Risk
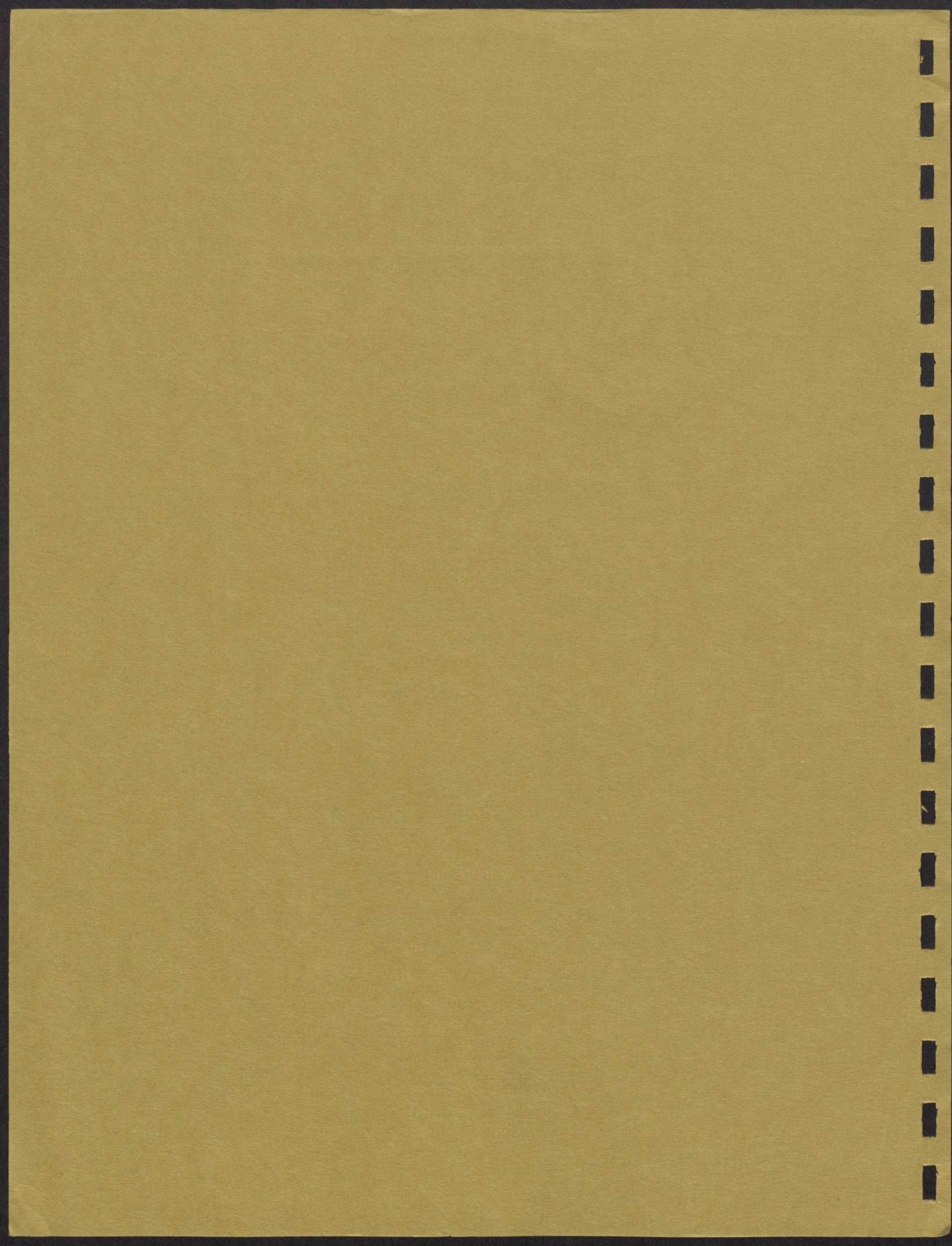
A SUMMARY OF THE PROCEEDINGS OF A SEMINAR ON RISK AND UNCERTAINTY

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FOREWORD

This publication summarizes the material presented at a seminar held at the University of Guelph in March 1979. The seminar was attended by staff of the Ontario Ministry of Agriculture and Food who are involved in providing farm management advisory services. It provided a forum for the interpretation and discussion of principles and techniques that are relevant for assisting farmers to develop management strategies that recognize different types of risk involved in operating farm businesses. Since individual farmers have different attitudes toward risk, the appropriate management strategy for each farmer must recognize his risk attitude as well as his individual goals, his resources, and his managerial ability.

The information presented at the seminar described the theoretical basis for analysing and evaluating farm management problems related to risk and uncertainty as well as the results of several research projects which dealt with this subject.

The specific objectives of the seminar were:
1. To identify various types of risk and uncertainty with which farmers have to contend.

2. To assess the effect of attitude toward risk on management decisions and on the performance and growth of farm businesses.

3. To examine the implications of alternative means of minimizing risk such as diversification of farm enterprises, adjusting the level of variable inputs and the use of risk-shared credit.

4. To consider the adequacy of the information available to assist farmers and extension personnel in developing farm plans that recognize risk.

At a later date it is planned to publish a more detailed technical publication on this subject. In the meantime, it is hoped that this summary will serve as a useful reference for extension personnel.

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ACKNOWLEDGMENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

TYPES OF RISK AND UNCERTAINTY IN FARM MANAGEMENT

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Managing an agricultural enterprise involves continual decision-making. As the outcomes of such decisions are seldom a certainty an effective decision-maker must understand the types of risk and uncertainty that he faces and how to distinguish between them. Outcomes that are not certain can be categorized in two ways:

Risk: Risk is used to describe a situation where
                        the probability of the event occurring can
                        be predicted.

Uncertainty: Uncertainty is used to describe a situation
                        where the probability of the event occurring
                        can not be predicted.

The distinction between the two is based upon the existence or non-existence of a probability distribution for the events occurring. Two types of distribution are important here:

1. Objective Distributions - These are based either upon
    analytical criteria (e.g. mathematical probabilities
    such as can be stated for rolling a 6 on an unbiased
    die) or upon empirical criteria (e.g. historical prob-
    ability based on records of such things as average
    yields).

2. Subjective Distributions - These are based on the sub-
    jective attitudes of the decision-maker towards the
    possibility of various outcomes occurring. A subjective
    assessment of the probability of a future event occurring
    is often necessary because of a lack of historical
    evidence on which to base a prediction. For example a
    river may have flooded so infrequently that the time
    and/or severity of the next flood can not be predicted.
    In other cases there may be a considerable body of

historical evidence (e.g. commodity prices) but the
data do not reveal a consistent pattern and are
therefore not a reliable indicator.

CLASSIFICATION OF RISK AND UNCERTAINTY

In reality there is often no distinct line separating risk and
uncertainty, rather there is a broad spectrum running from absolute
certainty through risk to pure uncertainty, with management's confidence
in the likelihood of an event occurring declining from one end to the
other. Generally however it is possible to group decisions into five
categories, always remembering that the distinctions may not, in real
life, be readily apparent.

1. Certainty: Certainty presumes perfect knowledge of
   future events and their prediction without error. In
   such a case only one outcome need be examined and, as
   a consequence, the managerial role becomes one of super-
   vision rather than one of risk evaluation and decision-
   making. However the outcome of an event in agriculture
   is rarely certain. For farmers operating self sufficient
   enterprises (few purchased inputs or off-farm sales and
   little, if any, debt burden) disregarding alternative
   possible outcomes is seldom disastrous. The majority
   of agricultural managers today however face substantial
   fixed costs and a heavy dependency on input and product
   prices. In such a situation an assumption of certainty
   is inappropriate and management must build risk assess-
   ment into their planning strategies so as to minimize
   the possibility of heavy losses.

2. Pure Risk: Pure risk occurs where the probability of
   the outcome can be readily predicted. It is based on
   the objective distributions discussed earlier where the
   error in predicting outcomes is small. Examples include
   the chances of fire or other property damage, sickness
   and death. Because the probability of these outcomes

can be predicted accurately, over a large population
it is possible to transfer this type of risk to a
financial intermediary at low cost (e.g. health,
property and automobile insurance).

3. <u>Subjective Risk</u>: Subjective risk is present where
information as to the probabilities of events
occurring are less precise due to the small number of
businesses or individuals to which it relates. Error
is therefore greater and any prediction contains more
uncertainty than is presumed in pure risk.

Because risk premiums increase dramatically with
increasing error in prediction, insurance may not always
be worthwhile and management may consider it more profit-
able to accept the risk themselves.

4. <u>Subjective Uncertainty</u>: Subjective uncertainty occurs
where too little data are present to determine a
probability distribution. For example, the local river
may flood approximately once in a generation and present
the possibility of heavy losses. Factors causing such
flooding are uncertain, thus transferring the risk, in
the form of insurance, to a third party is only possible
(if at all) at a prohibitive cost.

Coping with subjective uncertainty necessitates a
willingness to guess at the probability of its occur-
rence and its impact upon the business. Hence it is
highly subjective. A highly defensive strategy that
assumes the worst will happen (e.g. river flood levels
will reach or exceed the all-time high) and attempts to
minimize the loss (e.g. building an embankment higher
than the record high water level) may well be possible
but will seldom be worthwhile. A better policy may be
to accept a certain level of risk and only build, for
example, embankments to exceed the average flood level
over the last 100 years. Such a policy will generally

involve far smaller costs than would be necessary if one attempted to eliminate risk completely. Any decision must be based ultimately upon the individual manager's assessment of the situation.

5. <u>Uncertainty</u>: Uncertainty occurs where little or no knowledge of likely outcomes is available. This would be the case where either the event is unique or where so many factors are involved that it is impossible to calculate a reliable probability distribution. In such cases management might adopt a flexible strategy that is able to deal with a wide variety of possible outcomes - both favourable and unfavourable.

SUMMARY

The major features of the different types of risk and uncertainty with which farmers contend can be summarized as follows:

TYPE	FEATURES
1. Pure risk	- probability distribution based on historical observations
	- high reliability of predictions
	- risk can be transferred to a financial intermediary
2. Subjective risk	- probability distribution based on historical observations
	- moderate to low reliability of predictions
	- stop-loss insurance possible
	- risk posture inclined toward accepting some risk.
3. Subjective Uncertainty	- too few historical observations for a probability distribution
	- risk cannot be transferred
	- risk posture based on subjective considerations
4. Uncertainty	- no historical observations
	- complete lack of knowledge.

