Uncertainty with Discrete Probability Distributions," American Journal of Agricultural Economics 54: 192-220.

McSweeny, William T., D.E. Kenyon, and R.A. Kramer. 1987. "Toward an Appropriate Measure of Uncertainty in a Risk Programming Model." American Journal of Agricultural Economics 69: 87-96.

McSweeny, William T. and R.A. Kramer. 1986. "Soil Conversation with Uncertain Revenues and Input Supplies: Reply." American Journal of Agricultural Economics 68:361-363.

Meilke, K.D. 1976. "Acreage Response to Policy Variables in the Prairie Provinces," American Journal of Agricultural Economics 58: 572-577.

Meyer, J. 1977a. "Choice Among Distributions." Journal of Economic Theory. 14: 326-336.

Meyer, J. 1977b. "Second Degree Stochastic Dominance with respect to a function." International Economic Review. 18: 477-487.

Milon, J: Walter, 1986. "Interdependent Risk and Institutional Coordination for Nonpoint Externalities in Groundwater. ${ }^{n}$ American Journal of Agricultural Economics 68: 1229-1233.

Morzuch, B.J., R. D. Wever, and P.G. Helmberger. 1980 "Wheat Acreage Supply Response under Changing Farm Programs." American Journal of Agricultural Economics 62: 29-37.

Nerlove, Marc and K.L. Bachman. 1960. "The Analysis of Change in Agricultural Supply: Problems and Approaches," Journal of Farm Economics 42, No. 3: 531-554.

Nerlove, Marc. 1956. "Estimates of the Elasticities of Supply of Selected Agricultural Commodities." Journal of Farm Economics 38: 496-509.

Newbery, David M.G. and J.E. Stiglitz. 1981. The Theory of Commodity Price Stabilization: A Study in the Economics of Risk, Oxford University

Press. 69-95.
Pope, Rulon, Jean-Paul Chavas, and R. Just. 1983. "Economic Welfare Evaluations for Producers under Uncertainty." American Journal of Agricultural Economics 65: 98-107.

Pope, Rulon D. 1982. "Expected Profit, Price Change, and Risk Aversion." American Journal of Agricultural Economics 64: 581-585.

Pope, Rulon D. 1987. "An Analogy between Risk Aversion and Homothetic Production under Certainty." American Journal of Agricultural Economics 69: 378-381.

Pope, Rulon D. 1981. "Supply Response and the Dispersion of Price Expectations." American Journal of Agricultural Economics 63: 161163.

Pratt, John W. 1970. "Risk Aversion in the Small and in the Large," Econometrica 37: 537-42.

Raskin, Rob and M.J. Cocharan. 1986. Interpretations and Transofrmations of Scale for the Pratt-Arrow Absoulute Risk Aversion Coefficient Implications for Generalized Stochastic Dominace. American Journal of Agricultural Economics. 68: 204-210.

Roumasset, J. 1976. Rice and Risk: Decision Making Among Low-income Farmers. Amsterdam: North-Holland.

Saskatchewan Agriculture. 1986. Agricultural Statistics, 1985. Regina: Economic Statistics Branch, Saskatchewan Agriculture.

Segerson, Kathleen, 1986. "Risk Sharing in the Design of Environmental Policy." American Journal of Agricultural Economics 68: 1261-1265.

Sharples, T.A. 1969. "The Representative Farm Approach to Estimation of Supply Response," American Journal of Agricultural Economics 51: 361 369.

Sheehy, S.J. and R.H. McAlexander. 1965. "Selection of Representative Farms for Supply Estimation," Journal of Farm Economics 47, No. 3: 681-695.

Thomson, K.J. and P.B.R. Hazell. 1972. "Reliability of Using the Mean Absolute Deviation to Derive Efficient E,V Farm Plans," American Journal of Agricultural Economics 54: 503-506.

Tobin, J. 1958. "Liquidity Preference as Behavior Towards Risk," Review of Economic Studies 25: 65-85.

Tweeten, L.G. and C.L. Quance. 1969. "Positivistic Measures of Aggregate Supply Elasticities: Some New Approaches," American Journal of Agricultural Economics 51, No. 2: 342-352.

Weisensel, W.P. 1988. The Economics Of Soil Erosion in Saskatchewan. A Stochastic Dynamic Programming Approach. Unpublished Masters Thesis. University of Saskatchewan.

Wilson P.N. and V.R. Eidman. 1983. "An Empirical Test Of the Interval Approach for Estimating Risk Preferences." Western Journal of Agricultural Economics 8: 170-82.

Zentner, R.P., C.A. Campbell, D.W.L. Read and C.H. Anderson. 1984. "An Evaluation of Crop Rotation in Southwestern Saskatchewan." Canadian Journal of Agricultural Economics 32: 37-54.

APPENDIX A: Simulated Soil Moisture and Wheat Yield

Appendix Table A-1: Real-Time, Simulated Wheat Yields and Field Moisture, Brown Soils

| Obs | Precipitation |  |  | Est. Moisture |  | Yield |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Summer | Winter | Total | Fallow | Continuous | Fallow | Continuous |
| 1 | 12.9 | 14.3 | 27.3 | 11.0 | 8.3 | 1813 | 1448 |
| 2 | 17.7 | 13.5 | 31.2 | 19.6 | 8.6 | 2459 | 1873 |
| 3 | 13.7 | 12.9 | 26.5 | 13.0 | 8.3 | 2064 | 1520 |
| 4 | 12.6 | 17.9 | 30.6 | 12.2 | 8.3 | 1923 | 1432 |
| 5 | 8.0 | 13.1 | 21.2 | 9.0 | 6.6 | 1078 | 633 |
| 6 | 16.3 | 16.6 | 32.9 | 14.0 | 7.4 | 2278 | 1613 |
| 7 | 8.3 | 29.2 | 37.5 | 25.0 | 15.5 | 2340 | 1955 |
| 8 | 4.5 | 8.4 | 13.0 | 11.2 | 6.6 | 1047 | 180 |
| 9 | 19.0 | 13.2 | 32.2 | 24.2 | 8.1 | 2264 | 1894 |
| 10 | 19.1 | 18.7 | 37.8 | 18.0 | 7.3 | 2468 | 1810 |
| 11 | 17.4 | 19.2 | 36.6 | 16.7 | 7.4 | 2431 | 1700 |
| 12 | 13.1 | 14.1 | 27.2 | 12.6 | 7.7 | 2002 | 1376 |
| 13 | 15.4 | 11.6 | 26.9 | 17.9 | 8.5 | 2420 | 1695 |
| 14 | 21.8 | 18.6 | 40.4 | 24.4 | 6.7 | 2136 | 1909 |
| 15 | 21.5 | 15.3 | 36.8 | 25.0 | 7.2 | 2094 | 1943 |
| 16 | 21.7 | 10.2 | 31.9 | 25.0 | 10.0 | 2086 | 2218 |
| 17 | 7.6 | 11.2 | 18.8 | 11.7 | 6.8 | 1457 | 618 |
| 18 | 10.4 | 15.1 | 25.5 | 11.1 | 7.0 | 1614 | 984 |
| 19 | 9.8 | 16.1 | 26.0 | 9.5 | 7.2 | 1341 | 964 |
| 20 | 13.0 | 16.4 | 29.4 | 10.6 | 7.7 | 1774 | 1368 |
| 21 | 8.6 | 15.9 | 24.5 | 9.4 | 7.2 | 1202 | 825 |
| 22 | 17.9 | 14.5 | 32.4 | 18.9 | 7.9 | 2463 | 1801 |
| 23 | 15.3 | 20.9 | 36.2 | 11.8 | 8.3 | 2054 | 1659 |
| 24 | 4.9 | 32.9 | 37.8 | 25.0 | 22.0 | 2270 | 2197 |
| 25 | 16.7 | 16.1 | 32.8 | 22.0 | 13.7 | 2419 | 2271 |
| 26 | 19.3 | 14.7 | 34.0 | 25.0 | 10.4 | 2190 | 2148 |
| 27 | 7.2 | 16.1 | 23.3 | 12.6 | 8.1 | 1534 | 816 |
| 28 | 17.8 | 22.3 | 40.1 | 15.9 | 7.8 | 2416 | 1774 |
| 29 | 11.2 | 20.1 | 31.2 | 11.4 | 8.8 | 1716 | 1363 |
| 30 | 19.4 | 19.3 | 38.7 | 19.0 | 7.5 | 2463 | 1845 |
| 31 | 14.1 | 13.0 | 27.1 | 13.0 | 7.9 | 2099 | 1507 |
| 32 | 14.3 | 17.3 | 31.7 | 13.3 | 8.0 | 2128 | 1538 |
| 33 | 14.6 | 26.3 | 41.0 | 14.1 | 10.4 | 2207 | 1868 |
| 34 | 23.2 | 16.2 | 39.4 | 25.0 | 7.9 | 2004 | 2105 |
| 35 | 15.3 | 14.2 | 29.5 | 14.5 | 8.1 | 2264 | 1632 |
| 36 | 22.8 | 8.8 | 31.6 | 25.0 | 11.6 | 2025 | 2352 |
| 37 | 15.8 | 17.4 | 33.3 | 15.6 | 9.4 | 2348 | 1835 |
| 38 | 10.3 | 13.9 | 24.2 | 11.8 | 7.9 | 1706 | 1125 |
| 39 | 17.9 | 9.8 | 27.7 | 25.0 | 9.8 | 2243 | 2017 |
| 40 | 15.1 | 14.5 | 29.6 | 15.0 | 8.9 | 2286 | 1714 |
| 41 | 15.7 | 13.0 | 28.7 | 18.8 | 8.8 | 2441 | 1745 |
| 42 | 18.3 | 15.0 | 33.3 | 20.6 | 8.4 | 2441 | 1887 |
| 43 | 19.3 | 15.4 | 34.7 | 23.0 | 8.1 | 2331 | 1911 |
| 44 | 15.1 | 15.4 | 30.5 | 15.1 | 8.1 | 2297 | 1610 |
| Mean | 14.9 | 16.1 | 33.0 | 16.9 | 8.8 | 2060 | 1606 |
| StdDev | 4.70 | 4.74 | 5.9 | 5.4 | 2.6 | 386 | 474 |
| CV | 0.32 | 0.29 | 19.28 | $32.1 \%$ | $30.2 \%$ | 18.7\% | $29.5 \%$ |

APPENDIX B: Risk Survey and Results

## Risk Interval Results

Appendix Table B-1: Financial and Sociological Characteristics of Clusters

|  | Net <br> Income | Debt/ <br> Asset <br> Ratio | Net Worth | Age | Educ | $\begin{aligned} & \text { Farm } \\ & \text { Size } \end{aligned}$ | Farm Exper |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | ears) | (acres) | (years) |
| Cluster A: |  |  |  |  |  |  |  |
| Mean | \$62,327 | 14.90\% | \$1,009,762 | 36.1 | 5.6 | 2,090 | 15.4 |
| StDev | \$33,013 | 12.43\% | \$69,546 | 6.36 | 1.95 | 939 | 6.02 |
| Min | \$15,567 | 0.00\% | \$914,131 | 25 | 2 | 955 | 6 |
| Max | \$111,266 | $43.00 \%$ | \$1,114,552 | 46 | 8 | 3,760 | 25 |
| Cluster B: |  |  |  |  |  |  |  |
| Mean | \$33,875 | $22.72 \%$ | \$649,192 | 41.6 | 5.72 | 1,814 | 21.3 |
| StDev | \$44,119 | 11.96\% | \$94,853 | 8.71 | 4.36 | 798 | 9.63 |
| Min | (\$78,426) | $3.00 \%$ | \$426, 830 | 30 | 0 | 750 | -9 |
| Max | \$144,473 | $54.00 \%$ | \$834,814 | 63 | 23 | 3,980 | 43 |
| Cluster C: |  |  |  |  |  |  |  |
| Mean | \$4,080 | 37.90\% | \$234,938 | 36.2 | 5.95 | 1,311 | 13.2 |
| StDev | \$20,454 | 20.65\% | \$94,604 | 6.27 | 1.96 | 599 | 5.29 |
| Min | (\$62,796) | $5.00 \%$ | \$53,563 | 24 | 1 | 311 | - 4 |
| Max | \$38,438 | 83.00\% | \$390,124 | 57 | 11 | 2,860 | - 29 |

Appendix Table B-2: Mean, Lower and Upper 9 Ranges--Cluster A

|  | Mean <br> Risk Aversion Coefficient Income Level |  |  | Lower Risk Aversion Coefficient Income Level |  |  | Upper <br> Risk Aversion Coefficient Income Level |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| 1 | 0.0002 | 0.0000 | -0.0006 | 0.0000 | -0.0001 | -0.0010 | 0.0003 | 0.0001 | -0.0001 |
| 2 | -0.0006 | 0.0007 | 0.0000 | -0.0010 | 0.0003 | -0.0001 | -0.0001 | 0.0010 | 0.0001 |
| 3 | -0.0003 | 0.0007 | -0.0003 | -0.0005 | 0.0003 | -0.0005 | 0.0000 | 0.0010 | 0.0000 |
| 4 | -0.0003 | 0.0055 | -0.0003 | -0.0005 | 0.0010 | -0.0005 | 0.0000 | 0.0100 | 0.0000 |
| 5 | 0.0002 | 0.0007 | 0.0000 | 0.0000 | 0.0003 | -0.0001 | 0.0003 | 0.0010 | 0.0001 |
| 6 | -0.0003 | 0.0007 | 0.0002 | -0.0005 | 0.0003 | 0.0000 | 0.0000 | 0.0010 | 0.0003 |
| 7 | -0.0003 | 0.0002 | 0.0000 | -0.0005 | 0.0000 | -0.0001 | 0.0000 | 0.0003 | 0.0001 |
| 8 | 0.0028 | 0.0004 | 0.0000 | 0.0006 | 0.0001 | -0.0001 | 0.0050 | 0.0006 | 0.0001 |
| 9 | -0.0003 | 0.0002 | 0.0000 | -0.0005 | 0.0000 | -0.0001 | 0.0000 | 0.0003 | 0.0001 |
| 10 | -0.0006 | 0.0000 | -0.0006 | -0.0010 | -0.0001 | -0.0010 | -0.0001 | 0.0001 | -0.0001 |
| Mean | 0.0001 | 0.0009 | -0.0001 | -0.0004 | 0.0002 | -0.0004 | 0.0005 | 0.0015 | 0.0001 |
| StDev | 0.0009 | 0.0016 | 0.0002 | 0.0005 | 0.0003 | 0.0004 | 0.0015 | 0.0028 | 0.0001 |
| Min | -0.00055 | 0 | -0.00055 | -0.001 | -0.0001 | -0.001 | -0.0001 | 0.0001 | -0.0001 |
| Max | 0.0028 | 0.0055 | 0.00015 | 0.0006 | 0.001 | 0 | 0.005 | 0.01 | 0.0003 |

Appendix Table B-3: Mean, Lower and Upper T Ranges-Cluster B

|  | Mean <br> Risk Aversion Coefficient Income Level |  |  | Lower <br> Risk Aversion Coefficient Income Level |  |  | Upper <br> Risk Aversion Coefficient Income Level |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
|  |  |  |  |  |  |  |  |  |  |
| 11 | 0.0004 | -0.0003 | 0.0000 | 0.0001 | -0.0005 | -0.0001 | 0.0006 | 0.0000 | 0.0001 |
| 12 | 0.0055 | 0.0007 | -0.0003 | 0.0010 | 0.0003 | -0.0005 | 0.0100 | 0.0010 | 0.0000 |
| 13 | -0.0003 | 0.0002 | 0.0002 | -0.0005 | 0.0000 | 0.0000 | 0.0000 | 0.0003 | 0.0003 |
| 14 | -0.0003 | 0.0007 | -0.0003 | -0.0005 | 0.0003 | -0.0005 | 0.0000 | 0.0010 | 0.0000 |
| 15 | -0.0003 | 0.0002 | 0.0000 | -0.0005 | 0.0000 | -0.0001 | 0.0000 | 0.0003 | 0.0001 |
| 16 | -0.0006 | 0.0004 | -0.0006 | -0.0010 | 0.0001 | -0.0010 | -0.0001 | 0.0006 | -0.0001 |
| 17 | 0.0000 | 0.0002 | -0.0006 | -0.0001 | 0.0000 | -0.0010 | 0.0001 | 0.0003 | -0.0001 |
| 18 | 0.0004 | 0.0007 | -0.0003 | 0.0001 | 0.0003 | -0.0005 | 0.0006 | 0.0010 | 0.0000 |
| 19 | -0.0003 | 0.0007 | 0.0000 | -0.0005 | 0.0003 | -0.0001 | 0.0000 | 0.0010 | 0.0001 |
| 20 | 0.0000 | -0.0006 | 0.0000 | -0.0001 | -0.0010 | -0.0001 | 0.0001 | -0.0001. | 0.0001 |
| 21 | -0.0003 | 0.0002 | 0.0000 | -0.0005 | 0.0000 | -0.0001 | 0.0000 | 0.0003 | 0.0001 |
| 22 | 0.0002 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | -0.0001 | 0.0003 | 0.0003 | 0.0001 |
| 23 | -0.0006 | 0.0004 | 0.0000 | -0.0010 | 0.0001 | -0.0001 | -0.0001 | 0.0006 | 0.0001 |
| 24 | -0.0006 | -0.0003 | 0.0000 | -0.0010 | -0.0005 | -0.0001 | -0.0001 | 0.0000 | 0.0001 |
| 25 | 0.0028 | 0.0007 | 0.0002 | 0.0006 | 0.0003 | 0.0000 | 0.0050 | 0.0010 | 0.0003 |
| 26 | 0.0055 | 0.0007 | -0.0006 | 0.0010 | 0.0003 | -0.0010 | 0.0100 | 0.0010 | -0.0001 |
| 27 | -0.0006 | 0.0007 | -0.0003 | -0.0010 | 0.0003 | -0.0005 | -0.0001 | 0.0010 | 0.0000 |
| 28 | -0.0003 | 0.0007 | 0.0055 | -0.0005 | 0.0003 | 0.0010 | 0.0000 | 0.0010 | 0.0100 |
| 29 | 0.0007 | 0.0002 | 0.0055 | 0.0003 | 0.0000 | 0.0010 | 0.0010 | 0.0003 | 0.0100 |
| 30 | 0.0028 | 0.0055 | 0.0055 | 0.0006 | 0.0010 | 0.0010 | 0.0050 | 0.0100 | 0.0100 |
| 31 | 0.0055 | 0.0004 | -0.0006 | 0.0010 | 0.0001 | -0.0010 | 0.0100 | 0.0006 | -0.0001 |
| 32 | 0.0007 | 0.0002 | -0.0003 | 0.0003 | 0.0000 | -0.0005 | 0.0010 | 0.0003 | 0.0000 |
| 33 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | -0.0001 | -0.0001 | 0.0003 | 0.0001 | 0.0001 |
| 34 | -0.0006 | -0.0006 | -0.0006 | -0.0010 | -0.0010 | -0.0010 | -0.0001 | -0.0001 | -0.0001 |
| 35 | 0.0002 | -0.0003 | 0.0000 | 0.0000 | -0.0005 | -0.0001 | 0.0003 | 0.0000 | 0.0001 |
| 36 | 0.0002 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | -0.0001 | 0.0003 | 0.0003 | 0.0001 |
| 37 | 0.0004 | -0.0003 | -0.0003 | 0.0001 | -0.0005 | -0.0005 | 0.0006 | 0.0000 | 0.0000 |
| 38 | -0.0006 | -0.0006 | -0.0006 | -0.0010 | -0.0010 | -0.0010 | -0.0001 | -0.0001 | -0.0001 |
| 39 | 0.0002 | -0.0003 | -0.0003 | 0.0000 | -0.0005 | -0.0005 | 0.0003 | 0.0000 | 0.0000 |
| Mean | 0.00070 | 0.00035 | 0.00041 | -0.00014 | -0.00007 | -0.00026 | 0.00155 | 0.00076 | 0.00107 |
| StDev | 0.00182 | 0.00105 | 0.00174 | 0.00061 | 0.00045 | 0.00055 | 0.00313 | 0.00179 | 0.00303 |

Appendix Table B-4: Mean, Lower and Upper 9 Ranges-Cluster C

|  | Mean <br> Risk Aversion Coefficient Income Level |  |  | Lower <br> Risk Aversion Coefficient Income Level |  |  | Upper <br> Risk Aversion Coefficient Income Level |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1 | 2 | 3 | 1 | 2. | 3 | 1 | 2 | 3 |
| 40 | 0.0004 | -0.0003 | 0.0000 | 0.0001 | -0.0005 | -0.0001 | 0.0006 | 0.0000 | 0.0001 |
| 41 | 0.0004 | -0.0003 | 0.0000 | 0.0001 | -0.0005 | -0.0001 | 0.0006 | 0.0000 | 0.0001 |
| 42 | 0.0004 | 0.0002 | 0.0000 | 0.0001 | 0.0000 | -0.0001 | 0.0006 | 0.0003 | 0.0001 |
| 43 | 0.0028 | 0.0007 | 0.0028 | 0.0006 | 0.0003 | 0.0006 | 0.0050 | 0.0010 | 0.0050 |
| 44 | -0.0003 | -0.0003 | -0.0003 | -0.0005 | -0.0005 | -0.0005 | 0.0000 | 0.0000 | 0.0000 |
| 45 | -0.0003 | 0.0000 | 0.0000 | -0.0005 | -0.0001 | -0.0001 | 0.0000 | 0.0001 | 0.0001 |
| 46 | 0.0055 | 0.0028 | 0.0002 | 0.0010 | 0.0006 | 0.0000 | 0.0100 | 0.0050 | 0.0003 |
| 47 | 0.0028 | 0.0007 | -0.0006 | 0.0006 | 0.0003 | -0.0010 | 0.0050 | 0.0010 | -0.0001 |
| 48 | 0.0055 | 0.0007 | -0.0003 | 0.0010 | 0.0003 | -0.0005 | 0.0100 | 0.0010 | 0.0000 |
| 49 | 0.0055 | 0.0007 | -0.0003 | 0.0010 | 0.0003 | -0.0005 | 0.0100 | 0.0010 | 0.0000 |
| 50 | -0.0003 | 0.0007 | 0.0002 | -0.0005 | 0.0003 | 0.0000 | 0.0000 | 0.0010 | 0.0003 |
| 51 | 0.0028 | 0.0002 | 0.0002 | 0.0006 | 0.0000 | 0.0000 | 0.0050 | 0.0003 | 0.0003 |
| 52 | 0.0028 | 0.0002 | 0.0000 | 0.0006 | 0.0000 | -0.0001 | 0.0050 | 0.0003 | 0.0001 |
| 53 | 0.0004 | -0.0006 | 0.0000 | 0.0001 | -0.0010 | -0.0001 | 0.0006 | -0.0001 | 0.0001 |
| 54 | -0.0003 | 0.0002 | 0.0000 | -0.0005 | 0.0000 | -0.0001 | 0.0000 | 0.0003 | 0.0001 |
| 55 | -0.0003 | 0.0007 | -0.0003 | -0.0005 | 0.0003 | -0.0005 | 0.0000 | 0.0010 | 0.0000 |
| 56 | 0.0004 | 0.0004 | 0.0002 | 0.0001 | 0.0001 | 0.0000 | 0.0006 | 0.0006 | 0.0003 |
| 57 | 0.0002 | 0.0007 | 0.0000 | 0.0000 | 0.0003 | -0.0001 | 0.0003 | 0.0010 | 0.0001 |
| 58 | 0.0002 | -0.0003 | 0.0000 | 0.0000 | -0.0005 | -0.0001 | 0.0003 | 0.0000 | 0.0001 |
| 59 | 0.0028 | 0.0007 | 0.0000 | 0.0006 | 0.0003 | -0.0001 | 0.0050 | 0.0010 | 0.0001 |
| 60 | -0.0003 | -0.0006 | 0.0002 | -0.0005 | -0.0010 | 0.0000 | 0.0000 | -0.0001 | 0.0003 |
| 61 | 0.0028 | 0.0007 | -0.0003 | 0.0006 | 0.0003 | -0.0005 | 0.0050 | 0.0010 | 0.0000 |
| 62 | -0.0003 | 0.0007 | 0.0000 | -0.0005 | 0.0003 | -0.0001 | 0.0000 | 0.0010 | 0.0001 |
| 63 | -0.0003 | -0.0003 | 0.0000 | -0.0005 | -0.0005 | -0.0001 | 0.0000 | 0.0000 | 0.0001 |
| 64 | -0.0003 | -0.0003 | 0.0000 | -0.0005 | -0.0005 | -0.0001 | 0.0000 | 0.0000 | 0.0001 |
| 65 | 0.0004 | 0.0000 | 0.0002 | 0.0001 | -0.0001 | 0.0000 | 0.0006 | 0.0001 | 0.0003 |
| 66 | -0.0006 | -0.0006 | -0.0006 | -0.0010 | -0.0010 | -0.0010 | -0.0001 | -0.0001 | -0.0001 |
| 67 | -0.0006 | 0.0002 | 0.0000 | -0.0010 | 0.0000 | -0.0001 | -0.0001 | 0.0003 | 0.0001 |
| 68 | 0.0004 | 0.0007 | 0.0002 | 0.0001 | 0.0003 | 0.0000 | 0.0006 | 0.0010 | 0.0003 |
| 69 | 0.0002 | -0.0003 | 0.0002 | 0.0000 | -0.0005 | 0.0000 | 0.0003 | 0.0000 | 0.0003 |
| 70 | -0.0006 | -0.0006 | 0.0055 | -0.0010 | -0.0010 | 0.0010 | -0.0001 | -0.0001 | 0.0100 |
| 71 | 0.0028 | 0.0000 | 0.0000 | 0.0006 | -0.0001 | -0.0001 | 0.0050 | 0.0001 | 0.0001 |
| 72 | -0.0003 | 0.0007 | -0.0003 | -0.0005 | 0.0003 | -0.0005 | 0.0000 | 0.0010 | 0.0000 |
| 73 | 0.0028 | 0.0007 | 0.0002 | 0.0006 | 0.0003 | 0.0000 | 0.0050 | 0.0010 | 0.0003 |
| 74 | -0.0006 | 0.0004 | -0.0006 | -0.0010 | 0.0001 | -0.0010 | -0.0001 | 0.0006 | -0.0001 |
| 75 | 0.0004 | 0.0002 | 0.0000 | 0.0001 | 0.0000 | -0.0001 | 0.0006 | 0.0003 | 0.0001 |
| 76 | 0.0002 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | -0.0001 | 0.0003 | 0.0003 | 0.0001 |
| 77 | 0.0007 | 0.0000 | 0.0000 | 0.0003 | -0.0001 | -0.0001 | 0.0010 | 0.0001 | 0.0001 |
| 78 | 0.0002 | 0.0000 | 0.0000 | 0.0000 | -0.0001 | -0.0001 | 0.0003 | 0.0001 | 0.0001 |
| 79 | -0.0003 | -0.0003 | 0.0000 | -0.0005 | -0.0005 | -0.0001 | 0.0000 | 0.0000 | 0.0001 |
| Mean | 0.000953 | 0.00022 | 0.000162 | -0.00001 | -0.00009 | -0.00016 | 0.001922 | 0.000535 | 0.000485 |
| StDev | 0.001735 | 0.000581 | 0.000981 | 0.000565 | 0.000425 | 0.000354 | 0.002985 | 0.000836 | 0.001707 |

Appendix Table B-5: Mean, Lower and Upper $\theta$ Ranges--Cluster A

|  | Mean <br> Risk Aversion Coefficient <br> Income Level |  |  | Lower Risk Aversion Coefficient Income Level |  |  | Upper <br> Risk Aversion Coefficient Income Level |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| 2 | -5.5 | 13.0 | 0.0 | -10.0 | 6.0 | -4.0 | -1.0 | 20.0 | 4.0 |
| 3 | -2.5 | 13.0 | -10.0 | -5.0 | 6.0 | -20.0 | 0.0 | 20.0 | 0.0 |
| 4 | -2.5 | 110.0 | -10.0 | -5.0 | 20.0 | -20.0 | 0.0 | 200.0 | 0.0 |
| 5 | 1.5 | 13.0 | 0.0 | 0.0 | 6.0 | -4.0 | 3.0 | 20.0 | 4.0 |
| 6 | -2.5 | 13.0 | 6.0 | -5.0 | 6.0 | 0.0 | 0.0 | 20.0 | 12.0 |
| 7 | -2.5 | 3.0 | 0.0 | -5.0 | 0.0 | -4.0 | 0.0 | 6.0 | 4.0 |
| 8 | 28.0 | 7.0 | 0.0 | 6.0 | 2.0 | -4.0 | 50.0 | 12.0 | 4.0 |
| 9 | -2.5 | 3.0 | 0.0 | -5.0 | 0.0 | -4.0 | 0.0 | 6.0 | 4.0 |
| 10 | -5.5 | 0.0 | -22.0 | -10.0 | -2.0 | -40.0 | -1.0 | 2.0 | -4.0 |
| MEAN | 0.8 | 17.5 | -5.8 | -3.9 | 4.2 | -14.0 | 5.4 | 30.8 | 2.4 |
| STD | 9.4 | 31.3 | 9.3 | 4.6 | 6.2 | 14.6 | 14.9 | 56.9 | 4.5 |
| MIN-V | -5.5 | 0.0 | -22.0 | -10.0 | -2.0 | -40.0 | -1.0 | 2.0 | -4.0 |
| MAX-V | 28.0 | 110.0 | 6.0 | 6.0 | 20.0 | 0.0 | 50.0 | 200.0 | 12.0 |

Appendix Table B-6:
Mean,
Appendix Table B-6: Mean, Lower and Upper $\theta$ Ranges--Cluster B

|  | Mean <br> Risk Aversion Coefficient Income Level |  |  | Lower <br> Risk Aversion Coefficient Income Level |  |  | Upper <br> Risk Aversion Coefficient Income Level |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| 11 | 3.5 | -5.0 | 0.0 | 1.0 | -10.0 | -4.0 | 6.0 | 0.0 | 4.0 |
| 12 | 55.0 | 13.0 | -10.0 | 10.0 | 6.0 | -20.0 | 100.0 | 20.0 | 0.0 |
| 13 | -2.5 | 3.0 | 6.0 | -5.0 | 0.0 | 0.0 | 0.0 | 6.0 | 12.0 |
| 14 | -2.5 | 13.0 | -10.0 | -5.0 | 6.0 | -20.0 | 0.0 | 20.0 | 0.0 |
| 15 | -2.5 | 3.0 | 0.0 | -5.0 | 0.0 | -4.0 | 0.0 | 6.0 | 4.0 |
| 16 | -5.5 | 7.0 | -22.0 | -10.0 | 2.0 | -40.0 | -1.0 | 12.0 | -4.0 |
| 17 | 0.0 | 3.0 | -22.0 | -1.0 | 0.0 | -40.0 | 1.0 | 6.0 | -4.0 |
| 18 | 3.5 | 13.0 | -10.0 | 1.0 | 6.0 | -20.0 | 6.0 | 20.0 | 0.0 |
| 19 | -2.5 | 13.0 | 0.0 | -5.0 | 6.0 | -4.0 | 0.0 | 20.0 | 4.0 |
| 20 | 0.0 | -11.0 | 0.0 | -1.0 | -20.0 | -4.0 | 1.0 | -2.0 | 4.0 |
| 21 | -2.5 | 3.0 | 0.0 | -5.0 | 0.0 | -4.0 | 0.0 | 6.0 | 4.0 |
| 22 | 1.5 | 3.0 | 0.0 | 0.0 | 0.0 | -4.0 | 3.0 | 6.0 | 4.0 |
| 23 | -5.5 | 7.0 | 0.0 | -10.0 | 2.0 | -4.0 | -1.0 | 12.0 | 4.0 |
| 24 | -5.5 | -5.0 | 0.0 | -10.0 | -10.0 | -4.0 | -1.0 | 0.0 | 4.0 |
| 25 | 28.0 | 13.0 | 6.0 | 6.0 | 6.0 | 0.0 | 50.0 | 20.0 | 12.0 |
| 26 | 55.0 | 13.0 | -22.0 | 10.0 | 6.0 | -40.0 | 100.0 | 20.0 | -4.0 |
| 27 | -5.5 | 13.0 | -10.0 | -10.0 | 6.0 | -20.0 | -1.0 | 20.0 | 0.0 |
| 28 | -2.5 | 13.0 | 220.0 | -5.0 | 6.0 | 40.0 | 0.0 | 20.0 | 400.0 |
| 29 | 6.5 | 3.0 | 220.0 | 3.0 | 0.0 | 40.0 | 10.0 | 6.0 | 400.0 |
| 30 | 28.0 | 110.0 | 220.0 | 6.0 | 20.0 | 40.0 | 50.0 | 200.0 | 400.0 |
| 31 | 55.0 | 7.0 | -22.0 | 10.0 | 2.0 | -40.0 | 100.0 | 12.0 | -4.0 |
| 32 | 6.5 | 3.0 | -10.0 | 3.0 | 0.0 | -20.0 | 10.0 | 6.0 | 0.0 |
| 33 | 1.5 | 0.0 | 0.0 | 0.0 | -2.0 | -4.0 | 3.0 | 2.0 | 4.0 |
| 34 | -5.5 | -11.0 | -22.0 | -10.0 | -20.0 | -40.0 | -1.0 | -2.0 | -4.0 |
| 35 | 1.5 | -5.0 | 0.0 | 0.0 | -10.0 | -4.0 | 3.0 | 0.0 | 4.0 |
| 36 | 1.5 | 3.0 | 0.0 | 0.0 | 0.0 | -4.0 | 3.0 | 6.0 | 4.0 |
| 37 | 3.5 | -5.0 | -10.0 | 1.0 | -10.0 | -20.0 | 6.0 | 0.0 | 0.0 |
| 38 | -5.5 | -11.0 | -22.0 | -10.0 | -20.0 | -40.0 | -1.0 | -2.0 | -4.0 |
| 39 | 1.5 | -5.0 | -10.0 | 0.0 | -10.0 | -20.0 | 3.0 | 0.0 | 0.0 |
| MEAN | 7.0 | 6.9 | 16.2 | -1.4 | -1.3 | -10.5 | 15.5 | 15.2 | 42.9 |
| STD | 18.2 | 21.0 | 69.8 | 6.1 | 9.0 | 22.1 | 31.3 | 35.8 | 121.4 |
| MIN-V | -5.5 | -11.0 | -22.0 | -10.0 | -20.0 | -40.0 | -1.0 | -2.0 | -4.0 |

Appendix Table B-7: Mean, Lower and Upper $\theta$ Ranges--Cluster $C$


Appendix Table B-8: Profile of Sample Farmers According to Net Worth, 1987

| Net Wealth | Number of <br> Farmers | Relative <br> Frequency | Cumulative <br> Frequency |  |
| :--- | :---: | :---: | :---: | :---: |
| $\$ 0$ | - | $\$ 99,999$ |  | 6.3 |
| $\$ 100,000-\$ 499,999$ | 37 | 46.8 | 6.3 |  |
| $\$ 500,000-\$ 999,999$ | 32 | 40.6 | 53.1 |  |
| Above $\$ 1,000,000$ | 5 | 6.3 | 100.7 |  |
| Total | 79 | 100.0 |  |  |