The different types of risk and subjective uncertainty which farmers need to consider in making their management decisions are identified in the top row of Figure 1. The sources of risk have been categorized in terms of production, markets, financial, political and human, and are shown in the first column of the figure. Alternative methods farmers might employ to cope with each of these sources of risk are also identified. Subsequent articles in this publication examine the implications of some of these methods in greater detail.

FIGURE 1. SUMMARY OF RISKS FARMERS CONTEND WITH AND

METHODS OF CONTENDING WITH THOSE RISKS

CLASSIFICATION OF RISK & UNCERTAINTY	CERTAINTY:	PURE RISK:	SUBJECTIVE RISK:	SUBJECTIVE UNCERTAINTY:	UNCERTAINTY:
(SOURCES OF RISKS FARMERS CONTEND WITH)	-SINGLE VALUED OBSERVATIONS -PERFECT KNOWLEDGE	-PROBABILITY DISTRIBUTION -CONFIDENCE IN PREDICTION HIGH -CAN TRANSFER RISK TO FINANCIAL INTERMEDIATARY	-PROBABILITY DISTRIBUTION -CONFIDENCE IN PREDICTION MODERATE TO LOW -STOP LOSS INSURANCE POSSIBLE -RISK POSTURE REQUIRED	-TOO FEW HISTORICAL OBSERVATIONS FOR PROBABILITY DISTRIBUTION -CANNOT TRANSFER RISK -GAMING DEFENSIVE STRATEGIES WHICH DEPENDS ON PERCEPTIONS, ATTITUDES AND WILLINGNESS TO GUESS AT RISKINESS OF FUTURE EVENTS	-NO HIST OBSERVATIONS -COMPLETE LACK OF KNOWLEDGE
		--- METHODS OF CONTENDING WITH THOSE TYPES ---			
PRODUCTION: PHYSICAL OUTPUT TO INPUT VARIABILITY -WEATHER -DISEASE -PESTS		DRAINAGE ⟶ IRRIGATION ⟶ BIOLOGICAL & PHYSICAL TECHNOLOGY ⟶ IMPROVED PRACTICES ⟶	CROP & LIVESTOCK INSURANCE TO STOP LOSSES ENTERPRISE DIVERSIFICATION REDUCE VARIABLE INPUTS SHARED OUTPUT VARIABILITY IN LEASING ARRANGEMENTS	MANAGERIAL PLANNING FLEXIBILITY -CROP MIX & USE OF INPUTS -RATIONS -HARVESTING & STORING RESOURCE RESERVES	CAUTIOUS OPTIMISM
MARKET: -PRICE -QUOTAS		FORWARD CONTRACTING INPUTS & OUTPUTS	SHARED PRICE VARIABILITY IN FARM COMMODITIES & LEASING ARRANGEMENTS --------- HEDGING ---------	STABILIZATION & FARM SUPPORT PROGRAMS PLANNING FLEXIBILITY	
FINANCIAL & INVESTMENT: -CASH FLOW -CREDIT LIMITS -INTEREST -ASSETS		INCREASE AMORTIZATION PERIOD PROPERTY INSURANCE	RISK SHARED CREDIT TO FINANCE BRIDGE PERIOD FLEXIBLE CREDIT ARRANGEMENTS	MAINTAIN CASH & CREDIT RESERVES	
POLITICAL: -ARAB OIL CARTEL -RUSSIAN WHEAT SALE -POTENTIAL CHINESE MARKET -CHANGING SUBSIDIES & SUPPORTS -CHANGING TARIFFS & REGULATIONS -CREDIT RATIONING AND ETC.				DEVELOPING DEFENSIVE PRODUCTION, MARKETING AND/OR INVESTMENT STRATEGIES MAINTAINING RECORDS AND KEEPING INFORMED OF NEW DEVELOPMENTS & REGULATIONS	
HUMAN: -DISABILITY -DEATH -AGE -GOALS -PERCEPTIONS -ATTITUDES		LIFE & DISABILITY INSURANCE		BUSINESS ORGANIZED TO ASSURE BACK-UP MANAGEMENT MAINTAIN OPEN MIND TO FAMILY VIEWS AND NEEDS	

THEORY OF FARM DECISION-MAKING UNDER RISK

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Most commercial farmers recognize the need to budget and plan their farm businesses with variability in yields, input costs and product prices in mind. Too often, however, the process of making decisions in the face of uncertain outcomes is not done systematically. For many farmers, this may mean that too much allowance is made for risk - the farmer becomes too cautious, and is unwilling to expand an enterprise, adopt new cost-saving technology or apply more inputs such as fertilizer when it would be to his benefit to do so. To make better decisions under risk, the farmer needs more and better information about the extent of variability he is likely to face. One way to do this is to use the data for a number of recent years, from a number of similar farm enterprises in the vicinity to derive the most probable outcome (e.g. yield) and the degree to which actual results have varied from the most probable outcome.

ALLOWING FOR RISK IN A SINGLE ENTERPRISE

The most probable outcome can be measured statistically by calculating the average (arithmetic mean) outcome, and the degree of variability around the average can be measured by calculating the standard deviation.* Using the average and standard deviation statistics, the farmer can make decisions more systematically on the basis of a "representative outcome" according to the following:

Representative Outcome = Most Probable Outcome less an Allowance for Risk,

where,

Most Probable Outcome = Average Outcome

Allowance for Risk = Z times Standard Deviation of Outcome
(Z represents the farmer's attitude to risk, in terms of the number of standard deviations that are deducted from the average outcome in order to come up with the representative outcome).

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* See page 25.

The representative outcome is one that reflects the farmer's feeling about how far the actual outcome <u>might</u> fall below the most probable outcome, and is therefore the outcome upon which the farmer bases his decisions. If for example the mean average corn yield is 115 bushels per acre and the standard deviation is 20 bushels, then a farmer who wants to make a wide allowance for risk might base his decision on a "Z" value of 2. Thus:

Representative outcome = 115 - (2 x 20) = 115 - 40 = 75 bushels/acre.

If this farmer's corn yields are normally distributed over time, (i.e. follow a bell-shaped pattern) then he could expect to obtain a yield of 75 bushels per acre or better for 98 percent of the time (see Figure 2).

Suppose another farmer was not so averse to risk. He might base his decision on taking a "Z" value of 0.5, so that:

Representative outcome = 115 - (0.5 x 20) = 115 - 10 = 105 bushels/acre. In this case, the farmer would expect to obtain 105 bushels per acre or better for 68 percent of the time. Put another way, this farmer might expect to have less than 105 bushels per acre in 32 years out of 100, but he is willing to live with that.

This procedure for measuring probabilities of risky outcomes can be applied equally well to costs of inputs the farmer buys, such as feed or seed, and to prices of products the farmer sells, such as corn, milk or beef, again provided that the input costs and product prices are normally distributed.

ALLOWING FOR RISK IN TWO OR MORE ENTERPRISES

Extending the above procedure one stage further, we can combine several farm enterprises together (e.g. corn, soybeans and wheat) and calculate the representative outcome for the whole farm business in terms of net farm income. In this case, the representative net farm income is found by summing the expected gross margins per acre (multiplied by the number of acres grown) for each crop, and deducting the sum of the standard deviations[1] of gross margins per acre for each crop, adding

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[1] The sum of the standard deviations is found by summing across all crops the square root of the sum of the squared deviations from the average net income per acre for each crop.

FIGURE 2

PROBABILITY ASSURANCE LEVELS GIVEN BY
THE AREA UNDER THE NORMAL CURVE

2 STANDARD
DEVIATIONS

1 STANDARD
DEVIATION

EXPECTED
MEAN
YIELD

| 3 | 2 | 1 | 0.5 | Z=0 |

| 55 | 75 | 95 | 105 | 115 |

ASSURED OF THIS YIELD OR BETTER 50% OF THE TIME

ASSURED OF THIS YIELD OR BETTER 69% OF THE TIME

ASSURED OF THIS YIELD OR BETTER 84% OF THE TIME

ASSURED OF THIS YIELD OR BETTER 98% OF THE TIME
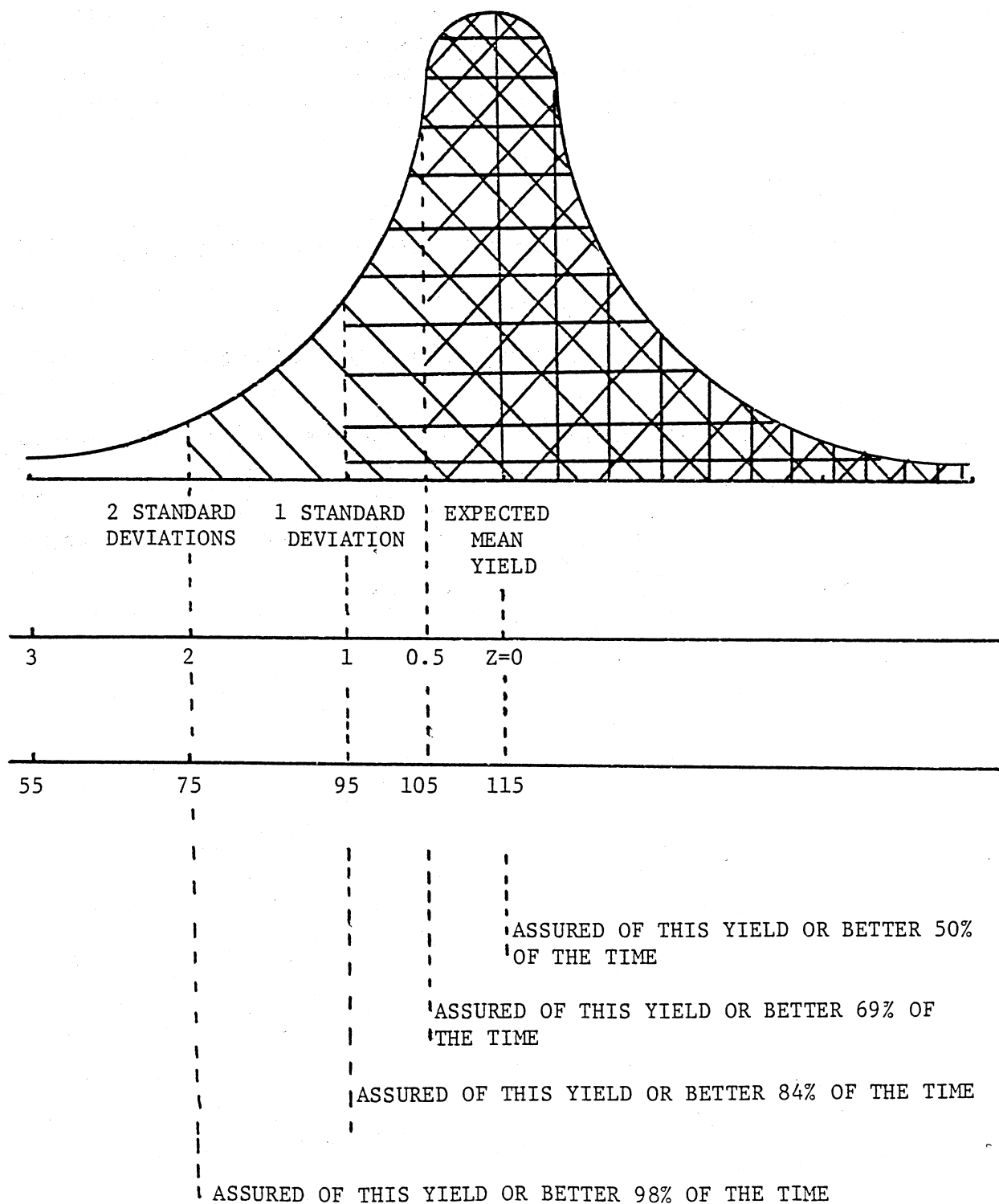
or subtracting the composite covariance [2], and deducting total fixed costs for the farm.

For example, given the following data:-

	Grain Corn	Soybeans	Winter Wheat
Gross Margin per acre (dollars)	164	143	143
Standard Deviation of Gross Margin per acre (dollars)	48.00	44.80	36.40
Number of Acres Grown	200	200	200
Average Fixed Cost per acre (dollars)	125	125	125

the representative net farm income is calculated as follows:-

$$\left[(164 \times 200) + (143 \times 200) + (143 \times 200)\right] - Z\sqrt{\left[(48.00 \times 200)^2 + (44.80 \times 200)^2 + (36.40 \times 200)\right] \pm \text{covariance}^{[3]}} - (125.00 \times 600)$$

$$= (32800+28600+28600) - Z\sqrt{(92160000 + 80281600 + 52998400)} - 75000$$

$$= 90000 - Z\ (15014.66) - 75000$$

The final item of information required is the "Z" value, or a measure of the farmer's attitude toward risk. If a farmer were fairly risk-averse, he may wish to base his decisions on a "Z" value of 0.5. Thus, representative net farm income would be equal to:-

$90,000 - 0.5 (15014.66) - 75000 = $7492.67, and he would expect to obtain this net farm income level or better 68 percent of the time.

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[2] Corvariance measures the way in which two outcomes vary together over time and among farms - for example, covariance measures the way corn yields and prices, or corn prices and fertilizer costs vary together. If a pair of outcomes varies in the same direction over time and among farms, then the covariance term will be positive and this will add to the total risk. If, however, a pair of outcomes varies in opposite directions, the covariance term will carry a negative sign, and this will help to reduce total risk.

[3] Covariance not calculated for this particular example.

ALLOWING FOR RISK FOR THE WHOLE FARM

In practice, the farmer is faced with a wide range of possible outcomes based on different enterprise levels and combinations and on different input levels and combinations. Each possible outcome represents a different farm plan, and each farm plan will have an expected net farm income and a standard deviation of income (or risk level) associated with it. If we graphed all these farm plans with expected income measured on one axis and standard deviation of income measured on the other axis, we would have the typical situation shown in Figure 3. Each dot represents a different farm plan. Some farm plans would be considered by a farmer to be superior to others. Consider, for example the farm plan denoted by "B" in Figure 2. This plan is better than plan "F" since plan "B" provides the same level of expected income but has a lower risk level. Plan "B" is also superior to either of plans "G" or "H", since all three plans have the same expected risk level, but "B" provides a higher expected farm income level than either of "G" or "H". Note that for every expected risk level, there is one farm plan that represents the maximum expected income level that can be obtained. Plan "B" is one such plan – plans A, C and D are others. A farmer can do no better than select one of these plans, which together represent points on the "optimum plan frontier". Each plan on the frontier is equally good in that no higher expected income level can be obtained <u>unless</u> the farmer is willing to accept a higher level of expected risk. Note also that a farmer would seldom find it profitable to choose any plan such as plan "E" on the frontier above plan "D" (or above the dotted line in Figure 3), since above this level the farmer would be facing a <u>lower</u> expected income level while expected risk level continues to increase.

The next problem is to help the farmer choose among all the equally good plans on the optimum plan frontier. To do this we need to know something about the farmer's attitude to risk, measured in terms of the trade-offs between expected income and risk levels that the farmer is willing to live with or operate under. Suppose we find that a certain farmer is equally happy with a set of farm plans that have increasing expected income levels so long as these are accompanied by <u>less than</u>

FIGURE 3

EXPECTED NET INCOME AND RISK LEVELS FOR A RANGE OF FARM PLANS
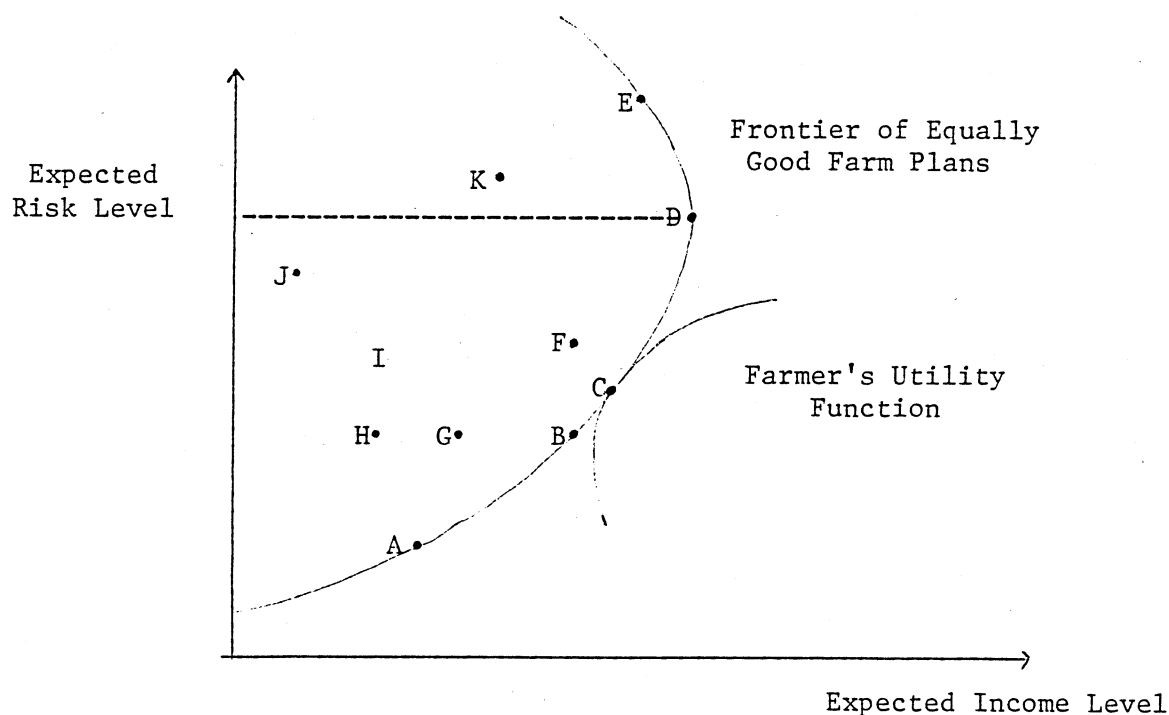
proportionately increasing expected risk levels. Such a situation is
shown in Figure 3 by the so-called "utility function" (the farmer obtains
the same level of satisfaction from all possible combinations of
expected income and risk levels on this curve). Now the unique best plan
for this farmer would be plan "C" where the farmer's utility function
just touches the optimum plan frontier, because at this point his
expected income will be maximized, given the degree of risk he is
prepared to assume. For other farmers with different utility functions,
plans A, B or D might be superior.

RISK AND INVESTMENT ALTERNATIVES

One appropriate method of choosing among alternative investment
opportunities is to compare the expected future streams of net income,
discount these income streams to a present value basis, and select the
investment alternative that is expected to provide the highest net income
stream in present value terms. The concept of discounting future
earnings for the lapse of time simply recognizes the fact that investors
prefer to have earnings in their pockets now rather than later; that is,
people place more value on income earned in earlier than in later time
periods. The traditional formula used to discount for lapsed time is:

$$NPV_j = E(R_{j1})\frac{1}{(1+r)^1} + E(R_{j2})\frac{1}{(1+r)^2} + \ldots + E(R_{jt})\frac{1}{(1+r)^t}$$

$$= \sum_{k=1}^{t} \left[E(R_{jk})\frac{1}{(1+r)^k} \right],$$

where NPV_j is the net present value of expected future (net) returns

from the jth investment alternative,

$E(R_{jk})$ is the undiscounted expected net return (most probable

outcome) from the jth investment in the kth time period,

including the salvage value of the investment in the tth

time period,

r is the discount rate, reflecting the decision-maker's allowance

for reduced value of returns expected in future time periods.

Note that this formulation is based on net returns _expected_ in future
time periods - this is the same as using the most probable or average
(arithmetic mean) net returns level - and no allowance is made for risk.
There are two methods by which a decision-maker can make allowances for
risk in his investment decisions. Firstly, he can reduce the average net
returns level in each year by "Z" times the standard deviation of net
returns, as explained previously. Secondly, he can vary the discount rate

among time periods to reflect his perception of how risk levels may change over time. As a general rule, the discount rate will tend to be increased in later, or more distant time periods, since a decision-maker will be less sure of events further in the future.

By making use of both of these risk allowance provisions, we can derive a modified formula which permits the decision-maker to base his investment decisions on net returns discounted for risk as well as for time thus:

$$NPV_j = \sum_{k=1}^{t} \left[E(R_{jk})\frac{1}{(1+r_k)^k} - Z(\sqrt{s_{R_{jk}}}) \right] ,$$

where $- Z(\sqrt{s_{R_{jk}}})$ is an allowance for risk through reducing the average net returns level,

Z is the decision-maker's attitude toward risk,

$\sqrt{s_{R_{jk}}}$ is the standard deviation of net returns from the jth investment alternative in the kth time period,

r_k is the discount rate for the kth year.