APPENDIX C: Simulated Income Distributions



| $\begin{aligned} & \text { Percontile } \\ & \infty \infty \end{aligned}$ | - 65 | 70 | 75 | $\pm{ }^{*}$ | $\overline{x c}=(\mathrm{Gs})$ | 9 | 95 | 100 | 105 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | (62,051) | (0,150) | $(39,581)$ | (38,791) | (38,361) | $(38,599)$ | ( 37.868 ) | $(30,976)$ | 57.267) |
| 2 | $(37,530)$ | $(36,779)$ | $(35,532)$ | (34,360) | ( 34,316$)$ | $(33,874)$ | $(33,40)$ | $(32,742)$ | $(32,260)$ |
| 3 | (36, 136) | (35,281) | (35,335) | (32,062) | $(32,162)$ | (31,729) | (31,630) | $(30,360)$ | $(30,321)$ |
| 4 | (34,740) | $(33,520)$ | (32,111) | (31,465) | $(30,327)$ | ( 29.934 ) | $(29,670)$ | $(29,212)$ | $(29,519)$ |
|  | $(33,159)$ | $(32,169)$ | $(31,210)$ | $(30,227)$ | $(29,027)$ | $(23,911)$ | $(28,730)$ | $(28,465)$ | $(28.498)$ |
| 6 | ( 31,779 ) | $(31,162)$ | $(30,132)$ | $(28.657)$ | $(28,066)$ | $(28,043)$ | $(28,008)$ | $(27,485)$ |  |
| 7 | ( 31,091 ) | $(30,172)$ | $(28,780)$ | (27,913) | (27,466) | $(27,289)$ | (26,862) | (26,683) | $(27.169)$ |
| 8 | (30, 102) | (29,085) | (28,116) | (27,309) | (26,740) | (26,420) | (26, 158) | (25,966) | (26,453) |
| 9 | $(29,297)$ | $(28,215)$ | $(27,567)$ | $(26,589)$ | $(25,903)$ | $(25,361)$ | $(25,347)$ | $(25,113)$ | $(25,621)$ |
| 10 | $(28,631)$ <br> 27 | $(27,786)$ | (26, 268 ) | $(25,906)$ | $(25,028)$ | ( 24.873$)$ | (24,932) | $(26,635)$ | (25,012) |
| 11 | (27,850) | $(27,222)$ | (26, 206) | $(25,313)$ | $(26,539)$ | $(26,295)$ | ( 26,234$)$ | $(23,967)$ |  |
| 12 | $(27,200)$ | (26,657) | (25,408) | (26,885) | (23,780) | (23,516) | $(23,572)$ | $(23,519)$ | (23, 856) |
| 13 | $(26,576)$ | $(26,119)$ | $(24,702)$ | $(26,376)$ | $(23,456)$ | $(23,123)$ | $(23,193)$ | (23,027) | $(23,220)$ |
| 16 | $(26,038)$ | $(25,265)$ | (26,031) | $(23,787)$ | $(23,126)$ | $(22,665)$ | $(22,625)$ | $(22,652)$ | $(22,835)$ |
| 15 | (25,446) | $(24,456)$ | $(23,625)$ | (23.485) | $(22,705)$ | $(22,180)$ | $(22,175)$ | $(22,300)$ | $(22,630)$ |
| 16 | $(25,032)$ | $(26,032)$ | $(23,261)$ | (23,129) | $(22,250)$ | $(21,616)$ | $(21,701)$ | $(21,958)$ | $(22,092)$ |
| 17 | (26, 37 ) | $(23,617)$ | (22,78) | (22,560) | (21,745) | ( 21,280$)$ | (21,406) | (21, 197) | $(21,707)$ |
| 18 | (23,760) | $(23.460)$ | $(22,526)$ | (21,982) | $(21,396)$ | $(20,914)$ | ( $20, \% 62$ ) | $(20,762)$ | $(21,357)$ |
| 19 | (23,388) | $(23,099)$ | $(22,251)$ | (21,721) | (20,926) | (20,619) | $(20,674)$ | $(20,385)$ | $(20,981)$ |
| 20 | $(23,067)$ | $(22,828)$ | $(21,877)$ | $(21,300)$ | $(20,567)$ | $(20,266)$ | $(20,232)$ | $(19,993)$ |  |
| 21 | $(22,672)$ | $(22,679)$ | (21,501) | $(20,903)$ | $(20,252)$ | $(19,890)$ | $(19,883)$ | $(19,688)$ | $(20,322)$ |
| 22 | $(22,387)$ | $(21,965)$ | $(20,953)$ | $(20,515)$ | $(19,815)$ | $(19,480)$ | $(19,526)$ | $(19,619)$ |  |
| 23 | $(22,016)$ | $(21,377)$ | $(20,536)$ | $(20,079)$ | $(19,443)$ | $(19,140)$ | $(19,192)$ | $(19,186)$ |  |
| 26 | $(21,002)$ | (20,966) | (20,075) | $(19.657)$ | $(19,140)$ | $(18,816)$ | $(18,282)$ | $(18,930)$ | $(19,133)$ |
| 25 | $(21,186)$ | $(20,656)$ | $(19.613)$ | $(19,250)$ | $(18,611)$ | $(18,365)$ | $(18,655)$ | $(18,616)$ | $(18,810)$ |
| 26 | (20,713) | $(20,320)$ | (19,115) | (18,826) | $(18,191)$ | $(18,075)$ | $(18,310)$ | $(18,398)$ | $(18,451)$ |
| 27 | (20,339) | $(20,076)$ | $(18,791)$ | $(18,431)$ | $(17,915)$ | (17,854) | $(18,008)$ | $(18,066)$ | $(18,233)$ |
| 28 | (20,010) | $(19,761)$ | $(18,485)$ | (18,098) | $(17,658)$ | $(17,538)$ | (17.735) | (17, 567) | $(17,967)$ |
| 29 | $(19,732)$ | $(19,613)$ | (17,991) | $(17,761)$ | $(17,612)$ | $(17,218)$ | $(17,663)$ | $(17,257)$ |  |
| 30 | $(19,450)$ | $(19,073)$ | $(17,746)$ | $(17,369)$ | $(17,101)$ | $(16,972)$ | $(17,158)$ | $(16,891)$ | $(17,24$ |
| 31 | $(19,021)$ | $(18,750)$ | $(17,231)$ | $(17,039)$ | $(16,925)$ | $(16,693)$ | $(16,923)$ | $(16,610)$ $(16,60)$ |  |
| 32 | $(18,631)$ | $(18,619)$ | $(16,897)$ | $(16,765)$ | $(16,679)$ | $(16,362)$ | $(16,597)$ | $(16,40)$ |  |
| 33 | (18,217) | $(17,982)$ | $(16,597)$ | $(16,582)$ | $(16,385)$ | (16,089) | $(16,230)$ | $(16.108)$ | $(16,361)$ |
| 36 | $(17,901)$ | $(17,601)$ | (16, 371 ) | $(16,276)$ | $(16,051)$ | $(15,767)$ | (15,952) | $(15,771)$ | $(16,110)$ |
| 35 | $(17,620)$ | $(17,076)$ | $(15,957)$ | $(15,860)$ | $(15,706)$ | $(15,469)$ | $(15,672)$ | $(15,615)$ |  |
| 36 | $(17,186)$ | $(16,736)$ | $(15,590)$ | $(15,537)$ | $(15,303)$ | ( 15,186 ) | $(15,420)$ | $(15,645)$ |  |
| 37 | $(16,907)$ | $(16,172)$ | $(15,289)$ | $(15,170)$ | $(16,915)$ | $(16,913)$ | $(15,171)$ | $(15,186)$ | $(15,652)$ |
| 38 | (16,679) | $(15,830)$ | (16,896) | $(14,807)$ | (14,506) | (14,683) | (14,789) | $(14,985)$ | $(15,161)$ |
| 39 | $(16,216)$ | $(15,587)$ | $(14.462)$ | $(16,403)$ | (16,154) | $(14,268)$ | (14,296) | $(14,783)$ | (14.955) |
| 40 | (15,909) | $(15,171)$ | $(16,146)$ | $(13,966)$ | $(13,697)$ | $(13,839)$ | (14,053) | $(16.467)$ | $(14,613)$ |
| 41 | $(15,597)$ | $(14,71)$ | $(13,802)$ | $(13,547)$ | $(13,495)$ | $(13,517)$ | $(13,809)$ | $(16,099)$ | $(14,216)$ |
| 62 | $(15,265)$ | $(16,328)$ | $(13.427)$ | (13,165) | $(13,166)$ | $(13,076)$ | $(13,653)$ | $(13,809)$ |  |
| 43 | (16,908) | $(13,929)$ | $(13,146)$ | $(12,889)$ | $(12,881)$ | ( 12,756 ) | $(13,158)$ | $(13,551)$ | $(13,822)$ |
| 46 | $(16,513)$ | $(13,548)$ | $(12,879)$ | $(12,463)$ | $(12,518)$ | $(12,543)$ | $(12,850)$ | $(13,167)$ | $(13,530)$ |
| 45 | $(16,263)$ | $(13,388)$ | $(12,595)$ | (12,407) | $(12,277)$ | (11,978) | ( 12.555$)$ | (12,627) | $(13,116)$ |
| 66 | (13,781) | $(13,036)$ | $(12,246)$ | $(12,016)$ | $(11,816)$ | $(11,587)$ | ( 11,979$)$ | $(12,080)$ | $(12,768)$ |
| 67 | (13,576) | $(12,702)$ | (11,887) | (11,709) | $(11,506)$ | (11,380) | (11,606) | (11, 773) | $(12,368)$ |
| 48 | $(13,053)$ | $(12,526)$ | $(11,588)$ | (11, 486) | $(11,233)$ | $(11,071)$ | (11, 261) | (11,471) | (12,013) |
| 49 | $(12,770)$ | $(12,301)$ | $(11,285)$ | (11.112) | (11, 1020 | ( 10,820$)$ | (10,895) | (11,266) |  |
| 50 | (12,381) | $(12,048)$ | $(11,028)$ | $(10,922)$ | $(10,688)$ | $(10,569)$ | ( 10,661 ) | $(10,933)$ | $(11,267)$ |
| 51 | $(12,183)$ | $(11,813)$ | $(10,746)$ | $(10,676)$ | $(10,319)$ | $(10,277)$ | $(10,376)$ | $(10,529)$ |  |
| 52 | (11,971) | $(11,540)$ | $(10,561)$ | $(10,626)$ | $(10,120)$ | $(9,953)$ | $(10,163)$ | $(10,332)$ | $(10,716)$ |
| 53 | (11, 733$)$ | $(11,307)$ | $(10,228)$ | $(10,193)$ | $(9,934)$ | (9,083) | $(9,916)$ | $(10,127)$ | $(10,436)$ |
| 56 | (11, 460$)$ | (11, 030$)$ | $(10,008)$ | (9.928) | $(9,611)$ | (9,675) | $(9.600)$ | $(9,866)$ | $(10,107)$ |
| 55 | (10,985) | ( 10,506$)$ | $(9,762)$ | ( 9.631 ) | (9,268) | $(9,237)$ | $(9.407)$ | $(9,40)$ | $(9,912)$ |
| 56 | (10,602) | $(10,025)$ | $(9,368)$ | (9,363) | $(1,001)$ | ( 8,952 ) | $(9,103)$ | $(9,420)$ |  |
| 57 | $(10.275)$ | $(9,785)$ | ( 9,0051 ) | (8,906) | ( 8,530$)$ | $(8,675)$ | (3.888) | (9,090) | (9.126) |
| 58 | ( 9.959 ) | $(9,362)$ | $(8,776)$ | (8.466) | $(8,168)$ | $(8,653)$ | (8,611) | $(3,372)$ |  |
| 59 | ( 9.635 ) | $(9,040)$ | $(8,366)$ | $(3,069)$ | (7.721) | ( 8,220$)$ | $(8,318)$ | $(3,551)$ | (8,581) |
| 60 | (9,605) | $(8.739)$ | (8,069) | (7.736) | $(7,403)$ | (7,903) | ( 8.038$)$ | $(8,310)$ | $(8,326)$ |
| 61 | $(9,167)$ | $(8,400)$ | $(7,585)$ | $(7,357)$ | $(7,028)$ | (7, 524 ) | (7, 001 ) | (7,928) | $(7,966)$ |
| 62 | $(8,782)$ | (8,096) | (7,287) | (7.069) | $(6,729)$ | $(7,159)$ | $(7,398)$ | $(7,656)$ | (7,647) |
| 63 | ( 8,358$)$ | (7, 803 ) | (6,996) | $(6,748)$ | $(6,452)$ | $(6,831)$ | $(7.157)$ | $(7,329)$ |  |
| ${ }_{6}^{65}$ | ( 5,083 ) | $(7,463)$ | $(6,693)$ | $(6,115)$ | $(6,150)$ | (6,488) | $(6,756)$ | $(7,029)$ | (7,223) |
| 65 | ( 7.863 ) | $(7,064)$ | $(6,350)$ | (5.799) | $(5,796)$ | (6,153) | ( 6.369$)$ | $(6,570)$ | (7.015) |
| 66 | $(7.639)$ | $(6,763)$ | (6,053) | $(5,653)$ | $(5,419)$ | ( 5,885$)$ | $(5,911)$ | $(6,211)$ | $(6,576)$ |
| 6 | $(6,961)$ | $(6,531)$ | $(5,711)$ | $(5,323)$ | $(5,053)$ |  | ( 5,546 ) | $(5,837)$ | $(6,116)$ |
| 68 | (6.628) | ( 5,901$)$ | $(5,269)$ | (6,858) | (4.753) | ( 5.017$)$ | $(5,127)$ | $(5,515)$ | (5, 045 ) |
| ${ }^{69}$ | (6, 175) | ( 5,597$)$ | $(6,639)$ | $(6,456)$ | ( 4,377$)$ | (6,435) | $(4.626)$ | (5,087) | (5,595) |
| 70 | ( 5,707$)$ | ( 5,270$)$ | $(6,370)$ | (6,125) | ( 3.867 ) | (3,818) | $(6,081)$ | $(6,773)$ | $(5,125)$ |
| 71 | ( 5,308$)$ | (6,989) | (4,021) | $(3,670)$ | ( 3.646 ) | ( 3,385 ) | ( 3.636 ) | $(6,472)$ | $(6,865)$ |
| 72 | (4,915) | $(6,005)$ | $(3,692)$ | (3,273) | $(2,976)$ | ( 2,930$)$ | $(3,103)$ | $(6,002)$ | $(6,563)$ |
| 73 | (4.618) | $(6,261)$ | $(3,447)$ | $(2,73)$ | $(2,386)$ | $(2,608)$ | $(2,736)$ | $(3,566)$ | $(3,481)$ |
| 75 | $(6,189)$ |  | $(3,223)$ | (2,369) |  | $(2,311)$ | $(2,622)$ | $(3,012)$ | (3,627) |
| 75 | ( 3.807 ) | $(3,146)$ | $(2,832)$ | $(2,126)$ | $(1,676)$ | $(1,983)$ | $(1,909)$ | $(2,062)$ | $(3,216)$ |
| 76 | $(3,313)$ | $(2,676)$ | $(2,393)$ | (1,878) | $(1,345)$ | (1,356) | $(1,466)$ | $(2,123)$ | (2,782) |
| 77 | $(2,816)$ $(2,451)$ | $(2,297)$ $(1,925)$ | $(2,068)$ $(1,60)$ | $(1,363)$ | $(782)$ | (762) | $(1,027)$ | $(1,589)$ | $(2,363)$ |
| 78 | (2,451) | $(1,925)$ | $(1,460)$ | (617) | (226) | (228) | (556) | $(1,131)$ | (1,752) |
| 79 | $(1,876)$ | $(1,421)$ | (881) | (151) | 273 | 226 | (120) | (672) | (1,319) |
| 80 | $(1,378)$ | (859) $(464)$ | $\left(\begin{array}{l}321) \\ 315\end{array}\right.$ | 259 | 636 970 | -629 | 282 | (375) | (662) |
| 81 82 | (779) | (466) | 315 | 741 | 970 | 1,148 | 713 | 176 | (265) |
| 82 83 | (311) | (176) | 797 | 1.082 | 1,323 | 1.638 | 1,236 | 579 | 261 |
| 88 | 35 | 369 | 1.323 | 1,503 | 1.690 | 1,885 | 1,721 | 903 | 665 |
| 88 | 517 | 922 | 1.778 | 1,901 | 2,286 | 2,42 | 2,173 | 1,661 | 1,069 |
| 85 | $\begin{array}{r}973 \\ \hline 155\end{array}$ | 1,317 | 2,213 | 2.697 | 2,779 | 2,463 | 2,709 | 2,383 | 1,925 |
| 88 | 1.455 | 1, 805 | 2,692 | 2,986 | 3,606 | 3,332 | 3,257 | 2,772 | 2,310 |
| 87 | 2,236 | 2,519 | 3,401 | 3, 884 | 4.025 | 3,8\% | 6.010 | 3,138 | 2,846 |
| 88 | 3,128 | 3,482 | 6.463 | 6.911 | 6,596 | 4.405 | 4,537 | 3,54 | 3,263 |
| 89 | 3,695 | 4.006 | 5.226 | 5,501 | 5,329 | 4,896 | S, 187 | 6,222 | 3,693 |
| 90 | 6,026 | 4,711 | 5.790 | 6.053 | 5.787 | 5,556 | 5,346 | 5,019 | 4,464 |
| 91 | 6.59 5.636 | 5,385 | 6,619 | \%.657 | 6.486 | 6.673 | 6,486 | 5,850 | 5,089 |
| 92 | 5,636 | 5,932 | 7.002 | 7.156 | 7,259 | 7.202 | 7,416 | 6,599 | 5,797 |
| 93 | 6,926 | 6,732 | 8,070 | 8,082 | 8.251 | 8,062 | 3,000 | 7,310 | 6,564 |
| 96 | 7,938 | 7,827 | 9,217 | 8.953 | ${ }^{8,926}$ | 8,998 | 8,754 | 8,217 | 7,617 |
| 95 | . 0221 | ,.460 | 10,122 | 10, 121 | 10,064 | 9,923 | -,716 | 9,250 | 3,736 |
| 97 | 10, 199 | 11,078 | 11,606 | 12,260 | 11,260 | 10,946 | 10,397 | 10,328 | 9,871 |
| 97 | 11,917 16503 | 13,007 | 13,161 15.18 | 13,655 | 12,781 | 12.083 | 11,513 | 11,266 | 11,059 |
| 98 | 16, 503 | 15,798 | 15,578 | 15,622 | 16,764 | 14,628 | 13.767 | 12,902 | 13,651 |
| 100 | 18,957 25,638 | 19,359 | 19,375 | 19, 810 | 20, 134 | 19,616 | 18,629 | 16,971 | 17.052 |
| 100 | 25,638 | 25,562 | 25,491 | 25,326 | 25.460 | 26,716 | 26,386 | 23,116 | 22,560 |
| Mean | $(11,988)$ | (11,421) | $(10,523)$ | $(10,159)$ | (9,846) | $(9,812)$ | (9.950) |  |  |
| stoer | 12,833 | 12,723 | 12,545 | 12,622 | 12,202 | 12,011 | 11,895 | 11,521 | $11,466$ |





| Percentile <br> No | 10.6 | 70 | 73 | $\pm$ | $=(65)$ | \% | \% | 100 | 105 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | (3,635) | (37,737) | (6,620) | (35,623) | (36,462) | (33,73) | $(33,690)$ | 3) |  |
| 2 | (34,820) | (35,796) | $(32,801)$ | (31, 190) | (30, 773$)$ | (29,603) | $(29,431)$ | (29,696) | $(29,659)$ |
| 3 | (31,679) | $(31,321)$ | (29,953) | $(28,874)$ | $(28,023)$ | $(27,307)$ | (77,465) |  |  |
| 6 | $(30,335)$ | $(29,779)$ | $(28,281)$ | $(27.850)$ | $(26,756)$ | $(26,226)$ | $(26,010)$ | $(25.856)$ |  |
| 5 | $(29,579)$ | (28,852) | $(27,700)$ | (26,596) | (26,016) | $(25,470)$ | $(24,008)$ | $(26,968)$ | $(25,140)$ |
| 6 | $(28,683)$ | $(27,961)$ | $(26,817)$ | $(25,651)$ | $(25,361)$ | $(26,678)$ | $(26,306)$ | $(26,326)$ |  |
| 7 | $(28,008)$ | (27,042) | (25,766) | $(26,822)$ | $(24,653)$ | $(26,106)$ | $(23,700)$ | (23,602) |  |
| 8 | $(27,205)$ | (26, 289) | $(25,023)$ | $(26,320)$ | $(26,269)$ | $(23,435)$ | $(23,158)$ | $(22,979)$ | $(23,116)$ |
| 9 | $(26,667)$ | $(25,575)$ | (26,261) | $(23,805)$ | $(23,540)$ | (22,936) | $(22,577)$ | $(22,518)$ | $(22,677)$ |
| 10 | $(26,300)$ | (26,817) | (23,631) | $(23,246)$ | $(23,065)$ | $(22,657)$ | $(21,876)$ | ( 21,806 ) | $(22,319)$ |
| 11 | $(25,531)$ | $(26,321)$ | $(23,162)$ | $(22,7 \times)$ | $(22,499)$ | $(21,793)$ | $(21,209)$ | $(21,279)$ | $(21,757)$ |
| 12 | (26,632) | (23, 500) | $(22,773)$ | $(22,107)$ | $(21,753)$ | (21,009) | $(20,795)$ | $(20,875)$ | ) |
| 13 | $(24,093)$ | $(23,195)$ | $(22,297)$ | (21,617) | $(21,057)$ | $(20,655)$ | $(20,500)$ | $(20,487)$ |  |
| 16 | $(23,619)$ | $(22,697)$ | $(21,821)$ | $(21,157)$ | $(20,689)$ | $(20,201)$ | $(20,140)$ | $(20,374)$ |  |
| 15 | (23,09) | $(22,326)$ | $(21,355)$ | $(20,715)$ | $(20,105)$ | $(19,776)$ | $(19,46)$ | $(20.039)$ | 20 |
| 16 | (22,567) | (21,960) | $(20,976)$ | $(20,178)$ | $(19,707)$ | (19,428) | $(19,642)$ | $(19.759)$ | 20 |
| 17 | (22,186) | (21,649) | $(20,578)$ | $(19,783)$ | $(19,340)$ | (19,027) | $(19,370)$ | $(19,546)$ | (19 |
| 18 | (21,861) | $(21,055)$ | $(20,169)$ | $(19,516)$ | $(19,115)$ | ( 18.762 ) | $(19,029)$ | $(19,350)$ |  |
| 19 | $(21,512)$ | $(20,484)$ | $(19,809)$ | $(19,349)$ | $(18,958)$ | $(18,544)$ | $(18,730)$ | $(18,992)$ | $(19,524)$ |
| 20 | (21,042) | $(20,136)$ | $(19,469)$ | $(19,106)$ | $(18,685)$ | $(18,341)$ | $(18,436)$ | $(18,617)$ |  |
| 21 | $(20,587)$ | (19,848) | $(19,121)$ | $(18,671)$ | $(18,617)$ | $(17,912)$ | 18,114) | $(18,53)$ | 13,655) |
| 22 | (20,285) | $(19,601)$ | $(18,701)$ | $(18,366)$ | $(18.089)$ | $(17,592)$ | $(17.790)$ | 17,946) |  |
| 23 | $(19,913)$ | $(19,239)$ | $(18,393)$ | $(16,082)$ | $(17,580)$ | $(17,358)$ | $(17.574)$ | $(17.567)$ | $(17,988)$ |
| 26 | (19,723) | (18,776) | $(18,129)$ | $(17,716)$ | $(17,124)$ | $(17,228)$ | $(17,308)$ | $(17,222)$ | (17.653) |
| 25 | $(19,403)$ | $(18,359)$ | $(17,848)$ | $(17,283)$ | $(16,664)$ | $(16,935)$ | $(17,114)$ | (16,934) |  |
| 26 | $(18,983)$ | $(18,165)$ | $(17,607)$ | $(16,973)$ | $(16,376)$ | $(16,380)$ | $(16,877)$ | $(16,673)$ |  |
| 27 | $(18,670)$ | $(17,953)$ | $(17,161)$ | $(16,580)$ | $(16,096)$ | $(16,051)$ | $(16,462)$ | $(16,450)$ | ) |
| 28 | $(18,467)$ | $(17,728)$ | $(16,746)$ | $(16,164)$ | $(15,823)$ | $(15,882)$ | $(16,055)$ | $(16,137)$ | ) |
| 29 | $(18,199)$ | $(17,472)$ | $(16,619)$ | $(15,910)$ | $(15,472)$ | $(15,636)$ | (15,799) | (15,735) |  |
| 30 | $(17,900)$ | $(17.148)$ | $(16,219)$ | $(15,561)$ | $(15,261)$ | $(15,421)$ | (15 | $(15,480)$ |  |
| 31 | $(17,570)$ | $(16,863)$ | $(15,906)$ | $(15,336)$ | $(14,972)$ | $(15,170)$ | $(15,261)$ | (075) |  |
| 32 | $(17,236)$ | $(16,609)$ | $(15,487)$ | $(15,120)$ | $(16,705)$ | $(14,963)$ | $(16,906)$ | $(14,876)$ | $(15,423)$ |
| 33 | $(16,951)$ | $(16,300)$ | $(15,138)$ | $(14,856)$ | $(16,361)$ | (14,656) | $(16,550)$ | $(14.616)$ | $(15,131)$ |
| 34 | $(16,784)$ | $(16,081)$ | $(14,927)$ | $(14,523)$ | $(16,132)$ | $(16,327)$ | $(14,183)$ | (14,36) |  |
| 35 | $(16,515)$ | $(15,801)$ | $(16,607)$ | $(16,168)$ | $(13,856)$ | $(16,059)$ | $(13,939)$ | $(16,165)$ |  |
| 36 | $(16,192)$ | $(15,553)$ | $(16,293)$ | $(13,902)$ | $(13,583)$ | $(13,694)$ | $(13,573)$ | $(13,862)$ |  |
| 37 | $(15,875)$ | $(15,262)$ | $(16,072)$ | $(13,550)$ | $(13,386)$ | $(13,482)$ | $(13,375)$ | $(13,567)$ | (13,988) |
| 38 | $(15,586)$ | $(14,972)$ | $(13,831)$ | $(13,390)$ | $(13,163)$ | $(13,195)$ | $(13,187)$ | $(13,319)$ | $(13,775)$ |
| 39 | $(15,232)$ | $(16,732)$ | $(13,532)$ | $(13,021)$ | $(12,800)$ | $(12,970)$ | $(12,952)$ | (13,073) | (13, |
| 60 | $(14,923)$ | $(14,485)$ | $(13,300)$ | $(12,629)$ | $(12,481)$ | $(12,652)$ | $(12,679)$ | $(12,858)$ | $(13,290)$ |
| 61 | $(14,663)$ | $(14,198)$ | (12,938) | $(12,425)$ | $(12,286)$ | $(12,387)$ | $(12,388)$ | $(12,636)$ |  |
| 42 | $(16,280)$ | $(13,804)$ | $(12,610)$ | $(12,155)$ | $(11,860)$ | $(12,131)$ | $(12,092)$ | $(12,353)$ | $(12,850)$ |
| 63 | $(16,026)$ | $(13,569)$ | $(12,241)$ | $(11,966)$ | $(11,458)$ | $(11,938)$ | ( 11,904 ) | $(12,150)$ |  |
| 44 | $(13,732)$ | $(13,301)$ | $(12,019)$ | $(11,680)$ | $(11,215)$ | $(11,679)$ | (11,753) | $(11,896)$ | $(12,306)$ |
| 45 | $(13,501)$ | ( 12,983 ) | $(11,836)$ | $(11,469)$ | $(11,010)$ | $(11,385)$ | $(11,488)$ | $(11,702)$ | $(12,093)$ |
| 46 | $(13,179)$ | (12,066) | $(11,676)$ | $(11,220)$ | $(10,682)$ | $(11,102)$ | (11,266) | $(11,539)$ |  |
| 47 | $(12,867)$ | $(12,419)$ | $(11,653)$ | $(10,962)$ | $(10,563)$ | $(10,820)$ | $(11,070)$ | $(11,386)$ | 11, |
| 48 | $(12,492)$ | $(12,138)$ | $(11,167)$ | $(10,630)$ | $(10,372)$ | $(10,523)$ | (10,779) | $(11,098)$ | 11 |
| 69 | $(12,125)$ | $(11,821)$ | $(10,892)$ | $(10,467)$ | $(10,199)$ | $(10,314)$ | $(10,587)$ | $(10,757)$ | (10, |
|  | $(11,871)$ | $(11,663)$ | $(10,667)$ | $(10,260)$ | $(10,020)$ | (10,126) | $(10,360)$ | $(10,576)$ | 10, |
| 51 | (11, 1153$)$ | (11,211) | $(10,462)$ | (9,856) | (9.801) | (9,482) | ( 10.007 ) | $(10,325)$ | 10,46) |
| 52 | $(11,261)$ | $(10,966)$ | $(10,102)$ | $(9,506)$ | (9,402) | $(9,748)$ | $(9,79)$ | $(10.065)$ | 10,256) |
| 53 | $(10,930)$ | $(10,622)$ | $(9.774)$ | $(9,434)$ | $(9,471)$ | $(9,007)$ | $(9,585)$ | $(9,773)$ |  |
| 56 | $(10,768)$ | $(10,326)$ | $(9,572)$ | $(0,327)$ | $(9,272)$ | $(9,385)$ | $(1,357)$ | $(9,593)$ |  |
| 55 | $(10,467)$ | $(10,068)$ | $(9,355)$ | $(9,099)$ | $(3,985)$ | $(9.070)$ | $(9,156)$ | $(9,320)$ |  |
| 56 | $(10,150)$ | $(9,753)$ | $(9,227)$ | $(3,760)$ | $(3,689)$ | $(8,707)$ | $(1,923)$ | $(9,085)$ | $(9,393)$ |
| 57 | $(9,90)$ | $(9,437)$ | (8.957) | $(8,576)$ | (8,457) | (3.355) | (8,580) | $(8,839)$ | (9,238) |
| 58 | $(9,630)$ | $(9,177)$ | (8.069) | ( 8.280$)$ | (8.212) | (8.106) | $(8,230)$ | $(8,613)$ | $(9,028)$ |
| 59 | $(9,323)$ | ( 8,977$)$ | $(8,388)$ | (8.011) | (7,992) | (7,046) | (1,065) | $(8,423)$ | (8,638) |
| 60 | $(9,092)$ | $(8,698)$ | $(8,128)$ | (7.726) | $(7.773)$ | (7.065) | $(7.856)$ | $(8,177)$ | (8,432) |
| 61 | (8,887) | $(8,499)$ | ( 7.848 ) | (7,562) | (7,538) | (7,431) | (7,568) | $(7,875)$ | $(8,276)$ |
| 62 | (8,692) | $(8,328)$ | (7,525) | $(7,270)$ | (7.236) | (7,220) | (7,290) | (7,572) | $(8,055)$ |
| 63 | (8,481) | (18, 162) | $(7,170)$ | (6,986) | $(7,029)$ | $(6,552)$ | (7,057) | $(7,235)$ | $(7,836)$ |
| 65 | $(8,266)$ | $(7,845)$ | $(6,802)$ | $(6,701)$ | $(6,739)$ | $(6,538)$ | $(6,590)$ | $(6,820)$ | $(7.517)$ |
| 65 | (8,026) | $(7,561)$ | $(6,675)$ | $(6,456)$ | $(6,619)$ | $(6,103)$ | $(6,208)$ | $(6,500)$ | $(7,117)$ |
| 66 | $(7.669)$ | (7,229) | $(6,312)$ | $(6,299)$ | $(6,182)$ | $(5,902)$ | $(5,978)$ | $(6,177)$ | $(6,790)$ |
| 67 | (7,485) | (6,980) | ( 5,977$)$ | ( 5,955$)$ | (5,926) | $(5,602)$ | $(5,730)$ | $(5,802)$ | $(6,507)$ |
| ${ }_{6}^{68}$ | (7.261) | $(6,674)$ | $(5,068)$ | (5,687) | (5,326) | (5,289) | $(5,130)$ | (5,483) | $(6,269)$ |
| 69 | $(6,963)$ | $(6,411)$ | $(5,397)$ | $(5,396)$ | $(4,839)$ | $(6,577)$ | $(4,796)$ | $(5,036)$ | (5,908) |
| 70 | $(6,543)$ | $(5,976)$ | $(5,106)$ | $(5,017)$ | $(4,002)$ | (4,557) | $(6,479)$ | ( 4,748$)$ | (5,725) |
| 71 | $(6,176)$ | (5,066) | $(6,806)$ | $(6,731)$ | $(6,318)$ | (6,653) | $(4,290)$ | $(4,547)$ | $(5,411)$ |
| 72 | $(5,922)$ | $(5,522)$ | $(4,625)$ | (4,39) | ( 6,034$)$ | ( 4,123 ) | $(6,121)$ | $(4,264)$ | $(4,970)$ |
| 73 | (5,629) | ( 5,286$)$ | $(6,46)$ | (4,0\%6) | $(3,726)$ | (3,354) | $(3,801)$ | (6,049) | $(6,582)$ |
| 76 | $(5,117)$ | $(4,816)$ | $(6,181)$ | $(3,721)$ | $(3,452)$ | $(3,507)$ | $(3,612)$ | $(3,543)$ | $(4,158)$ |
| 75 | (6,695) | (6, 504) | (3,735) | $(3,613)$ | $(3,166)$ | (3.448) | (3,40) | $(3,552)$ | $(3,854)$ |
| 76 | (6,373) | (6.211) | $(3,417)$ | $(3,131)$ | $(2,02)$ | (3,058) | ( 3,126 ) | $(3,316)$ | $(3,559)$ |
| 78 | (3,945) | (3,476) | (3,096) | $(2,463)$ | $(2,546)$ | (2,745) | (2, 228$)$ | $(3,043)$ | (3,273) |
| 78 | (3,616) | (3,490) | $(2,74)$ | (2,425) | $(2,313)$ | $(2,356)$ | $(2,495)$ | $(2,792)$ | $(3,020)$ |
| 79 | $(3,230)$ | (2,923) | $(2,005)$ | $(2,072)$ | $(1,0 \times 2)$ | (1,745) | $(2,055)$ | $(2,482)$ | $(2,872)$ |
| 80 | $(2,902)$ | $(2,611)$ | $(1,891)$ | $(1,729)$ | $(1,580)$ | (1,46) | $(1,628)$ | $(1,988)$ | $(2,629)$ |
| 81 | $(2,526)$ | $(2,250)$ | $(1,405)$ | (1,382) | $(1,127)$ | $(1,139)$ | $(1,295)$ | $(1,605)$ | $(2,237)$ |
| 82 | $(2,032)$ | (1,851) | $(1,250)$ | (929) | (627) | (695) | (557) | $(1,367)$ | $(1,860)$ |
| 83 | $(1,634)$ | $(1,340)$ | (326) | (610) | (167) | (430) | (581) | $(1,019)$ | $(1,489)$ |
| 85 | $(1,233)$ | $(1,039)$ | (486) | (197) | 187 | (226) | (259) | (724) | $(1,169)$ |
| 85 | (907) | (499) | (78) | 376 | 518 | 206 | 176 | (278) | (852) |
| 86 | (507) | 181 | 377 | 803 | 1.025 | 43 | 641 | 191 | (673) |
| 87 | 92 | ${ }_{6} 15$ | 20 | 1,151 | 1,676 | 1,228 | 1,235 | 714 | 150 |
| 88 | 642 | 1,002 | 1,386 | 1.609 | 1,909 | 1, 209 | 1,656 | 1,150 | 600 |
| 8 | 1,076 | 1,569 | 1,835 | 2,361 | 2,409 | 2,161 | 2,007 | 1.504 | 1,069 |
| 9 | 1,467 | 2,316 | 2,570 | 3,107 | 3,030 | 2,730 | 2,626 | 2,113 | 1,527 |
| 91 | 2,159 | 2,690 | 3,460 | 3,773 | 3,532 | 3,746 | 3,08s | 2,461 | 2,095 |
| 92 | 3,246 | 3,798 | 6,471 | 6,402 | 6,279 | 6.699 | 3,890 | 3,085 | 2,506 |
| 93 | 6.211 | 4.732 | 5,229 | 5,308 | 5,326 | 6,987 | 6,450 | 3,873 | 3,356 |
| 9 | 5,171 | 3.627 | 5,976 | 6.101 | 6,340 | 5,916 | 5,272 | 6,720 | 6,267 |
| 95 | 6,190 | 6,521 | 6,997 | 6,732 | 7,203 | 6,879 | 6,499 | 5,767 | 5,276 |
| 9 | 7.067 | 7.326 | 3,295 | 8,715 | 8,620 | 8,239 | 7,727 | 6.897 | 6,702 |
| 97 | 8.795 | 9.147 | 10.060 | 9.467 | 10,328 | 10.023 | 8,981 | 8,271 | 7,965 |
| 98 | 10,859 | 11,061 | 12,087 | 12.018 | 12,895 | 11,922 | 11,621 | 10,518 | 10,025 |
| 0 | 16,522 | 16,796 | 15,048 | 15,574 | 15,582 | 15,765 | 15,246 | 13,600 | 12,759 |
| 100 | 21,071 | 21,513 | 21,305 | 21,137 | 20,712 | 20,530 | 20,2\% | 19,308 | 18,072 |
| Mean | $(11,689)$ | (11, 140) | $(10,286)$ | $(0,873)$ | $(9,590)$ | (9,566) | $(9,653)$ | $(9,890)$ | $(10,327)$ |
| stoer | 10,928 | 10,767 | 10,570 | 10,363 | 10,232 | 10,013 | 9,564 | 9,609 | 9,522 |


| $\begin{aligned} & \text { Percentile } \\ & \text { No } \end{aligned}$ | 65 | 70 | 73 | 80 | $N C=\left(\operatorname{ma}_{35}\right)$ | \% | es | 100 | 105 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | (22,668) | $(22.020)$ | (20 | (19, | (18,233) | 1) | 17,276) | $(16,692)$ | 5) |
| 2 | $(16,010)$ | $(15,573)$ | $(15,100)$ | $(16,795)$ | $(13,067)$ | $(12,556)$ | $(12,909)$ | ( 12,654$)$ | $(13,253)$ |
| 3 | $(12,787)$ | $(11,409)$ | $(11,485)$ | ( 10,396 ) | ( 9,952 ) | ( 9,683 ) | $(10,045)$ | $(10,583)$ | $(11,285)$ |
|  | $(9,995)$ | $(9,395)$ | ( 8,703 ) | $(8,363)$ | $(8,099)$ | (7,559) | (8,795) | (8, 285 ) | $(9,353)$ |
| 5 | ( 7,961 ) | ( 5,082$)$ | (7.049) | (6.169) | ( 6.620$)$ | ( 5,588$)$ | ( 7.084 ) | ( 7,535 ) | (1.155) |
| , | (6,598) | $(6,816)$ | $(5,601)$ | $(4,046)$ | $(5,396)$ | $(5,207)$ | $(6,140)$ | $(6,013)$ | $(6,785)$ |
| 7 | (5,561) | ( 6,681 ) | $(6.485)$ | $(3,882)$ | $(3,870)$ | $(3,826)$ | $(4,577)$ | $(4,907)$ | $(5,769)$ |
| , | (6.895) | $(6,115)$ | $(3,465)$ | $(3,110)$ | $(2,002)$ | $(3,356)$ | ( 3.695 ) | $(4,080)$ | (4.763) |
| 9 | (4,201) | (3,481) | $(2,425)$ | $(2,552)$ | $(2,106)$ | $(2,502)$ | $(2,577)$ | $(3,167)$ | $(3,817)$ |
| 10 | $(3,209)$ | $(2, \infty)$ | (1,785) | $(1,543)$ | $(1,352)$ | $(1,512)$ | $(1,926)$ | $(2,361)$ | $(3,161)$ |
| 11 | $(2,367)$ | $(1,836)$ | (919) | (703) | (585) | (915) | (1,350) | (1,851) | $(2,735)$ |
| 12 | $(1,533)$ | $(1,175)$ | (146) | 120 | (17) | (312) | (809) | (1,289) | $(2,050)$ |
| 13 | (823) | (410) | 459 | 690 | 559 | 236 | (421) | (726) | (1,492) |
| 16 | 62 | ${ }^{636}$ | 1.300 | 1,366 | 1,176 | 857 | 403 | (33) | (451) |
| 15 | 518 | 1,073 | 1,936 | 2, 107 | 1,682 | 1,2*0 | 1,067 | 237 | (543) |
| 16 | 1,020 | 1.763 | 2, 589 | 2,534 | 2,406 | 1,076 | 1,565 | 855 | (36) |
| 17 | 1.626 | 2,524 | 2,899 | 2,893 | 3,177 | 2,767 | 2,118 | 1,459 | 517 |
| 18 | 2,140 | 2,989 | 3,423 | 3,300 | 3.470 | 3,615 | 2,765 | 2,240 | 1,270 |
| 19 | 2.830 | 3,479 | 3,874 | 4,065 | 3,766 | 3,976 | 3,397 | 2,886 | 1,691 |
| 20 | 3,192 | 3,9\% | 6,436 | 4,677 | 4,386 | 6,697 | 3,855 | 3,290 | 2,623 |
| 21 | 3,490 | 4,401 | 5,081 | 5,151 | 5,375 | 5,123 | 6,274 | 3,703 | 3,018 |
| 22 | 6,107 | 6,911 | 5,509 | 6.096 | 5,997 | 5,625 | 6,765 | 6,167 | 3,268 |
| 23 | 4,981 | 5,285 | 6,213 | 6,530 | 6,586 | 6,017 | 5,207 | 4,558 | 3,637 |
| 26 | 5,338 | 5.662 | 6.600 | 6,929 | 6,970 | 6,569 | 5,859 | 5,009 | 6.107 |
| 25 | 3,839 | 6,058 | 6,946 | 7.167 | 7.195 | 7.057 | 6,368 | 5,44 | 6,361 |
| 26 | 6,331 | 6.476 | 7.356 | 7.500 | 7.391 | 7.275 | 6,662 | 5,885 | 6.766 |
| 27 | 6,744 | 6,981 | 7,751 | 7,866 | 7.649 | 7.655 | 7,077 | 6,344 | 5,117 |
| 28 | 7.068 | 7,426 | 7,981 | 8.185 | 7,572 | 7.699 | 7.382 | 6,646 | 5,6\% |
| 29 | 7.523 | 7,866 | 8,305 | 8,525 | 3,156 | 3,118 | 7,656 | 6,954 | 5,973 |
| 30 | 7.799 | 3,302 | 8.616 | 8.886 | 8,509 | 8.505 | 8,039 | 7.263 | 6,278 |
| 31 | 8.072 | 8,581 | P,067 | 9,268 | 8.957 | 8,481 | 8,627 | 7,600 | 6.681 |
| 32 | 8.360 | 8,997 | 9.295 | 9,536 | , 508 | 9,261 | 8,733 | 8,188 | 7.259 |
| 33 | 8,878 | 9,424 | 9,556 | 1,866 | 9,799 | 9,599 | 8,966 | 8,462 | 7.864 |
| 36 | 9.330 | 9,840 | 10,009 | 10,379 | 10,162 | 9,926 | 9,377 | 3,923 | 8,106 |
| 35 | 9,731 | 10,252 | 10,543 | 10,820 | 10,319 | 10,162 | 9,637 | 9.612 | 8,336 |
| 36 | 10, 172 | 10,599 | 10,932 | 11,304 | 10,825 | 10,471 | 10,000 | 9,740 | 8,530 |
| 37 | 10, 582 | 11,138 | 11, 362 | 11,652 | 11,326 | 10,947 | 10,382 | 9.928 | 8,736 |
| 38 | 10,982 | 11,463 | 11,743 | 12,003 | 11,728 | 11,221 | 10,711 | 10,144 | 9,046 |
| 39 | 11,297 | 11,723 | 12,007 | 12,632 | 12,023 | 11,406 | 11,034 | 10,468 | 9,510 |
| 60 | 11,650 | 12,063 | 12,460 | 12,920 | 12,351 | 11,760 | 11,289 | 10,798 | 9,877 |
| 61 | 12,109 | 12,425 | 12,895 | 13,313 | 12,856 | 12,151 | 11,561 | 11,146 | 10,163 |
| 62 | 12,495 | 12,793 | 13,297 | 13,798 | 13,312 | 12,558 | 12,01 | 11,357 | 10,586 |
| 63 | 12,759 | 13, 175 | 13,772 | 14,060 | 13,652 | 13,207 | 12,006 | 11,733 | 10,980 |
| 46 | 12,985 | 13,467 | 16,082 | 14,500 | 14,098 | 13,597 | 13,011 | 12,127 | 11,359 |
| 45 | 13.629 | 13,913 | 14,534 | 16,862 | 14,340 | 13,934 | 13,661 | 12,557 | 11.658 |
| 46 | 16,012 | 14,340 | 14,974 | 15,261 | 14,539 | 14,272 | 13,778 | 12,856 | 12,010 |
| 47 | 14,580 | 14,673 | 15,350 | 15,534 | 16,923 | 16,555 | 16,000 | 13,186 | 12,308 |
| 48 | 15,039 | 14,975 | 15,761 | 15,899 | 15,381 | 16,941 | 14,234 | 13,516 | 12,541 |
| 69 | 15,653 | 15,432 | 16,268 | 16,352 | 15,607 | 15,334 | 16,615 | 13,839 | 12,805 |
| 50 | 16,096 | 15,877 | 16,693 | 16,657 | 16,140 | 15,813 | 15,070 | 16,259 | 13,292 |
| 51 | 16,467 | 16.441 | 16,934 | 16,063 | ${ }^{16,492}$ | 16,097 | 15,503 | 14,609 | 13,638 |
| 52 | 16,761 | 16,719 | 17,109 | 17,155 | 16,821 | 16,369 | 15,765 | 16,979 | 16,093 |
| 53 | 17.162 | 17,116 | 17,384 | 17.424 | 17,145 | 16,675 |  | 15,222 | 14,462 |
| 58 | 17.420 | 17,571 | 17,849 | 17,835 | 17,518 | 17,006 | 16,462 | 15,646 | 16,772 |
| 55 | 17,788 | 18,011 | 18,268 | 18,237 | 17,902 | 17,358 | 16,829 | 16,196 | 15,101 |
| 56 | 18,150 | 18,232 | 18,613 | 18,675 | 18,370 | 17,676 | 17,168 | 16,670 | 15,433 |
| 57 | 18,381 | 18.508 | 18,901 | 18,757 | 18,773 | 17,967 | 17,625 | 16,788 | 15,850 |
| 58 | 18,760 | 18,743 | 19,221 | 19, 196 | 18,911 | 18,238 | 18,080 | 17.186 | 16,271 |
|  | 19,106 | 19.162 | 19,667 | 19,536 | 19,109 | 18,756 | 18,435 | 17,617 | 16,583 |
| 60 | 19,392 | 19.581 | 20.240 | 19,908 | 19.639 | 19,050 | 18,743 | 17.008 | 16,867 |
| 61 | 19,648 | 19.911 | 20,653 | 20,359 | 19,748 | 19,297 | 19,111 | 17,960 | 17, 153 |
| 62 | 20.036 | 20,349 | 20,981 | 20,703 | 20.082 | 19.657 | 19,286 | 18,387 | 17,521 |
| 63 | 20.655 | 20.682 | 21,288 | 20,938 | 20,569 | 20,140 | 19,635 | 18,875 | 17,772 |
| ${ }_{65}^{6}$ | 20,809 | 21.162 | 21, 808 | 21,636 | 21, 136 | 20,505 | 20,054 | 19,236 | 18,066 |
| 65 | 21,260 | 21,501 | 22, 205 | 21,913 | 21,806 | 20, 885 | 20,616 | 19,647 | 18,265 |
| 66 | 21,826 | 22,039 | 22,863 | 22, 335 | 22, 179 | 21, 505 | 20,775 | 20,070 | 18,720 |
| ${ }_{6}^{67}$ | 22,265 | 22,506 | 23,250 | 22,752 | 22,535 | 21, 888 | 21,248 | 20,413 | 19,195 |
| 68 | 22,598 | 22,896 | 23,606 | 22,962 | 22,909 | 22, 145 | 21,646 | 20,774 | 19,566 |
| 69 | 22,884 | 23,271 | 24.087 | 23,326 | 23,323 | 22.461 | 22, 267 | 21,216 | 19,971 |
| 70 | 23, 222 | 23,636 | 26,529 | 23,981 | 23,621 | 22,760 | 22,687 | 21,610 | 30,345 |
| 71 | 23,953 | 26,278 | 26,853 | 24,308 | 23,976 | 22,935 | 23,095 | 21,900 | 20,661 |
| 72 | 24,665 | 24,781 | 25,324 | 26,566 | 24,253 | 23,265 | 23, 324 | 22, 267 | 21,055 |
| 73 | 25.237 | 25,158 | 25,401 | 25,119 | 26,566 | 23,667 | 23,615 | 22,869 | 21,537 |
| 76 | 25,779 | 25,460 | 25,931 | 25,730 | 26, 265 | 24,254 | 24,001 | 23, 407 | 21,895 |
| 75 | 26,231 | 25,848 | 28,400 | 26,213 | 25,472 | 26,909 | 24,342 | 23,921 | 22,589 |
| 76 | 26, 642 | 26,650 | 26,907 | 26,545 | 25,005 | 25,612 | 26,411 | 26,307 | 23,096 |
| 77 | 27, 270 | ${ }^{27}$ | 27.350 | 27,977 | 26, 111 | 26,064 | 25, 543 | 24,324 | 23,530 |
| 78 | 27,729 28,002 | 27.488 | 27.735 28,353 | 27, 250 | 27.909 | 28,791 | 26,205 | 25,245 | 23,983 |
| 80 | 28,002 | 28,029 | 28,353 28,765 | 28, 252 | 27, 28.078 | 27.338 | 27, 958 | 25,900 | 26,659 |
| 81 | 29,516 | 29,375 | 29,176 | 29,123 | 28,072 28.672 | 23,519 | 27, $7 \%$ | 27,006 | 25,306 |
| 82 | 30,236 | 30.110 | 29.613 | 29.512 | 29, 362 | 20.166 | 28,312 | 27.490 | 27,010 |
| 83 | 30,899 | 30,815 | 30,290 | 30.276 | 30,190 | 29,750 | 29.092 | 27,953 | 27,677 |
| 85 | 31.622 | 31,373 | 31,046 | 31,258 | 30,908 | 30,222 | 30, 152 | 28,753 | 28,210 |
| 85 | 32,316 | 31,767 | 32,061 | 32,089 | 31,892 | 30,691 | 31,036 | 29,949 | 28,977 |
| 86 | 33,032 33,45 | 32,779 | 32,634 | 33,062 | 32,682 | 31,379 | 31,208 | 30,854 | 29,925 |
| 88 | 33,665 36,625 | 35,934 | 33,501 | 33,065 | 33,325 | 32,670 | 32,606 | 31,916 | 30,565 |
| 88 | 34,425 35,196 | 34,512 35,295 | 33,735 | 35,383 | 33,538 | 33,636 | 33, 142 | 32,465 | 31,409 |
| 89 | 35,196 36,266 | 35,295 36,176 | 35,679 | 36,360 | 35,713 | 34,751 | 33,963 | 35,070 | 32,029 |
| 91 | 37,266 | 36, 176 | 36,670 | 37.372 | 36,455 | 36,046 | 34,875 | 33,787 | 32,655 |
| 91 | 37.265 38.595 | 37,151 | 37.662 | 38,410 | 37,540 | 37,180 | 35,864 | 35,166 | 33, 397 |
| 92 | 38,595 | 38.402 | 39,177 | 39,261 | 38,694 | 38.465 | 37,382 | 36,301 | 36,357 |
| 93 | 39,771 | 39,629 | 40.420 | 39,936 | 39,652 | 99,755 | 38,680 | 37,055 | 35,548 |
| 9 | 40, 805 | 40,953 | 41,822 | 61,392 | 41,386 | 61,063 | 39,49\% | 38,590 | 37,217 |
| 95 | 42,363 | 42,754 | 43.409 | 42,994 | 42,769 | 42,322 | 40,948 | 40.072 | 36,882 |
| 97 | 63,713 66.567 | 46,061 66,687 | 44,993 47 178 | 46.919 | 46, 120 | 43,723 | 42.869 | 42,072 | 40,430 |
|  |  | 46,067 51 | 47.178 50.758 | 46,913 | 65,718 | 45.336 | 46,769 | 43,963 | 62,403 |
| 98 | 51,025 | 51,044 | 50,538 | 51,072 | 48,678 | 47,579 | 47,039 | 46,218 | 45,055 |
| $\infty$ | 54,913 | 56, 656 | 54,677 | 54,910 | 53,617 | 52,356 | 50,500 | 49,610 | 48,898 |
| 100 | 64,909 | 65,161 | 63,870 | 66,539 | 63,677 | 62,476 | 61.691 | 59,519 | 58,375 |
| Mesn | 16,556 | 16,807 | 17.296 | 17,608 | 17,081 | 16,661 | 16,128 | 15,395 | 14,389 |
| stoer | 15,686 | 15,676 | 15,295 | 15,153 | 16,845 | 14,656 | 16,536 | 14,313 | 14,165 |



| parcentito | - . 65 | 70 | 73 | $\pm 0$ | $=(6)$ | \% | 4 | 100 | 105 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | $(5,908)$ | $(5,357)$ | $(3,610)$ | $(2,740)$ | (2,546) | (2,779) | (2,768) | (2,585) | 10) |
| 2 | 4.123 | 6,159 | 4,303 | 5,008 | 6,065 | 5,408 | 5,319 | 4.001 | 2,792 |
| 3 | 7,155 | 7,918 | 7.387 | 7,767 | 7,261 | 7.423 | 7.246 | 6,278 | 4,816 |
| 4 | 9,061 | 10,637 | 10,054 | 10, 184 | 9,939 | 9,953 | 6,748 | 1,456 | 7.104 |
| 5 | 11,733 | 11,897 | 11,826 | 12,364 | 12,160 | 11,979 | 11,364 | 10,391 | 3,035 |
| 6 | 13, 282 | 13,486 | 13,765 | 13,760 | 16,006 | 13,576 | 13,075 | 12,493 | 10, 125 |
| 7 | 16,616 | 16,913 | 15,767 | 16,182 | 15,324 | 14,719 | 13, 255 | 13,712 | 11,471 |
| 8 | 15,632 | 16, 197 | 17.330 | 17,676 | 16,725 | 15,541 | 14,756 | 14,421 | 12,679 |
| 9 | 16,283 | 17,240 | 18,657 | 18,836 | 17,997 | 17.179 | 15,830 | 15,485 | 13,980 |
| 10 | 17.492 | 17,848 | 19,598 | 19,734 | 19.153 | 17,711 | 17,106 | 16,726 | 14,976 |
| 11 | 18.196 | 18,849 | 20.497 | 20.490 | 19,789 | 19, 102 | 18,209 | 17,319 | 16,323 |
| 12 | 19,234 | 20,290 | 21,469 | 21, 162 | 20,661 | 20,305 | 19,309 | 18,276 | 17,218 |
| 13 | 20,785 | 21,373 | 22,491 | 22,367 | 21,611 | 21.253 | 20.077 | 19,240 | 18,336 |
| 14 | 22,275 | 22,717 | 23,269 | 23,044 | 22,049 | 21,998 | 20, 200 | 20, 285 | 19.031 |
| 15 | 23,120 | 23,540 | 26,003 | 26,096 | 23,260 | 22,667 | 21,783 | 21,178 | 19,740 |
| 16 | 23,853 | 26,612 | 24,506 | 26.693 | 23,962 | 23,271 | 22.423 | 21,935 | 20,373 |
| 17 | 26,693 | 25,110 | 24,927 | 25, 168 | 26,553 | 26,006 | 23,010 | 22,355 | 20,841 |
| 18 | 25,558 | 25,468 | 25,712 | 25,785 | 25,215 | 26,703 | 23,632 | 22,828 | 21,368 |
| 19 | 26,009 | 26,223 | 26,396 | 26, 210 | 26,159 | 25, 171 | 26,570 | 23,706 | 22,112 |
| 20 | 26.652 | 26,630 | 26,867 | 27,605 | 26,659 | 25,727 | 25,340 | 24,371 | 22,768 |
| 21 | 26,979 | 27, 171 | 27.459 | 27, 289 | 27, 248 | 26,223 | 25,754 | 24,949 | 23, 387 |
| 22 | 27,088 | 27,940 | 28,136 | 27,996 | 27.678 | 26,735 | 26,096 | 25,320 | 23,917 |
| 23 | 28,486 | 28,806 | 28,832 | 28.468 | 23,351 | 27.126 | 26,689 | 25,808 | 24, 167 |
| 26 | 29,089 | 29.618 | 29,040 | 29, 103 | 28,926 | 27,625 | 27,086 | 26,402 | 24,504 |
| 25 | 29,598 | 30,069 | 30,023 | 29.618 | 29,196 | 27,996 | 27.380 | 26,42 | 25,117 |
| 26 | 30,202 | 30,721 | 30,301 | 30,286 | 29,625 | 28,756 | 27.777 | 27,352 | 25,593 |
| 27 | 30,948 | 31,270 | 30,776 | 30,858 | 30.135 | 27.455 | 28.455 | 27,863 | 25,951 |
| 28 | 31,506 | 31,820 | 31,165 | 31,716 | 30,753 | 30,094 | 27.195 | 28,509 | 26,702 |
| 29 | 32,445 | 32,397 | 32,065 | 32,617 | 31,418 | 30,760 | 29,902 | 29,069 | 27,251 |
| 30 | 33,154 | 33,065 | 32,861 | 32,976 | 32,265 | 31,286 | 30,590 | 29.576 | 27,636 |
| 31 | 33,876 | 53,708 | 33,524 | 33,649 | 32,951 | 31,756 | 31,127 | 29,882 | 28, 270 |
| 32 | 34.636 | 36,297 | 34,406 | 34,393 | 33,733 | 32,130 | 31,662 | 30,272 | 28,746 |
| 33 | 35, 212 | 34,915 | 34,913 | 34,738 | 34,276 | 32,879 | 32,086 | 30,928 | 29.311 |
| 34 | 35,563 | 35,552 | 35,612 | 35, 184 | 36,817 | 33,478 | 32,511 | 31,385 | 29,708 |
| 35 | 36,057 | 36,009 | 35,859 | 35,546 | 35,090 | 34,132 | 33,067 | 31,952 | 30,281 |
| 36 | 36,627 | 36,399 | 36,356 | 36,000 | 35,498 | 34,702 | 33,502 | 32,388 | 30,589 |
| 37 | 36,878 | 36,882 | 36,783 | 36,572 | 36,099 | 35,111 | 36,127 | 32,777 | 31.198 |
| 38 | 37,428 | 37,322 | 37.302 | 36,927 | 36,697 | 35,782 | 36,797 | 33,386 | 31,831 |
| 39 | 37,970 | 38,050 | 37.860 | 37,518 | 37,190 | 36,638 | 35,367 | 33,968 | 32,610 |
| 40 | 38.646 | 38,605 | 38,316 | 38, 110 | 37,473 | 37.006 | 35,909 | 34,512 | 33, 116 |
| 61 | 39,079 | 39,033 | 38,811 | 38,519 | 38,078 | 37.465 | 36,485 | 35,061 | 33,561 |
| 62 | 39,817 | 39,691 | 39,256 | 39,152 | 38,573 | 37,988 | 37.021 | 35,628 | 34, 138 |
| 43 | 40,367 | 40, 160 | 40,113 | 39,836 | 39.132 | 38,433 | 37,565 | 35,985 | 34,661 |
| 46 | 41,077 | 40.663 | 40,729 | 40,402 | 39,652 | 38,742 | 37,900 | 36,350 | 35,133 |
| 65 | 41.717 | 61.623 | 41.531 | 41,383 | 40.154 | 39, 176 | 38,157 | 36,718 | 35,588 |
| 46 | 42,313 | 42, 138 | 61,970 | 61,886 | 40,618 | 39,737 | 38,562 | 37,203 | 36,193 |
| 47 | 43,006 | 42,445 | 42,623 | 62,468 | 41,008 | 40,363 | 38,927 | 37.637 | 36,767 |
| 48 | 43,399 | 43,090 | 43,235 | 43, 156 | 61,532 | 40,800 | 39.486 | 38,160 | 37, 270 |
| 69 | 43,816 | 43.652 | 43.856 | 43,712 | 62,062 | 41,006 | 39.973 | 38,538 | 37,618 |
| 50 | 44,398 | 4,315 | 4, 653 | 46.677 | 43,081 | 42,209 | 40.574 | 37.062 | 38,075 |
| 51 | 46,887 | 46, 878 | 45,064 | 44,883 | 43,492 | 42,858 | 41,301 | 39,705 | 34,691 |
| 52 | 45, 171 | 45, 140 | 45,507 | 45,269 | 4,162 | 43,375 | 41,472 | 40,236 | 35,072 |
| 53 | 45,652 | 45,669 | 46,070 | 45,739 | 46,661 | 43,660 | 42,380 | 40,827 | 39,616 |
| 56 | 46,073 | 46,386 | 46,608 | 46, 189 | 65,165 | 44,137 | 42.886 | 41,529 | 40,153 |
| 55 | 66,733 | 46.394 | 47. 109 | 46,703 | 45,637 | 46.679 | 43,491 | 62,018 | 40,620 |
| 56 | 47,329 | 47,362 | 47.576 | 67,196 | 46,055 | 45,123 | 46,025 | 42.446 | 41,212 |
| 57 | 48, 125 | 47,760 | 47,977 | 47,769 | 46,49 | 65,673 | 46.553 | ${ }^{63}, 363$ | 61,76 |
| 58 | 48,625 | 48,229 | 48,629 | 48,501 | 67,185 | 46,238 | 45,363 | 43,79 | 42,315 |
| 59 | 49,122 | 49,047 | 48,981 | 69,350 | 47.711 | 46,723 | 46,001 | 44,096 | 42.765 |
| 60 | 69.838 | 49.687 | 49,408 | 69,658 | 48,182 | 47,233 | 46,634 | 4.681 | 43,375 |
| 61 | 50,409 | 50,059 | 49,852 | 50,213 | 48,615 | 67,482 | 67,259 | 45,319 | 43,709 |
| 62 | 50,858 | 50,711 | 50,575 | 50,750 | 69, 171 | 47,863 | 67,775 | 45,949 | 44,072 |
| 63 | 51,319 | 51,397 | 51,065 | 51,186 | 69,696 | 48,492 | 48,297 | 66,730 | 44,033 |
| 66 | 51,599 | 51,905 | 51,885 | 51,746 | 50,501 | 49,133 | 46,760 | 47.171 | 45,048 |
| 65 | 52,038 | 52,391 | 52,455 | 52, 167 | 51,044 | 69,781 | 69,301 | 67,566 | 45,564 |
| ${ }^{6}$ | 52,611 | 52,932 | 53,030 | 52,571 | 51,461 | 50,316 | 50,073 | 48,089 | 66,277 |
| 67 | 53, 234 | 53,491 | 53,565 | 53, 126 | 51,938 | 51,164 | 50,027 | 48,531 | 47,068 |
| 68 | 53,947 | 54,076 | 54.19 | 53,560 | 52,360 | 51,906 | 51,323 | 69,195 | 67,671 |
| 69 | 54,502 | \$4,518 | 54,742 | 54,156 | 53,250 | 52,386 | 51,799 | 69,706 | 48,775 |
| 70 | 55,360 | 55,202 | 55,095 | 54,655 | 53,705 | 52,762 | 52,381 | 50,234 | 49,032 |
| 71 | 55,936 | 55,926 | 55,536 | 55,209 | 53,992 | 53, 250 | 52,376 | 51.051 | 69,498 |
| 72 | 56,435 | 56,46 | 56,057 | 55,48 | 54,713 | 53,839 | 53,321 | 51,648 | 50,036 |
| 73 | 57,089 | 57,067 | 56,477 | 55,907 | 55,369 | 54,403 | 53,825 | 52,162 | 50,469 |
| 76 | 57.681 | 57,500 | 57.155 | 56,697 | 53,997 | 54,911 | 54,125 | 52,631 | 51,036 |
| 75 | 58,267 | S5,006 | 57.610 | 57,322 | 56,588 | 55,407 | 54,594 | 53.314 | 51,617 |
| 76 | 58.721 | 54,40 | 58,309 | 57.872 | 57.380 | 56,075 | 55,140 | 53, 327 | 52,018 |
| 77 | 59.162 | 59,636 | 59.051 | 58,726 | 57.916 | 56,611 | 55,844 | 56,430 | 52,509 |
| 78 | 59,826 | ¢0,343 | 59,750 | 59,469 | 58,612 | 57,444 | 56,264 | 55,140 | 53,026 |
| 79 | 60, 526 | 60,477 | 60,626 | 54,970 | 55, 134 | 58,208 | 56,730 | 55,592 | 53,43 |
| 80 | 61, 110 | 61,578 | 60.909 | 60,652 | 59,781 | \$8,627 | 57.353 | 56,066 | 54.071 |
| 81 | 61,576 | 61.793 | 61,680 | 61,026 | 40.611 | ${ }^{50} 108$ | 58, 157 | 56, 590 | 56, 642 |
| 82 | 62,083 | 62.157 | 62,062 | 61.489 | 60,663 | 59,563 | 58,047 | 57.321 | 55,435 |
| 83 | 62,069 | 62,797 | 62,620 | 62,085 | 61,497 | ¢0,316 | 59,626 | 57,988 | 56,312 |
| 86 | 63,670 | 63,416 | 63,608 | 63, 172 | 61,842 | * 0 ,909 | +0,027 | 56,828 | 56,903 |
| 85 | 64,976 | 4,006 | *,967 | 64, 160 | 62,219 | 61,645 | ¢0,549 | 59, 717 | 57.667 |
| 86 | 65,850 | 65, 302 | 65,849 | 65,069 | 63, 207 | 62,019 | 61,25s | 60,290 | \$8,202 |
| 87 | 47.012 | 4, 319 | 6, 355 | 6, 148 | 4, 365 | 62, 631 | ${ }^{62}, 043$ | 40, 810 | 59,016 |
| 88 | 68.235 | 67,90 | 67,981 | 67.343 | 45,363 | 63,931 | 63,069 | 61,563 | 59,378 |
| 89 | 69,330 | 69.176 | 68,861 | 68,761 | 4, 327 | 65,009 | 6, 503 | 62,406 | 60,903 |
| 90 | 70,847 | 70.890 | 70,099 | 69,718 | 67,983 | *6,576 | ${ }^{66}, 039$ | 63, 826 | 61,972 |
| 91 | 72,531 | 72,767 | 71,373 | 71,052 | 69.436 | 68,358 | 67.736 | 65, 261 | 63,036 |
| 92 | 73,725 | 73,765 | 72,607 | 72,551 | 71,240 | 69,599 | 68,961 | 66,979 | 64,670 |
| 93 | 74,983 | 76,818 | 76,063 | 73,718 | 72,378 | 71,525 | 70,696 | 68,918 | 65,980 |
| 9 | 76,575 | 76,406 | 75,657 | 74,873 | 74,376 | 73,303 | 72,520 | 69,968 | 67.976 |
| 95 | 79,217 | 74,591 | 78,486 | 77.232 | 76,106 | 74,400 | 73, 871 | 71,539 | 69,650 |
| 9 | 81,603 | 81,393 | 80,969 | 79,976 | 78,600 | 77,331 | 75,619 | 73, 378 | 71,239 |
| 97 | ${ }^{86,575}$ | 83,720 | 83,607 | 83, 208 | 82,283 | 81,498 | 79,071 | 75,710 | 73,575 |
| 98 | 87.739 | 87,256 | 87,678 | 36,707 | 85,323 | 84,463 | 22,975 | 80,198 | 77,520 |
| 9 | 92,736 | 91.258 | 90,883 | 89,969 | 89,581 | 34,021 | 87, 143 | 84, 285 | 81,959 |
| 100 | 101,856 | 100,754 | 99,85 | 98,629 | 97,826 | \%,576 | 95,698 | 92,429 | 89,928 |
| nean | $4.791$ | $4.236$ | $44,836$ | $44,620$ | $63,735$ | $42,819$ | $41.952$ | $40,595$ | $\begin{array}{ll} 38, \% 1 \end{array}$ |
| stDer | 20,573 | $20,297$ | 20,027 | 19,748 | 19.676 | 19,250 | $19,162$ | 18,604 | $18,467$ |