While it is true that this modified formula is more sophisticated and can assist the farmer in making more relevant investment decisions, it is also true that the formula is more complex and generally requires the use of computerized solution techniques. These concepts concerning investment decisions and risk discounting will be further developed in the section on "Evaluating Financial Risks Associated with Investment," by J.H. Clark, pp. 38-42.

ATTITUDES TOWARD RISK : THE CONCEPTUAL FRAMEWORK

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The management of any business involves reconciling different objectives, many of which may be conflicting. Two major objectives in most businesses are the maximization of net income to the business and the ensuring of some minimum level of income sufficient to cover all necessary expenses. These two objectives frequently conflict because the maximization of net income involves risk-taking and the greater the risk involved, the greater the possibility that the minimum required income level will not be attained.

Well established farmers with a large equity may well afford the occasional bad year when income falls below the minimum level needed. Those with heavy debt burdens, and little equity, could not afford such failures.

TABLE 1

The Effect of Losses on Five
Farms with Different Debt-Equity Ratios

(in $000's)

	A	B	C
Farm Assets	500	500	500
Farm Debt	0	200	400
Owner's Equity	500	300	100
Interest and Repayment of Debt	0	20	40
Loss*	25	25	25
Remaining Equity**	475	255	35
% Reduction in Equity	5	15	65

* Assuming net income drops to a level equivalent to a loss of 5% on farm assets.

** Original equity minus (Loss + interest and principal debt repayments).

Table 1 shows three farms, each with total assets of $500,000 but with different amounts of equity ranging from complete equity in the case of Farmer A to only 20% for Farmer C.   In a year in which income declines sharply, the effects on each farm will be very different. Farmer A, with no debt burden, and with an overall loss of 5% will lose only 5% of his equity. The remaining farms however must meet outside debt repayments and so will lose the $25,000 lost by Farmer A plus the cost of servicing the debt (taken here as a straight 10% for simplicity). As can be seen, the higher the debt, the less the farmer can afford any risk of loss. Farmer C, for example, is virtually wiped out, as he loses $65,000 from his original equity of $100,000.

External obligations and fixed costs are major determinants of attitudes to risk but there are others. Attitudes to risk vary according to amounts of money involved. Many people would accept a win or lose toss of a coin for $5; few however would contemplate the same proposition when the sum was $5,000. Again managers vary in their subjective attitudes to risk - some relish it, others will take great care to avoid it. With such a large number of factors determining people's attitudes it is not surprising that they are often transitory, varying from one decision to another.

Nevertheless people have traditionally been categorized into three groups according to their general attitude to risk. These categories are risk takers, risk averters and those who are risk neutral. The approach of each type of manager can be illustrated in Figure 4.

In Figure 4, the middle (unbroken) curve represents the average expected net farm income at various levels of risk and it can be seen that as risk increases, income also increases - at least initially. Also shown are the maximum and minimum expected income curves which are plotted respectively, two standard deviations above and below the average expected income curve. It will be noted that as the level of risk increases the difference between the minimum and maximum expected incomes also increases. Indeed at high levels of risk, minimum expected income drops to a very low level.

The risk neutral manager will choose to produce at risk level R_O for this will give him the maximum average expected income possible (D).

FIGURE 4

Choice of Risk Level and its Effect on Income
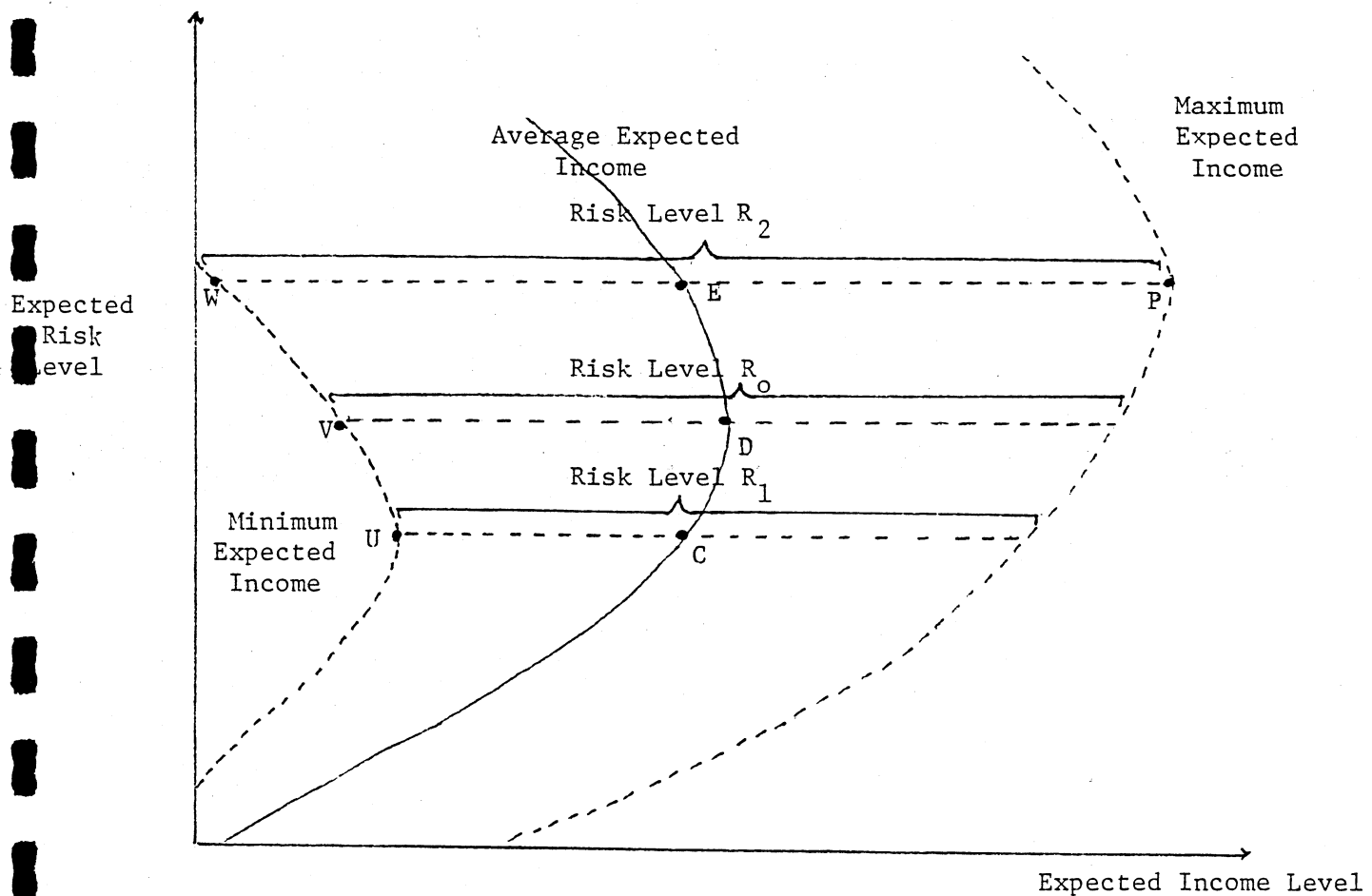
He could expect that his income would be in excess of the minimum expected income for that level of risk (V) more than 97 percent of the time. Thus, except in very unusual cases, he is assured of an income above this level.

A farmer producing at any risk level below R_o is considered a risk averter. In general, production at any level of risk below R_o will be inferior because the average expected income (point C for example at risk level R_1) will be lower. However a risk averter may have sound reasons for choosing a lower level of risk. At risk level R_1, average expected income is lower than for the risk neutral case, but because the level of risk relative to expected income is lower, the expected minimum income (U) is higher for the lower level of risk than for the risk neutral case (V). This is important for farmers such as Farmer C in Table 1, for with risk level R_1 minimum expected income is at its highest level. Thus, where security of income is paramount, it may be preferable to produce at this lower level of risk.

A risk taker is considered to be anyone who produces at risk levels above R_o. This too is considered generally inferior as the average expected income (E) will be lower than at D and perhaps more importantly, the minimum expected income at point Z, for example, with risk level R_2 is extremely low. Perhaps the only reason for producing at risk level R_2 is that one has the possibility of obtaining the highest possible income (P). This might be undertaken as a 'last ditch' gamble - going for broke as it were. However, it is improbable that such levels of return will occur often and they will be cancelled out, on average, by returns at a correspondingly low level.

Risk taking managerial behaviour is almost always illogical and detrimental to the financial position of the firm; risk averting behaviour, though sacrificing the higher returns available by adopting a risk neutral stance, may be necessary to ensure the continued survival of the business. Very few farm managers are risk takers. Some, but not many are risk neutral. The majority operate in the risk aversion zone - including those who have sufficient equity to be able to afford the occasional decline in returns that risk neutral behaviour will entail. This may be due largely to a lack of reliable information on income variability at different risk levels. Without such information managers, like most people, tend to be cautious in their decision-making.

One final point must be made. We have been discussing risk in this situation as if one could control the level to suit one's managerial preferences. This is often possible, for example in the use of variable inputs such as fertilizer, where the greater the amount used the greater is the expected yield (but where the difference between minimum and maximum expected yield is also greater). In many cases, however, risk is not so easily controlled, as in the establishment of a new enterprise. Economies of scale may dictate a certain minimum size of operation. Here then the decision is one of 'Can I afford the risk or not?' - a yes or no type of decision. To make this kind of decision effectively it is not enough to know the expected return from the enterprise, one must also understand the risk involved and most importantly one's attitude to that risk.

FARMERS' ATTITUDES TOWARD RISK

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Large numbers of low income farmers persist in Canadian Agriculture.
In an effort to gain a better understanding of this phenomenon, research
was undertaken at the University of Guelph to identify and evaluate the
business and behavioural differences of various economic classes of farms
in Ontario. This research was part of a broader study that sought to
examine ways and means of improving farm performance and the general well-
being of limited resource farmers.[1]   Limited resource farmers were
considered to be those having less than $15,000 gross sales in 1971.

FRAMEWORK FOR ANALYSIS

In 1975, approximately 200 limited resource farmers in Grey and
Renfrew Counties were interviewed. Based on the information obtained, the
respondents were divided into two major groups; those <u>receptive</u> to making
farm improvements and those who were <u>unreceptive</u> to making farm improvements.
Further interviews were conducted the following year with 25 of the
receptive to change group and 53 of those unreceptive to change to obtain
more detailed business and behavioural information.