| $\begin{aligned} & \text { percentite } \\ & \text { No } \end{aligned}$ | - 65 | 70 | 75 | $0^{\sim}$ | $\bar{m}=\left(\operatorname{cs}_{8 s}\right)$ | 9 | 93 | 100 | 105 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | $(60,400)$ |  | (37,47) | (35,500) |  | $(33,322)$ |  |  |  |
| 2 | $(36,143)$ | $(35,225)$ | $(33,615)$ | $(33,148)$ | (31,606) | $(30,739)$ | (31,265) | $(30,552)$ | ) |
| 3 | (34, 267) | $(35,435)$ | (31,846) | $(30,973)$ | (30, 179) | $(29,427)$ | (29,435) | $(28,736)$ |  |
| 4 | (32,985) | ( 31,976 ) | $(30,413)$ | $(29,302)$ | $(28,812)$ | $(28,190)$ |  |  |  |
| 5 | $(31,675)$ | $(30,529)$ | $(28,979)$ | $(28,009)$ | (27,690) | $(26,945)$ | $(26,716)$ | $(26,881)$ | $(26,708)$ |
| 6 | $(30,657)$ | (29,282) | $(28,252)$ | $(27,003)$ | $(26,363)$ | $(26,118)$ | $(25,769)$ | (25,757) |  |
| 7 | (29,540) | ( 28,175 ) | (27,260) | $(25,813)$ | ( 25,456 ) | $(25,064)$ | (25,129) | (25,109) | 8) |
| 8 | (28,657) | (27,427) | (26,337) | $(25,158)$ | ( 24,829 ) | $(26,288)$ | $(26,331)$ | (26,193) |  |
| 9 | (27, 841 ) | (26,943) | $(25,655)$ | $(26,791)$ | (24,299) | $(23,762)$ | (23, 786) | (23,488) |  |
| 10 | $(27,041)$ | (26, 336) | ( 24,972$)$ | $(26,363)$ | (23,867) | $(23,332)$ | (23, 356) | $(23,067)$ | 1) |
| 11 | $(26,365)$ | $(25,624)$ | $(24,523)$ | $(23,975)$ | $(23,512)$ | $(22,975)$ | $(22,854)$ | 22,762) |  |
| 12 | (25,858) | $(25,222)$ | $(26,080)$ | (23,450) | (23, 161) | $(22,583)$ | $(22,323)$ | (22,232) | $)$ |
| 13 | (25,399) | ( 24,886 ) | $(23,481)$ | $(23,092)$ | (22,701) | $(22,163)$ | (21,850) | 21,919) |  |
| 16 | $(25,109)$ | (26,496) | (23,006) | $(22,670)$ | (22,117) | $(21,748)$ | $(21,516)$ |  |  |
| 15 | (24,445) | $(23,904)$ | $(22,46)$ | $(22,106)$ | $(21,575)$ | $(21,422)$ | $(21,173)$ | $(21,327)$ | $(21,326)$ |
| 16 | $(26,288)$ | $(23,301)$ | $(22,150)$ | $(21,772)$ | $(21,237)$ | $(21,165)$ | $(20,936)$ | (21,058) | 21 |
| 17 | $(23,872)$ | (22,864) | (21,823) | ( 21,673$)$ | $(20,007)$ | $(20,771)$ | (20,652) | (20,865) | (38) |
| 18 | $(23,164)$ | $(22,475)$ | $(21,614)$ | $(21,094)$ | $(20,390)$ | $(20,393)$ | (20,367) | $(20,604)$ | (20,638) |
| 19 | (22,606) | $(22,150)$ | $(21,031)$ | $(20,589)$ | $(20,016)$ | $(20,01)$ | (20,016) | (20, 287) |  |
| 20 | $(22,201)$ | ( 21,606 ) | $(20,560)$ | $(20,357)$ | $(19,765)$ | $(19,673)$ | $(19,707)$ | $(19,936)$ |  |
| 21 | (21,911) | $(21,315)$ | $(20,286)$ | $(20,022)$ | $(19,396)$ | $(19,619)$ | $(19,326)$ | (19,582) | 2) |
| 22 | $(21,416)$ | ( 21,039 ) | (20,011) | (19,537) | $(19,093)$ | $(19,010)$ | $(19,008)$ | $(19,131)$ | ) |
| 23 | (20,887) | (20,769) | $(19,706)$ | (18, 899 ) | $(18,832)$ | (18.615) | $(18,606)$ | 1) |  |
| 26 | (20, 338$)$ | $(20,473)$ | (19,381) | (18,518) | $(18,333)$ | $(18,20)$ | $(18,058)$ | $(18,402)$ |  |
| 25 | $(20,193)$ | $(20,080)$ | (19,037) | $(18,216)$ | $(18,028)$ | $(17,7 \%)$ | $(17,536)$ | $(18,085)$ |  |
| 26 | $(19,906)$ | $(19,767)$ | $(18,655)$ | (17,829) | $(17,572)$ | $(17,361)$ | $(17,282)$ | $(17,797)$ |  |
| 27 | $(19,685)$ | $(19,448)$ | $(18,236)$ | $(17,577)$ | $(17,139)$ | $(16,966)$ | $(17,010)$ | $(17,633)$ |  |
| 28 | $(19.402)$ | $(19,081)$ | $(17,865)$ | $(17,213)$ | $(16,885)$ | $(16,620)$ | (16,706) | (17,096) | 5) |
| 29 | $(18,893)$ | (18,002) | $(17.518)$ | $(16,901)$ | $(16,513)$ | $(16,365)$ | (16,408) | 2) |  |
| 30 | $(18,530)$ | $(18,056)$ | $(17,017)$ | $(16,631)$ | $(16,180)$ | $(16,016)$ | $(16,023)$ | $(16,333)$ |  |
| 31 | (18,162) | $(17,515)$ | (16,796) | $(16,355)$ | (15,934) | $(15,833)$ | (15,811) | $(16,010)$ |  |
| 32 | (17,654) | $(17,161)$ | $(16,467)$ | $(15,978)$ | $(15,661)$ | $(15,481)$ | (15,530) | 15,591) | $(16,282)$ |
| 33 | $(17,300)$ | (16,869) | $(16,160)$ | $(15,707)$ | $(15,345)$ | $(15,130)$ | $(15,327)$ | $(15,345)$ |  |
| 34 | $(16,909)$ | $(16,571)$ | $(15,866)$ | $(15,451)$ | $(15.156)$ | $(16,782)$ | $(15,107)$ | $(15,075)$ |  |
| 35 | $(16,718)$ | $(16,160)$ | $(15,617)$ | (15,008) | $(14,779)$ | (14,465) | (14,796) | $(14,762)$ | (15 |
| 36 | $(16,483)$ | $(15,919)$ | ( 15.266$)$ | (11,565) | (16.553) | (11, 129) | (16,658) | (14,539) |  |
| 37 | $(16,216)$ | $(15,736)$ | $(16,877)$ | (16, 305) | $(16,134)$ | $(13,767)$ | (16,189) | 375 |  |
| 38 | ( 15,893$)$ | ( 15,537$)$ | (16,595) | $(16,037)$ | $(13,706)$ | $(13,508)$ | (13,816) | (16, 140) |  |
| 39 | $(15,729)$ | $(15,347)$ | $(16,298)$ | $(13,778)$ | $(13,373)$ | $(13,208)$ | $(13,526)$ | $(13,608)$ | 13 |
| 40 | $(15,463)$ | $(15,006)$ | $(13,952)$ | $(13,672)$ | $(13,101)$ | $(12,998)$ | (13, 26 ) | (13.305) |  |
| 41 | $(15,153)$ | $(16.695)$ | (13,735) | $(13,213)$ | (12, 663 ) | $(12,769)$ | (12,908) | (13,049) |  |
| 42 | $(16,766)$ | $(16,296)$ | $(13,436)$ | $(12,912)$ | $(12,655)$ | $(12,529)$ | $(12,462)$ | 12,659) |  |
| 43 | (14,608) | $(13,866)$ | $(13,043)$ | $(12,536)$ | $(12,405)$ | (12,220) | $(12,160)$ | $(12,229)$ | (36) |
|  | $(16,638)$ | $(13,425)$ | $(12,650)$ | $(12,190)$ | $(12,202)$ | $(11,902)$ | $(11,329)$ | $(11,952)$ | (12,556 |
| 65 | (16,000) | $(13,213)$ | (12,316) | (11,970) | $(11,876)$ $(1,44)$ | $(11,657)$ | $(11,482)$ | (11,745) |  |
| 46 | ( 13,782 ) | $(13,010)$ | $(12,092)$ | (11,701) | $(11,446)$ | $(13,271)$ | $(11,236)$ | $(11,453)$ | (89) |
| 47 | $(13,380)$ | $(12,815)$ | $(11,855)$ | $(11,407)$ | $(11,054)$ | $(10,998)$ | $(10,958)$ | $(11,231)$ |  |
| 68 | $(13,159)$ | $(12,636)$ | $(11,584)$ | $(11,107)$ | $(10,716)$ | $(10,753)$ | $(10,692)$ | $(11,073)$ | $(11,570)$ |
| 69 | - (12,858) | $(12,171)$ | $(11,269)$ | $(10,801)$ | $(10,490)$ | $(10,489)$ | $(10,412)$ | (10.893) |  |
| 50 | $(12,483)$ | $(11,831)$ | (11,006) | $(10.590)$ | $(10,306)$ | $(10,268)$ |  |  |  |
| 51 | $(12,168)$ | ( 11,532$)$ | (10,703) | $(10,319)$ | $(9,930)$ | $(10,059)$ | $(10,161)$ | 10,420) |  |
| 52 | (11,773) | $(11,316)$ | $(10,353)$ | $(10,029)$ | $(1,576)$ | $(\mathrm{P}, 750)$ | $(9,862)$ | (10.036) |  |
| 53 | ( 11.454$)$ | $(11,031)$ | $(10,169)$ | (9.7\%) | (9,326) | $(0,420)$ | ( 9.618$)$ | $(9,692)$ | 10 |
| 58 | (11,328) | ( 10,765 ) | ( 9.818 ) | (9.425) | $(8,983)$ |  | $(9,313)$ |  |  |
| 55 | (11,100) | $(10,383)$ | $(5,367)$ | ( 6,992$)$ | $(8,702)$ | ( 6,768$)$ | $(8,970)$ | $(9,181)$ |  |
| 56 | $(10,609)$ | $(10,155)$ | ( 9,062 ) | $(8,772)$ | ( 8,533$)$ | (12.655) | (8,454) | $(8,925)$ |  |
| 57 | $(10.093)$ | (9,0\%) | (8,856) | (8,519) | $(8,2 k 1)$ | (8, 156 | $(8,335)$ | (3,715) |  |
| 58 | $(9,853)$ | ( 9,001 ) | $(8,530)$ | ( 6,196$)$ | (7,94) | (8,005) | $(8,078)$ | (3,477) | $(3,914)$ |
| 59 | (9,533) | $(1,309)$ | (8, 197) | (7,933) | $(7,852)$ | $(7,727)$ |  |  |  |
| 60 | ( 9,310$)$ | ( 8,979$)$ | (7,988) | $(7,540)$ | $(7,560)$ | (7.626) | (7,454) | $(8,016)$ | $(8,426)$ |
| 61 | (9.069) | (1,651) | (7,720) | (7,369) | (7,266) |  |  |  |  |
| 62 | $(8,730)$ | ( 3,293$)$ | (7.441) | (7.173) | $(6,910)$ | (6,896) | $(6,936)$ | (7.202) | (7.928) |
| ${ }^{63}$ | ( 8.322 ) | $(7,930)$ | ( 7.109 ) | (6.767) | ( 6.680 ) | $(6,596)$ | $(6,557)$ | $(6,575)$ | (7,621) |
| 66 | (7.906) | (7.626) | (6,726) | (6.637) | $(6,000)$ | $(6,202)$ | (6,281) | $(6,528)$ | $(7,272)$ |
| 65 | (7, 562) | ( 7.169 ) | $(6,316)$ | ( 6,139 ) | $(5.779)$ | ( 5,882$)$ | $(6,083)$ | $(6,360)$ | (7,032) |
| 67 | $(7,316)$ | $(6,782)$ $(6,626)$ | ( 5.978$)$ | (5,758) | ( 5.465$)$ | $(5,616)$ | $(5,887)$ |  |  |
|  |  |  | $(5.677)$ | (5, 581) | ( 5,005$)$ | $(5,235)$ | ( 5,587$)$ | (5,795) | $(6,571)$ |
| 68 | $(6,756)$ | ( 6.126 ) | ( 5.463 ) | $(5,208)$ | $(6,776)$ | $(6,932)$ | (5,329) | ( 5,455$)$ |  |
| 69 | (6,530) | ( 5,677$)$ | $(5,145)$ | $(6,871)$ | (4,426) | ( 6,087$)$ | $(6,997)$ | ( 5.195$)$ | ( 5,716 ) |
| 70 | ( 6.157$)$ | ( 5,338$)$ |  |  |  |  | $(6,726)$ | (6,997) | $(5,262)$ |
| 71 | (5,565) | (4,880) | $(6,212)$ | (6.406) | (3,552) | (6,040) | $(6,479)$ | ( 6,715 ) | (6,976) |
| $\begin{aligned} & 72 \\ & 73 \end{aligned}$ |  |  |  | $(6,167)$ |  | $(3,671)$ | $(6,169)$ | $(4,396)$ | $(6,723)$ |
| 73 76 | $(4,671)$ $(4,367)$ | $(4,368)$ $(3,776)$ | $(3,631)$ $(3,35)$ | (3,837) | (2,850) | $(3,268)$ | $(3,681)$ |  | $(6,311)$ |
| 76 75 | $(4,367)$ | $(3,776)$ $(3.452)$ | $(3,353)$ $(2,586)$ | $(3,463)$ $(2,985)$ | $(2,558)$ $(2,256)$ | $(2,902)$ $(2,574)$ | $(3,278)$ $(2,974)$ | (3,714) | $(3,848)$ |
| 76 | $(3,637)$ | $(2,927)$ | ( 2,316$)$ | $(2,343)$ | (1,9n2) | $(2,54)$ $(2,198)$ | $(2,974)$ $(2,434)$ | ( 2,944 ) | $(3,573)$ $(3,262)$ |
| 77 | $(3,347)$ | (2,4 4 ( ${ }^{(1)}$ | ( 2,018$)$ | $(1,0 \times 4)$ | $(1,773)$ | (1,953) | $(1,977)$ | $(2,032)$ | (2,835) |
| 78 | $(2,839)$ $(2,387)$ | (2,131) | $(1,606)$ $(156)$ | (1,450) | $(1,346)$ | (1,42) | (1, 673) | $(2,010)$ | $(2,467)$ |
| 79 | (2,387) | (1,646) |  | $(1,0 \infty)$ |  | $(1,226)$ | $(1,167)$ | $(1,478)$ | (2,111) |
| 80 | $(2,036)$ $(1,592)$ | $(1,304)$ | $(710)$ $(325)$ | (680) | (515) | (401) | (755) | $(1,174)$ | (1,715) |
| 81 |  |  | (325) | (269) | (108) | (2+5) | (317) | (591) | $(1,377)$ |
| 82 83 | $(1,263)$ $(202)$ | $(761)$ $(329)$ | 160 06 | 267 | 573 | 138 | 300 | (214) | (1,038) |
| 83 86 | (302) | (329) | 408 | 759 | 752 | 63 | 735 | (6) | (576) |
| 88 | (356) | 402 | 1,056 | 1,223 | 1.131 | 1,079 | 1,170 | 438 | (225) |
| 85 36 | 277 | 1,000 | 1,699 | 1.876 | 1,612 | 1,430 | 1.621 | 990 | 138 |
| 86 87 | 937 | 1,533 | 2,666 | 2,546 | 2.056 | 1,935 | 2,157 | 1,671 | 89 |
| 87 | 1.896 2,423 | 2,655 | 3.138 3.655 | 3,046 | 2,562 | 2,946 | 2,689 | 2,310 | , 331 |
| 38 | 2.423 | 2,985 | 3.655 | 3,726 | 3,276 | 2,991 | 3,306 | 2,791 | 1,879 |
| 30 | 3,067 | 3.767 | 4,050 | 4,390 | 3,902 | 3,728 | 3,909 | 3,346 | 2,587 |
| 90 | 6.121 | 6, 564 | 6,690 | 5.164 | 6.615 | 6,313 | 4,625 | 4,042 | 3,371 |
| 91 | 4,802 | 5,109 | 5,396 | 5,771 | 5,412 | 5,310 | 3, 314 | 4,677 | 6,166 |
| 92 93 | 3,540 | 5,771 | \%.188 | 6.531 | 6.332 | 6,171 | 6,019 | 5,369 | 4,926 |
| 93 9 | 6,517 8,266 | 7,056 | 7.167 | 7.886 | 7.621 8.927 | 7,262 8,113 | 6,705 $\mathbf{7}, 876$ | 6,360 | 5,727 |
| 95 | 10, 131 | 9,651 | 10,096 | 10,075 | 10,111 | 9,807 | 9.256 | 8,606 | 7,829 |
| 9 | 11,386 | 11, 293 | 11.693 | 11,216 | 11,406 | 11,030 | 10, 002 | 10, 121 | 0.113 |
| 97 | 12,600 | 13,322 | 16,025 | 13.659 | 13,348 | 12,805 | 12, 238 | 11,575 | 10,364 |
| 98 | 14,195 | 14,765 | 15.913 | 15,750 | 16,321 | 14,403 | 13,742 | 12,761 | 12,229 |
| 10 | 16,616 23,150 | 16,876 22 | 17.399 | 17.601 | 16,940 | 16,408 | 16,692 | 15,659 | 15,452 |
| 100 | 23,150 | 22,752 | 22,456 | 22,572 | 22,370 | 21,964 | 21,089 | 20,607 | 19,652 |
| Nemm | (11,677) | $(11.121)$ | $(10,248)$ | $(9,873)$ | $(9,585)$ | (9,554) |  |  |  |
| Stoer | 12,214 | 12,066 | 11,791 | 11,521 | 11,276 | 11,016 | $10,912$ | $10,705$ | $10,500$ |


| $\qquad$ | 65 | 70 | 73 | $0^{\prime \prime}$ |  | $\bigcirc$ | * 5 | 100 | 105 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |




| Percentile <br> No | - 65 | 70 | 73 |  | $\overline{\omega c}=\left(\sin _{s}\right)$ | 90 | 4 | 100 | 105 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | (7,999) | $(7,063)$ | (5,793) | (6,564) | (4,469) | $(6,028)$ | $(5,372)$ | ( 6,262 ) | 71 |
| 2 | 1,765 | 3,311 | 2,955 | 3,528 | 3,391 | 3,965 | 2.722 | 2.783 | 1,582 |
| 3 | 5,420 | 6,035 | 6,583 | 6,736 | 7,801 | 7,716 | 6,190 | 6,282 | 5,347 |
| 6 | 8,546 | 8,523 | 9,507 | 9.030 | 562 | 10,162 | , 265 | 8,416 | 7,400 |
| 5 | 10,665 | 10,965 | 11,279 | 11,506 | 11,272 | 12,083 | 10,821 | 9,926 | 9,401 |
| 6 | 12,378 | 13,354 | 13,422 | 13,837 | 13, 132 | 13, 188 | 12,086 | 11,679 | 10,002 |
| 7 | 13,938 | 16,063 | 16.891 | 15,271 | 14,268 | 16,505 | . 13,216 | 12,386 | 11,396 |
| 8 | 15,169 | 15,866 | 16,240 | 16,567 | 15,716 | 15,665 | 14,400 | 13,738 | 12,482 |
| , | 16,188 | 17,239 | 17,586 | 17,936 | 17,081 | 16,437 | 15,355 | 14,721 | 13,588 |
| 10 | 17.261 | 18,64 | 18,332 | 19,115 | 18,221 | 17,300 | 16,361 | 15,972 | 14.639 |
| 11 | 18,548 | 19,635 | 19.730 | 19,942 | 19,276 | 17,999 | 17,588 | 17,185 | 15,906 |
| 12 | 19,482 | 20,217 | 20,736 | 20.459 | 19,991 | 19,020 | 13,2\% | 17,951 | 17,028 |
| 13 | 20,290 | 20.654 | 21,579 | 21,34 | 20,605 | 20,319 | 19,236 | 18,5\%1 | 17,840 |
| 15 | 21,362 | 21,509 | 22,556 | 22,092 | 21,232 | 21,108 | 20,256 | 19, 181 | 18,534 |
| 15 | 22,373 | 22, 005 | 23, 240 | 23, 118 | 22,489 | 22,061 | 21,037 | 19,43 | 19,123 |
| 16 | 23,725 | 23,699 | 23,775 | 23,699 | 22,993 | 22,802 | 21,606 | 20,632 | 19,791 |
| 17 | 26,361 | 24,370 | 24,587 | 26,369 | 23,706 | 23,458 | 22,376 | 21,002 | 20,239 |
| 18 | 25,076 | 26,925 | 25,149 | 25,155 | 24,361 | 23,908 | 23,154 | 21,610 | 20,792 |
| 19 | 25,767 | 25,553 | 25,748 | 26.192 | 24,962 | 26,673 | 23,955 | 22,453 | 21,226 |
| 20 | 26,301 | 26,032 | 27.468 | 26,830 | 25,587 | 25,506 | 26,452 | 23, 141 | 21,832 |
| 21 | 26,907 | 26,827 | 27.189 | 27.355 | 26,158 | 26,098 | 25,092 | 23.784 | 22,648 |
| 22 | 27,563 | 27.816 | 27.740 | 27,998 | 26,714 | 26,645 | 25,73 | 24,701 | 23, 206 |
| 23 | 28,225 | 28,455 | 28,369 | 28,583 | 27,669 | 27,221 | 26,256 | 25,392 | 23,853 |
| 26 | 28,823 | 29,027 | 29,139 | 29,399 | 28,287 | 27,851 | 2\%,736 | 25,808 | 26,711 |
| 25 | 29,682 | 29,673 | 30,075 | 29,936 | 23,713 | 28,560 | 27,166 | 26,319 | 25,167 |
| 26 | 30,303 | 30,099 | 30,606 | 30,552 | 29,101 | 28,820 | 27.570 | 27, 120 | 25,548 |
| 27 | 30,765 | 30,546 | 31, 170 | 31,246 | 29,898 | 29.165 | 27,904 | 27.76 | 25,933 |
| 28 | 30,986 | 31,020 | 31,928 | 31,864 | 30,618 | 29.715 | 28,532 | 28, 133 | 26, 281 |
| 29 | 31,582 | 31,441 | 32,467 | 32,238 | 31,121 | 30,300 | 29,071 | 28,539 | 26,868 |
| 30 | 32,278 | 32.081 | 32,945 | 32,860 | 31,703 | 30,668 | 29,544 | 29,016 | 27,600 |
| 31 | 32,650 | 32,810 | 33,651 | 35,326 | 32,281 | 31,057 | 30,195 | 29,457 | 28,228 |
| 32 | 33,076 | 33, 263 | 34, 103 | 33,662 | 32,769 | 31,732 | 30,872 | 29,822 | 23,661 |
| 33 | 33,573 | 33,763 | 34,587 | 33,996 | 33,515 | 32,362 | 31,625 | 30,327 | 29,039 |
| 36 | 36,389 | 34,554 | 36,918 | 34,7\% | 34,014 | 32,982 | 32,208 | 30,900 | 29,642 |
| 35 | 35,096 | 35,106 | 35,283 | 35,361 | 34,636 | 33,628 | 32,811 | 31,596 | 30,131 |
| 36 | 35,701 | 35,748 | 35,817 | 35,783 | 35,118 | 34,113 | 33,43 | 31,885 | 30,586 |
| 37 | 36,276 | 36,09 | 36,121 | 36,065 | 35,736 | 34,678 | 36,041 | 32,502 | 31,209 |
| 38 | 36,680 | 36,612 | 36,695 | 36,368 | 36,129 | 35,361 | 34,569 | 33,002 | 31,653 |
| 39 | 37. 185 | 36,909 | 37.518 | 37.055 | 36,328 | 35,787 | 35, 135 | 33,731 | 32,186 |
| 60 | 37.634 | 37,689 | 38,032 | 37.501 | 37,053 | 36,211 | 35,521 | 36,466 | 32,967 |
| 61 | 38,219 | 38,159 | 38,737 | 38,069 | 37,683 | 36,890 | 36,068 | 34,941 | 33,432 |
| 42 | 38.691 | 38,775 | 39, 124 | 38,706 | 57,838 | 37,612 | 36,535 | 35,363 | 33,741 |
| 43 | 39,362 | 39,183 | 39,589 | 39,238 | 38,374 | 37,87 | 36,969 | 35,677 | 36,285 |
| 4 | 39,923 | 39,753 | 40,093 | 39,904 | 39,064 | 38, 195 | 57.480 | 35,994 | 36,649 |
| 65 | 40,452 | 40,654 | 40,561 | 40,693 | 39,913 | 38,775 | 37.892 | 36,378 | 35,012 |
| 46 | 40,886 | 40.842 | 41,277 | 41,271 | 40,646 | 39,135 | 38,351 | 36,934 | 35,388 |
| 47 | 61,697 | 41,366 | 61,987 | 61,885 | 41,096 | 39,665 | 38,726 | 37,311 | 35,963 |
| 48 | 42,256 | 42,219 | 42,509 | 42,365 | 41.489 | 40,612 | 39,230 | 37,878 | 36,321 |
| 49 | 62,780 | 42,875 | 43,016 | 42,780 | 61,953 | +0,956 | 34,929 | 30,593 | 36,758 |
| so | 43,235 | 43,543 | 43.617 | 43, 103 | 42,314 | 41,374 | 40.671 | 38,976 | 37, 149 |
| 51 | 63,764 | 44,077 | 43,689 | 43,636 | 42,956 | 42,027 | 61,219 | 39,387 | 37,598 |
| 52 | 44.409 | 44,564 | 44,379 | 46,050 | 43,402 | 42,462 | 61,400 | 39,712 | 38, 272 |
| 53 | 45,355 | 44,947 | 45,096 | 4,628 | 4,037 | 42,74 | 42,268 | 40,109 | 38,609 |
| 54 | 45,919 | 45,386 | 45,235 | 45,066 | 46,360 | 43,239 | 42,714 | 40,665 | 39,066 |
| 55 | 46,431 | 65,958 | 46,080 | 45,759 | 44,675 | 43,900 | 43.006 | 40,970 | 39,43 |
| 56 | 47,097 | 46.624 | 46,717 | 46,532 | 45, 122 | 44.293 | 43,300 | 41,369 | 39,755 |
| 57 | 67.411 | 47,082 | 47.283 | 46,971 | 45,574 | 4, 7005 | 43,610 | 41,829 | 40,388 |
| 58 | 47.85 | 47.535 | 47,729 | 47,546 | 45,960 | 45,089 | 44,035 | 42.641 | 40,726 |
| 59 | 48, 325 | 4,030 | 48.280 | 47.921 | 46,430 | 45,729 | 4, 500 | 43, 135 | 41.463 |
| 60 | 48,960 | 48.854 | 48.813 | 48,240 | 47.153 | 46,263 | 4,945 | 43,766 | 41,903 |
| 61 | 49.508 | 49,533 | 49,321 | 48,665 | 47,729 | 46, 824 | 65,431 | 46,256 | 42,375 |
| 62 | 49,967 | 50,017 | 49,613 | 69,159 | 48,213 | 47,383 | 46,392 | 44,804 | 42,960 |
| 63 | 50,616 | 50,753 | 50, 130 | 49,766 | 48,877 | 48,058 | 4,994 | 45,373 | 43,508 |
| 66 65 | 51,288 | 51,206 | 50,605 | 50,365 | 49.425 | 48,709 | 47.427 | 45,759 | 46,198 |
| 65 | 51,857 | 51,677 | 51.115 | 50,860 | 49,987 | 49,385 | 48,007 | 46,096 | 46,959 |
| 66 | 52,616 | 52,149 | 51,560 | 51.629 | 50,906 | 49,853 | 48,532 | 46,702 | 45,575 |
| 67 | 52,966 | 52,446 | 51,996 | 52,002 | 51,639 | 50,485 | 69, 108 | 47.438 | 46,299 |
| 68 | 53,559 | 53, 326 | 52,455 | 52,569 | 52,291 | 50,935 | 69.958 | 48,089 | 46,887 |
| 69 | 56,063 | 54,056 | 53, 135 | 53,018 | 52.888 | 51,432 | 50,500 | 48.878 | 47.405 |
| 70 | 56,665 | 54, 4.47 | 53, 719 | 53.648 | 53,317 | 52,488 | 50,969 | 49.452 | 48,085 |
| 71 | 55,232 | 55, 216 | 54,723 | 55,460 | 53, 826 | 53.080 | 51,299 | 49,919 | 48,558 |
| 72 | 55,570 | 55,678 | 55,698 | 55,266 | 54, 226 | 53, 35 | 51,764 | 50,566 | 49.085 |
| 73 | 56,055 | 56, 215 | 56,621 | 55,863 | 56,772 | 54,087 | 52, 326 | 51,032 | 49,582 |
| 76 | 56,505 | 56,749 | 56.999 | 56,509 | 55,417 | 54,685 | 52,486 | 51,362 | 50,009 |
| 75 | 57.153 | 57.200 | 57.715 | 57.093 | 55,940 | 55,207 | 53, 362 | 52,223 | 50,480 |
| 76 | 58, 293 | 58.092 | 58,222 | 57,591 | 56,791 | 55,732 | 53,949 | 32,7\% | 51,126 |
| 77 | 59.138 | 54,927 | 59.026 | 58.500 | 57, 509 | 56, 287 | 54, 826 | 53.484 | 51,976 |
| 78 | 50, 006 | 59.772 | ${ }^{\infty} 0.016$ | 59.048 | 58,076 | 56,762 | 55,355 | \$5,296 | 52, 802 |
| 79 | 60.465 | 60,902 | 60,685 | 60, 182 | 58,934 | 57,550 | 55,943 | 55,213 | 53,706 |
| 80 | 61.727 | 61,907 | 61,406 | 61,027 | 59,912 | 58,348 | 56,523 | 55,847 | 54,192 |
| 81 | 63, 279 | 42, 878 | 62,335 | 61,765 | 61,069 | 59.151 | 57,377 | 56,408 | 54,593 |
| 82 | 64,251 | 63, 352 | 63, 197 | 62,511 | 61.773 | 59, 805 | 84, 105 | 57,021 | 55,035 |
| 83 | 65, 210 | 66,990 | 4, 061 | 63,577 | 62, 193 | 61,050 | 59.151 | 57,930 | 55,765 |
| 8 | 66, 228 | 65,931 | 65,031 | ${ }^{64} .805$ | 62,671 | 62,079 | 59,963 | 54,703 | 56, 596 |
| 85 | 67. 195 | 67,118 | 65,632 6563 | 66, 110 | 63,636 | 62,838 | 61,076 | 59.397 | 57.723 |
| 86 | 68, 104 | 67, 858 | 66,763 | ${ }_{6}^{6}, 991$ | M, 0.02 | 63,630 | 62.193 | ${ }^{40,976}$ | 58,75 |
| 87 | 68,811 | 68, 831 | 67,997 | 67,948 | 65,590 | 60,570 | 63, 142 | 62, 296 | 59,745 |
| 88 | 70,014 | 60,950 | 64,308 | 68,966 | 6, 69 | 65,988 | 64, 46 | 63,376 | 61, 173 |
| 89 | 71, 272 | 70, 115 | 70,581 | 70.036 | 67.781 | 67.481 | 65,755 | 64,760 | 62,393 |
| 90 | 72,276 | 72.123 | 71,503 | 70,740 | 88, 857 | 68.771 | 67,425 | ${ }^{66}, 081$ | 64, 257 |
| 91 | 73,200 | 73,093 | 72,366 | 72,018 | 70,088 | 69,813 | 68,74 | 67,541 | 65,658 |
| 92 | 74,606 | 75,008 | 73,935 75 | 73,551 | 71.687 | 71, 262 | 69, 825 | 68, 162 | 66,718 |
| 93 | 76,480 | 76.885 78.503 | 75.676 77 | 76.966 | 76.086 | 72,940 | 71, 14. | ${ }^{69} .176$ | 67.977 |
|  | 78,400 | 78,503 | 77.535 | 76,500 | 75,720 | 74,513 | 73, 343 | 71,169 | 69, 170 |
| 95 | 80,600 | 60,74 | 79.358 | 78,4\% | 77.218 | 76,047 | 74,997 | 72,692 | 71,092 |
| 96 | 82,591 | 82,054 | 81,277 | 80.008 | 79,046 | 77.971 | 76,640 | 76,584 | 72,944 |
| 97 | 86,918 | 4,951 | 83,986 | 82.461 | 81,459 | 80,610 | 79,017 | 77,666 | 73,093 |
| 98 | 88,365 | ${ }^{35}, 048$ | 83, 275 | 86,956 | 86,902 | 83, 311 | 12,281 | 20,990 | 79,416 |
| 9 | 93.467 | 9,405 | 93, 809 | 92,906 | 91,512 | 90.118 | 86,946 | 87.983 | 87,049 |
| 100 | 117,467 | 116,659 | 115,819 | 115,232 | 113,569 | 111,913 | 110,497 | 107,712 | 105,545 |
| mean | 46.704 | 44,759 | 44.738 | 46.699 | 43.533 | 42.752 | 61.602 | 40,367 | 38,888 |
| stoer | 21,658 | 21,461 | 21,050 | 20,757 | 20,465 | 20,191 | 19,941 | 19,055 | 19,621 |



| percentile <br> No | 65 | 70 | 75 | 20 | ne (m) |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |


|  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $(31,220)$ |  |  | 3) |  |  |  |  |
|  | (29,746) | $(28,320)$ |  | (2) |  |  |  |  |  |
|  | $(28,203)$ | (27,400) | $(26,483)$ | (25,588) | (25,043) | (26,345) | (26, 257 | (24,086 |  |
|  |  |  |  |  |  |  |  |  |  |
|  | $(26,363)$ | $(25,666)$ | $(26,429)$ | $(23,587)$ | $(22,906)$ | $(22,085)$ | ( 22,638 | 19 |  |
|  | (25,668) |  |  | $(22,643)$ |  |  |  | 5) |  |
|  | $(25,298)$ | $(26,535)$ | $(23,014)$ | $(21,951)$ | $(21,576)$ | $(20,766)$ | $(20,937)$ |  |  |
| , | $(26,865)$ | $(23,880)$ | $(22,212)$ | (21 |  |  |  |  |  |
|  | $(26,232)$ | $(23,179)$ |  |  |  |  |  |  |  |
| 11 | $(23,488)$ | $(22,678)$ | $(21,408)$ | $(20,370)$ |  | (19,348 |  |  |  |
| 2 | (22 |  |  |  | $(19,326)$ | $(19,032)$ |  |  |  |
| 3 | $(22,003)$ | (21 |  |  | $(19,032)$ | (18,753) | $(16,656)$ |  |  |
| 16 | $(22,172)$ |  | (20 | $(19,160)$ |  |  |  |  |  |
|  | $(21,757)$ | $(20,851)$ |  |  | $(18,617)$ | (13,184) | $(18,203)$ |  |  |
| 16 | $(21,328)$ | (20 | $(19,161)$ |  | (18 | (17 | (1) 051 | (18,111 |  |
|  | $(20,882)$ |  |  |  |  |  |  |  |  |
| 8 | $(20,404)$ | $(19,737)$ |  | $(18,006)$ | $(17,584)$ | $(17,543$ |  | $(17,627)$ |  |
| 9 | $(20,028)$ |  | 46) | $(17,743)$ | (17 | (17,332 | 17) |  |  |
|  | $(19,565)$ | $(19,169)$ | $(18,003)$ | $(17,388)$ | $(16,922)$ | $(17,127)$ |  | 223) |  |
| 21 | $(19,163)$ | $(18,825)$ | $(17,765)$ | $(17,081)$ | $(16,738)$ | (16 |  | 22) |  |
| 2 | (18) |  |  |  | (16 | $(16.628)$ |  |  |  |
| 23 | (18,616) | $(18,122)$ | $(17,106)$ | (16) | $(16,28)$ | $(16,419)$ | (16,463) | 33) |  |
| 5 | $(18,388)$ | $(17,832)$ |  |  |  |  |  |  |  |
|  | $(18,178)$ | $(17,647)$ | $(16,506)$ | (15,986) | (15,788) | $(15,885)$ | (16 | $(16,191)$ |  |
| 26 | (17.930) | $(17,369)$ | $(16,265)$ | (15 | $(15,61$ | $(15,665$ | (15,953 |  |  |
| 27 | (17 721 | (17 |  |  | (15 | $(15,628)$ |  |  |  |
| 28 | (17,511) | $(16,867$ | $(15,816)$ | (15 | (15 | (15,093) | (15,465 | (15. |  |
| 29 | (17,146) | (16,559 | $(15,580)$ | (15 | (14,986) | (14, 821 | $(15,120)$ | (1) |  |
|  | $(16,903)$ | $(16,322)$ | $(15,372)$ | (16 | (14,741) | (16,571) | (16,849) |  |  |
| 31 | $(16,579)$ | (16 | (15 | (4) | (14) | (16,35 |  |  |  |
|  | $(16,287)$ | $(15,805)$ | $(16,865)$ | $(16.471$ | (14, 385 | $(16,018$ | (1) | $(14,374)$ |  |
| $33$ | $(16,024)$ | $(15,583)$ | $(16,682)$ | $(16,265)$ | $(14,162)$ | $(13,835)$ | $(14,113)$ |  |  |
|  | $(15,756)$ | $(15,365)$ | (16, 522 | (14,056 | $(13,774$ | $(13,623)$ | $(13,85)$ |  |  |
| 35 | $(15,621)$ | (15,037) | $(14,390)$ | $(13,875)$ | (13,560) | $(13,451)$ | $(13,656)$ | $(13,719)$ |  |
|  | $(15,480)$ | $(14,825)$ |  | (13.046) | (13,365) | (13,281) |  |  |  |
|  | 228) | $(16,621)$ | $(13,968)$ | (13,435 | $(13,195)$ | $(13,082)$ | $(13,136)$ | 272 |  |
| $38$ | $(14,969)$ | $(16.412)$ | (13 | (13,232 | (12 |  |  |  |  |
|  | 736) | (4, 276) | $(13,426)$ |  | (12,727) | $(12,76$ |  |  |  |
| 6 | $(14,516)$ | $(14,122)$ | $(13,195)$ | $(12,810)$ | $(12,530)$ | $(12,467)$ | $(12,502)$ | 52) |  |
| 1 | $(16,317)$ | $(13,875)$ | $(12,926)$ | $(12,573)$ | $(12,275)$ | $(12,173)$ |  | 28) |  |
|  | $(16,153)$ | $(13,631)$ |  | $(12,633)$ | $(12,097)$ | (11.925) |  |  |  |
| 63 | $(13,980)$ | $(13,621)$ | $(12,416)$ | $(12,263)$ | $(11,903)$ | $(11,708)$ | 21) | 26) |  |
|  | $(13,688)$ | 206) | 160 |  |  | $(11,649)$ | $(11,317)$ |  |  |
| $65$ | $(13,353)$ | $(12,990)$ | $(11,899)$ | $(11,589)$ | $(11,412)$ | $(11,299)$ | $(11,118)$ |  |  |
|  | (13,085 | $(12,655)$ | $(11,562)$ | $(11,44)$ | (11,131 | (11,086) | $(10,936)$ | ) |  |
| 6 | $(12,95)$ | $(12,362)$ | $(11,354)$ | $(11,227)$ | $(10,961)$ | (10 |  |  |  |
| 48 | $(12,736)$ | $(12,116)$ | $(11,051)$ | $(10,933)$ | $(10,659)$ | (10 |  |  |  |
|  |  | 876) | 4s) | 10,679) |  | (10, |  |  |  |
| 5 | $(12,175)$ | $(11,546)$ | $(10,695)$ | $(10,502)$ | $(10,061)$ | $(10,087$ | $(0,836)$ | 5) |  |
|  | (11,839) | $(11,320)$ | $(10,529)$ | $(10,336)$ | $(9,785)$ | (9, |  |  |  |
| 32 | (11,595) | 156) |  | (10, 151 |  |  | 15) |  |  |
| 53 | (11,336) | $(10,943)$ | $(10,112)$ | $(9,926)$ | $(9,410)$ |  |  |  |  |
|  |  | 687) |  |  |  |  | ,0056) |  |  |
|  | (11,072) | (10,654) | (9,501) | (9,400 |  |  |  | 23) | 02) |
|  |  |  |  |  |  |  |  |  |  |
| $57$ | (10,768) | $(9,987)$ | (9,238) | (3,934 | (8,54 | (1,632 |  |  |  |
|  | ( 90.462$)$ | $(9,775)$ | $(9,031)$ |  |  | (132) |  |  |  |
|  |  |  |  |  |  | 226) |  |  |  |
|  |  |  |  | 176 |  |  |  |  |  |
|  |  |  |  |  |  | (7,915 | 13) |  |  |
| 62 | (9,390) | $(9,028)$ | $(8.127)$ | 783 | (7,699) | (7,806) | 65) | (7,922) | 95) |
|  |  |  | 990) | (133) | (7,473 | 627 |  |  | 226) |
|  | $(9.016)$ | $(8.600)$ | 792) | 332 | $(7,203$ | 30 | (7,354) |  |  |
|  | ( 8,810$)$ | $(8,365)$ | 51) | $(7,146)$ | (6,968 | 197) | (7, 183 |  | 26) |
|  | 588) |  |  |  |  |  |  |  |  |
|  | 305) | 11 | 170) | 43 | $(6$ | (6,879 | ,761 | 58 |  |
|  |  |  |  |  |  | 59 | 35 |  |  |
| $59$ | 819) | 438) | 325 | 526 | (6,199) | $(6,230$ | 13) | 519 | 85) |
|  | (23) | 227 | \% | $(6,253$ | $(5,851$ | (6,068) | (195) |  | 95) |
| 1 | 356) | (7,055) |  |  | 646 |  | 876 | (1) |  |
| $12$ | 182) | $(6,913)$ | 222) |  | 405 | 552 | 53 | *1) | 287) |
|  |  | (09) | 016) |  |  |  |  |  |  |
|  | ( 0,561 ) | $(6,409)$ | (5,689) | 46 | $(4,874)$ | (4,9095 | (5,056 | (5,394 | 47) |
|  | $(6,344)$ | $(6,123)$ | $(5,321$ | 14 | (4) | ( 4,730 | (1) | $(5,022)$ | (5,296) |
|  | ( 6,077 ) | $(5,846)$ | 236) |  |  |  |  |  |  |
|  | (5,40) | $(5,500)$ | $(4,655)$ | (6,455 | (, | $(6,173$ | (4,194) | 4,533 | 3*) |
|  |  | 195) | ,257) |  |  |  |  | , |  |
| 9 | $(5,286)$ | $(6,760)$ | $(3,977)$ | (3, 235 | (3,54 | (3,572 | $(3,45)$ | (1) | 29) |
| $30$ | $(5,032)$ | $(4,245)$ | $(3,45)$ | $(3,444)$ | (3,205 | (3,231 | $(3,112)$ | (761) | 13) |
| $11$ | (6,658) | (3, 806 ) | $(3,076)$ | 911 | (2,668) | (2,912 | 933) | $(3,328)$ |  |
| 2 | $(4,532)$ | $(3,502)$ | $(2,702)$ | $(2,682)$ | (2,290 | (2,512 | $(2,681)$ | 2,879 | (4) |
|  | 769) | (3,237) | 36) | (2,120 | $(1,973$ | $(2,162)$ |  |  |  |
| 6 | $(3,397)$ | $(2,96)$ | (1.832) | $(1,670)$ | (1,542 | (1,708) | (1,946 | $(2,223)$ | (2.629) |
|  | $(2,779)$ | $(2,495)$ | $(1,360)$ | $(1,259)$ | $(1,265)$ | $(1,361)$ | (1,696) | $(1,913)$ | 2,222) |
|  | $(2,277)$ | (1, 198 ) | $(1,065)$ | (874) | (920) | $(1,156)$ | $(1,186)$ | (1.406) | (1,912) |
|  | $(1,96)$ | $(1,486)$ | (630) | (481) | (590) | (4) | (351) | $(1,061)$ | $(1,626)$ |
|  | , 645 ) | (952) | (73) | (18) | 286 | $133)$ | (699) | (685) | , 397) |
|  | (790) | (295) | 455 | 616 | 226 |  | (150) | (201) | (973) |
|  | (153) | 357 | 985 | ${ }^{899}$ | 03 | 899 | 385 | 251 | 56) |
| 1 | 417 | \% | 1,461 | 1,490 | 1,431 | 1,480 | 1,085 | 648 | 58 |
|  | 27 | 1,366 | 1,872 | 1,961 | 2, 107 | 2,035 | 1.765 | 1,062 | 41 |
| 93 | 1.612 | 2,123 | 2,431 | 2,554 | 2,761 | 2,573 | 2,066 | 1, 881 | . 258 |
| \% | 2,620 | 2,751 | 3,201 | 3,402 | 3,436 | 3,272 | 2,671 | 2,254 | 1,806 |
|  | 3,600 | 3.748 | 4,179 | 6,211 | 6.43 | 6,432 | 3,853 | 3,228 | 2,629 |
| 9 | 6,856 | 4,746 | 5,360 | 5,746 | 5,662 | 6,953 | 5,092 | 6,002 | 3,358 |
|  | 295 | 257 | 531 | cos | ,767 | , 230 | . 379 | 927 | . 176 |
| 0 | ,565 | 7,76 | 8,282 | 3,200 | 8,551 | 3,374 | 7.565 | 6,705 | 6.136 |
| 99 | 787 | 10,031 | , 591 | 0,730 | 0,39 | 10,162 | , 550 | ,968 | 183 |
|  | 15,232 |  |  |  | 72 | 16,700 | 6, 2 | 13,279 | 2,690 |
|  | 11,387) | $(11,612)$ | $\left(\begin{array}{l}(10,515) \\ 8,965\end{array}\right.$ | $(10,131$ 8.706 | $(9,818)$ 8,530 | (9,785) | $(9,859)$ 8,229 | $(10,082)$ 8,016 | 70,461) |