Data were collected for each of these farms regarding the value of
total assets, the farmer's equity in his farm business, number of tillable
acres and the amount of gross farm sales and net farm income. In addition,
the managerial attitudes of the farm operator were rated by evaluating his:

- risk orientation   - willingness to accept risk
- economic orientation   - value placed on financial success
- scientific orientation - willingness to adopt new technologies
                            and ideas.

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[1] For a more detailed report on the results of this study see;

Blackburn, D.J., G.L. Brinkman, H.C. Driver and T.D. Wilson, 1979. "<u>A
Comparison of Behavioural and Economic Characteristics of Selected
Commercial and Limited Resource Farmers</u>". School of Agricultural Economics
and Extension Education Publication AEEE/79/2.

Driver, H.C., G.L. Brinkman, D.J. Blackburn and J.L. Houghton,"<u>A Realistic
Assessment of Policy Instruments Designed to Aid Limited Resource Farmers
in Making Major Farm Improvements</u>", School of Agricultural Economics and
Extension Education, O.A.C., University of Guelph, March 1979, Publication
AEEE/79/3.

This information was then used to classify farmers receptive to change into the following three groups:

Transitions Group - consisting of young, or energetic managers who had made or were making considerable changes in their farm operations such as land purchases, construction of major livestock facilities and/or the addition of new enterprises;

Transition - Potential Commercial Group - consisting of older established managers who had made a series of minor changes over the course of their farming life, but were operating smaller more traditional businesses;

Potential Commercial Group - consisting of older established managers who appeared to have made little or no change to their farming operations and consequently operated small, traditional farm businesses.

For comparative purposes similar information was collected in 1978 from 39 commercial farmers (gross farm sales of $25,000 or more in 1976).

MAJOR FINDINGS

The results of the business and behavioural analyses are illustrated in Table 2. The table indicates that the Transition group controlled considerably more resources (total assets) and made more extensive use of external financing (lower percent equity) than the other groups. Likewise, tillable acreage and gross farm sales for the Transition group were considerably larger. Net income, however, was lower. Further analysis indicated that the group included respondents experiencing difficult market conditions in 1976. Cattlemen faced low beef prices and dairy producers had insufficient market-sharing quota to permit sale of his total production. These conditions in combination with high interest expenses led to a low level of net farm income at the time of the interviews.

The behavioural analysis indicated that the Transition group scored particularly high in risk orientation (3.4 out of a possible 5.0) vis-a-vis the remaining groups which were .9 and .83 respectively. Similarly, the Transition group scored higher in economic and scientific orientation

Table 2.   Selected Business and Behavioral Characteristics of
            Three Receptive to Change Limited Resource Farm Groups

	Transition	Transition-Potential Commercial	Potential Commercial
Number of Farmers	5	9	6
Business Characteristics:			
Total Assets	$230,550	$145,957	$103,744
Percent Equity	72.2%	95.5%	95.0%
Tillable Acres	225	193	180
Gross Farm Sales	$ 35,600	$ 24,300	$ 11,519
Net Farm Income	$ 3,173	$ 8,541	$ 5,463
Behavioral Characteristics:			
Risk Orientation (5.0)[1]	3.4	.9	.83
Economic Orientation (5.0)	2.8	1.55	.83
Scientific Orientation (5.0)	4.2	2.33	3.0
Age	41	48	45

[1] Number in brackets indicates maximum score possible.

although the differences were less dramatic than those for risk.

The business and behavioural characteristics of the receptive to change farmers were aggregated as a group and compared to a commercial group of farmers and the unreceptive to change group. This comparison is illustrated in Table 3.

In comparison to the commercial farms, the receptive to change group ranked lower in total assets, tillable acreage, gross sales and net farm income and held a higher percent equity. Similarly, the receptive to change group ranked ahead of the unreceptive to change farmers in all these characteristics.

Table 3.   Selected Business and Behavioral Characteristics of
            Commercial, Receptive to Change, and Unreceptive to
            Change Farm Groups

	Commercial	Receptive to Change	Unreceptive to Change
Number of Farmers	39	25	53
Business Characteristics:			
Total Assets	$159,905	$144,353	$ 85,332
Percent Equity	70.6%	88.4%	97.7%
Tillable Acres	N/A	190	172
Gross Farm Sales	$ 59,167	$ 20,439	$ 8,978
Net Farm Income	$ 11,865	$ 5,467	$ 2,537
Behavioral Characteristics:			
Risk Orientation (5.0) [1]	2.7	1.44	.72
Economic Orientation (5.0)	1.9	1.64	.98
Scientific Orientation (5.0)	4.31	3.04	2.7
Age	41	44	53

[1] Number in brackets indicates maximum score possible.

A similar pattern existed among the groups with regard to their
behavioural characteristics. The commercial group had the strongest
orientation with regard to willingness to accept risk, value placed on
financial success and willingness to adopt new techniques. For example,
the willingness to accept risk within the commercial group, as indicated by
their score (2.7), was considerably stronger than that for the unreceptive
to change group (.72) and the receptive to change farmers (1.44).

CONCLUSIONS

The results outlined in this paper indicate that substantial economic
and behavioural differences do exist among and within the classified groups
of farmers (commercial, receptive limited resource and unreceptive
limited resource). Typically, the commercial farm group exhibited strong
behavioural tendencies which in turn were reflected in the size and scale

of their farming operations. This was also true of the transition stage limited resource farmers who were receptive to change, although they had not yet acquired sufficient resources to equal the performance of their commercial counterparts. However, the remaining receptive and unreceptive to change groups were characterized by weaker business and behavioural settings and hence were much less likely to consider adjustment within their farm businesses.

These results suggest that if programs oriented toward assisting limited resource farmers are to be successful, high priority should be given to ensuring that the credit required to make the necessary farm adjustments is available. Furthermore, for many farmers in both the receptive and unreceptive to change groups, perhaps the first and most important requirement is programs which encourage them to extend their existing perceptions of what constitutes realistic achievement targets.

THE INFLUENCE OF RISK ON THE LEVEL OF VARIABLE INPUTS

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Variability in the output of any agricultural product over a period of time could be caused by many different factors in addition to the amount of variable inputs which are used. Because crop yield is affected by factors other than variable inputs, the farmer can expect a range of yields for any given level and combination of variables. For example, an estimate of the potential variability in yield becomes an important consideration for the farmer when he is making his decision regarding how much fertilizer to apply. His decision will also be conditioned by his attitude toward risk.

Variability is usually expressed in terms of deviation from the mean. The most commonly used statistical measurement is the standard deviation (S.D.). This is a particularly useful measurement of variability where the individual observations are distributed normally around the mean, enabling one to estimate the percentage of observations that will occur within specific ranges measured around that mean. For a normal distribution the range specified by the mean plus and minus one S.D. will include about 68 percent of the observations and extending the range to the mean plus and minus two S.D. will include about 95 percent of the observations. Thus, given a series of data that are normally distributed, by calculating the mean and the S.D., one can predict the probability of occurrence of a result falling within specific ranges.

A farmer's main concern with regard to risk is to protect himself from the possibility of his decisions producing an outcome that he is not prepared to accept. Hence a more useful method of expressing variability is to calculate the percentage of times the outcome can be expected to exceed a certain level. This approach is illustrated in Figure 5.

FIGURE 5

NORMAL DISTRIBUTION AND CONFIDENCE LEVELS
DERIVED FROM THE STANDARD DEVIATIONS
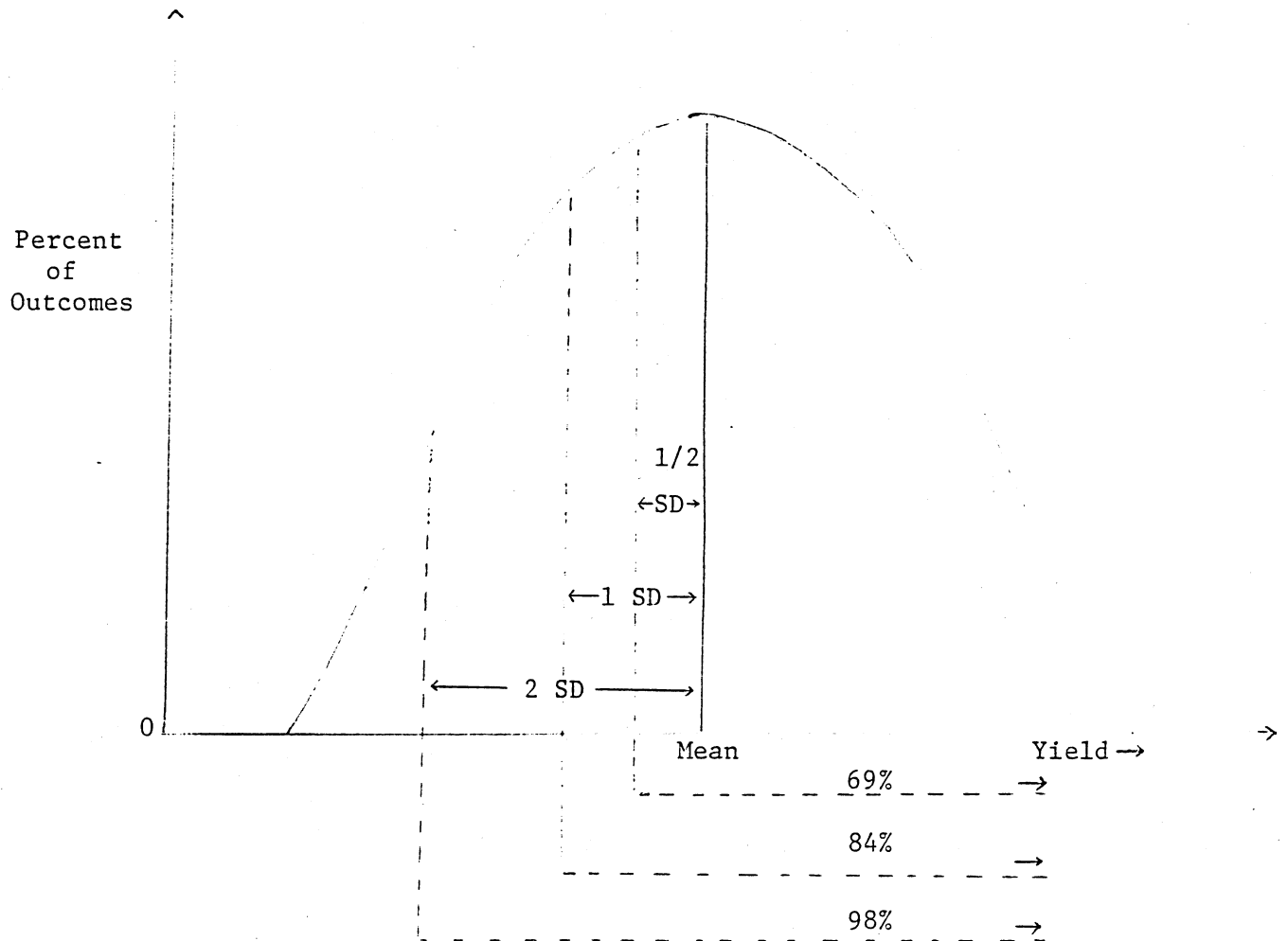
As mentioned above, a range of one S.D. above and below the mean will include 68% of the outcomes. But as we are interested only in exceeding some level we can determine that the probability of the outcome exceeding a level equivalent to the mean minus one S.D. is 84 percent (i.e.,

$50 + \frac{68}{2} = 84$). Similarly the probability of the outcome exceeding the mean minus 2 S.D. would be about $(50 + \frac{95}{2})$ or 97.5 percent.