| percontile No | 45 | 70 | 75 | 20 | $\overline{M c}=\left(\text { gis }_{s}\right)$ | 90 | 45 | 100 | 105 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | (19,206) | (16, 113$)$ | (16,855) | (15.180) | (14. 132$)$ | (13.680) | (13, 0123 | (13,211) | (15,067) |
| 2 | (12,995) | (12,167) | (12,150) | (10,798) | $(10,291)$ | $(10,336)$ | $(10,359)$ | ( 9,880$)$ | $(10,921)$ |
| 3 | $(9,426)$ | $(3,676)$ | $(3,351)$ | (7.751) | $(7,123)$ | $(7,501)$ | $(8,107)$ | $(7,973)$ | $(7,889)$ |
| 4 | $(7,356)$ | $(5,938)$ | $(5,800)$ | $(5,698)$ | $(5,211)$ | $(5,123)$ | $(5,408)$ | $(6,313)$ | $(6,362)$ |
| 5 | $(5,577)$ | $(4,926)$ | $(4,303)$ | ( 4.301 ) | $(3,698)$ | $(3,303)$ | $(3,826)$ | ( 4,051 ) | $(4,905)$ |
|  | $(4,815)$ | $(6,133)$ | $(3,119)$ | $(2,738)$ | $(2,632)$ | (1.890) | $(2,856)$ | $(2,029)$ | $(3,863)$ |
| 7 | $(3,961)$ | $(3,266)$ | $(1,849)$ | $(1,542)$ | $(1,655)$ | (636) | $(1,555)$ | $(1,46)$ | $(2,675)$ |
| 8 | $(2,889)$ | $(1,829)$ | (1,156) | (119) | (160) | 81 | (491) | (779) | (1,641) |
| 9 | $(2,103)$ | (1,151) | (246) | 1.163 | 467 | ${ }^{13}$ | 365 | 80 | (1,019) |
| 10 | $(1,411)$ | (699) | 746 | 1.836 | 1,387 | 1,763 | 1.203 | 582 | (406) |
| 11 | (387) | 472 | 1,655 | 2,613 | 2,148 | 2,375 | 1,693 | 1,085 | 156 |
| 12 | 545 | 1,357 | 2,299 | 3,081 | 2,913 | 2,956 | 2,009 | 1,399 | 508 |
| 13 | 1,415 | 1,882 | 2,905 | 3,555 | 3,484 | 3,469 | 2,329 | 1,799 | 462 |
| 16 | 1,935 | 2,368 | 3,472 | 3,979 | 4,067 | 3,759 | 2,846 | 2,172 | 1,238 |
| 15 | 2,529 | 2,761 | 4,350 | 4,390 | 4.497 | 3,986 | 3,291 | 2,600 | 1,721 |
| 16 | 3,157 | 3,330 | 4,905 | 4,780 | 4,940 | 6,370 | 3,59\% | 3,020 | 2,226 |
| 17 | 3,693 | 3,915 | 5,389 | 5,268 | 5,349 | 6,587 | 6,017 | 3,416 | 2,770 |
| 18 | 4,206 | 4,932 | 5,698 | 5,462 | 5,728 | 4,853 | 4,385 | 3, 198 | 3,146 |
| 19 | 4,586 | 5,196 | 5,980 | 6,029 | 6,091 | 5,250 | 4,946 | 4,158 | 3,411 |
| 20 | 5,180 | 5,706 | 6,398 | 6,505 | 6,531 | 5,597 | 5,419 | 4,462 | 3,883 |
| 21 | 5,972 | 6,059 | 6,731 | 6,877 | 6,882 | 5,932 | 3,752 | 4,821 | 4,372 |
| 22 | 6,301 | 6,436 | 7.137 | 7,285 | 7,311 | 6,338 | 5,974 | 5,335 | 4,463 |
| 23 | 6,676 | 6.879 | 7.434 | 7,724 | 7,529 | 6.863 | 6,223 | 3,77 | 5,305 |
| 26 | 6,988 | 7,213 | 7.789 | 8,044 | 7.843 | 7.166 | 6,510 | 6,193 | 5,614 |
| 25 | 7.273 | 7.555 | 8,063 | 8,500 | 8,152 | 7.439 | 6,893 | 6,511 | 5,936 |
| 26 | 7,703 | 8,109 | 8.427 | 8,942 | 8,324 | 8,016 | 7,206 | 6,938 | 6,230 |
| 27 | 8,193 | 8,562 | 8,682 | 9,269 | 8,551 | 8.451 | 7.528 | 7,222 | 6.465 |
| 28 | 8,691 | 8,966 | 9,235 | 9,552 | 8,988 | 8,803 | 8,123 | 7,545 | 6,756 |
| 29 | -,163 | 9,346 | 9,716 | 10,042 | 9,381 | 9,280 | 8,517 | 8,062 | 6,998 |
| 30 | 9,459 | 9,686 | 10,139 | 10,369 | 9,739 | 9,540 | 9,106 | 8,519 | 7,262 |
| 31 | 9,681 | 9,988 | 10,552 | 10,365 | 10,093 | 9,991 | 9,461 | 8,899 | 7.673 |
| 32 | 10,029 | 10, 26 | 10,808 | 11, 115 | 10,607 | 10,631 | 9,700 | 9,148 | 7,909 |
| 33 | 10,452 | 10,750 | 11,072 | 11,329 | 10,972 | 10,319 | 9,363 | 9,463 | 8,310 |
| 36 | 10,898 | 11,089 | 11,357 | 11,525 | 11,334 | 11,028 | 10,237 | 1,902 | 8,613 |
| 35 | 11,193 | 11,399 | 11,827 | 11,865 | 11,563 | 11,321 | 10,491 | 10,268 | 8,399 |
| 36 | 11,510 | 11.65 | 12,190 | 12,260 | 11,962 | 11,706 | 10,845 | 10,520 | 9,210 |
| 37 | 11,787 | 11,928 | 12,566 | 12,573 | 12,180 | 12,097 | 11,244 | 10,977 | 9,517 |
| 38 | 12,073 | 12,260 | 12,968 | 12,926 | 12,505 | 12,422 | 11,698 | 11,263 | 10,032 |
| 39 | 12,325 | 12,700 | 13,306 | 13,307 | 12,921 | 12,761 | 12,076 | 11,535 | 10,695 |
| 60 | 12,677 | 13.011 | 13,498 | 13,633 | 13,269 | 12,925 | 12,450 | 11,752 | 10,783 |
| 61 | 12,960 | 13,346 | 13,867 | 13,918 | 13,461 | 13,180 | 12,891 | 11,981 | 11,063 |
| 42 | 13,370 | 13,746 | 14,208 | 14, 131 | 13,810 | 13,529 | 13,209 | 12,236 | 11,399 |
| 43 | 13,921 | 13,988 | 14,580 | 14,420 | 14, 148 | 13,842 | 13,458 | 12,527 | 11,561 |
| 46 | 16,176 | 14,333 | 14,817 | 14,722 | 16,629 | 14,168 | 13,714 | 12,868 | 12,082 |
| 45 | 14,486 | 14,716 | 15,183 | 15,068 | 14,981 | 14,435 | 16,029 | 13,099 | 12,253 |
| 46 | 14,890 | 15,076 | 15,605 | 15,417 | 15,322 | 14.699 | 14,625 | 13,400 | 12,658 |
| 47 | 15,060 | 15,616 | 15,931 | 15,685 | 15,579 | 15,117 | 14,806 | 13,696 | 12,653 |
| 48 | 15,336 | 15,691 | 16,220 | 15,909 | 16,000 | 15,787 | 15,239 | 13,995 | 12,888 |
| 69 | 15,715 | 15,912 | 16,487 | 16,158 | 16,229 | 16,061 | 15,645 | 14,615 | 13,278 |
| 50 | 16,000 | 16,203 | 16, 332 | 16,601 | 16,547 | 16,304 | 16,070 | 16,709 | 13,647 |
| 51 | 16,376 | 16,838 | 17,262 | 16,966 | 16,882 | 16,525 | 16,390 | 15,073 | 14,065 |
| 52 | 16,836 | 16,947 | 17,474 | 17,367 | 17,160 | 16,795 | 16,657 | 15,319 | 14,430 |
| 53 | 17,130 | 17,299 | 17,735 | 17,776 | 17,548 | 17,018 | 16,922 | 15,630 | 16,702 |
| 54 | 17,391 | 17,548 | 18,123 | 18,223 | 17,835 | 17,289 | 17,240 | 15,992 | 16,977 |
| 55 | 17.633 | 13,054 | 18,608 | 18,556 | 18,097 | 17,656 | 17,483 | 16,335 | 15, 183 |
| 56 | 18,050 | 18,402 | 18,752 | 18,903 | 18,652 | 17,930 | 17,810 | 16,636 | 15,547 |
| 57 | 18.630 | 18,650 | 19,147 | 19,235 | 18,661 | 13,136 | 13,116 | 16,914 | 15,879 |
| 58 | 18,807 | 18,640 | 19,580 | 19,40 | 18,986 | 18,509 | 18,30\% | 17.168 | 16,261 |
| 59 | 19.158 | 19, 171 | 19,962 | 19,949 | 19,320 | 18,769 | 18,519 | 17,692 | 16,546 |
| 60 | 19.627 | 19,466 | 20.261 | 20,211 | 19,623 | 19,093 | 18,756 | 17,357 | 16,351 |
| 61 | 19.659 | 19,612 | 20.627 | 20,526 | 20,057 | 19.490 | 18,981 | 18,319 | 17,126 |
| 62 | 19,971 | 20, 150 | 20.680 | 20,764 | 20,561 | 19.726 | 19,225 | 18,631 | 17.426 |
| 63 | 20, 176. | 20,461 | 20.948 | 21,048 | 20.798 | 20,046 | 19,473 | 18,911 | 17,674 |
| 66 | 20,550 | 20,716 | 21,147 | 21,231 | 20,982 | 20.403 | 19,718 | 19,231 | 17,981 |
| 65 | 20.816 | 20,90\% | 21,362 | 21.504 | 21,318 | 20.663 | 20, 126 | 19.446 | 18,292 |
| 66 | 21,172 | 21.408 | 21,610 | 21,797 | 21,600 | 20,976 | 20,380 | 19,703 | 18,476 |
| 67 | 21,693 21.922 | 21,746 | 21.876 23 | 22,000 | 21,752 | 21,216 | 20,660 | 20, 132 | 18,766 |
| 68 | 21,922 | 22.048 | 22,070 | 22,245 | 22,023 | 21,455 | 21,100 | 20,40\% | 19,679 |
| 69 | 22,258 | 22,546 | 22,302 | 22,538 | 22,351 | 21,799 | 21,325 | 20,43 | 19,831 |
| 70 | 22,572 | 22,744 | 22,612 | 22,805 | 22,616 | 22,092 | 21,651 | 21, 01 | 20, 139 |
| 71 | 22,921 | 22,962 | 22,957 | 23, 234 | 22,953 | 22,588 | 22,082 | 21,328 | 20,412 |
| 72 | 23,386 | 23, 277 | 23,629 | 23, 555 | 23,173 | 22,992 | 22,344 | 21,716 | 20,732 |
| 73 | 23,722 | 23,729 | 23,969 | 23, 876 | 23.615 | 23, 335 | 22,628 | 22,142 | 21,225 |
| 76 | 24,041 | 26,028 | 26,673 | 24,186 | 24,144 | 23,714 | 23, 101 | 22,514 | 21,619 |
| 75 | 24,317 | 26,400 | 26,928 | 26,556 | 26,671 | 26,041 | 23.674 | 22,836 | 22,173 |
| 76 | 26,581 | 26,927 | 25,378 | 25,074 | 25, 100 | 24, 297 | 23,970 | 23,004 | 22,544 |
| 7 | 25,146 | 25,510 | 25,829 | 25,642 | 25,629 | 26, 776 | 24,400 | 23,393 | 22,629 |
| 78 | 25,64 | ${ }^{26,052}$ | 26,266 | 26,077 | 26,075 | 25, 121 | 26,796 | 23,657 | 23,076 |
| 79 | 26,030 | 26,467 | 26,843 | 26, 592 | 26, 625 | 25,606 | 25, 277 | 26,169 | 23, 338 |
| 80 | 26,514 | 26,948 | 27,379 | 27,092 | 28,799 | 26,086 | 25,652 | 26,547 | 23, 776 |
| 81 | 27.164 | 27,551 | 27, 876 | 27,620 | 27.138 | 28,520 | 26, 207 | 25,119 | 26,193 |
| 82 | 28,115 | 28,146 | 28.620 | 28,245 | 27,540 | 27,968 | 26.620 | 25,623 | 26.651 |
| 83 | 28,537 | 28,616 <br> 10 | 28,905 | 28,699 | 28, 203 | 27, 370 | 27.018 | 26,070 | 25, 235 |
| 85 | 28,905 | 29.137 | 29,783 | 29,568 | 26,473 | 27.976 | 27,508 | 26,735 | 25,753 |
| 85 | 29,459 | 29,631 | 30,63 | 30,313 | 29,296 | 28, 311 | 28, 206 | 27.197 | 26,185 |
| 86 | 30, 210 | 30, 198 | 31,110 | 31,029 | 27.765 | 29,393 | 28,757 | 28,069 | 26,482 |
|  | 30,831 31,826 | 30,881 31 | 31,665 32,146 | 31,606 | 30,408 | 29.829 | 29,313 | 28,608 | 27, 228 |
| 88 | 31,826 32,453 | 31,821 32,522 | 32,146 32,743 | 32,048 | 31, 231 | 30,639 | 29,839 | 29, 148 | 27.716 |
| 89 90 | 32,653 33,038 | 32,522 33,525 | 32,763 33,365 | 32,545 | 32,213 32,98 | 31,603 | 30,698 | 29.332 | 28,307 |
| 90 | 33,038 | 33,525 | 33,365 | 33, 182 | 32,892 | 32,262 | 31,526 | 30,580 | 28,986 |
| 91 | 34,055 | 34, 191 | 36,143 | 33,992 | 36,028 | 33, 163 | 32,261 | 31, 150 | 29,778 |
| 92 | 36,820 | 35,020 | 35,252 | 34,923 | 34, 689 | 33,968 | 33, 144 | 31,855 | 30,358 |
| 93 | 36, 221 | 36, 103 | 36,030 | 35,976 | 35,388 | 34,978 | 34,041 | 32,905 | 31,285 |
| 95 | 37,308 | 37,386 | 37, 138 | 37,026 | 36,620 | 35,793 | 36,991 | 33,948 | 32,634 |
| 95 | 38,829 | 38,576 | 38,165 | 38,115 | 37,697 | 36,940 | 36,162 | 34, 338 | 36,132 |
| 97 | 40,510 | 40, 164 | 39,897 | 39,937 | 39,251 | 38,541 | 37.045 | 35,848 | 35,279 |
| 97 | 42,961 | 42,231 | 42, 197 | 42.018 | 41,380 | 40, 205 | 39,003 | 37,307 | 35,908 |
| 98 | 4,756 | 45,036 | 46.351 | $4{ }^{4}, 271$ | 43,783 | 43,04 | 49,426 | 39,922 | 38,750 |
| $\infty$ | 47.655 | 67.538 | 48,096 | 47.486 | 46,497 | 45,715 | 44,615 | 63,523 | 42,120 |
| 100 | 55,392 | 35,957 | 36,491 | 54,461 | 53, ${ }^{16} 6$ | 53, 196 | 52, 109 | 50,169 | 46,531 |
| "can | 16,616 | 16,697 | 17,173 | 17,269 | 16,996 | 16,569 | 16,013 | 15,265 |  |
| stoer | 13,488 | 13,282 | 13,011 | 12,748 | 12,531 | 12,314 | 12,221 | 11,939 | 11,426 |




| $\begin{aligned} & \text { percontile } \\ & \text { No } \end{aligned}$ | 65 | 70 | 73 | $\pm 0$ | $\overline{m c}=\left(\text { 柬 }_{3}\right.$ | 5 | 95 | 100 | 105 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | (33,449) | (31,798) | (31,304) | $(30,619)$ | (30,266) | $(30,452)$ | (29,818) | (29,062) | ) |
| 2 | $(29,526)$ | $(28,872)$ | $(27,790)$ | $(26,772)$ | (26,736) | (26,350) | $(26,164)$ | $(25,367)$ | $(26,931)$ |
| 3 | $(28,312)$ | $(27,571)$ | $(25,882)$ | $(25,298)$ | $(24,863)$ | $(24,487)$ | (26,228) | $(23,299)$ | $(23,266)$ |
|  | (27, 102) | (26,062) | $(26,820)$ | $(26,259)$ | $(23,270)$ | $(22,930)$ | $(22,700)$ | $(22,303)$ | $(22,569)$ |
| 5 | $(25,729)$ | (24, 352 ) | $(26,057)$ | (23, 156) | $(22,142)$ | $(22,042)$ | $(21,854)$ | $(21,636)$ | $(21,683)$ |
| 6 | $(26,531)$ | $(23,995)$ | $(23,101)$ | $(21,821)$ | $(21,308)$ | (21,288) | $(21,258)$ | $(21,151)$ | $(20,98)$ |
| 7 | (23,936) | $(23,136)$ | $(21,928)$ | ( 21,175 ) | (20,785) | (20,636) | ( 20,263 ) | $(20,107)$ | $(20,529)$ |
| 1 | $(23,075)$ | $(22,192)$ | $(21,351)$ | (20.651) | $(20,157)$ | $(19,879)$ | $(19,651)$ | $(19,485)$ | $(19,907)$ |
| 9 | $(22,376)$ | $(21,637)$ | $(20,875)$ | $(20,025)$ | $(19,508)$ | (18,960) | $(18,967)$ | $(18,746)$ | $(19,185)$ |
| 10 | $(21,625)$ | ( 21,085 ) | $(20,268)$ | $(19,432)$ | $(18,671)$ | $(18,536)$ | $(18,547)$ | $(18,329)$ | $(18,656)$ |
| 11 | ( 21,121 ) | $(20,575)$ | $(19,692)$ | $(18,916)$ | $(18,246)$ | $(18,035)$ | $(17,981)$ | $(17,732)$ | $(16,206)$ |
| 12 | $(20,556)$ | $(20,085)$ | $(19,078)$ | $(18,546)$ | $(17,587)$ | $(17,358)$ | $(17,407)$ | $(17,361)$ | $(17,653)$ |
| 13 | $(20,014)$ | $(19,613)$ | $(18,387)$ | $(18,103)$ | $(17,306)$ | $(17,016)$ | $(17,077)$ | $(16,936)$ | $(17.101)$ |
| 14 | $(19,567)$ | $(18,876)$ | $(17,805)$ | $(17,593)$ | $(17,020)$ | $(16,619)$ | $(16,584)$ | $(16,608)$ | $(16,767)$ |
| 15 | $(19,036)$ | $(18,173)$ | $(17,453)$ | $(17,331)$ | $(16,654)$ | $(16,196)$ | $(16,196)$ | $(16,302)$ | $(16.615)$ |
| 16 | $(18,674)$ | $(17,806)$ | $(17,136)$ | $(17,022)$ | $(16,259)$ | (15,709) | $(15,783)$ | $(16,006)$ | $(16,121)$ |
| 17 | $(18,157)$ | $(17,466)$ | $(16,717)$ | $(16,510)$ | $(15,821)$ | $(15,617)$ | $(15,526)$ | $(15,365)$ | $(15,787)$ |
| 18 | $(17,569)$ | $(17,309)$ | $(16,697)$ | $(16,026)$ | $(15,517)$ | $(15,009)$ | $(15,161)$ | $(14,967)$ | $(15,483)$ |
| 19 | $(17,267)$ | $(16,995)$ | $(16,260)$ | $(15,800)$ | $(15,109)$ | $(16,843)$ | $(14,850)$ | $(14,400)$ | $(15,157)$ |
| 20 | $(16,968)$ | $(16,761)$ | $(15,935)$ | $(15,634)$ | $(16,797)$ | $(14,536)$ | $(14,507)$ | $(16,300)$ | $(14,873)$ |
| 21 | $(16,625)$ | $(16,657)$ | $(15,608)$ | $(15,090)$ | $(16,525)$ | $(16,210)$ | $(14,204)$ | $(16,035)$ | $(16,585)$ |
| 22 | $(16,377)$ | $(15,996)$ | $(15,133)$ | $(14,752)$ | $(14,145)$ | ( 13,854 ) | $(13,296)$ | $(13,201)$ | $(14,220)$ |
| 23 | (16,056) | $(15,501)$ | $(14,769)$ | $(16,374)$ | $(13,822)$ | $(13,559)$ | $(13,604)$ | $(13,599)$ | $(13,820)$ |
| 26 | ( 15.696 ) | $(15,146)$ | $(14,370)$ | $(14,008)$ | $(13,559)$ | $(13,276)$ | $(13,335)$ | $(13,377)$ | $(13,583)$ |
| 25 | $(15,335)$ | $(16,875)$ | $(13,970)$ | $(13,655)$ | ( 13,099 ) | (12,869) | $(13,138)$ | $(13,102)$ | $(13,272)$ |
| 26 | $(14,926)$ | $(14,883)$ | $(13,537)$ | $(13,286)$ | $(12,735)$ | (12,634) | $(12,838)$ | $(12,915)$ | $(12,91)$ |
| 27 | $(14,600)$ | (14, 371$)$ | $(13,256)$ | $(12,943)$ | (12,695) | $(12,451)$ | $(12,576)$ | $(12,607)$ | $(12,71)$ |
| 28 | $(14,316)$ | (14,081) | $(12,991)$ | $(12,655)$ | $(12,272)$ | ( 12,168 ) | $(12,339)$ | $(12,176)$ | $(12,523)$ |
| 29 | $(14,073)$ | (13,796) | $(12,562)$ | $(12,365)$ | $(12,059)$ | (11,890) | $(12,103)$ | $(11,926)$ | $(12,232)$ |
| 30 | $(13,828)$ | (13,501) | $(12,369)$ | $(12,006)$ | (11,788) | $(11,677)$ | $(11,838)$ | $(11,606)$ | $(11,915)$ |
| 31 | $(13,656)$ | $(13,220)$ | $(11,902)$ | $(11,735)$ | $(11,636)$ | $(11,635)$ | (11,636) | $(11,363)$ | $(11,701)$ |
| 32 | (12,966) | $(12,933)$ | $(11,611)$ | $(11,679)$ | $(11,622)$ | $(11,147)$ | $(11,351)$ | (11,215) | $(11.615)$ |
| 33 | (12,758) | (12,586) | $(11,351)$ | (11, 338$)$ | ( 11,167$)$ | (10,910) | $(11,032)$ | $(10,926)$ | $(11,128)$ |
| 36 | $(12,483)$ | $(12,223)$ | $(11,155)$ | $(11,071)$ | $(10,877)$ | $(10,631)$ | $(10,791)$ | $(10,636)$ | $(10,928)$ |
| 35 | $(12,065)$ | $(11,767)$ | (10,795) | ( 10,694 ) | $(10,577)$ | (10,372) | $(10,548)$ | $(10,699)$ | $(10,76)$ |
| 36 | $(11,863)$ | (11,670) | (10,677) | (10,631) | $(10,227)$ | $(10,125)$ | $(10,329)$ | $(10,351)$ | $(10,567)$ |
| 37 | $(11,620)$ | $(10,982)$ | $(10,215)$ | $(10,113)$ | ( 9.891 ) | $(9,889)$ | $(10.113)$ | $(10,126)$ | $(10,357)$ |
| 38 | $(11,622)$ | $(10,685)$ | $(9,872)$ | $(9,797)$ | $(9,536)$ | $(9,689)$ | $(9,782)$ | $(9,952)$ | (10, 105) |
| 39 | $(11,020)$ | $(10,675)$ | $(9,697)$ | $(9,465)$ | $(9,230)$ | $(9,329)$ | $(9,356)$ | $(9,777)$ | (9,925) |
| 40 | ( 10,756 ) | $(10,116)$ | $(9,222)$ | ( 9.050 ) | $(8,836)$ | $(8,957)$ | $(9,125)$ | $(9,502)$ | $(9,629)$ |
| 61 | $(10,483)$ | $(9,765)$ | $(8,925)$ | $(8,706)$ | $(8,658)$ | $(8,677)$ | $(8,931)$ | $(9,182)$ | $(9,283)$ |
| 62 | $(10,177)$ | $(9,381)$ | $(8,600)$ | $(8,371)$ | $(3,372)$ | $(8,293)$ | $(8,622)$ | $(3,931)$ | $(9,098)$ |
| 43 | $(9,885)$ | $(9,035)$ | $(8,355)$ | $(8.132)$ | $(8.125)$ | $(8,015)$ | $(8,366)$ | $(3,707)$ | $(8,9 \times 2)$ |
| 46 | $(9,542)$ | $(8,706)$ | $(3,123)$ | $(7,919)$ | $(7.810)$ | $(7,658)$ | $(8,098)$ | $(8,374)$ | $(8,585)$ |
| 45 | ( 9,307 ) | $(3,566)$ | (7,877) | (7,716) | $(7.600)$ | (7,361) | (7, 562 ) | (7,906) | $(8,329)$ |
| 46 | $(8,907)$ | (8, 260) | $(7,576)$ | $(7,374)$ | (7.199) | (7,002) | (7,362) | $(7,430)$ | (8,027) |
| 47 | $(8,555)$ | (7,970) | $(7,262)$ | $(7,106)$ | $(6,932)$ | $(6,822)$ | $(7.019)$ | $(7,163)$ | $(7,650)$ |
| 48 | ( $(8,274)$ | $(7,817)$ | $(7, \infty 3)$ | $(6,914)$ | ( 6.6095 ) | ( 6,554 ) | (6,718) | $(6,901)$ | $(7,372)$ |
| 49 | (8,029) | (7,622) | $(6,740)$ | $(6,589)$ | $(6,496)$ | $(6,536)$ | $(6,401)$ | $(6,723)$ | (7,013) |
| 50 | (7,691) | (7.402) | $(6,516)$ | $(6.625)$ | $(6,221)$ | $(6,118)$ | $(6,181)$ | $(6,436)$ | $(6,726)$ |
| 51 | $(7,519)$ | (7, 198) | $(6,271)$ | $(6,210)$ | $(5,901)$ | $(5,860)$ | $(5,951)$ | $(6,083)$ | $(6,529)$ |
| 52 | (7,335) | $(6,961)$ | $(6,093)$ | $(5,992)$ | $(5,728)$ | $(5,583)$ | $(5,765)$ | $(5,912)$ | $(6,244)$ |
| 53 | (7,128) | $(6,759)$ | $(5,822)$ | $(5,792)$ | ( 5.5487$)$ | ( 5.349$)$ | ( 5,550 ) | $(5,734)$ | $(6,001)$ |
| 56 | $(6,876)$ | $(6,519)$ | $(5,631)$ | ( 5.561$)$ | $(5,286)$ | ( 5.164$)$ | $(5,329)$ | (5,508) | ( 5,717$)$ |
| 55 | $(6,479)$ | $(6,140)$ | $(5,617)$ | $(5,303)$ | ( 4.988 ) | $(4,962)$ | $(5,109)$ | $(5,311)$ | $(5,548)$ |
| 56 | $(6,199)$ | ( 5.645$)$ | ( 5,076 ) | ( 5.053 ) | ( 6.757 ) | $(4,714)$ | (4,045) | ( 5,120 ) | (5,195) |
| 57 | ( 5.862$)$ | $(5.638)$ | $(4,800)$ | $(4.673)$ | $(4,348)$ | $(4.674)$ | (6,659) | $(4,834)$ | (6,865) |
| 58 | ( 5,588$)$ | ( 5,053$)$ | (4,539) | $(6,292)$ | ( 6.036 ) | $(4,281)$ | $(6,619)$ | (4,065) | $(6,636)$ |
| 59 | $(5,307)$ | $(6,791)$ | $(4,206)$ | (3,968) | ( 3.646 ) | $(6,079)$ | (6.166) | $(4,364)$ | $(6,392)$ |
| +0 | $(5,107)$ | ( 4,527$)$ | $(3,988)$ | ( 3.657$)$ | ( 3,369 ) | $(3,803)$ | (3,921) | (6.157) | (6,169) |
| 61 | $(4,901)$ | $(6,235)$ | $(3,527)$ | $(3,329)$ | (3,046) | $(3,676)$ | $(3,561)$ | $(3,825)$ | $(3,858)$ |
| 62 | ( 4,567 ) | $(3,971)$ | $(3,269)$ | $(3,062)$ | $(2,786)$ | $(3,158)$ | (3,365) | $(3,589)$ | $(3,581)$ |
| 63 | (6, 199) | $(3,717)$ | (3,016) | ( 2,801 ) | (2,546) | $(2,873)$ | (3,156) | (3,305) | $(3,427)$ |
| 66 | $(3,959)$ | ( 3,404 ) | ( 2,753$)$ | $(2,251)$ | ( 2,281$)$ | (2,549) | $(2,808)$ | (3,045) | (3,213) |
| 65 | $(3,769)$ | $(3,075)$ | $(2,456)$ | $(1,977)$ | $(1,976)$ | $(2,286)$ | $(2,672)$ | $(2,646)$ | (3,033) |
| 66 | $(3,401)$ | $(2,816)$ | $(2,198)$ | $(1,850)$ | (1,647) | $(2,051)$ | $(2,076)$ | $(2,335)$ | (2,650) |
| 67 | $(2,968)$ | $(2,639)$ | $(1,901)$ | $(1,563)$ | $(1,312)$ | $(1,716)$ | $(1,756)$ | $(2,010)$ | (2,252) |
|  | ( 2,696 ) | $(2,066)$ | (1,500) | $(1,160)$ | $(1,069)$ | (1,298) | $(1,393)$ | (1.730) | $(2,080)$ |
| 69 | $(2,303)$ | (1.801) | (970) | (810) | (743) | (793) | (959) | (1,358) | (1, 8 ) |
| 70 | $(1,897)$ | $(1,518)$ | (736) | (523) | (300) | (257) | (455) | (1,086) | (1,392) |
| 71 | $(1, \infty 02)$ | (1,276) | (433) | (128) | ${ }^{67}$ | 119 | (99) | (825) | $(1,164)$ |
| 72 | (1,209) | (960) | (147) | 216 | 476 | 513 | 363 | (617) | (730) |
| 73 | (951) | (661) | 65 | 650 | 985 | 79 | 682 | (21) | (399) |
| 76 | (580) | (149) | 259 | 1,018 | 1,353 | 1,051 | 955 | 43 | (92) |
| 75 | (248) | 328 | 59 | 1,216 | 1.605 | 1,136 | 1.401 | 74 | 257 |
| 76 | 181 | 736 | 90 | 1.428 | 1,47 | 1,842 | 1.735 | 1,216 | 42 |
| 77 | 613 | 1.063 | 1.262 | 1,876 | 2,378 | 2,3\% | 2,166 | 1,678 | 1,023 |
| 78 | 930 | 1,346 | 1,790 | 2,522 | 2,462 | 2,859 | 2,575 | 2,076 | 1, 136 |
| 79 | 1.430 | 1,826 | 2,293 | 2,926 | 3,29 | 3,253 | 2,953 | 2,674 | 1,912 |
| 80 | 1,061 | 2,312 | 2,779 | 3,309 | 3,608 | 3,604 | 3,303 | 2,731 | 2,463 |
| 81 | 2,381 | 2,655 | 3,331 | 3,701 | 3,900 | 6,054 | 3,401 | 3,210 | 2,465 |
| 82 | 2,787 | 2,906 | 3,750 | 3,906 | 6.206 | 4,306 | 4.131 | 3,560 | 3.284 |
| 83 | 3,087 | 3,378 | 6,206 | 6,362 | 6,525 | 4.696 | 4.552 | 3,41 | 3,618 |
| 85 | 3,506 | 3.858 | 4.601 | 4.77 | 5,040 | 3,177 | 4,946 | 6,482 | 3,968 |
| 85 | 3,902 | 6.201 | 6,979 | S. 225 | 3,670 | S.525 | 5.409 | 3,126 | 4,723 |
| 86 | 4.321 | 4.026 | 5,395 | 5,650 | 6,090 | 3,968 | 5,885 | 3.464 | S.063 |
| 87 | 6,997 | 5,265 | 6.010 | 6.433 | 6.551 | 6.49 | 6,597 | 3,782 | 3,528 |
| 88 | 5,773 | 6,080 | 6.932 | 7.321 | 7.046 | 6.882 | 6.997 | 6.151 | 5,890 |
| 89 | 6.265 | 6.533 | 7.595 | 7.833 | 7.683 | 7.308 | 7.560 | 6,723 | 6,264 |
| 90 | 6.553 | 7.167 | 8.006 | 8,312 | 8.082 | 7,879 | 8.122 | 7.616 | 6.918 |
| 91 | 7.047 | 7,735 | 8.630 | 8,819 | 8.688 | 8.677 | 8.687 | 3,165 | 7.675 |
| 92 | 7,950 | 8,207 | 9.136 | 9,270 | -, 360 | 9,310 | 9,496 | 8,735 | 8.090 |
| 93 | -,069 | 8,902 | 10,065 | 10.076 | 10,220 | 10,056 | 10,003 | 9, 000 | 8,756 |
| 96 | 9,909 | 9,852 | 11.059 | 10,830 | 10,805 | 10,869 | 10,657 | 10, 191 | 9,670 |
| 95 | 10,859 | 11,270 | 11, 565 | 11,844 | 11, 7\% | 11,672 | 11,493 | 11,083 | 10,640 |
| 9 | 11,911 | 12,676 | 13,133 | 13,701 | 12, 116 | 12,560 | 12,004 | 12,023 | 11,627 |
| 97 | 13.403 | 16,369 | 14.464 | 14,736 | 14.153 | 13,547 | 13,052 | 12,855 | 12,658 |
| 98 | 15.658 | 16,773 | 16, 818 | 16,446 | 15,875 | 15,583 | 15,009 | 14,258 | 14,735 |
| 99 | 19,515 | 19,966 | 19,878 | 20,255 | 20,537 | 20,087 | 19,056 | 17,791 | 17,41 |
| 100 | 25,315 | 25,232 | 25,187 | 25,044 | 25,161 | 24,515 | 26,226 | 23,123 | 22,403 |
| Mean | $(7,350)$ | $(6,858)$ | (6.078) |  |  | ( 5,461 ) | (5,581) | $(5,780)$ | (6,069) |
| stoer | 11,141 | 11,045 | 10,891 | 10,786 | 10,593 | 10,428 | 10,327 | 10,002 | 9,956 |