THE CHOICE OF VARIABLE INPUT LEVELS

Two basic points must be borne in mind when considering variability in yield per unit of input:

1. As the level of inputs rise, output will eventually increase at a
    diminishing rate - while variability will increase at a (proport-
    ionately) <u>higher</u> rate. Thus risk averse managers will be inclined
    to use lower levels of inputs than those who are risk neutral or
    risk-takers.

2. New technology or methods may reduce variability in yield in
    relation to output. For example drainage may make it safer to use
    greater levels of fertilizer. That is not to say that drainage in
    itself will necessarily increase yields but that it will reduce
    the extremes at either end. Hence in considering the introduction
    of new techniques etc. it is important to consider their effect
    on yield variability over a range of input levels.

   To illustrate the first point, consider Table 4. Column 1 represents
different levels and combinations of variable inputs. Given the expected
mean yields shown in column 2 and the standard deviations in column 3, the
minimum expected yields and marginal products at those yields can be
evaluated for various probability levels.

TABLE 4

EFFECT OF RISK ATTITUDE ON LEVEL OF VARIABLE INPUTS

1	2	3	4			5			
Level and Combination of Variable Inputs	Expected Mean Yield	Standard Deviation	Minimum Expected Yields at Probability Level			Marginal Product Based on Expected Minimum Yields at Probability Level			
			69%	84%	98%	50% (Mean)	69%	84%	98%
A	80	10	75.	70	60				
B	100	15	92.5	85	70	20	17.5	15	10
C	115	20	105.	95	75	15	12.5	10	5
D	120	25	107.5	95	70	5	2.5	0	-5
E	123	30	108.	93	63	3	0.5	-2	-7

Note that as inputs increase (from A-E) expected mean yield rises but at a diminishing rate, whereas standard deviation rises at a constant rate. Column 4 shows confidence levels for various minimum expected yields. The operator is confident that 69% of yields will be 75 units or higher for input level A. Similarly he is confident that 84% of yields, for the same input level, will be 70 units or higher. As the level of inputs increases, expected mean yield increases but because variability (S.D.) is increasing more rapidly, the minimum yields that can be expected will increase at a slower rate and may even decline as illustrated in column 4. For example, if one wished to have a 98% assurance that the minimum expected yield would not fall below 75, one would not apply D units of variable input. If one had a heavy debt burden that had to be met, it would be better to use input level C.

This can be seen even more dramatically if one examines column 5 (Marginal Product). Expected marginal products are always positive (i.e., even at level E one can expect to gain an additional 3 units of output for the last unit of input). However, when one takes account of probabilities, the situation changes. For 84% confidence in the yield both levels D and E are unacceptable since the input costs money and the operator may well lose on the last units applied in each case.

Table 5 introduces values to input and output to demonstrate the choices open to either risk neutral or risk averse managers.

If the product sells at $2.40 per unit, expected marginal value product will be as shown in column 2 (that is expected marginal products, column 5 of Table 4 x $2.40). Confidence levels are shown in column 2. As can be seen, one can be confident that 69% of the time input level E will still yield a marginal value product of at least $1.20 but for the 84% and 98% confidence levels the marginal value products based on the minimum expected yields are zero or negative beyond input level C.

If we now include a cost for the input (column 3) - allowing decreasing costs as more is used - we can calculate the marginal gross margins as shown in column 4. The marginal gross margin based on the expected mean yield is still positive, even for input level E. Hence it would be chosen by a risk neutral manager. For those strongly averse to risk only input level C is

acceptable, as it predicts a marginal gross margin above $5 even at the 98% level of confidence.

TABLE 5

EFFECT OF RISK ATTITUDE ON EXPECTED GROSS MARGIN (Dollars)

1	2				3	4			
Level and Combination of Variable Inputs	Marginal Value Product @ $2.40 unit Based on Minimum Yields at Probability Levels:				Marginal Input Costs	Marginal Gross Margin Based on Expected Minimum Yields at Probability Levels:			
	50% (Mean)	69%	84%	98%		50% (Mean)	69%	84%	98%
A									
B	48.	42.	36.	24.	8	40.	34.	28.	16.
C	36.	30.	24.	12.	7	29.	23.	17.	5.
D	12.	6.	0.	-12.	6	6.	0.	-6.	-18.
E	7.2	1.2	-4.8	-16.8	6	1.2	-4.8	-10.8	-11.8

Lastly, Table 6 shows the same results but expressed in terms of Gross

TABLE 6

RELATIONSHIP OF RISK ATTITUDE AND EXPECTED GROSS MARGIN (Dollars)

1	2	3	4	5	6		
Level and Combination of Variable Inputs	(Based on Expected Mean Yield)			Standard Deviation of Gross Margin	Minimum Expected Gross Margin at Probability Levels		
	Gross Revenue	Variable Input Costs	Gross Margin		69%	84%	98%
A	192.	97.	95.	24.	83.	71.	47.
B	240.	105.	135.	36.	117.	99.	63.
C	276.	112.	164.	48.	140.	116.	68.
D	288.	118.	170.	60.	140.	110.	50.
E	295.2	124.	171.2	72.	135.2	99.2	27.2

Margin. It can be seen that although input level E is <u>on average</u> the most profitable, (column 4 - $171.20). For those who are either risk averse or who cannot afford risk, input level C is the best choice (column 6).

In conclusion, it is clear that one's attitude to risk is crucial in the realistic determination of variable input levels. Managers who are (and can afford to be) risk neutral or even gamblers, are able to use higher (sometimes much higher) levels of variable inputs than can managers who must exceed certain minimum profit levels in order to meet their obligations. Thus before one decides upon a certain level of input to be used, effective management will always consider at least three questions:

1. What is the variability of yield per unit of input at the level chosen and how does it compare with variabilities at other levels of input?

2. What is the effect of new technology on those variabilities for similar levels of variable inputs? To what extent can a new technology be profitably used to reduce risk relative to yield bearing in mind that new technology will usually reduce variability of output in relation to input?

3. What is my attitude to risk - how much risk can I afford?

It is realized that in practice the detailed information required to make these assessments may not be available. The final article in this publication discusses existing sources of information.

THE INFLUENCE OF RISK ON ENTERPRISE DIVERSIFICATION

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We have already examined the influence of the level of variable inputs on risk in the production process. However many other ways exist for reducing risk. One of the most commonly used is enterprise diversification. Here, by spreading production inputs and costs over a variety of enterprises, any unexpected phenomenon (e.g. disease) is less likely to affect farm income.

Let us suppose that a manager has selected one of the input combinations for corn production examined in the previous section. In the same way he has also selected appropriate input levels for the production of soybeans and wheat. The resulting gross margins and standard deviations for each crop are presented in Table 7 .

Now let us also suppose that this manager operates 600 acres of tillable land - how is he to decide a rotational plan that best fits his needs and wishes with regard to the level of risk? He may decide that soil fertility and structure are to be maintained and that there are three possible rotations that can be considered. These are presented in Table 8 . The total gross margins and standard deviations of each rotation are also presented in the table.

Observe that when acreages are equalized among crops the risk tends to be lowest. Although this is commonly so it is not always the case. For example, net returns may be extremely attractive for one of the enterprises as compared to others, making it more profitable even when allowance is made for the higher risk levels it entails. Alternatively a strong negative covariance may exist between two enterprises (thus a good yield in one crop will always be balanced by a poor yield in the other - this may reduce risk but it means that average yields will never be very high). In these cases the lowest overall risk levels may be associated with some degree of specilization in one or two crops relative to a third.

Table 7. Estimated Per Acre Gross Margin and Standard Deviation of
Selected Crops, Given a Single Level and Combination
of Inputs for Each Crop

	Corn	Soybeans	Wheat
	--- dollars ---		
Gross Margin	164	143.	143.
Gross Margin Standard Deviation	48	44.80	36.40

Table 8. Example of the Effects of Selection and Size of Crop
Enterprise on Total Gross Margin/Risk Trade-offs,
Assuming Independence Among Enterprises

Crop Rotation Plan		Acres	Total Expected Gross Margin	Standard* Deviation of Total Gross Margin
			--- dollars ---	
1. Continuous Corn		600	98,400	28,800
2. 4-Year	Corn,Corn	300		
	Soybeans	150	92,100	16.803
	Wheat	150		
3. 3-Year	Corn	200		
	Soybeans	200	90,000	15,015
	Wheat	200		

*The standard deviation of total gross margin was calculated by taking
the square root of the summation of the square of each crop acreage
times its estimated gross margin standard deviation.

However, diversification still results in reduced levels of risk as compared to complete specialization.

Table 9 shows only the deviation of total gross margin at one-half a standard deviation. By examining the variation from the expected gross margin at several levels of standard deviations one can construct probability assurance levels in the same manner as was done in the last section.

Table   9.   Probability Assurance of Gross Margin Outcomes
(in percentages)

Crop Rotation Plan	50 (Mean)	69	84	98
	--- dollars ---			
1	98,400	84,000	69,600	40,800
2	92,100	83,699	75,297	58,494
3	90,000	82,492	74,985	59,970

Given a risk neutral posture, a manager would select Plan 1, assuring a mean gross margin of $98,400 (that is 50% of the time gross margin would be at this level or better). However if the manager wishes to be 98% confident of the gross margin, Plan 1 would guarantee only $40,800 - nearly $18,000 less than Plan 2.