| $\begin{aligned} & \text { percentile } \\ & \text { No } \end{aligned}$ | - 65 | 70 | 73 | $\pm$ | Mc = (6) | 9 | * | 100 | 105 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | $(19,876)$ | $(19,626)$ | $(19,540)$ | (18,298) | $(16,195)$ | $(16,573)$ | $(15,316)$ | $(14,5 * *)$ | $(16,065)$ |
| 2 | (16, 105) | $(13,586)$ | $(12,136)$ | $(12,303)$ | $(11,832)$ | (12,071) | $(11,47)$ | $(11,40)$ | $(11,812)$ |
| 3 | ( 10.976 ) | $(11,00)$ | $(10,485)$ | $(9,929)$ | $(9,917)$ | ( 9.610$)$ | ( 9.484$)$ | $(9,616)$ | $(0,536)$ |
| 4 | $(9,386)$ | (9,14) | $(8,628)$ | $(1,030)$ | $(7,851)$ | $(7,382)$ | $(7,519)$ | $(7,930)$ | $(1,184)$ |
| 5 | (3.034) | (7.679) | (7.109) | $(6,257)$ | ( 5,799$)$ | $(5,300)$ | ( 6,065 ) | (6,420) | ( 6,467 ) |
| 6 | $(6,900)$ | $(6,354)$ | $(6,129)$ | $(5,48)$ | $(4,610)$ | $(4,285)$ | $(4,549)$ | (6.356) | (5,541) |
| 7 | ( 5,777$)$ | ( 5,535$)$ | (4,806) | ( 3.984 ) | (3,801) | $(3,575)$ | ( 3,561 ) | (3,873) | $(4,515)$ |
| 8 | ( 4.746 ) | ( 6,510$)$ | $(3,703)$ | (2,927) | $(2,822)$ | $(2,463)$ | $(2,682)$ | $(2,926)$ | (3,906) |
| 9 | $(3,846)$ | $(3,496)$ | (2,459) | $(1,806)$ | $(1,829)$ | (1,736) | $(2, \infty 1)$ | $(2,306)$ | $(3,46)$ |
| 10 | $(2,970)$ | $(2,505)$ | $(1,100)$ | (931) | (938) | (911) | $(1,654)$ | $(1,47)$ | $(2,769)$ |
| 11 | $(2,288)$ | $(1,878)$ | (291) | (326) | (356) | (352) | (1,026) | (1,279) | $(1,862)$ |
| 12 | $(1,232)$ | (917) | 185 | 143 | 464 | 239 | (670) | (89) | $(1,251)$ |
| 13 | (349) | 32 | 769 | 509 | 1,232 | 840 | 571 | (\%) | (372) |
| 16 | 352 | 5 m | 1,381 | 1,229 | 1,939 | 1,461 | 1,326 | 206 | 362 |
| 15 | ${ }^{973}$ | ${ }_{76} 9$ | 1,067 | 1,885 | 2,803 | 2,188 | 1,676 | 1,619 | 80 |
| 16 | 1.675 | 1.740 | 2,385 | 2,783 | 3,6\% | 2,783 | 2,211 | 2,049 | 1,300 |
| 17 | 2,293 | 2,239 | 3,093 | 3,586 | 3,891 | 3,2\% | 3,003 | 2,499 | 1,922 |
| 18 | 2,746 | 2,961 | 3,818 | 4.409 | 6,619 | 3,754 | 3,506 | 3,078 | 2,657 |
| 19 | 3,028 | 3,393 | 6,311 | 4,770 | 4,484 | 6.175 | 6. 193 | 3,432 | 2,205 |
| 20 | 3.697 | 3,806 | 4,895 | 5,393 | 5,156 | 4,582 | 6,738 | 4,027 | 3,238 |
| 21 | 4.125 | 4,527 | 3.402 | 5,893 | 5,565 | 3,129 | 5,060 | 4,733 | 3, 368 |
| 22 | 6,652 | 5.083 | 5,676 | 6,289 | 6.015 | 5.736 | 5,470 | 5,331 | 6,586 |
| 23 | 5,188 | 5,729 | 6,696 | 6,730 | 6,536 | 6.331 | 5,912 | 5,739 | 4,977 |
| 26 | 5.876 | 6,164 | 6,898 | 7,003 | 6,905 | 6,067 | 6,463 | 6,027 | 5,290 |
| 25 | 6,676 | 6.716 | 7,392 | 7,325 | 7.487 | 7,085 | 6,830 | 6.461 | 5,700 |
| 26 | 6,969 | 7,347 | 8.091 | 8,035 | 7,862 | 7,836 | 7.115 | 6,757 | 6.118 |
| 27 | 7.612 | 7,006 | 8,728 | 8,760 | 8,356 | 8,225 | 7.551 | 7,114 | 6,363 |
| 28 | 7,816 | 8,277 | 9.069 | 9,256 | 8.826 | 8,558 | 8,085 | 7.582 | 6,671 |
| 29 | 8,291 | 8,775 | 9.486 | 9,506 | 9.126 | 8,899 | 8,406 | 8.110 | 7.180 |
| 30 | 8,868 | 9,306 | 9,355 | 10,011 | 9.616 | 9,248 | 8,838 | 8,509 | 7,406 |
| 31 | 0,512 | 9.096 | 10,409 | 10,386 | 9.881 | 9,670 | 9,167 | 8,735 | 3.007 |
| 32 | 9,979 | 10,085 | 10,990 | 10,751 | 10,298 | 9,91 | 9,393 | 9,169 | 8,406 |
| 33 | 10,312 | 10,532 | 11,291 | 11,081 | 10,6\% | 10,340 | 9,720 | 9,493 | 3,690 |
| 36 | 10, 858 | 11,039 | 11,575 | 11,487 | 10,981 | 10,830 | 10,120 | 9,776 | 9.065 |
| 35 | 11,143 | 11,459 | 11,874 | 11,830 | 11,329 | 11,051 | 10,597 | 10,062 | 9,369 |
| 36 | 11,508 | 11,84 | 12, 153 | 12,229 | 11,702 | 11,481 | 10,996 | 10, 369 | , 764 |
| 37 | 11,806 | 12,126 | 12,537 | 12,559 | 12,259 | 12,101 | 11,389 | 10,677 | 10,109 |
| 38 | 12,107 | 12,625 | 12,853 | 12,872 | 12,696 | 12,400 | 11,876 | 11,015 | 10,327 |
| 39 | 12,570 | 12,898 | 13,197 | 13,389 | 13,087 | 12,636 | 12,158 | 11,390 | 10,505 |
| 40 | 12,972 | 13,366 | 13,600 | 13,685 | 13,357 | 12,967 | 12,489 | 11,677 | 10,765 |
| 41 | 13.420 | 13,863 | 13,930 | 16,211 | 13,626 | 13.412 | 12,721 | 11,962 | 11.186 |
| 42 | 13,873 | 16,198 | 16,357 | 14,636 | 13,973 | 13,701 | 12,910 | 12,290 | 11,548 |
| 43 | 14,230 | 14,396 | 14.654 | 14,681 | 14,607 | 16,052 | 13,165 | 12,587 | 11,826 |
| 64 | 14.657 | 14,723 | 14,997 | 14,965 | 14,779 | 14,455 | 13,576 | 12,910 | 12,179 |
| 65 | 16,910 | 15,078 | 15,258 | 15,271 | 15,097 | 16,791 | 13,928 | 13,332 | 12,686 |
| 46 | 15,285 | 15,599 | 15,630 | 15,506 | 15,448 | 15,128 | 14,315 | 13,619 | 12,992 |
| 67 | 15,820 | 16,015 | 16,076 | 15,917 | 15,766 | 15,433 | 14,709 | 13,964 | 13,469 |
| 48 | 16,375 | 16,398 | 16,348 | 16,156 | 16, 187 | 15,633 | 15,026 | 16,393 | 13,871 |
| 69 | 16,679 | 16,828 | 16,610 | 16,601 | 16,677 | 15,880 | 15,314 | 16,766 | 16,281 |
| so | 16,925 | 17,298 | 16,803 | 16,201 | 16,705 | 16,216 | 15,595 | 15,106 | 16,600 |
| 51 | 17.215 17 | 17.556 | 17.390 | 17,582 | 16,916 | 16,584 | 15,817 | 15,433 | 16,988 |
| 52 | 17.665 | 17,466 | 17,836 | 18,089 | 17,123 | 16,948 | 16,017 | 15,64 | 15,253 |
| 53 | 17.736 | 18,152 | 18,120 | 18,326 | 17,653 | 17,179 | 16,311 | 15,904 | 15,605 |
| 56 | 18,035 | 18,533 | 18.665 | 18,646 | 17,978 | 17,458 | 16,630 | 16,408 | 15,909 |
| 55 | 18,390 | 18,790 | 13,679 | 19,207 | 18,323 | 17, 866 | 17,062 | 17,004 | 16,179 |
| 56 | 18,906 | 19,201 | 19,332 | 19.003 | 18, 896 | 18,233 | 17,473 | 17.439 | 16,729 |
| 57 | 19,308 | 19,621 | 19,803 | 19,914 | 19.157 | 18,650 | 17, 852 | 17,736 | 17,111 |
| 58 | 19,921 | 20,075 | 20,466 | 20.295 | 19,729 | 19,131 | 18,222 | 18, 131 | 17,494 |
| 59 | 20,265 | 20,454 | 20,858 | 20.732 | 20, 109 | 19,593 | 18,202 | 13,347 | 17,882 |
| $\infty$ | 20.683 | 20,893 | 21, 170 | 21,012 | 20.568 | 20,025 | 19,266 | 18,674 | 18,317 |
| 61 | 20,982 | 21,327 | 21,533 | 21,606 | 21,091 | 20,49 | 19,812 | 19.220 | 18,606 |
| 62 | 21,299 | 21,769 | 21,966 | 22,005 | 21,535 | 20.969 | 20,439 | 19.717 | 18,962 |
| 63 | 21,726 | 22,075 | 22, 374 | 22,363 | 22,094 | 21,394 | 20,968 | 20,306 | 19,251 |
| 65 | 21,969 | 22,379 | 22,731 | 22,526 | 22,336 | 21,74 | 21,458 | 20,932 | 19,519 |
| 65 | 22, 250 | 22,762 | 23, 174 | 22,902 | 22,647 | 22,632 | 21, 848 | 21,355 | 20,032 |
| 66 | 22,361 | 23, 322 | 23,515 | 23,353 | 23,027 | 22,940 | 22, 130 | 21,5*4 | 20,519 |
| 67 | 23,395 | 23,681 | 23,906 | 23,726 | 23,675 | 23,206 | 22,461 | 22,045 | 20,352 |
| 68 | 23,925 | 26,308 | 24,485 | 24.016 | 26,007 | 23,558 | 22,945 | 22,656 | 21,137 |
| 69 | 26,470 | 26,708 | 26,964 | 26,393 | 24,452 | 23,791 | 23,303 | 22,418 | 21,505 |
| 70 | 25,848 | 25,091 | 25,590 | 26,850 | 26,958 | 26,235 | 23,636 | 23, 123 | 21,797 |
| 71 | 25, 281 | 25,613 | 25,912 | 25,271 | 25,310 | 26,761 | 23.948 | 23,433 | 22.100 |
| 72 | 25,663 | 25,997 | 26,318 | 25,497 | 25,783 | 25,171 | 26,352 | 23,790 | 22,370 |
| 73 | 26. 292 | 26,285 | 26.670 | 26.370 | 26, 292 | 25,530 | 25,066 | 26.128 | 22,756 |
| 76 | 26,682 | 26,032 | 27,085 | 26.697 | 26,784 | 26,078 | 25,439 | 26,549 | 23,164 |
| 75 | 27, 218 | 27.146 | 27,510 | 27.119 | 27, 240 | 26.779 | 26.119 | 28,490 | 23,508 |
| 76 | 27,916 | 27, 264 | 27.926 | 27,570 | 27.713 | 27,206 | 26.481 | 25,320 | 26,056 |
| 77 | 28, 236 | 28,256 | 28,285 | 27.890 | 28,006 | 27.655 | 27,172 | 25,673 | 26,673 |
| 78 | 28,596 | 26, 303 | 28,700 | 28,453 | 28,971 | 28,041 | 27, 592 | 23, 142 | 25, 107 |
| 79 | 29,654 | 29,353 | 29,187 | 29.120 | 28,791 | 28,505 | 27,401 | 2\%,615 | 25.703 |
| 80 | 30.407 | 29.929 | 29,876 | 29.893 | 29,259 | 28,995 | 28,226 | 27.106 | 27,377 |
| 81 | 30, 823 | 30,758 | 30,613 | 30, 54. | 29,976 | 29,419 | 28,467 | 27.406 | 28, 294 |
| 82 | 31,176 | 31.35 | 31,253 | 31,316 | 30,530 | 29,860 | 29,003 | 28, 109 | 27.543 |
| 83 | 31,661 | 31,917 | 31,825 | 31,467 | 31,200 | 30,369 | 29,573 | 26,455 | 28,025 |
| 85 | 32,385 | 32,720 | 32,466 | 32,286 | 31,883 | 31,092 | 30,477 | 29,573 | 26,754 |
| 85 | 33, 171 | 33,345 | 35, 116 | 32, 305 | 32,701 | 31,008 | 31,128 31.760 | 30, 108 | 29,326 |
| 86 | 33,759 | 34,016 | 33, 855 | 33,633 | 33,248 | 32,606 | 31,760 | 30, 813 | 29,879 |
| 87 | 35,189 <br> 58 | 35,680 | 33,848 | 33,717 | 33,920 | 33,251 | 32,854 | 31,713 | 30,517 |
| 88 | 35.467 | 35,698 | 35,917 | 35,950 | 36,929 | 34,255 | 33,916 | 32,468 | 31,038 |
| 89 | 36,728 | 36,793 | 36,612 | 36,841 | 35,662 | 35,115 | 34,694 | 33,432 | 31,763 |
| 90 | 37.776 | 37,825 | 37.606 | 37,620 | 36,175 | 36.026 | 35,238 | 36,248 | 32,672 |
| 91 | 39.019 | 39,008 | 33,616 | 38, 386 | 37. 102 | 36.491 | 36,076 | 36,931 | 33,871 |
| 92 | 39,849 | 39,772 | 39,488 | 39, 176 | 36, 287 | 37,372 | 36,983 | 35,995 | 35,056 |
| 93 | 40,915 | 40,928 | 40,210 | 40, 157 | 39,330 | 39.165 | 38,189 | 36.321 | 36,147 |
| 9 | 41,972 | 42.043 | 41,546 | 41,229 | 40,595 | 40.176 | 38,970 | 37,74 | 37,066 |
| 95 | 43,009 | 42.885 | 42,807 | 42, 150 | 61,971 | 40,921 | 39,873 | 38,403 | 38, 191 |
| 96 | 44, 275 | 4,069 | 45.264 | 44,395 | 63.115 | 42,556 | 41,718 | 39.826 | 39,254 |
| 97 | 45,351 | 45.692 | 45, 802 | 46,502 | 45.223 | 44.239 | 43,516 | 42,162 | 41,381 |
| 98 | 48,767 | 48,597 | 48,570 | 48, 806 | 67.700 | 65,866 | 46,527 | 45,058 | 63,916 |
| 9 | 54,098 | 54,165 | 53, 199 | 53.716 | 53,634 | 53,474 | 52,567 | 50,459 | 47,914 |
| 100 | 67,116 | 66,698 | 64,329 | 64,136 | 63,001 | 61,243 | 59,873 | 57.674 | 56,710 |
| can | 17.677 | 17,703 | 17,999 | 18.035 | 17,765 | 17,366 | 16,803 | 16,150 | 15,326 |
| stoer | 15,677 | 15,576 | 15,177 | 15,011 | 14,463 | 16,659 | 14,265 | 13,499 | 13,721 |


| $\begin{aligned} & \text { percontile } \\ & \text { No } \end{aligned}$ | - 65 | 70 | 73 | 80 | $n=\left(\ln _{i s}\right)$ | 0 | 4 | 100 | 105 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | (4,986) | (3,950) | (3,850) | $(2,353)$ | $(2,729)$ | $(4,238)$ | $(3,255)$ | $(2,557)$ | $(3,815)$ |
| 2 | 3,352 | 4,194 | 4.805 | 4.729 | 4,301 | 6.789 | 6,132 | 2,783 | 2,821 |
| 3 | 6.651 | 6,405 | 7.913 | 8,145 | 7.801 | 7,836 | 7.116 | 6,445 | 5,465 |
| 4 | 3,343 | 1,861 | 9,853 | 10,161 | , 770 | 1,40 | 1,739 | 7.663 | 6,953 |
| 5 | 10,259 | 10,781 | 11,501 | 11,940 | 11,776 | 10, 856 | 10,265 | 9,578 | 8.112 |
| 6 | 11,507 | 12,441 | 13, 106 | 13, 179 | 13,115 | 12,199 | 11,716 | 11,326 | 9,721 |
| 7 | 12,904 | 13.439 | 14,637 | 14,269 | 14,121 | 13,640 | 12,746 | 12,496 | 11,587 |
| 8 | 16.492 15.92 | 14.651 15 | 14,930 | 15,485 | 15,213 | 16,746 | 13,568 | 13,597 | 12.823 |
| , | 15,618 | 15,763 | 15,815 | 16,361 | 16,206 | 16,121 | 14,841 | 14,590 | 13,622 |
| 10 | 16,361 | 17,125 | 16,958 | 17.600 | 17,677 | 17,086 | 15,835 | 15,626 | 14,75 |
| 11 | 17.447 | 13,401 | 18,329 | 18,615 | 18.481 | 17,792 | 16,965 | 16.401 | 13,450 |
| 12 | 18,318 | 19.156 | 19,427 | 19,146 | 19,219 | 13,620 | 17.832 | 16,948 | 15,912 |
| 13 | 18,974 | 19,677 | 20,051 | 20,263 | 19,779 | 19.217 | 18,628 | 17,688 | 16,502 |
| 16 | 19,694 | 20,306 | 20,701 | 21,050 | 20,479 | 20,239 | 19,517 | 18,398 | 17,297 |
| 15 | 20,566 | 21,200 | 21.611 | 21,640 | 21,123 | 21,017 | 20.192 | 19.035 | 18,003 |
| 16 | 21,512 | 21.813 | 21, 267 | 22,265 | 21,973 | 21,589 | 20, 811 | 19,478 | 18,731 |
| 17 | 22,199 | 22,472 | 22,352 | 22,448 | 22,659 | 22,230 | 21,312 | 20,085 | 19,474 |
| 18 | 22,876 | 23, 119 | 22,995 | 23,446 | 23, 272 | 23, 047 | 21,828 | 20,657 | 20,173 |
| 19 | 23,444 | 23,672 | 23, 549 | 26, 263 | 23,916 | 23,692 | 22,558 | 21,001 | 20,901 |
| 20 | 24,062 | 24,538 | 26,620 | 25,962 | 26,643 | 24,000 | 23,165 | 21,699 | 21,392 |
| 21 | 26,577 | 26,946 | 25,379 | 25,565 | 25,321 | 26,546 | 23,657 | 22,438 | 21,819 |
| 22 | 25,914 | 25,538 | 26,085 | 26, 221 | 26,169 | 25.252 | 26,200 | 23,287 | 22,315 |
| 23 | 26,786 | 26,363 | 26, 337 | 27,211 | 26,744 | 26,203 | 26,793 | 23,741 | 22,850 |
| 26 | 27.397 | 27.153 | 27,360 | 27.768 | 27,292 | 26,743 | 25,526 | 26,331 | 23,246 |
| 25 | 27,896 | 27.649 | 28,052 | 28,248 | 27,661 | 27, 232 | 26,089 | 26,874 | 26,001 |
| 26 | 28,540 | 28,203 | 28,616 | 28, 889 | 28,061 | 27.530 | 26,768 | 25,380 | 26,499 |
| 27 | 29.072 | 29,095 | 28,951 | 29.236 | 28,619 | 27,78 | 27,331 | 26,113 | 25,067 |
| 28 | 29,820 | 29,857 | 29.767 | 29,801 | 29,051 | 28,326 | 27,782 | 26.618 | 25,658 |
| 29 | 30,657 | 30,572 | 30.293 | 30,399 | 29.745 | 29,057 | 28,177 | 27,090 | 28.484 |
| 30 | 31.055 | 31.033 | 30,929 | 31,093 | 30,304 | 29,597 | 28,792 | 27,788 | 26,917 |
| 31 | 31,501 | 31,758 | 31,937 | 31,700 | 30,814 | 30.145 | 27,465 | 28,419 | 27, 05 |
| 32 | 32,032 | 32,493 | 32,806 | 32,329 | 31,179 | 30,553 | 29,666 | 28,861 | 27,976 |
| 33 | 32,387 | 33,186 | 33,912 | 33.037 | 31,708 | 31.085 | 30,212 | 29,651 | 28,569 |
| 36 | 32,819 | 33,809 | 34,564 | 33,741 | 32,348 | 31,652 | 30,613 | 30,056 | 28,908 |
| 35 | 33,363 | 34,222 | 35,098 | 34,219 | 33,069 | 32,322 | 31,358 | 30,560 | 29.146 |
| 36 | 33,961 | 34, 763 | 35,581 | 34, 816 | 33,880 | 32,96 | 32,015 | 31.011 | 29, 546 |
| 37 | 34,530 | 35,236 | 36, 107 | 35,285 | 34,371 | 33,600 | 32,520 | 31.71 | 30,378 |
| 38 | 35, 110 | 35,673 | 36,487 | 35,730 | 34,760 | 34,184 | 32,933 | 32,311 | 31,053 |
| 39 | 35,436 | 36,050 | 36,869 | 36,166 | 35,398 | 34,966 | 33,388 | 32,719 | 31,475 |
| 40 | 35,835 | 36,626 | 37, 163 | 36,546 | 35,858 | 35,322 | 33,933 | 33,062 | 31,906 |
| 41 | 36,446 | 37.161 | 37,670 | 37,008 | 36,269 | 35,625 | 36,616 | 33,611 | 32,365 |
| 42 | 37,016 | 37,503 | 38,052 | 37,506 | 36,653 | 35,899 | 36,857 | 34,206 | 32,907 |
| 63 | 37.089 | 37,928 | 38,672 | 37,931 | 37.145 | 36,406 | 35,236 | 34,732 | 33,595 |
| 4 | 38,264 | 38,382 | 39,021 | 38,210 | 37.652 | 36,893 | 35,711 | 35,161 | 33,927 |
| 45 | 38,861 | 38,718 | 39,566 | 38.607 | 37.953 | 37,360 | 36,516 | 35,607 | 34,316 |
| 46 | 39,208 | 39,054 | 39.900 | 39,218 | 38.076 | 37,756 | 37.109 | 36,072 | 34,806 |
| 67 | 39,601 | 39,370 | 40,348 | 39.738 | 38,318 | 38,039 | 37,636 | 36,491 | 35,238 |
| 48 | 39,919 | 39.737 | 40,709 | 40,180 | 38,744 | 38,310 | 37,851 | 36,982 | 35,562 |
| 49 | 40,731 | 40,281 | 41,051 | 40.046 | 39,243 | 34,066 | 38,206 | 37.417 | 35,908 |
| 50 | 41,355 | 61,003 | 41,439 | 41,072 | 39.774 | 34,048 | 36,573 | 37,759 | 36,203 |
| 51 | 41,447 | 41,401 | 41,709 | 61,351 | 40,378 | 39,401 | 39,149 | 36,057 | 36,503 |
| 52 | 42, 623 | 41,924 | 42, 182 | 41,757 | 40.897 | 39,905 | 39,565 | 38,530 | 36,928 |
| 53 | 42,920 | 42,570 | 42,578 | 42.326 | 61,550 | 40,326 | 40,023 | 39,065 | 37,328 |
|  | 43,312 | 42.911 | 42,999 | 42,762 | 42,002 | 40,877 | 40,517 | 39,544 | 37,730 |
| 55 | 43, 465 | 43,364 | 43,313 | 43.195 | 42,367 | 41.651 | 40,770 | 39,987 | 38,271 |
| 56 | 44, 195 | 43,900 | 43.674 | 43.760 | 42,350 | 42,042 | 61.251 | 40,377 | 38,64 |
| 57 | 44, 546 | 44,308 | 4, 4181 | 4, 428 | 43,306 | 42.478 | 61,770 | 40,712 | 39,237 |
| 58 | 46, 895 | 46,693 | 45,760 | 46, 45 | 43,779 | 43,304 | 42, 282 | 41.018 | 39,722 |
| 59 | 65, 281 | 65,013 | 65, 352 | 45,203 | 46, 260 | 43,708 | 42.627 | 61, 4.9 | 40,350 |
| 60 | 45,891 | 45,546 | 45,922 | 45,604 | 64,693 | 44,090 | 42,999 | 42,197 | 40,965 |
| 61 | 46.628 | 46,235 | 46,613 | 46,222 | 65,478 | 44,619 | 63,396 | 42,502 | 61,234 |
| 62 | 46,997 | 46,653 | 47.164 | 56,048 | 65,910 | 4.905 | 43.880 | 42.736 | 41,575 |
| 63 | 47.622 | 47,238 | 47,547 | 47,066 | 46.41 | 45,349 | 4.635 | 63,116 | 41,976 |
| 66 | 48.038 | 47.810 | 48, 180 | 47.698 | 46.711 | 45,977 | 4, 635 | 43,547 | 42,46 |
| 65 | 48,587 | 48,695 | 48.735 | 47.928 | 47,111 | 46,331 | 45,354 | 44, 110 | 42,778 |
| 66 | 49,306 | 48,909 | 49,221 | 48,480 | 47,647 | 46,76 | 45,821 | 4, 635 | 43,265 |
| 67 | 50.056 | 49,538 | 49,743 | 49,002 | 48,390 | 47.090 | 46,229 | 45,091 | 43,499 |
| 68 | 50, 365 | 50,052 | 50, 188 | 49,676 | 48,931 | 47,500 | 46,545 | 45,516 | 4.,055 |
| 69 | 50,757 | 50,784 | 50,513 | 50, 378 | 49.44 | 43,372 | 47,186 | 45,925 | 46,500 |
| 70 | 51,054 | 51,078 | 51,036 | 50, 870 | 49,909 | 48,663 | 4,222 | 46,293 | 65,104 |
| 71 | 51,612 | 51, 592 | 51,638 | \$1,300 | 50,590 | 49,378 | 48,769 | 66,923 | 45,898 |
| 72 | 52,366 | 52, 249 | 51,943 | 51,829 | 51,258 | 49,900 | 69,565 | 67,707 | 4,425 |
| 73 | 52,928 | 52,875 | 52,671 | 52,390 | 51,635 | 50,470 | 50.136 | 48, 278 | 67, 101 |
| 76 | 53,526 | 53, 285 | 52,970 | 52,883 | 52,139 | 51,356 | 50,549 | 48,840 | 47,464 |
| 75 | 54, 188 | 53,753 | 53,444 | 53.45 | 52,640 | 52,162 | 51,501 | 69,793 | 48,126 |
| 76 | 55,002 | 54,672 | 56,369 | 53,935 | 53,291 | 52,742 | 52,202 | 50,537 | 4,409 |
| 77 | 55,827 | 55, 335 | 55,190 | 54, 856 | 53,939 | 53, 378 | \$2,920 | 51,098 | 49,129 |
| 78 | 56,588 | 56, 232 | 55,761 | 55,762 | 54,357 | 53,770 | 53,422 | 51,948 | 49, 203 |
| 79 | 57,517 | 57,237 | 56, 775 | 56,356 | 55,039 | 54,226 | 53,933 | 52,731 | 50,351 |
| 80 | 58,099 | 57,919 | 57.028 | 56,970 | 55,655 | 54,313 | ${ }_{5}^{53,623}$ | 53, 363 | 51,010 |
| 81 | 58,585 | 58,614 | 57.761 | 57.534 | 56,508 | 55, 631 | 55,138 | 53,680 | 51,965 |
| 82 | 59.201 | 59,060 | 58,702 | 58,283 59 | 57,690 | 56,555 | 55, 772 | 54,356 | 52,906 |
| 83 | ${ }^{60,073}$ | 59,799 | 59,596 | 59,167 | 58,188 | 57.45 | 56,357 | 54,955 | 53,357 |
| 85 | 60,978 | 00,606 | 60,409 | 59,938 | 59, 310 | 58, 131 | 57, 264 | 55,439 | 54,286 |
| 85 | 62.046 | 61,628 | 61,400 | 60,616 | 60,476 | 59,234 | 58,263 | 56,500 | 56,900 |
| 86 | 62,719 | 62,672 | 62,548 | 61,622 | 61,410 | 59.407 | 59,155 | 57,653 | 55,615 |
| 87 | 63,470 <br> 600 | 63,461 | 63,390 | 62,798 | 62,091 | 61, 193 | 59.870 | 88, 359 | 56,302 |
| 88 | 66,700 | 64,680 | 64,057 | 63,710 | 63,306 | 61,921 | 60,608 | 59,266 | 57,033 |
| 89 | 66,013 | 65,447 | 65,316 | ${ }_{66} 689$ | 4, 4.45 | 63,354 | 61,890 | 60, 104 | 57,970 |
| 90 | 67.167 68.822 | 66,783 | 66,630 67.495 | 66,297 | 65,450 | $\begin{array}{r}46.632 \\ \\ \hline 6.238\end{array}$ | 63, 522 | 60,992 | 59.255 |
| 91 | 68,822 70,079 | 68,555 70,011 | 67,995 70,013 | 67,528 69,235 | 66,740 68,311 | 66,233 | 65,612 c\%,876 | 62,878 64,476 | 60,856 62,368 |
| 93 | 71, 380 | 71, 765 | 72, 048 | 71, 314 | 70, 702 | 69,677 | 68,679 | 66, 312 | 62, 293 |
| 9 | 72,778 | 73,755 | 73,523 | 73, 167 | 72, 102 | 71,006 | 69,375 | 67,561 | 6, 072 |
| 95 | 74,979 | 75,713 | 75,046 | 75,440 | 73,680 | 72, 227 | 71,723 | 69,975 | 68,484 |
| 9 | 77.675 | 77.097 | 77,406 | 77,146 | 76,185 | 76, 293 | 76, 792 | 71,900 | 70,338 |
| 97 | 80,288 | 79,\%5 | 80,050 | 79,012 | 78,846 | 77.737 | 75,540 | 74,486 | 71,956 |
| 98 | 83, 297 | 84, 222 | 82, 297 | 82, 690 | 81,315 | 80, 189 | 78,042 | 77.305 | 75,618 |
| 9 | 87,012 | 87,870 | 87,137 | 86,513 | 85,683 | 4,208 | 83,320 | 81,562 | 80,103 |
| 100 | 101,675 | 101,019 | -3,066 | 97,535 | 97, 115 | \%,282 | 12,092 | 89,850 | 4,287 |
| Mcan | 42,006 | 42.071 | 62,196 | 61,991 | 61,267 | 40,511 | 39,621. | 38,465 | 37.125 |
| stoer | 19,798 | 19,605 | 19,269 | 19,006 | 18,860 | 13,653 | 18,486 | 18,109 | 17,739 |


|  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |


| Percentite | 65 | 70 | 73 | $\infty^{n c}=\left(\ln _{s 5}\right)$ | 90 | 95 | 100 | 105 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |






| percentile No | - 65 | 70 | 73 | 30 | $\overline{n c}=\left({ }_{35}\right)$ | 9 | 4 | 100 | 105 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | $(3,887)$ | $(3,076)$ | $(1,972)$ | (905) | (822) | $(2,176)$ | (1,606) | (643) | (2,392) |
| 2 | 4,572 | 5,932 | 5,623 | 6.121 | 6,002 | 6,483 | 5.420 | 5.674 | 4,430 |
| 3 | 7.763 | 8,818 | 3,772 | 8.906 | 9.830 | 9,756 | 8,431 | 3,511 | 7.699 |
| 4 | 10,476 | 10,656 | 11,311 | 10, 897 | 11,359 | 11,862 | 11,097 | 10,363 | 9,99 |
| 5 | 12,316 | 12,577 | 12,849 | 13.067 | 12,844 | 13,547 | 12,652 | 11,675 | 11.219 |
|  | 13, 806 | 16,651 | 16,710 | 15,070 | 14.654 | 16,507 | 13,568 | ${ }^{13,023}$ | 11,761 |
| 7 | 13,158 | 15,787 | 15,985 | 16,315 | 15,627 | 15,650 | 16,531. | 13,808 | 12,951 |
| , | 16,209 | 16,830 | 17,156 | 17,460 | 16,609 | 16,656 | 15.611 | 14,986 | 13, 396 |
| 9 | 17,111 | 18,023 | 18,308 | 13,627 | 17,856 | 17,327 | 16,388 | 15,857 | 14,854 |
| 10 | 18,043 | 19,069 | 18,972 | 19,652 | 18,976 | 18,076 | 17.246 | 16,923 | 15,767 |
| 11 | 19,195 | 19,930 | 20.186 | 20, 370 | 19,792 | 18,485 | 18,301 | 17,977 | 16,846 |
| 12 | 19,971 | 20,609 | 21.058 | 20,845 | 20.413 | 19,570 | 18,961 | 18,462 | 17.40 |
| 13 | 20,680 | 20,998 | 21,791 | 21, 605 | 20,998 | 20,697 | 19,757 | 19,200 | 13,545 |
| 16 | 21, 885 | 21,731 | 22,639 | 22,236 | 21.490 | 21,383 | 20,661 | 19,709 | 19,148 |
| 15 | 22,482 | 22,855 | 23,253 | 23, 127 | 22,581 | 22,209 | 21,320 | 20, 110 | 19,659 |
| 16 | 23,654 | 23,432 | 23,609 | 23,632 | 23,019 | 22,353 | 21,815 | 20,705 | 20,25 |
| 17 | 24,206 | 24,214 | 24.402 | 26,213 | 23,438 | 23,423 | 22,482 | 21,291 | 20,628 |
| 18 | 26, 827 | 26,6\% | 26,891 | 26,8\% | 26,189 | 23, 813 | 23,158 | 21, 315 | 21,108 |
| 19 | 25,627 | 25,261 | 25,410 | 25,7\% | 26,728 | 26,477 | 23,854 | 22,550 | 21,485 |
| 20 | 25,890 | 25,700 | 26,036 | 26,350 | 25, 270 | 25,252 | 26,286 | 23.147 | 22,011 |
| 21 | 26,416 | 26, 347 | 26,661 | 26, 805 | 25,767 | 25,714 | 26,861 | 23,709 | 22,719 |
| 22 | 26,986 | 27,206 | 27,140 | 27,364 | 26, 269 | 26,206 | 25,432 | 26, 502 | 23, 202 |
| 23 | 27,561 | 27.761 | 27.685 | 27.872 | 26,906 | 26,689 | 25,850 | 25, 101 | 23,765 |
| 24 | 28,080 | 28,257 | 28,356 | 26,528 | 27,615 | 27, 262 | 26, 268 | 25,462 | 26,510 |
| 25 | 28,826 | 28, 118 | 29.167 | 29,046 | 27,986 | 27,834 | 26,061 | 25,907 | 26,90\% |
| 26 | 29.365 | 29.188 | 29,680 | 29.581 | 28,321 | 28,077 | 26,992 | 26.601 | 25,257 |
| 27 | 29.748 | 29,576 | 30,118 | 30, 183 | 29,013 | 28,377 | 27,360 | 27.162 | 25,571 |
| 28 | 29.957 | 29,987 | 30,776 | 30,722 | 29,639 | 28,854 | 27.827 | 27.481 | 25,873 |
| 29 | 30,675 | 30,353 | 31,226 | 31,046 | 30,075 | 29,362 | 28, 295 | 27,833 | 26,383 |
| 30 | 31,080 | 30,908 | 31,658 | 31,585 | 30,580 | 29,682 | 28,741 | 28,247 | 27,019 |
| 31 | 31,603 | 31,541 | 32,271 | 31,990 | 31,082 | 30,019 | 29,271 | 28,631 | 27,563 |
| 32 | 31,772 | 31.917 | 32,664 | 32,281 | 31,506 | 30,605 | 29,859 | 28,947 | 27,922 |
| 33 | 32,204 | 32,349 | 33,065 | 32,570 | 32,153 | 31,152 31 | 30,339 | 29, 386 | 28,268 |
| 34 | 32,912 | 33,055 | 33,371 | 33, 264 | 32,586 | 31,691 | 31,019 | 29,883 | 28,791 |
| 35 | 33,526 | 33,533 | 33,670 | 33,739 | 33, 126 | 32,252 | 31,562 | 30,486 | 29,216 |
| 36 | 34,051 | 36,092 | 36,151 | 34,122 | 33,565 | 32,672 | 32,090 | 30,738 | 29,593 |
| 37 | 34,551 | 34,392 | 36,615 | 34,368 | 34,082 | 33, 163 | 32,610 | 31.276 | 30,151 |
| 38 | 34,901 | 34,008 | 34,914 | 34,630 | 34,622 | 33, 738 | 33,069 | 31,708 | 30,537 |
| 39 | 35,339 | 35,100 | 35,628 | 35,235 | 34,596 | 34,126 | 33,560 | 32,361 | 30,999 |
| 40 | 35,729 | 35,77 | 36,075 | 35,614 | 35,225 35 | 34,496 | 35, 895 | 32,979 | 31,677 |
| 41 | 36,237 | 36, 185 | 36,687 | 36, 107 | 35,598 | 35,083 | 34,369 | 33,391 | 32,081 |
| 62 | 36.647 | 36,720 | 37,023 | 36.600 | 35,906 | 35,536 | 34,776 | 33,762 | 32,350 |
| 43 | 37.229 | 37,074 | 37.627 | 37,122 | 36,571 | 35,905 | 35,169 | 34,030 | 32,822 |
| 46 | 37.716 | 37,569 | 37.84 | 37,700 | 36,970 | 36,216 | 35,596 | 34,306 | 33, 138 |
| 45 | 38,175 | 38,181 | 38,270 | 38,785 | 37,708 | 36,719 | 35,953 | 34,639 | 33,453 |
| 66 | 38,552 | 38,514 | 38,891 | 38,887 | 38,362 | 37,033 | 36,352 | 35, 121 | 33,799 |
| 47 | 39,083 | 38,969 | 39,508 | 39,620 | 38,733 | 37,492 | 36,676 | 35,469 | 34, 278 |
| 48 | 39,742 | 39,709 | 40,016 | 39,836 | 39,076 | 34,161 | 37.158 | 35,961 | 36,590 |
| 69 | 40.197 | 40, 279 | 40,401 | 40,1\% | 39,479 | 38,611 | 37,722 | 36,562 | 35,969 |
| So | 40,540 | 40,877 | 40.749 | 40,477 | 39,792 | 38,976 | 38,366 | 36,89\% | 35,308 |
| 51 | 61,034 | 61,323 | 40,966 | 40,960 | 40,349 | 39,543 | 38,861 | 37,251 | 35,696 |
| 52 | 61,611 | 41.747 | 41,585 | 41.299 | 40,737 | 39,920 | 39, 172 | 37.533 | 36,283 |
| 53 | 42,632 | 42,078 | 42, 207 | 41,201 | 41,288 | 40,200 | 39,753 | 37.877 | 36,627 |
| 54 | 42.921 | 42,459 | 42,588 | 42,181. | 41,551 | 40,595 | 40,140 | 38,363 | 36,990 |
| 55 | 43,540 | 42,955 | 43.045 | 42,783 | 41,861 | 41,221 | 40.463 | 38,625 | 37,300 |
| 56 | 43,946 | 43,300 | 43,615 | 43,454 | 42,230 | 41,510 | 40,648 | 38,455 | 37.571 |
| 57 | 46, 217 | 43,931 | 44,106 | 43,835 | 42,622 | 41.868 | 40,918 | 37,371 | 38,120 |
| 58 | 46,612 | 44,324 | 44,693 | 44,351 | 42,988 | 42,202 | 41,287 | 40,076 | 38.612 |
| 59 | 45,010 | 44,755 | 44,971 | 4,660 | 43,365 | 42,756 | 41,690 | 40,505 | 39,056 |
| $\infty$ | 45,544 | 45.470 | 45,434 | 44,937 | 43,993 | 43.203 | 42,093 | 41,053 | 39,505 |
| 61 | 66,038 | 46,050 | 45,875 | 45,306 | 44,493 | 43,708 | 42,672 | 41,478 | 99,455 |
| 62 | 46,436 | 46, 479 | 46. 129 | 45,74 | $4{ }^{4}, 914$ | 44.193 | 43,332 | 41,954 | 40,335 |
| 63 | 66,999 | 67, 118 | 46,577 | 46,762 | 45,489 | 44,788 | 43,855 | 42.457 | 40,879 |
| 66 | 47,583 | 47.511 | 46,989 | 46,74 | 45,966 | 45,344 | 44,233 | 42,733 | 41,359 |
| 65 | 48.077 | 47,878 | 47.438 | 47,211 | 46.453 | 45,931 4 | 45.735 | 43.075 | 62,099 |
| 68 | 48,562 | 48,330 | 47.819 | 47,705 | 47,249 | 46,363 | 45,190 | 43,601 | 42,623 |
| 67 | 49.057 | 48,937 | 48, 196 | 48,202 | 47.887 | 46, 885 | 45,691 | 46,243 | 43,251 |
| 68 | 49.554 | 49,350 | 48,505 | 48.695 | 48.454 | 47,276 | 46,429 | 46,205 | 63,762 |
| 69 | 49,975 | 49.906 | \$9, 186 | 49,085 | 48,972 | 47,882 | 46,398 | 45,691 | 4.212 |
| 70 | 50,515 | 50,325 | ${ }_{50}^{40.693}$ | 49,632 | 49.365 | 48,599 | 47.306 | 65.989 | 4. 403 |
| 71 | 51,006 |  | 50,565 | 50,319 | 49,786 | 49.138 | 47,586 | 46,308 | 45,213 |
| 72 | 51,300 | 51,396 | 51,611 | 51,036 | 50,133 | 49.532 | 47.999 | 46.954 | 65.671 |
| 73 | 51,721 | 51,860 | 52,039 | 51,586 | 50,607 | 50,013 | 48,482 | 67,361 | 46, 102 |
| 76 | 52.112 | 52,323 | 52, 51 | 52,115 | 51,167 | 50,532 | 48.949 | 47,47 | 46.472 |
| 75 | 52,676 | 52,719 | 53,162 | 52,622 | 51,664 | 50,985 | 49.383 | 4, 3\% | 46.451 |
| 76 | 53,664 | 53,499 | 53, 002 | 53,034 | 52,360 | 51.440 | 49,936 | 48,890 | 67.41 |
| 77 | 54,398 | 54,216 | 54,301 | 53, 418 | 53,018 | 51,923 | 50,654 | 69.489 | 4, 178 |
| 78 | 54,976 | 54,948 | 55,188 | 54,319 | 53,476 | 52, 335 | 51,116 | 50,194 | 45,597 |
| 79 | 55,538 | 55,979 | 55,761 | 55,305 | ${ }^{34} \mathbf{5}, 221$ | 53,019 | 51,067 | 50,900 | 64, 682 |
| 80 | 56,645 | 56, 801 | 56, 365 | 56,038 | 55,089 | 33,712 | 52.128 | 51,573 | 50, 106 |
| 81 | 57,992 | 57,609 | 57.173 | 56, 681 | 56,057 | 54,409 | 52, 549 | 52,028 | 50,452 |
| ${ }_{83}^{82}$ | 58,437 59 | 58,40 59 | 57,921 | 57.328 | ${ }_{56,085}$ | ${ }^{56}, 977$ | 38,501 | 52,540 | 30,235 |
| 83 | 59,669 | 54.479 | 58,672 | 58,251 | 57.050 | 56,057 | 54.409 | 53,349 | 51,499 |
| 85 | 60,551 | \$0,295 | 59,514 | 59,318 | 57,465 | 56,951 | 55,116 | 54,020 | 52, 191 |
| 85 | 61,393 | ${ }^{61,326}$ | 60,036 | 60,450 | 58,303 | 57.610 | 56,080 | 54, 623 | 33, 169 |
| 86 | 62, 182 | 61,966 | 61,000 | 61,215 | 59, 142 | 58,297 | 57.050 | 55,911 | 54.064 |
| 87 88 | 62,795 63,450 | 62,813 63,74 | 62,069 63,227 | 62,046 62,930 | 50,999 | 59,113 00,365 | 57.874 59.021 | 5.138 58.07 | 54.925 56.165 |
| 89 | 66,932 | 64,335 | 64, 313 | 63,857 | 61,901 | 61,006 | 60,163 | 59,278 | 57,223 |
| 90 | 65, 806 | 65.671 | 65, 132 | 65,670 | 42,836 | 42,761 | 61,592 | 60,625 | 58,462 |
| 91 | 66,006 | 66, 512 | 65,864 | 65,579 | 63,904 | 63,665 | 62,755 | 61,693 | 59.886 |
| 92 | 67,826 | 68, 175 | 67, 263 | 66,910 | 65,292 | 64,923 | 63,676 | 62, 232 | 60,978 |
| 93 | 69,453 | ${ }^{60} .805$ | 68,75 | 68, 138 | 67,376 | 46,380 | 6, 621 | ${ }_{63}{ }^{4}, 112$ | 62,028 |
| 9 | 71.172 72 | 71,209 | 70, 369 | 69,470 | 88,793 | 67,765 | 66, 730 | ${ }_{6}^{6} .862$ | 63, 107 |
| 95 | 72,936 | 73.111 76.292 | 71,952 | 71, 203 | 70,096 | ${ }^{69} .077$ | 68,165 | 66, 164 | 64,776 |
| 96 | 74,758 | 74.292 | 73,582 | 72,516 | 71,681 | 70,747 | 69,592 | 67, 807 | 66.618 |
| 97 | 76,778 | 76,807 | 75,969 | 74,628 | 73,776 | 72,865 | 71.655 | 70,482 | 68,269 |
| 98 | 79,754 | 79,4\% | 79,692 | 73,566 | 76, 317 | 75, 817 | 74.690 | 73, 369 | 72,002 |
| ${ }_{10}$ | 86,200 | 35,016 | ${ }^{84,698}$ | 83,711 | 82,503 | 81,293 | 80,310 | 79,40 | 73,628 |
| 100 | 105,035 | 106,35 | 103,605 | 103,095 | 101,636 | 100,216 | 98,986 | 96,567 | 9,085 |
| mean | 41,867 | 61,914 | 61,8\% | 41.689 | 40,850 | 40.172 | 39,174 | 38, 102 | 36,818 |
| stoer | 18,802 | 18,631 | 13,274 | 18,020 | 17,749 | 17,529 | 17,346 | 17,066 | 16,860 |



| $\begin{aligned} & \text { percentile } \\ & \text { to } \end{aligned}$ | - 65 | 70 | 73 | $\infty$ | $\overline{n c}=\left(\text { Br }_{s}\right)$ | 9 | 93 | 100 | 105 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | $(28,610)$ | $(27,702)$ | (26, 585) | $(25,101)$ | (23,467) | (23,031) | (22,620) | (22,065) | (23,039) |
| , | (26,946) | $(26,066)$ | $(22,927)$ | $(21,832)$ | (21,513) | (21,036) | (20,716) | $(20,304)$ | (20,393) |
| 3 | $(22,767)$ | $(21,529)$ | $(21,005)$ | $(20,491)$ | (19,885) | $(19,511)$ | $(19,232)$ | $(19,163)$ |  |
| 4 | $(21,426)$ | $(20,730)$ | $(19,935)$ | $(19,157)$ | (18,684) | $(18,077)$ | $(18, \infty 1)$ | $(17,855)$ | $(17.675)$ |
| 5 | $(20,574)$ | $(19,83)$ | $(18,770)$ | (18, 228 ) | $(17,646)$ | (17,015) | $(17,205)$ | $(16,922)$ | $(17,040)$ |
|  | $(19,812)$ | $(19,225)$ | $(18,150)$ | $(17,619)$ | ( 16.828 ) | $(16,118)$ | $(16,422)$ | $(15,954)$ | $(16,254)$ |
| 7 | (19,226) | $(18,722)$ | $(17,507)$ | $(16,600)$ | $(16,199)$ | $(15,580)$ | $(15,753)$ | $(15,282)$ | $(15,819)$ |
| 1 | $(18,904)$ | $(18,262)$ | $(16,922)$ | $(15,994)$ | $(15,500)$ | (14,968) | $(15,119)$ | $(14,963)$ | $(15,369)$ |
| 9 | $(18,512)$ | $(17.676)$ | $(16,226)$ | $(15,550)$ | $(16,918)$ | $(16,573)$ | $(14,591)$ | $(14,668)$ | $(16,973)$ |
| 10 | (17,979) | $(17,065)$ | $(15,851)$ | $(15,137)$ | $(14,526)$ | (16.168) | $(16,307)$ | $(14,465)$ | $(16,031)$ |
| 11 | $(17,334)$ | $(16,630)$ | $(15,528)$ | $(14,627)$ | $(14,262)$ | $(13,739)$ | $(13,928)$ | $(16,085)$ | $(16,442)$ |
| 12 | $(16,900)$ | $(16,127)$ | $(15,086)$ | $(14,255)$ | $(13,720)$ | $(13,465)$ | $(13,491)$ | $(13,804)$ | $(16,077)$ |
| 13 | $(16,565)$ | $(15,705)$ | $(16,708)$ | $(13,939)$ | $(13,605)$ | $(13,223)$ | $(13,137)$ | $(13,480)$ | $(13,723)$ |
| 14 | $(16,191)$ | $(15,362)$ | (14,426) | $(13.576)$ | $(13,188)$ | $(12,933)$ | $(12,95)$ | $(13,186)$ | $(13,507)$ |
| 15 | $(15,831)$ | (15,046) | $(13,927)$ | $(13,292)$ | $(12,931)$ | $(12,729)$ | $(12,765)$ | $(13,020)$ | $(13,269)$ |
| 16 | $(15,458)$ | (14, 686 ) | $(13,577)$ | (13, 134) | $(12,625)$ | $(12,519)$ | $(12,613)$ | $(12,046)$ | $(13, \infty 5)$ |
| 17 | ( 15,071 ) | $(16,350)$ | $(13,262)$ | $(12,918)$ | $(12,421)$ | $(12,315)$ | $(12,349)$ | $(12,419)$ | $(12,643)$ |
| 18 | ( 14,655 ) | $(16,077)$ | $(12,992)$ | $(12,573)$ | $(12,208)$ | $(12,173)$ | $(12,112)$ | $(12,246)$ | $(12,397)$ |
| 19 | $(14,330)$ | $(13,909)$ | $(12,781)$ | $(12,346)$ | $(11,916)$ | $(11,989)$ | $(11,849)$ | $(12,093)$ | $(12,189)$ |
| 20 | (13,928) | $(13,567)$ | $(12,571)$ | $(12,038)$ | (11,633) | $(11,811)$ | $(11,646)$ | $(11,895)$ | (11,\%1) |
| 21 | $(13,578)$ | $(13,286)$ | $(12,365)$ | $(11,71)$ | $(11,473)$ | $(11,553)$ | $(11,489)$ | $(11,635)$ | $(11,801)$ |
| 22 | (13, 301 ) | $(13,011)$ | $(12,103)$ | (11, 544) | $(11,301)$ | $(11,378)$ | $(11,368)$ | $(11,460)$ | ( 11,46$)$ |
| 23 | (13,104) | $(12,673)$ | $(11,792)$ | $(11,323)$ | $(11,077)$ | $(11,1 \%)$ | $(11,217)$ | $(11,296)$ | $(11,436)$ |
| 26 | $(12,906)$ | $(12,426)$ | (11,48) | $(10,999)$ | $(10,911)$ | $(10,979)$ | $(11,096)$ | $(11,125)$ | $(11,221)$ |
| 25 | $(12,723)$ | $(12,263)$ | $(11,272)$ | $(10,819)$ | $(10,649)$ | $(10,733)$ | $(10,956)$ | $(10,998)$ | ( 11,054 ) |
| 26 | $(12,509)$ | (12,006) | (11,046) | $(10,650)$ | $(10,495)$ | $(10,525)$ | $(10,775)$ | $(10,700)$ | $(10,827)$ |
| 27 | $(12,327)$ | $(11,776)$ | $(10,817)$ | $(10,519)$ | $(10,321)$ | $(10,536)$ | $(10,487)$ | $(10,493)$ | $(10,687)$ |
| 28 | $(12,165)$ | (11,568) | $(10,673)$ | $(10,392)$ | $(10,179)$ | $(10,065)$ | $(10,351)$ | $(10,154)$ | $(10,392)$ |
| 29 | (11,826) | $(11,318)$ | $(10,468)$ | $(10,127)$ | $(9,953)$ | $(9,809)$ | $(10,069)$ | $(9,468)$ | $(10,218)$ |
| 30 | $(11,617)$ | $(11,112)$ | $(10,287)$ | $(9,873)$ | $(9,740)$ | $(9,592)$ | $(9,853)$ | $(9,771)$ | $(10,063)$ |
| 31 | $(11,336)$ | (10,907) | $(10,016)$ | $(9,673)$ | $(9,537)$ | $(0,608)$ | $(9,651)$ | $(9,599)$ | $(9,915)$ |
| 32 | $(11,082)$ | $(10,654)$ | $(9,130)$ | $(9,505)$ | $(9,431)$ | $(9,132)$ | $(9,479)$ | $(9,422)$ | (9.729) |
| 33 | (10,856) | $(10,671)$ | $(0,689)$ | $(9,309)$ | $(9,237)$ | $(8,952)$ | $(9,195)$ | $(9,223)$ | $(9,564)$ |
| 36 | (10,621) | $(10,281)$ | $(9,550)$ | $(9,165)$ | $(8,900)$ | $(8,769)$ | (8,954) | $(9,018)$ | $(9,409)$ |
| 35 | $(10,506)$ | $(9,997)$ | $(9,636)$ | $(8,985)$ | $(8,715)$ | $(8,620)$ | (8,79) | $(8,853)$ | $(9,136)$ |
| 36 | $(10,382)$ | ( 9.813 ) | (9,277) | $(8,826)$ | $(8,528)$ | $(8,673)$ | (8,569) | (8,685) | $(8,855)$ |
| 37 | $(10,163)$ | $(9,635)$ | $(9,069)$ | $(8,606)$ | $(8,398)$ | $(8,282)$ | $(8,365)$ | $(8.464)$ | $(1,709)$ |
| 38 | $(9,938)$ | $(9,455)$ | (8,826) | $(8,430)$ | $(8,199)$ | $(8,183)$ | $(8.161)$ | (8.156) | $(8,547)$ |
| 39 | $(9,736)$ | $(9,335)$ | $(8,597)$ | $(8,286)$ | $(7.992)$ | $(8,021)$ | $(7,967)$ | $(7,999)$ | $(8,380)$ |
| 40 | $(9,543)$ | $(9,203)$ | $(3,397)$ | $(8.063)$ | $(7,820)$ | (7.749) | (7,796) | $(7,753)$ | $(8,217)$ |
| 41 | $(9,372)$ | $(8,988)$ | $(8,163)$ | ( 7.858 ) | (7,599) | (7,511) | $(7,557)$ | (7,471) | $(7,965)$ |
| 42 | $(9,230)$ | $(8,77)$ | $(7,907)$ | (7,736) | (7.444) | (7.295) | (7,289) | (7,302) | (7,769) |
| 63 | $(9.079)$ | $(8,596)$ | (7,720) | $(7,571)$ | $(7,276)$ | $(7.107)$ | (7.031) | (7,120) | $(7,603)$ |
| 46 | (8,825) | $(8,405)$ | (7,499) | $(7,276)$ | $(7,057)$ | $(6,882)$ | $(6,767)$ | $(6,932)$ | $(7,410)$ |
| 45 | $(8,535)$ | (8.219) | $(7,272)$ | (7,006) | $(6,850)$ | $(6,751)$ | (6,595) | $(6,805)$ | $(7,266)$ |
| 46 | $(8,302)$ | (7,929) | $(6,960)$ | $(6,873)$ | (6.606) | $(6,567)$ | $(6,435)$ | $(6,709)$ | (7.078) |
| 67 | $(\mathrm{S}, 181)$ | (7,676) | $(6,799)$ | (6,639) | (6,458) | $(6,334)$ | $(6,236)$ | $(6,550)$ | (6,878) |
| 48 | (7,999) | (7,460) | $(6,536)$ | $(6,436)$ | (6, 196) | $(6,165)$ | $(5,970)$ | (6,348) | $(6,673)$ |
| 69 | (7,776) | (7,251) | $(6,361)$ | $(6,213)$ | (5,905) | $(5,926)$ | (5,719) | $(6,188)$ | (6,547) |
| 50 | $(7,513)$ | $(6,97)$ | $(6,227)$ | $(6,060)$ | $(5,677)$ | $(5,700)$ | $(5,481)$ | $(6,011)$ | $(6,376)$ |
| 51 | (7,220) | $(6,770)$ | $(6,083)$ | $(5,916)$ | $(5,440)$ | $(5,461)$ | $(5,280)$ | $(5,889)$ | $(6,209)$ |
| 52 | (7,009) | $(6,627)$ | $(5,917)$ | $(5,755)$ | $(5,302)$ | ( 5,258$)$ | $(5,203)$ | $(5,655)$ | $(6,098)$ |
| 53 | $(6,782)$ | $(6,478)$ | $(5,722)$ | ( 5,558$)$ | $(5,112)$ | $(5,051)$ | $(5,031)$ | ( 5,507$)$ | $(5,897)$ |
| 58 | $(6,671)$ | $(6,221)$ | $(5,426)$ | $(5,322)$ | $(6,939)$ | $(4,868)$ | $(6,202)$ | $(5,251)$ | $(5,575)$ |
| 55 | $(6,556)$ | $(6,018)$ | $(5,226)$ | $(5,103)$ | (6,736) | $(6,608)$ | $(6,626)$ | $(5,123)$ | $(5,366)$ |
| 56 | (6,428) | (5,836) | ( 5,083$)$ | (6,901) | ( 6,569 ) | $(6,410)$ | (6,487) | $(4,951)$ | ( 5,176$)$ |
| 57 | $(6,291)$ | $(5,613)$ | ( $4, \% 62$ ) | $(6,702)$ | $(6,360)$ | $(6,262)$ | $(4,365)$ | $(4,717)$ | $(5,032)$ |
| 58 | (6,025) | ( 5,429 ) | $(4,783)$ | ( 4,043 ) | $(6,175)$ | $(4,182)$ | $(6,240)$ | (4,493) | ( 6,891 ) |
| 59 | $(5,722)$ | $(5,246)$ | $(6,573)$ | $(4,196)$ | (3,996) | ( 6,085$)$ | $(6,116)$ | $(6,291)$ | (6,500) |
|  | ( 5,542 ) | $(5,039)$ | $(4,367)$ | $(4,061)$ | $(3,908)$ | $(3,953)$ | $(3,955)$ | $(4,163)$ | (4,506) |
| 61 | $(5,33)$ | $(6,912)$ | $(6,176)$ | $(3,913)$ | $(3,765)$ | $(3,814)$ | $(3,812)$ | $(6,013)$ | $(4,361)$ |
| 62 | ( 5,096 ) | (4,780) | ( 3,998$)$ | $(3,700)$ | $(3,626)$ | ( 3,718 ) | (3,684) | $(3,820)$ | $(4,231)$ |
| 63 | (4,929) | $(6,617)$ | $(3,879)$ | (3,491) | $(3,431)$ | (3,586) | (3,696) | (3,627) | (6,085) |
| 64 | ( 4,768$)$ | (4,409) | $(3,707)$ | $(3,308)$ | ( 3,196 ) | $(3,358)$ | $(3,327)$ | (3.430) | (3,01) |
| 65 | $(6,591)$ | $(6,205)$ | $(3,498)$ | (3,165) | $(2,975)$ | $(3,191)$ | $(3,176)$ | $(3,279)$ | $(3,735)$ |
| 66 | ( 6,598$)$ | (3,951) | $(3,296)$ | (2,967) | $(2,826)$ | $(3,069)$ | $(2,912)$ | (3,150) | $(3,485)$ |
| 67 | $(4,153)$ | $(3,811)$ | $(3,167)$ | $(2,846)$ | $(2,630)$ | $(2,507)$ | $(2,812)$ | $(2,980)$ | $(3,538)$ |
| 68 | (3.856) | $(3.606)$ | (3,030) | $(2,737)$ | $(2,474)$ | $(2,598)$ | $(2,616)$ | $(2,808)$ | $(3,168)$ |
| 69 | (3,731) | $(3,399)$ | $(2,868)$ | $(2,005)$ | $(2,326)$ | (2,358) | $(2,40)$ | $(2,002)$ | $(3,007)$ |
|  | (3,54) | (3,217) | $(2,64)$ | ( 2,371 ) | $(2,022)$ | (2,210) | (2,255) | $(2,430)$ | (2,41) |
| 71 | $(3,327)$ | $(3,067)$ | (2,400) | $(2,196)$ | $(1,842)$ | (1,960) | $(2,046)$ | $(2,257)$ | (2,40) |
| 72 | $(3,177)$ | $(2,946)$ | ( 2,344 ) | $(2,011)$ | (1,635) | (1.762) | (1.850) | $(2,117)$ | $(2,400)$ |
| 73 | $(2,963)$ | ( 2,780$)$ | $(2,106)$ | (1,872) | $(1,416)$ | (1,532) | (1,622) | $(1,921)$ | $(2,101)$ |
| 75 | (2,638) | ( 2,507$)$ | (1, 881$)$ | (1,671) | $(1,176)$ | (1,279) | $(1,332)$ | $(1,577)$ | (1,879) |
| 75 | $(2,450)$ | $(2,288)$ | $(1,582)$ | $(1,43)$ | (901) |  |  | $(1,303)$ | $(1,56)$ |
| 76 | (2,218) | $(2,017)$ | $(1,315)$ | (1,194) | (693) | (502) | (770) | $(1,051)$ | (1,250) |
| 77 | ( 2,047$)$ | $(1,717)$ | (984) | (302) | (690) | (567) | (587) | (878) | (931) |
| 78 | $(1,852)$ | $(1,452)$ | (621) | (43) | (272) | (330) | (246) | (672) | (764) |
| 79 | (1,531) | (1,075) | (395) | (271) | (62) | (46) | 32 | (382) | (614) |
| 80 | (1,311) | (663) | (125) | ${ }_{5}^{68}$ | 275 | 166 | 336 | (191) | (431) |
| 81 | (906) | (267) | 388 | 530 | 761 | 503 | 511 | 100 | (123) |
| 82 | (703) | 17 | 711 | 72 | 1.049 | 877 | 747 | 558 | 311 |
| 83 | (197) | 247 | 1,006 | 1,217 | 1,361 | 1,181 | 1,034 | 801 | 517 |
| 85 | 109 | 483 | 1.467 | 1,606 | 1,719 | 1,573 | 1,368 | 1,128 | 775 |
| 35 | ${ }^{665}$ | ${ }^{891}$ | 1,677 | 1,965 | 1,959 | 1,876 | 1,759 | 1,397 | 1.129 |
| 86 | 1.081 | 1.610 | 2,150 | 2,249 | 2,258 | 2,036 | 2,029 | 1,838 | 1,397 |
| 87 | 1,351 | 1,767 | 2,511 | 2,640 | 2,545 | 2,328 | 2,319 | 2,137 | 1,467 |
| 88 | 1,786 | 2,231 | 2,996 | 3,062 | 2,810 | 2,768 | 2,626 | 2.663 | 1,895 |
| 89 | 2,372 | 2,802 | 3,493 | 3,419 | 3,254 | 3,163 | 2,918 | 2,883 | 2.213 |
| 90 | 2,923 | 3,367 | 3,915 | 3, 338 | 3,957 | 3,836 | 3,392 | 3,275 | 2.401 |
| 91 | 3,619 | 3,036 | 4,326 | 4,351 | 6,300 | 6,362 | 4,000 | 3,620 | 3, 107 |
| 92 | 3, 662 | 6,246 | 6,083 | 4,77 | 4,887 | 6,826 | 6,572 | 3,979 | 3,657 |
| 93 | 6,457 | 4,900 | 5,168 | 5,276 | 5.454 | 5,291 | 6.551 | 6,630 | 4,150 |
| 9 | 5.159 | 5,45 | 5,836 | 6,011 | 6,060 | 5,898 | 5,376 | 5,016 | 6,625 |
| 95 | 6.252 | 6,311 | 6,685 | 6,713 | 6,905 | 6,905 | 6,403 | 5,859 | 5,340 |
| 96 | 7,272 | 7.176 | 7.711 | 8,065 | 7,973 | 7,357 | 7,678 | 6.532 | 5,973 |
| 97 | 8,522 | 8.489 | 8,727 | 9.139 | 8,933 | 8,456 | 8.161 | 7,396 | 6,681 |
| 98 | 9.625 | \%,808 | 10.267 | 10. 176 | 10.481 | 10, 311 | 9,625 | 8,878 | 6,386 |
| $\stackrel{9}{ }$ | 11.354 | 11,766 | 12,252 | 12,373 | 12,083 | 11,562 | 11,348 | 10,463 | 10,162 |
| 100 | 16,281 | 16,610 | 16,270 | 16,170 | 16,142 | 15,819 | 15,455 | 14,586 | 14,076 |
| an | $(7,316)$ | $(6,850)$ | (6,071) | (5,737) | $(5,466)$ | (5,438) | $(5,501)$ | $(5.695)$ | $(6,025)$ |
| strer | 3,100 | 7,955 | 7,765 | 7,560 | 7,405 | 7,229 | 7,146 | 6,959 | 6,892 |






appendix fable C-25: sleulatod monalized income cofs, Cluetar C, mo price intervention, Low price sconario, Broun solls, saskatchewan

| percentite No | - 65 | 70 | 73 | 80 | $\overline{M c}=\left(\mathrm{m}_{85}\right)$ | $\pm$ | 93 | 100 | 105 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | (27,867) | (26, 676) | (26, 320) | $(25,825)$ | (25,555) | (23,706) | $(25,246)$ | (26,486) | $(26,857)$ |
| 2 | $(25,034)$ | $(26,564)$ | $(23,783)$ | $(23,044)$ | $(23,020)$ | (22,746) | $(22,610)$ | $(22,044)$ | $(21,720)$ |
| 3 | (24, 160) | $(23,623)$ | $(22,606)$ | ( 21,986 ) | $(21,671)$ | $(21,399)$ | $(21,212)$ | $(20,542)$ | $(20,517)$ |
| 4 | $(23,286)$ | $(22,522)$ | $(21,639)$ | $(21,234)$ | $(20,521)$ | $(20,275)$ | $(20,110)$ | $(19,822)$ | $(20,015)$ |
| 5 | ( 22,296$)$ | $(21,63)$ | ( 21,076 ) | (20,658) | $(19,707)$ | (19,036) | $(19,520)$ | $(19,361)$ | $(19,375)$ |
|  | $(21,631)$ | $(21,046)$ | $(20,399)$ | $(19,675)$ | $(19,105)$ | $(19,090)$ | $(19,085)$ | $(18,991)$ |  |
| 7 | $(21,000)$ | $(20,424)$ | $(19,552)$ | $(19,009)$ | $(18,727)$ | $(18,618)$ | $(18,350)$ | $(18,238)$ | $(13,542)$ |
| 8 | $(20,380)$ | $(19,743)$ | $(19,136)$ | $(18,630)$ | $(18,276)$ | $(18,073)$ | $(17,909)$ | $(17,789)$ | $(14,004)$ |
| , | $(19,876)$ | $(19,198)$ | $(18,792)$ | $(18,179)$ | (17,805) | $(17,610)$ | $(17,401)$ | $(17,254)$ | $(17,572)$ |
| 10 | $(19,353)$ | $(18,929)$ | $(18,354)$ | (17.751) | $(17,201)$ | $(17,106)$ | $(17,161)$ | $(16,954)$ | $(17,191)$ |
| 11 | $(18,989)$ | $(18,576)$ | $(17,938)$ | $(17,380)$ | $(16.895)$ | $(16,742)$ | $(16,703)$ | $(16,526)$ | $(16,464)$ |
| 12 | $(18,562)$ | $(18,222)$ | (17,455) | $(17,111)$ | $(16,619)$ | $(16,256)$ | $(16,289)$ | $(16,286)$ | $(16,467)$ |
| 13 | $(18,171)$ | $(17,885)$ | $(16,996)$ | $(16,791)$ | $(16,216)$ | $(16,007)$ | $(16,051)$ | $(15,977)$ | $(16,068)$ |
| 16 | $(17,836)$ | $(17,349)$ | $(16,576)$ | $(16,426)$ | $(16,009)$ | $(15,720)$ | $(15,045)$ | $(15,712)$ | $(15,827)$ |
| 15 | $(17.463)$ | (16,857) | $(16,322)$ | $(16,234)$ | $(15,746)$ | (15,417) | $(15,616)$ | $(15.492)$ | $(15,573)$ |
| 16 | $(17,203)$ | $(16,577)$ | $(16,093)$ | $(16,011)$ | $(15,461)$ | $(15,043)$ | $(15,117)$ | $(15,278)$ | $(15,361)$ |
| 17 | $(16,830)$ | $(16,317)$ | $(15,791)$ | $(15,642)$ | $(15,146)$ | $(14,853)$ | $(14,932)$ | $(14,801)$ | $(15,120)$ |
| 18 | ( 16,406 ) | $(16,218)$ | $(15,632)$ | $(15,292)$ | $(16,925)$ | $(16,623)$ | $(14,653)$ | $(14,528)$ | $(14,901)$ |
| 19 | $(16,173)$ | $(15,992)$ | ( 15.461 ) | $(15,129)$ | $(16,631)$ | $(14,438)$ | $(16,473)$ | $(16,292)$ | $(14,665)$ |
| 20 | $(15,972)$ | $(15,823)$ | $(15,227)$ | (14,865) | (14,406) | (16,217) | (16,196) | (14,066) | (14,460) |
| 21 | (15,725) | $(15,606)$ | $(14,991)$ | $(14,617)$ | $(14,209)$ | $(13,982)$ | $(13,977)$ | $(13,855)$ | $(14,252)$ |
| 22 | $(15,546)$ | $(15,269)$ | ( 14,648 ) | ( 14,373 ) | $(13,934)$ | $(13,725)$ | ( 13,756 ) | $(13,687)$ | $(13,988)$ |
| 23 | $(15,312)$ | $(14,913)$ | (14,885) | $(16,100)$ | $(13,701)$ | $(13,512)$ | (13,54) | $(13,540)$ | $(13,700)$ |
| 26 | ( 15,056 ) | $(14,656)$ | $(14,097)$ | $(13,836)$ | $(13,512)$ | $(13,307)$ | $(13,350)$ | $(13,380)$ | $(13,507)$ |
| 25 | $(14,796)$ | $(14,661)$ | $(13,808)$ | (13, 581 ) | ( 13,120$)$ | $(13,016)$ | $(13,208)$ | $(13,182)$ | $(13,305)$ |
| 26 | $(14,497)$ | (16,251) | (13,696) | $(13,315)$ | (12,917) | $(12,846)$ | $(12,992)$ | $(13,067)$ | $(13.080)$ |
| 27 | $(14,263)$ | (14,096) | $(13,293)$ | $(13,067)$ | (12,746) | ( 12,712 ) | $(12,802)$ | $(12,825)$ | ( 12,943 ) |
| 28 | $(14,057)$ | $(13,888)$ | $(13,101)$ | $(12,859)$ | ( 12,583 ) | $(12,508)$ | $(12,631)$ | $(12,513)$ | ( 12,764 ) |
| 29 | $(13,882)$ | $(13,683)$ | $(12,792)$ | $(12,635)$ | $(12,629)$ | $(12,307)$ | $(12,461)$ | $(12,332)$ | $(12,554)$ |
| 30 | $(13,706)$ | $(13,470)$ | $(12,638)$ | $(12,389)$ | ( 12,236$)$ | (12,153) | $(12,270)$ | $(12,102)$ | $(12,325)$ |
| 31 | $(13,637)$ | $(13,267)$ | $(12,316)$ | (12,195) | $(12,126)$ | (11,979) | $(12,122)$ | $(11,926)$ | $(12,170)$ |
| 32 | $(13,068)$ | $(13,060)$ | $(12,106)$ | $(12,011)$ | $(11,969)$ | $(11,771)$ | $(11,918)$ | $(11,820)$ | $(11,964)$ |
| 33 | $(12,933)$ | $(12,766)$ | $(11,918)$ | (11,909) | (11,785) | $(11,600)$ | $(11,645)$ | $(11,612)$ | $(11,757)$ |
| 36 | $(12,735)$ | $(12,547)$ | $(11,77)$ | (11,716) | $(11,576)$ | (11,396) | $(11,516)$ | $(11,401)$ | (11,613) |
| 35 | (12,634) | $(12,219)$ | $(11,517)$ | $(11,446)$ | (11,360) | $(11,212)$ | (11,338) | $(11,303)$ | $(11,503)$ |
| 36 | $(12,287)$ | $(12,006)$ | $(11,287)$ | ( 11,256 ) | $(11,107)$ | $(11,053)$ | $(11,181)$ | $(11,196)$ | $(11,352)$ |
| 37 | $(12,112)$ | $(11,652)$ | $(11,099)$ | (11,026) | $(10,864)$ | $(10,863)$ | $(11,024)$ | $(11,033)$ | $(11,201)$ |
| 38 | $(11,970)$ | $(11,438)$ | $(10,851)$ | ( 10,796 ) | $(10,608)$ | ( 10,719 ) | $(10,786)$ | $(10,908)$ | $(11,019)$ |
| 39 | $(11,679)$ | (11,286) | $(10,580)$ | $(10,544)$ | $(10,388)$ | $(10,459)$ | $(10,477)$ | $(10,732)$ | $(10,889)$ |
| 40 | $(11,487)$ | $(11,025)$ | $(10,381)$ | $(10,257)$ | $(10,101)$ | $(10,190)$ | $(10,312)$ | $(10,583)$ | $(10,675)$ |
| 61 | $(11,292)$ | $(10,774)$ | $(10,167)$ | $(10,007)$ | $(9.975)$ | $(9,985)$ | $(10,171)$ | $(10,353)$ | $(10,425)$ |
| 62 | (11,071) | $(10,696)$ | $(9,932)$ | (9,768) | $(9,768)$ | (9,711) | (9,968) | $(10,172)$ | $(10,292)$ |
| 43 | (10,860) | $(10,247)$ | $(9,756)$ | (9,595) | $(9,590)$ | (9,510) | $(9,765)$ | $(10,010)$ | $(10,179)$ |
| 46 | (10,612) | $(10,008)$ | $(9,588)$ | (9.461) | $(9,362)$ | $(9,253)$ | $(9,570)$ | $(9,769)$ | (9,9\%6) |
| 65 | $(10,463)$ | $(9,908)$ | $(9,610)$ | $(9,293)$ | $(9,211)$ | $(9,026)$ | $(0,385)$ | $(9,430)$ | $(9,737)$ |
| 46 | ( 10,154 ) | ( 9,687 ) | $(9.192)$ | ( 9,048$)$ | $(8,921)$ | $(8,779)$ | $(9,025)$ | $(9,085)$ | $(9,519)$ |
| 47 | $(9,900)$ | $(9,678)$ | $(8,967)$ | $(8,856)$ | $(8,728)$ | $(3,649)$ | $(8,791)$ | $(8,895)$ | (9,269) |
| 48 | $(9,698)$ | $(9,367)$ | $(8,780)$ | $(8,716)$ | $(8,557)$ | $(8,656)$ | $(8,575)$ | $(8,706)$ | $(9,066)$ |
| 49 | $(9,520)$ | $(9,226)$ | $(8,590)$ | $(8.481)$ | $(8,613)$ | $(8,298)$ | $(8,365)$ | $(8,578)$ | $(8,787)$ |
| 50 | $(9,277)$ | $(9,068)$ | $(8,429)$ | $(8,362)$ | $(8,215)$ | $(8,161)$ | $(8,165)$ | $(8,369)$ | (8,579) |
| 51 | $(9,152)$ | $(8,921)$ | $(8,252)$ | $(8,208)$ | $(7,986)$ | (7,958) | $(5,020)$ | $(3,116)$ | $(8,638)$ |
| 52 | $(9,020)$ | $(8,750)$ | $(8,123)$ | $(8,051)$ | $(7,860)$ | $(7,755)$ | $(7,887)$ | $(7,993)$ | $(8,232)$ |
| 53 | ( 8,870$)$ | ( ${ }^{(1,004 \text { ) }}$ | $(7,928)$ | (7,906) | (7,746) | $(7,546)$ | $(7,731)$ | (7,845) | (3,057) |
| 5 | (8,587) | $(8,430)$ | (7.790) | $(7,739)$ | (7,541) | $(7,456)$ | $(7,572)$ | $(7,701)$ | (7,852) |
| 55 | ( 8.402 ) | $(8,157)$ | (7.636) | (7,553) | $(7,326)$ | (7,307) | $(7,413)$ | $(7,559)$ | $(7,730)$ |
| 56 | (8,199) | $(7,800)$ | $(7,389)$ | $(7,373)$ | $(7,159)$ | $(7,128)$ | $(7,222)$ | (7.621) | $(7,475)$ |
| 57 | (7,957) | (7,650) | $(7,190)$ | (7,098) | ( 6,0645$)$ | $(6,955)$ | (7,045) | ( 7.215$)$ | (7,237) |
| 58 | (7,759) | $(7,373)$ | $(7,016)$ | $(6,823)$ | $(6,657)$ | $(6,815)$ | $(6,915)$ | $(7,078)$ | (7,070) |
| 59 | (7,556) | $(7,183)$ | $(6,760)$ | $(6,575)$ | $(6,357)$ | (6, ©6) | $(6,731)$ | $(6,877)$ | (6,896) |
| 60 | (7.412) | ( 6,986 ) | $(6,575)$ | ( 6,365$)$ | ( 6.157$)$ | (6,671) | (6,555) | $(6,726)$ | (6,735) |
| 61 | $(7,263)$ | $(6,782)$ | $(6,271)$ | $(6,129)$ | $(5,922)$ | $(6,253)$ | $(6,281)$ | $(6,487)$ | (6,510) |
| 62 | (7,022) | $(6,591)$ | ( 6,085 ) | $(5,936)$ | $(5,735)$ | $(6,005)$ | (6.156) | $(6,316)$ | $(6,310)$ |
| 63 | $(6,756)$ | (6.408) | $(5,902)$ | $(5,747)$ | ( 5,561$)$ | $(5,799)$ | (6,006) | (6,111) | (6.199) |
| ${ }_{6} 6$ | (6,583) | $(6,182)$ | $(5,712)$ | $(5,351)$ | $(5,372)$ | $(5,565)$ | ( 5,752 ) | $(5,923)$ | $(6,046)$ |
| 65 | $(6,46)$ | $(5,965)$ | $(5,498)$ | $(5,152)$ | $(5,150)$ | $(5,376)$ | $(5,510)$ | ( 5.635 ) | $(5,916)$ |
|  | $(6,180)$ | ( 5,756$)$ |  | $(5,061)$ | $(4,916)$ | $(5,206)$ | $(5,222)$ | $(5,611)$ | (5,038) |
| 67 | (5,868) | $(5,486)$ | (5,098) | ( 4,854 ) | (4,673) | ( 4,962$)$ | (6,993) | $(5,176)$ | ( 5,351 ) |
| 68 | $(5,672)$ | $(5,217)$ | ( 6,808 ) | $(4,563)$ | (4.497) | (4.603) | ( 4,731 ) | (4,974) | $(5,212)$ |
| 69 | (5,388) | (5,026) | (6.426) | $(4,310)$ | $(6,262)$ | ( 6.298$)$ |  |  |  |
| 70 | (5,095) | (6, 521 ) | $(6,257)$ | (6, 103) | (3,962) | (3,911) | (6,076) | $(6,509)$ | (4,730) |
| 71 | $(6,882)$ | (6,665) | ( 4.038 ) | ( 3.818 ) | (3.677) | $(3,640)$ | (3,797) | $(4,321)$ | (6,567) |
| 72 | (6, 598) | $(6,404)$ | $(3,832)$ | (3,570) | $(3,386)$ | ( 3.535 ) | $(3,463)$ | ( 5,026$)$ | (4,253) |
| 73 | (4,612) | ( 6,184$)$ | (3,678) | $(3,257)$ | $(3,012)$ | ( 3,153$)$ | $(3,253)$ | $(3,740)$ | (6,013) |
| 76 | ( 6.165 ) | $(3,835)$ | (3,538) | $(2,991)$ | (2,748) | $(2,987)$ | $(3,036)$ | $(3,406)$ | (3,792) |
| $\begin{aligned} & 75 \\ & 75 \end{aligned}$ | (3, 905 ) | (3,489) | (3,293) | $(2,850)$ $(2,505)$ | $(2,548)$ | ( 2,761 ) | $(2,715)$ | $(3,176)$ | $(3,533)$ |
| $\begin{aligned} & 76 \\ & 77 \end{aligned}$ | (3, 595) | (3, 196) | (3,018) | $(2,645)$ | $(2,393)$ | ( 2,367$)$ | $(2,47)$ | (2,459) | (3,262) |
| 77 | $(3,283)$ | $(2,958)$ | $(2,815)$ | $(2,373)$ | $(2,009)$ | (1,94) | $(2,162)$ | $(2,515)$ | $(2,987)$ |
| 78 | $(3,054)$ | $(2,725)$ | $(2,436)$ | $(1,905)$ | (1,060) | $(1,642)$ | $(1,457)$ | $(2,227)$ | $(2,617)$ |
| 79 |  | $(2,409)$ | $(2,071)$ | (1.613) | $(1,348)$ | (1,377) | $(1,546)$ | (1,940) | (2,365) |
| 80 | $(2,382)$ |  |  | (1,35) | $(1,122)$ | (1,125) | $(1,362)$ | $(1,756)$ | (1,936) |
| 81 82 | $(2,007)$ | (1, 209 ) | $(1,322)$ $(1,019)$ | (1,054) | (911) | (790) | (1,049) | (1.409) | (1,072) |
| $\begin{aligned} & 82 \\ & 83 \end{aligned}$ | $(1,716)$ | $(1,628)$ $(1,285)$ | (1,019) | (51) | (690) | (618) | (745) | (1,156) | (1,355) |
| $83$ | $(1,497)$ | (1,288) | $(690)$ (405) | (577) | (460) | (358) | (450) | (953) | (1,115) |
| 88 | $(1,105)$ | (901) | (405) | (278) | (88) | 11 | (157) | (690) | (e62) |
| 85 | (909) | (60\%) | (132) | 46 | 222 | 262 | 179 | (26) | (313) |
| 86 | (607) | (384) | 168 | 352 | 670 | 542 | 522 | 213 | (71) |
| 87 | (119) | ${ }_{0}$ | ${ }^{172}$ | ${ }^{9} 17$ | 1.003 | 922 | 92 | 44 | 265 |
| 88 | 491 | 663 | 1,278 | 1,558 | 1,360 | 1,262 | 1,326 | 716 | 986 |
|  | 797 | $900$ | 1,756 | 1,928 | 1,820 | 1,549 | 1.731 | 1,127 | 795 |
| 90 | 1,006 | 1,633 | 2,109 3,103 | 2.274 | 2,107 | 1,961 | 2,136 | 1.626 | 1,247 |
| 91 | 1,381 | 1,856 2,198 | 2,503 | 2.640 | 2.565 | 2,537 | 2,54 | 2,153 | 1.670 |
| 93 | 2,013 | 2,196 | 2,869 | 2,965 | 3,030 | 2,994 | 3,127 | 2,579 | 2, 113 |
| 93 |  |  | 3,538 4.256 | 3,545 | 3.651 | 3, 532 | 3,490 | 3,062 | 2,594 |
| 95 | 3,455 | 3,385 4.409 | 4,256 | 4,091 | 4.073 | 6,119 | 3,966 | 3,630 | 3,254 |
| 95 | 4.13 | 4.409 | 4.826 | 6, 323 | 6,797 | 6.699 | 6,569 | 4.277 | 3,956 |
| 9 | 4,871 | 5.622 | 5,753 | 6,163 | 5,526 | 3,340 | 4.996 | 6,952 | 4,666 |
| 97 | 5,968 | 6.631 | 6,715 | 6,912 | 6.489 | 6.052 | 3,605 | 5,553 | 5,611 |
| 98 | 7,569 | 8,380 | 8,242 | 8,144 | 7,732 | 7,521 | 7,107 | 6.565 | 6,909 |
| 9 | 10,359 | 10,611 | 10,621 | 10,896 | 11,097 | 10.772 | 10,028 | 9.115 | 9,165 |
| 100 | 16,546 | 14.486 | 14,453 | 14,350 | 16,634 | 13,968 | 13,760 | 12,946 | 12,617 |
| mean | $(9,030)$ | $(8,675)$ | $(8,112)$ |  |  |  |  |  |  |
| stier | 8,061 | 7.972 | 7,860 | $\begin{gathered} (7,886) \\ 7,783 \end{gathered}$ | $7.665$ | $\begin{aligned} & (, \infty 7) \\ & 7,526 \end{aligned}$ | $(7,754)$ | $\begin{aligned} & (7,897) \\ & 7,219 \end{aligned}$ | $\begin{aligned} & (8,105) \\ & 7,185 \end{aligned}$ |


















| $\begin{aligned} & \text { percentile } \\ & \text { to } \end{aligned}$ | 65 | 70 | 73 |  |  | 9 | * | 100 | 105 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | (13,556) | ( 12.248$)$ | (12,000) | ( 11,030 ) | $(10,405)$ | ( 10,046 ) | $(9,672)$ | ( $0,7 \times 6$ ) | 10,968) |
| 2 | $(0,661)$ | $(9,130)$ | $(9,132)$ | $(8,286)$ | (7,967) | (7,996) | $(8,010)$ | ( 7,61 ) | $(8,362)$ |
| 3 | (7,424) | $(6,954)$ | $(6,73)$ | $(6,376)$ | $(5,942)$ | $(6,219)$ | $(6,509)$ | $(6,516)$ | $(6,462)$ |
| 4 | $(6,128)$ | $(5,240)$ | $(5,183)$ | $(5,069)$ | (4,7M) | $(4,724)$ | $(3,032)$ | $(5,676)$ | $(5,505)$ |
| 5 | $(5,013)$ | $(6,606)$ | $(4,215)$ | $(4,216)$ | $(3,836)$ | ( 3,589 ) | $(3,916)$ | $(6,057)$ | $(4,649)$ |
| 6 | (4,536) | (4.109) | $(3,473)$ | $(3,235)$ | $(3,168)$ | $(2,703)$ | $(3,307)$ | $(3,164)$ | $(3,939)$ |
| 7 | $(4, \infty 01)$ | $(3,546)$ | $(2,678)$ | $(2,360)$ | $(2,431)$ | $(1,916)$ | $(2,493)$ | $(2,550)$ | $(3,195)$ |
| + | $(3,329)$ | $(2,065)$ | $(2,262)$ | $(1,593)$ | (1,619) | $(1,468)$ | $(1,826)$ | $(2, \infty)$ | $(2,547)$ |
| 9 | (2,837) | $(2,240)$ | $(1,673)$ | (790) | (988) | (c)7) | $(1,303)$ | (1,449) | $(2,157)$ |
| 10 | $(2,403)$ | $(1,832)$ | (1,053) | (370) | (650) | (614) | (765) | $(1,154)$ | $(1,72)$ |
| 11 | $(1,761)$ | (1,223) | (482) | (7) | (173) | (31) | (658) | (a39) | $(1,423)$ |
| 12 | $(1,177)$ | (681) | (78) | 411 | 307 | 334 | (260) | (632) | $(1,201)$ |
| 13 | (632) | (360) | 301 | 709 | 04 | 42 | (59) | (130) | (979) |
| 16 | (307) | (35) | 657 | 974 | 1.062 | 836 | 206 | (158) | (743) |
| 15 | ${ }^{66}$ | 211 | 1,194 | 1,232 | 1,249 | 979 | 543 | 150 | (41) |
| 16 | 640 | 544 | 1,555 | 1,476 | 1,576 | 1,219 | 735 | 373 | (126) |
| 17 | 795 | 934 | 1,858 | 1,760 | 1,833 | 1,356 | 98 | 620 | 217 |
| 18 | 1.116 | 1,321 | 2,052 | 2,016 | 2,070 | 1,522 | 1,289 | 792 | 482 |
| 19 | 1,355 | 1,757 | 2,228 | 2,259 | 2,296 | 1.71 | 1,005 | 1,087 | 618 |
| 20 | 1.727 | 2,053 | 2,4\% | 2,557 | 2,574 | 1,988 | 1,877 | 1,277 | 916 |
| 21 | 2,223 | 2,278 | 2,698 | 2,790 | 2,7\% | 2,198 | 2,086 | 1,502 | 1,221 |
| 22 | 2,629 | 2,514 | 2,953 | 3,046 | 3,062 | 2,483 | 2,224 | 1,824 | 1,528 |
| 23 | 2,064 | 2,792 | 3,139 | 3,321 | 3,199 | 2,769 | 2,381 | 2,101 | 1,805 |
| 26 | 2,860 | 3,001 | 3,361 | 3,521 | 3,420 | 2,971 | 2,560 | 2,361 | 1,949 |
| 25 | 3.038 | 3,215 | 3,533 | 3,807 | 3,589 | 3, 143 | 2,800 | 2,561 | 2,200 |
| 26 | 3,308 | 3,562 | 3,762 | 4,004 | 3,697 | 3,504 | 2,997 | 2,323 | 2,385 |
| 27 | 3,615 | 3,833 | 3,921 | 4,289 | 3,839 | 3,776 | 3,198 | 3,006 | 2,332 |
| 28 | 3.927 | 4,098 | 4,267 | 4.466 | 6,113 | 3,997 | 3,571 | 3,209 | 2,714 |
| 29 | 4,222 | 4,336 | 6,569 | 4,773 | 4,359 | 6,296 | 3,818 | 3,520 | 2,366 |
| 30 | 4.408 | 6,549 | 4,836 | 4,978 | 6.583 | 6,659 | 4,185 | 3,319 | 3,032 |
| 31 | 4,547 | 6,740 | 5,093 | 5,276 | 4,805 | 6.742 | 6,409 | 6,057 | 3,166 |
| 32 | 6,765 | 5,012 | 5,253 | 5,383 | 5,127 | 5,017 | 6,559 | 6.217 | 3,637 |
| 33 | 5,030 | 5,217 | 5.619 | 5,580 | 5,356 | 5,260 | 4,461 | 6.410 | 3,686 |
| 34 | 5,307 | 5,430 | 5,597 | 5,703 | 5,583 | 5,391 | 6,895 | 4,645 | 3,378 |
| 35 | 5.495 | 5,626 | 5,892 | 5,916 | 5.727 | 5,575 | 5,053 | 4.915 | 6,057 |
| 36 | 5,693 | 5,802 | 6.119 | 6,163 | 5,964 | 5,816 | 5,277 | 5,073 | 4,252 |
| 37 | 5,867 | 5,955 | 6,355 | 6,359 | 6,113 | 6,061 | 5,526 | 5,359 | 6.446 |
| 38 | 6,046 | 6,163 | 6.006 | 6,580 | 6,317 | 6,265 | 3,811 | 5,539 | 6,767 |
| 39 | 6,203 | 6,439 | 6,818 | 6,819 | 6,577 | 6,477 | 6,048 | 3,709 | 5,057 |
| 40 | 6,424 | 6,636 | 6.939 | 7.023 | 6,795 | 6,580 | 6,282 | 5,845 | 5,238 |
| 61 | 6,002 | 6,846 | 7.170 | 7,202 | 6.916 | 6,740 | 6,558 | 5,968 | 5,613 |
| 42 | 6,859 | 7,096 | 7.383 | 7,335 | 7,136 | 6,958 | 6,758 | 6,147 | 5,626 |
| 43 | 7.206 | 7,246 | 7.616 | 7.516 | 7,346 | 7,154 | 6,913 | 6,330 | 5,900 |
| 4 | 7,363 | 7.462 | 7.765 | 7,706 | 7.048 | 7,358 | 7,076 | 6,544 | 6,052 |
| 45 | 7,556 | 7.702 | 7,995 | 7,920 | 7,868 | 7,52\% | 7.272 | 6,689 | 6,158 |
| 46 | 7.811 | 7.927 | 3,259 | 8,161 | 8,081 | 7.691 | 7.520 | 6,878 | 6,287 |
| 67 | 7.917 | 3,130 | 8.463 | 8,309 | 8.262 | 7.953 | 7.758 | 7.062 | 6.409 |
| 48 | 8,091 | 8.313 | 3.645 | 8,450 | 8.506 | 8,373 | 8.029 | 7.250 | 6,557 |
| 69 | 8.328 | 8.451 | 3,812 | 8,006 | 8,650 | 8,545 | 8,284 | 7.516 | 6.801 |
| 50 | 8,506 | 8.634 | 9.028 | 8,443 | 8,869 | 8.697 | 8,551 | 7,697 | 7.057 |
| 51 | 8.762 | 8,846 | 9,236 | 9,112 | 9,059 | 1,235 | 8,751 | 7,925 | 7,282 |
| 52 | 9,029 | 9,113 | 9.430 | , 363 | 9.233 | O,005 | 8.904 | 8,080 | 7.523 |
| 53 | 9.215 | 9,321 | 9,596 | 9,619 | 0.477 | 9,146 | 2,004 | 8,274 | 7.693 |
| 5 | 9,378 | 9,501 | 9,837 | 9,399 | 9,655 | 9,316 | 9,263 | 8,502 | 7.265 |
| 55 | 9,529 | 9,793 | 10,016 | 10,108 | 9,821 | 9,546 | 9,436 | 8,716 | 7,995 |
| 56 | 9,791 | 10,011 | 10,231 | 10,325 | 10,003 | 0,716 | 9,4 1 | 8,905 | 8,223 |
| 57 | 10,029 | 10, 167 | 10,478 | 10,535 | 10, 174 | 9,844 | 9.832 | 9,079 | 8.430 |
| 58 | 10,265 | 10,317 | 10,749 | 10.787 | 10, 377 | 10,079 | 9,951 | 9,238 | 8,670 |
| 59 | 10,486 | 10,4\% | 10,969 | 10,993 | 10,587 | 10, 242 | 10,035 | 9,461 | 3,861 |
| 60 | 10,654 | 10,678 | 11,166 | 11,145 | 10,77 | 10,445 | 10,232 | 9,670 | 9,039 |
| 61 | 10,793 | 10,895 | 11,280 | 11,343 | 11,069 | 10,693 | 10,376 | 9,959 | 9,211 |
| 62 | 10,995 | 11, 112 | 11.639 | 11.696 | 11, 366 | 10, 51 | 10.527 | 10,155 | , 398 |
| 63 | 11,122 | 11,302 | 11,607 | 11,670 | 11,513 | 11,042 | 10,683 | 10,350 | 9,556 |
| ${ }_{65}^{68}$ | 11,357 | 11.461 | 11,732 | 11,74 | 11,628 | 11,265 | 19,836 | 10,531 | 9,748 |
| 65 | 11,526 | 11,637 | 11,866 | 11,955 | 11,839 | 11,628 | 11,090 | 10,656 | 9,963 |
| 66 | 11,747 | 11,695 | 12,021 | 12,138 | 12,015 | 11,626 | 11,251 | 10,827 | 10,058 |
| 67 | 11,948 | 12, 107 | 12, 187 | 12,266 | 12,111 | 11,775 | 11.426 | 11,005 | 10,239 |
| 68 | 12,217 | 12,2\% | 12,310 | 12,619 | 12,280 | 11,925 | 11,702 | 11,267 | 10,647 |
| 69 | 12,628 | 12,007 | 12,455 | 12,603 | 12,486 | 12,140 | 11,43 | 11,628 | 10,907 |
| 70 | 12,626 | 12,751 | 12,650 | 12,70 | 12,652 | 12,324 | 12,061 | 11,645 | 11,100 |
| 71 | 12,843 | 12,481 | 12,866 | 13,062 | 12,863 | 12.616 | 12,317 | 11,465 | 11, 771 |
| 72 | 13,135 | 13,065 | 13,286 | 13, 241 | 13,001 | 12,886 | 12,507 | 12,048 | 11, 503 |
| 73 | 13.345 | 13, 349 | 13,487 | 13.461 | 13, 778 | 13, 102 | 12,60 | 12,353 | 11,780 |
| 76 | 13,545 | 13, 36 | 13,815 | 13,636 | 13,610 | 13,340 | 12,956 | 12,548 | 12,027 |
| 75 | 13,718 | 13,826 | 14. 101 | 13,667 | 13,940 | 13,545 | 13,109 | 12,749 | 12,373 |
| 76 | 13,883 | 14,100 | 16,382 | 16,192 | 16,214 | 13,705 | 13,500 | 12,956 | 12,607 |
| 77 | 14,269 | 14,464 | 16,065 | 14,561 | 14,414 | 16,006 | 13,770 | 13, 139 | 12,735 |
| 78 | 16,542 | 14, 1505 | 16,939 | 14,321 | 14,819 | 14,222 | 14.019 | 13,304 | 12,900 |
| 79 | 16,791 | 15,045 | 15,300 | 15,143 | 15,099 | 14,526 | 14,319 | 13,625 | 13,105 |
| 80 | 15,006 | 15,706 | 15.037 15.46 | 15,438 | 15,273 | 14,324 | 14,554 | 13,462 | 13,253 |
| 81 | 15,501 | 15.744 | 15,96 | 15,784 | 15,64 | 15,048 | 14,902 | 14,221 | 13.40 |
| 82 | 16,086 | 16,142 | 16,268 | 16,179 | 15,738 | 15,379 | 15,161 | 14.57 | 14,052 |
| 8 | 16,362 1659 | 16,411 | 16.618 | 16,403 | 16, 152 | 15,731 | 15.610 | 14,316 | 14,326 |
| ${ }_{85}^{36}$ | 16,593 16,90 | 16,738 17 | 17.143 17 | 17.009 | 16,573 | 16,009 | 15,717 | 15,253 | 14.618 |
|  | 16,940 | 17.048 | 17.581 | 17,675 | 16, 87 | 16,534 | 16,155 | 15,522 | 14, 888 |
| 88 | 17.410 17 | 17.402 17.231 | 17,974 | 17,923 | 17.119 | 16, 348 | 16,500 | 16,068 | 15,323 |
| 87 | 17,799 | 17.831 | 18,322 | 18,324 | 17.535 | 17,172 | 16,848 | 16,407 | 15,542 |
| 88 | 18,423 | 18,420 18.250 | ${ }^{18,623}$ | 18,562 | 18,050 | 17.679 | 17.178 | 16,776 | 15,946 |
| 89 | 18, 816 | 18,859 | 18,997 | 18, 873 | 18,605 | 10,158 | 17,716 | 17,173 | 16,216 |
| 90 | 19,182 19 | 19.487 | 19,387 | 19,272 | 19,091 | 18, $6 \%$ | 18,253 | 17,422 | 16,663 |
| 91 | 19,819 | 19,905 | 19,876 | 19,780 | 19.802 | 19.781 | 18,605 | 17,909 | 17, 179 |
| 92 | 20,299 | 20.625 | 20,569 | 20,363 | 20.205 | 19.745 | 19,269 | 18,460 | 17,503 |
| 9 | 21,858 | 21.103 21.005 | 21,057 | 21,023 | 20.655 | 20, 398 | 19.811 | 19,155 | 18,085 |
| 95 | 22,811 | 22,052 | 21,79 22,39 | 21, 22,36 | 21, 31 | 20.909 | 20.406 | 19,75 | 18,979 |
| 9 | 23,866 | 23,637 | 23,480 | 23, 505 | 23,075 | 21,627 22,630 | 21.127 | 20.310 | 19,848 |
| 97 | 25,387 | 26,902 | 26,921 | 26, 809 | 26,409 | 23,673 | 22,920 | 21, 857 | 20,9\%1 |
| 98 | 26,526 | 26.609 | 26,586 | 26, 221 | 25.915 | 25.465 | 24.638 | 23,6\% | 22,761 |
| $\infty$ | 28,216 | 28,280 | 28,616 | 28,235 | 27,616 | 27,125 | 26,436 | 25,752 | 26,873 |
| 100 | 35,502 | 33,543 | 32,626 | 32,593 | 32,201 | 31,813 | 31,132 | 29,916 | 28,890 |
| 4can | 8.767 | 8,023 | 9,261 | 9,302 | 9, 130 | 8.863 | 8,515 | 8,053 | 7.611 |
| stoer | 8,652 | 8,322 | 8,152 | 7,906 | 7,352 | 7.716 | 7,656 | 7,41 | 7,610 |



90 Working Paper \# 1 - An Analysis of Wheat Supply Response Under Risk and Uncertainty


[^0]:    ${ }^{2}$ The selectivity associated with the participation requirements of the Top Management Workshops themselves means that the participants are not representative of the population as a whole.

[^1]:    ${ }^{3}$ For example, two types of response models often used are the Nerlovian or the Ryan-Goodwin models which are subsequently modified to include a risk variable.

[^2]:    5 The sum of absolute deviations is labelled by semi-variance.
    6 Semivariance is the sum of absolute deviations from the mean.
    7 For further criticisms of the MOTAD model refer to Chen.

[^3]:    8 This set of data is independent of the original weather information.

[^4]:    9 Each variable was increased by 1 mm , holding the remaining variables constant.

[^5]:    10 It is assumed that soil moisture could not fall below 0 nor exceed 25 cm of moisture.

    11 These data were obtained from the Soil Science Department at the University of Saskatchewan.

[^6]:    12 SDRF is further explained in Chapter II.

[^7]:    13 The participants criticized the pretest questionnaire as being difficult to choose between the pairs of distributions because they were not significantly different, in their perception. Thus, the standard deviation was increased in the final questionnaire.

[^8]:    15 The relative risk aversion coefficient is defined as
    $\theta=\tau I$
    where $\theta=$ relative risk aversion coefficient,
    $\tau$ = absolute risk aversion coefficient and
    I = mean net income.

[^9]:    16 There still remains a slight problem of ambiguity in that perfect risk aversion would also imply an upper level of $\theta<0$.

[^10]:    ${ }^{17}$ Average Top Management direct labor requirements are 0.82 hours/ hectare.

[^11]:    18 Initial simulations included a range from 40 to 130 mm .

[^12]:    19 The opportunity cost of production approach is based on component pricing of each input including fixed assets using as its price the returns that resource or input could have earned when used in its highest and best use. In the case of machinery, this refers to the forgone interest which could have been earned if capital had been invested elsewhere plus the loss in value (i.e. depreciation), if any. The opportunity of short and intermediate capital was set at $10 \%$. The opportunity cost of capital invested in land was set at $5 \%$. Alternatively, the opportunity cost of land would be its cash rents.

[^13]:    20 A lower cost of production would be expected for areas producing lower quality wheats such as the black soil zones; the yield and rotational differences have already been factored in through the calculation of the average total costs. Thus, the black soil zone would be expected to have a lower opportunity cost of production.

[^14]:    $\overline{\text { a }}$ Low and prices are based on the historical mean $\pm 75 \%$ of the standard deviation.
    ${ }^{b}$ Standard deviations are based on a coefficient of variation of $31.2 \%$.
    ${ }^{c}$ Price floors and ceilings are based on the mean $\pm$ of the standard deviation.

[^15]:    22 If two fallow years following each other are disallowed, then the comparisons would be direct and exact.

[^16]:    24 Direct operating and fixed costs of machine ownership are held constant per unit across farm size. The latter includes all machines directly used in the production process such as most tractors, all tillage, harvesting, and processing machines, and most trucks used in transporting grain. Indirect overhead costs are treated as "lumpy": costs. Indirect overhead costs include operating and ownership costs associated with pickup trucks; the shop; a portion of larger trucks; legal and accounting expenses, the business portion of the household and a number of miscellaneous expenses. Thus, as farm size increases, average total costs decline because of the lumpiness of indirect overhead costs.

[^17]:    25 If the columns are used, then the signs are reversed and a "-1" indicates dominance.

[^18]:    26 Note that the no price policy program and the truncation policy actually overlap. The risk efficient portfolio, $M_{c}{ }^{*}$, of the no price policy consists of both the 80 and 85 mm strategies while the truncation $M_{c}{ }^{*}$ consists of the 80 mm .

    27 Here, significance is used in a dominating sense. While the averaging of multiple $M_{c}$ 's is used to demonstrate potential change, it is not significant. There may a number of practical reasons for a lack of significance including the variability associated with differing random draws between simulations.

[^19]:    ${ }^{28}$ The simulation model incorporates stochastic elements and thus, there can be a problem with the selection of differing random "events." This has been minimized through the standardizing of the initial seed value and generating all stochastic variables whether or not they are used. This guarantees that each simulation should be based on the same set of random variables. In addition, the set of 1000 observations of income are sorted and pooled into a set of 100 observations making up the cdf. The latter limit of 100 is imposed by the SDWF software. Accordingly, the impact of extremely unlikely ( 1 in 1000) events is partially absorbed in the pooling effect.

[^20]:    29 The reason may also be due the "fuzziness" associated with simulation and SDWF.

[^21]:    31 While all 36 strategies are compared, only the individual risk efficient strategies need to be compared; less programming was required to compare all 36 then to compare the set of individual price policy risk efficient strategies.

[^22]:    33 The truncated policy should dominate the insurance policy at the lowest levels because of the insurance premium associated with the latter.

[^23]:    34 The selectivity associated with the participation requirements of the Top Management Workshops themselves means that the participants are not representative of the population as a whole.

    35 The absolute risk premium, P , is defined as $0.5 \tau \sigma^{2}$ where is $\tau$ is absolute risk aversion coefficient.
    ${ }^{36}$ The relative risk premium $\mathrm{P} / \mathrm{Y}$ is defined as $0.5 \mathrm{R} \sigma^{2}$ where $R$ is the relative risk aversion coefficient.