The procedure then, is similar to that used in determining the level of variable inputs to be used. Such calculations however can never tell a manager the best point at which to operate, only the assurance levels at different magnitudes of risk. It is the manager who must decide, in the end, which level of risk suits his managerial style and financial resources best.

INFLUENCE OF RISK IN PLANNING A BEEF FEEDLOT FARM

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INTRODUCTION

Within any farm enterprise lower income earning activities use fewer variable inputs and normally have a lower variance in income relative to their average expected income than do higher income activities (see Table 4 p. 27). Diversification of activities through increasing the number of enterprises can reduce income variation (risk) still more. The selection of enterprises and activities which generate lower income but with lower relative risk in place of other activities that produce higher but more variable income involves a trade-off between lower risk and higher income.

A linear programming-risk simulation model (LP-RS) was developed for use on beef feedlot farms by Driver and Stackhouse (1975 and 1976). This model generates alternative farm plans with different degrees of diversification and levels of variable inputs. The LP-RS model was used to generate quantified income/risk trade-off information for introduction into the planning process on a beef feedlot farm.

PROCEDURE

The principal management problems of the farmer cooperating on this study were identified and relevant farm data obtained. The LP-RS model was then run and three alternative farm plans generated for each of the three problem settings identified. Each problem setting represented a different organization of resources and different income-risk combination. A report containing these plans were presented to the farmer at a seminar, with a follow-up evaluation at his home three weeks later.

Taking into account income-expenditure statements, physical production levels, and the following income-risk criteria for each plan, the farmer was asked to indicate which plan he preferred for actual implementation

Long-Run Criteria:

Each plan was examined and evaluated in terms of the following long-run and short-run criteria:

1. Expected Net Farm Income - the net income from farming operation when average prices and yields are realized for specified productive activities.

2. Standard Deviation - a measure of the variability of net farm income. Net farm income in any one year would be expected to fall within the range of the average net farm income plus and minus one standard deviation 68 percent of the time.

3. Required Income - the amount needed to meet cash operating expenses, debt repayments and personal withdrawals for the current year.

4. Probability of Success - the probability of the minimum expected net farm income being not less than the required income.

5. Change in Net Cash Position - the change in current liabilities from the beginning to the end of the year assuming inventories remained the same.

Short-Run Criteria:

The short-run criteria were expressed in terms of the possibility of low income years occurring. They were designed to determine what the income effects in relation to required income would be if a bad year occurred. The following three possibilities were examined:

Bad year 1 - Net farm income fell below required income but with only a 15% chance of it being any lower.

Bad year 2 - was one for which there was a 10% chance of net farm income falling to a lower level.

Bad year 3 - was one for which there was a 5% probability of net farm income being lower than the indicated level.

In interpreting the results of these analyses two points should be noted. First the minimum expected net cash income as one moves from Bad

year 1 to Bad year 3 becomes progressively lower because the probability
of an even lower income occurring becomes progressively less. Secondly,
the effects of these three bad years on net cash income become relatively
less severe as specialization declines.

FARMER'S REACTION

Table 10 shows the long and short run implications of three alternative
plans for dealing with one of the farm operator's major concerns, namely
that a continuous corn rotation was depleting his soil fertility. Conse-
quently he wished to explore the possibility of introducing a legume into
the rotation and also of improving his cash flow by increasing winter
wheat areas.

Table 10—Criteria for Evaluating Income-Risk Tradeoffs

	Plan 1	Plan 2	Plan 3
Expected net farm income	$82,451	$80,505	$70,727
Standard risk (1 std. deviation)	53,706	48,885	44,248
Required income	34,020	34,020	34,020
Probability of success	81.64%	82.92%	79.66%
Change in net cash position	74,270	71,110	61,616
BAD YEAR 1			
Net income + depreciation	50,774	53,826	48,855
Likelihood of worse	15%	15%	15%
BAD YEAR 2			
Net income + depreciation	37,675	41,903	38,063
Likelihood of worse	10%	10%	10%
BAD YEAR 3			
Net income + depreciation	18,110	24,094	21,943
Likelihood of worse	5%	5%	5%

Based on the long and short run criteria the farmer's initial
reaction was to choose Plan 2 which indicated the highest probability of
success (82.92%). However, he finally decided to choose Plan 1 because
the reduction in risk was not large enough, relative to income given up,
by choosing Plan 2.

The farmer considered the risk information very useful. He understood

the risk data and felt the use of predicted prices and anticipated farm
structure changes made the model a useful planning tool. Indeed he
requested that the model be rerun incorporating other possible structural
changes for his farm.

GENERAL CONCLUSIONS

The opportunities for avoiding risk by diversification on specialized
beef feedlot farms are minimal. The potential for LP-RS as a planning tool
would be much greater on farms which offered the scope for diversifying
into alternative livestock enterprises as well as cash crop and forage
enterprises.

EVALUATING FINANCIAL RISKS ASSOCIATED WITH INVESTMENT

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INTRODUCTION

Farm investment planning involves the commitment of relatively large amounts of capital for long periods into the future where outcomes are uncertain. The recommended method of evaluating investment alternatives is to discount the expected stream of net costs or benefits generated by the capital outlay to present values. If the net present value (NPV), see formula page 13) is greater than the initial capital outlay the project will increase profits or wealth. Where more than one investment alternative is feasible then the alternative with the highest NPV should be chosen.

To calculate NPV, one must account for all cash inflows and outflows associated with the investment. Cash inflows include the asset value at the end of the planning period. Cash outflows will be the initial investment required to purchase the asset which can be considered as the depreciation over the period of ownership. These cash flows must be discounted to present values to arrive at the net present value. Net present values express the value of future cash flows in today's dollars.

The rate used to discount future flows to the present is referred to as the desired rate of return. The desired rate of return represents that rate of return, after taxes, which a farm manager is willing to accept on new investments. The higher the desired rate of return, the lower the price the manager is willing to pay for a new asset given the same expected cash inflows. The financing terms of the investment, the interest on the loans and the business tax situation will also affect the net present value estimates of a given investment proposal. But the major factors which influence the estimates are the expected cash flows and the discount rate used to represent the manager's desired rate of return.

RISK EVALUATION IN CAPITAL BUDGETING

Risk can be evaluated in capital budgets by adjusting either the net

cash flows or the discount rate in the NPV formula. If the adjustment is made to the net cash flows the annual expected net benefits less an annual risk adjustment are each discounted at the manager's desired rate of return. The risk adjustment is the estimated standard deviation of expected net cash flows multiplied by a Z coefficient which represents the manager's level of risk aversion (see formula page 14). The resultant NPV can then be evaluated in terms of probability of assurance levels acceptable to the manager. However, the method requires a considerable number of calculations to obtain standard deviations of estimated net cash flows which are not likely to be made unless the manager has access to computerized programs.

The second method involves adjusting the discount rate to include a risk premium. For example, capital investment proposals for dairy enterprises which have low price risk might be evaluated using a relatively low discount rate of 10%. Whereas cash crop and feeder livestock investments would be evaluated by adding a risk premium of 3-5% to account for higher price risk, giving a required rate of return of 13-15%. This method is simpler than adjusting the net present values for risk and can easily be used for most capital budgeting problems. However, the selection of the amount of the risk premium is very subjective. Finally, either of the above two methods of risk adjustment can be used for any capital budgeting problem (but not both) in the same evaluation.

EXAMPLE OF CAPITAL BUDGETING FOR MACHINERY PURCHASE

Two capital budgeting techniques can be used to evaluate the fixed cost of owning a machine. The standard averaging technique involves estimating annual depreciation plus an annual interest charge based on the manager's desired rate of return. The NPV method involves converting the new cost less the present value of the salvage value to an annual cash outflow which would be equivalent to an annuity paid out each year at the manager's desired rate of return. The two techniques give different estimates of annual costs and are illustrated in the following example.

Annual Fixed Cost New Tractor

Purchase price   - $20,000.
Trade-in Value in 8 years - $ 5,000.
Manager's desired rate of return 10%.

Averaging Technique

Annual Depreciation = $\dfrac{\text{New Cost Less Trade-in Value}}{\text{Number of Years Owned}}$ = $\dfrac{\$20,000-\$5,000}{8}$ = $1,875.

Annual Interest Charge = Average Investment x Interest Rate

$$= \frac{\$20,000 + \$5,000}{2} \times .10 = \$1,250.$$

<div align="right">Average Annual Fixed Cost $3,125.</div>

NPV Technique

NPV of Cash Outflow = New Cost Less PV of Trade-in Value @ 10%, year 8

$$= \$20,000 - (\$5,000 \times .4665) = \$17,668.$$

Average Annual NPV of Cash Outflow = $\dfrac{\text{NPV of Cash Outflow}}{\text{Cumulative PV @ 10\%, 8 years}}$

$$= \frac{\$17,668.}{5.335} = \$3,312.$$

Both techniques require two calculations. The first requires the estimation of annual depreciation and then the estimation of an annual interest charge. The second requires using discount rate factors in two steps.

1. Deducting the present value of the trade-in value from the purchase cost to obtain the NPV of the cash outflow.

2. Dividing the NPV of the cash outflow by the cumulative present value factor to convert this amount to an annuity.

Both of these present value factors are available in tables published in the Ontario Farm Management Handbook. The NPV technique gives an annual fixed cost estimate of $3,312., for our example, compared to $3,125 if the averaging technique is used. The estimates are always higher when the NPV technique is used because this technique discounts for the timing of the actual cash outflows which occur in the first year when the machine is purchased.

If a risk premium of 4% is added to the desired rate of return the estimated annual cost of owning the machine using both techniques would be as follows:

Averaging Techinque

Depreciation = $\dfrac{\$20,000. - \$5,000.}{8}$ = $ 1,875.

Interest   = $\dfrac{\$20,000. + \$5,000.}{2}$ x .14   = $ 1,750.

<div align="right">Average Annual Fixed Cost $ 3,625.</div>

NPV Technique

NPV of Cash Outflow = $20,000. - ($5,000. x .3506) = $18,247.

Average Annual NPV of Cash Outflow = $\frac{\$18,247.}{4.637}$ = $\underline{\$\ 3,933.}$

The risk premium increased the annual cost by nearly 20% for this example and increased the difference estimated by the two techniques from $187 to $308. Finally, tax considerations and financing terms for an investment project will modify the above estimates of the annual fixed costs of owning a machine but differences due to technique will remain, as will the increases due to the risk premium.

EXAMPLE OF A CAPITAL BUDGET FOR A LAND PURCHASE

The cash inflows from a land purchase include the annual net returns (after tax) to land plus the after tax capital sale value of the land at the end of the manager's planning period. The sum of these two amounts in present value terms, at the manager's desired rate of return, will estimate the maximum price the manager can pay for the land to earn that return over the period.

If the manager estimated that the annual net return to land would be $100 per acre per year for 20 years and that the sale price of the land at the end of year 20 would be $2500 the maximum bid price at a 10% rate of return would be as follows:

Maximum Bid Price
(equivalent NPV) = (Annual net returns x Cumulative P.V. Factor, 10%, 20 yrs.)
+ (Terminal Value x P.V. Factor, 10%, year 20).
= ($100. x 8.514) + ($2,500. x .1486)
= $851.40 + $371.50 = $\underline{\$1,222.90.}$

The first term in this formula capitalizes the annual net return at 10% for 20 years and the second term discounts the expected sale price at 10% back to a present value.

If the potential purchaser wishes to add a risk premium of 4% to his calculations the discount rate increases to 14% and the maximum bid price declines.

Maximum Bid Price = ($100. x 6.623) + (2,500. x .0728)
@ 14% for 20 yrs. = $662.30 + $182.00 = $\underline{\$844.30}$

Increasing the discount rate by 4 percentage points decreased the maximum bid price by about 30% for this example. The risk premium adjustment had a substantial influence on the present value of the terminal value in this example because of the long planning period. Thus the risk premium adjustment increases the cost or reduces maximum capital outlay as the planning period is extended. Again, the method of financing the land purchase and the mortgage terms can modify the estimated maximum bid price but these factors have a lesser effect on the estimates than do the factors considered here. The computerized capital budgeting program available through R. Ross at the Ridgetown College of Agricultural Technology includes financing terms, taxes, and net returns adjustment factors in order to estimate the maximum bid price for land for farmers. This model should be used by farmers who wish a more complete analysis of a proposed land purchase.

CAPITAL INVESTMENT RISK AND LEVERAGE

Most investment decisions of farm businesses involve borrowing to purchase fixed assets. Growth of equity or wealth of the owner can be increased by the use of borrowed funds for capital expansion if the required rate of return is greater than the cost of the loan and the terms of the loan correspond to the useful life of the asset. But liquidity of the business as represented by working capital and credit reserves declines as debt increases. Thus, managers must balance the increased risk of severe losses as reserves decline with the possible benefits of taking advantage of growth opportunities. Farmers as a group seldom totally exhaust their borrowing capacity, even though higher leverage appears profitable. In an uncertain world, there is need for flexibility of debt repayment terms to match them to variable cash flows. This will involve increasing farm managers' skills in demonstrating credit worthiness by the preparation of cash flow and capital budgets which include assessment of risks.

THE SIGNIFICANCE OF RISK-SHARED CREDIT INSTRUMENTS

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Limited resource farmers making major improvements in their farm businesses are faced with two main problems. These problems are:

- generating enough income to provide for farm expenses, family needs and current debt obligations during the period when capital is already borrowed and structural changes have been made, but income from the investment has not yet come on stream; and,

- meeting these cash requirements during periods of depressed and/or adverse yields and prices.

Similar difficulties are faced by young farmers starting in business for the first time and having to cope with high debt loads.

Risk-shared credit can help farmers to cope with these problems.

FEATURES OF RISK-SHARED CREDIT

Like other forms of farm credit, risk-shared credit may be used for the acquisition of productive assets such as modern livestock facilities and larger herds. Interest and principal payments are amortized in equal annual instalments over a fixed number of years. The instrument has two special features, - a bridging feature and flexible repayment terms.

Under the bridging feature of risk-shared credit instruments the borrower is not required to make any payments on the loan during the bridging period. Interest is forgiven and principal deferred for one or two years after the loan is taken. This permits borrowers to realise income from the investment before repayment of the loan begins. The length of the bridging feature depends on the nature of the investment. The interest forgiven is a type of capital grant that serves to encourage limited resource farmers to make major farm improvements.

Risk-shared credit instruments also permit the borrower to defer

repayment of the loan in low income years. The amortization period is then extended by one year and the deferral plus accumulated interest is repaid in the final year. Deferral may be made only up to a specified maximum number of times.

The borrower has the option to prepay any outstanding principal (or deferred payments) in a high income year. Deferral and prepayment options permit the borrower to match his repayment schedule with his ability to repay.

AN APPLICATION

The effects of major farm improvements with and without risk-shared credit were analysed on a single farm which had the potential to become a commercial farm operation. The farmer selected had a beef cow-calf enterprise (50 cows) and a sheep enterprise (70 ewes). He appeared to be an average manager, in that his crop and livestock yields were near the county average. A static linear programming model was developed to simulate the current operation and the effects of major farm improvements. A set of income targets were then developed to assess current levels of economic viability and the effects of major farm improvements on these levels.

The short-term income target was to generate enough income from the farm-business in any given year to cover the farm cash expenses, the minimum family living requirements and the current debt obligations.

In the long-term a farm must generate sufficient income to permit replacement of the productive assets as they wear out (depreciation) and to provide a margin for growth. In this analysis the farm business was considered to be viable over the long-term if the total of the annual incomes after meeting all targets was greater than zero when discounted back to present time.

The case farm was found to be generating enough income to meet short-term requirements in any given year but was not viable over the long-term because insufficient income was being earned to provide for all long-term requirements over time.

A farm plan to implement the major farm improvements and which was consistent with this operator's planning considerations and management ability was then developed and simulated. The plan consisted of expanding

both the beef and sheep enterprises, fertilizing both cuts of hay, build-
ing a bunker silo and a lean-to for the sheep and growing more corn
silage with improved production techniques.

The capital cost was approximately $25,000 which was borrowed at 12%
and amortized over a six year period. From the model it was found that
implementation of this plan would permit attainment of overall long-term
farm viability. However, there would be insufficient income to cover all
short-term requirements during the bridging period and also subsequently
if there were periods of depressed prices for the product. A risk-shared
credit program with a one year bridging period followed by a six year
amortization period and flexibility in payment was shown to help the
operator meet all short-term requirements during these periods. The program
enhanced the attainment of long-term viability as the discounted value of
residual income rose, implying that the farm family's real standard of
living would increase.

FARM SURVEY RESULTS

A sample survey of limited resource full-time farmers who were receptive
to change was conducted regarding their attitude toward risk-shared credit.
They indicated that, in general, the bridging and flexible repayments would
be useful components of a credit system. All respondents (20) felt that
risk-shared credit would be useful to young farmers just getting started
while 80% indicated that it would be helpful to established farmers who
were interested in making improvements. Sixty percent of those surveyed
stated that it would be of use to themselves while a further 35% felt that
they were too old to undertake major farm improvements.

IMPLICATIONS FOR ADVISORY SERVICES

It would appear that the availability of risk-shared credit could
assist and encourage limited resource farmers who were receptive to the idea
of farm improvement to implement major structural and technological improve-
ments. However, it is unlikely that risk-shared credit could be effective
without the use of the relevant advisory services. Such services would
need to be oriented toward limited resource farmers and would help them
search out and develop planning packages that were consistent with their
managerial abilities, and the potential of their resources. At the same
time the plan would need to be consistent with individual farmers' perceptions
of how adjustments could be implemented and managed over time, and sensitive
to the problems of uncertain production and financial outcomes.

GUIDELINES FOR RENTAL RATE DETERMINATION

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The rental rate that a tenant pays for his land may well be one of the most important factors in determining the success or failure of his enterprise. Estimation of such rates is frequently, however, a rather haphazard process. The aim of this article is to examine some of the criteria that are of importance in determining an equitable rental for a particular piece of land. There are many factors that may influence the value of land to the tenant, such as risk, drainage, productive capacity of the soil and excess capacity of non-land inputs already possessed by the prospective tenant. All of these will influence the amount that he can afford to offer.

GROSS MARGIN

Gross Margin (GM=Returns-Variable Costs) was calculated as the maximum amount of land rental that a prospective tenant could afford to pay in the short term without losing money. It assumes that the farmer already possesses excess capacity. Non-land inputs such as equipment, labour and management time, sufficient for the cultivation of the land without incurring additional fixed costs. Even where such capacity exists it can only be considered on a short term basis, for in the long term the farming of the land will, of necessity, entail additional fixed costs. Thus a rental rate based on the gross margin is only a feasible solution for short term lease by a farmer who is keen for an outlet for his excess capacity. It also represents the maximum return possible for the landlord.

NET OPERATING MARGIN

Net Operating Margin (NOM) represents the maximum rent a tenant could afford to pay in the long term (NOM=GM-Overhead Costs). Overhead costs that would have to be considered in the long term include extra machinery, storage facilities, and miscellaneous costs such as hydro, telephone, insurance and a share of office and vehicle costs.

NOM does not, however, provide a return to the tenant for his management of the land. It may be a feasible proposition where excess management time exists or where the tenant is confident of his ability to obtain higher than average yields for that particular piece of land - thus guaranteeing him some profit from the land. Alternatively, if the tenant is confident that future input/product price relationships will improve it may be an acceptable rental level. NOM tends to favour the landlord and should only be considered where the tenant has reason to believe that special factors favour him.

RISK DISCOUNTING

Both GM and NOM can be discounted against risk. The process involves subtracting a Standard Deviation (SD - a measure of the variation of yield about the average or mean yield) from the mean yield. If, as is usual, yields are distributed evenly about the mean (normal distribution) then after subtracting one SD, 84% of yields will be greater or equal to that discounted minimum yield. Without discounting, (where one is using the mean yield) 50% of the yields will be greater than or equal to the average yield.

Although one SD is an arbitarily selected figure and the actual level of discounting will depend upon the tenant's attitude toward risk, this approach when used in financial budgeting tends to closely approximate average current rental rates. For example, given the most popular crop rotation (corn, corn, soybeans and wheat) the weighted value of returns (NOM-SD) on specialized cash grain farms operated under relatively dry land conditions in Kent county was $80.52/acre in 1978. This estimate approximated the average current rental rate of the area.

In view of the above finding the NOM-SD criteria was accepted as a lower limit on rental rates. Price risk per se was assumed to be the responsibility of the tenant. However, price uncertainty is another matter and will be dealt with in the next article.

PRODUCTIVE CAPACITY

Three different rental levels have been established, GM, NOM, NOM-SD, with rents tending to fall within the band NOM - NOM-SD and grouping at the lower end.

The next question is how these levels change with different types of land. Figure 6 shows the different levels of GM, NOM and NOM-SD on varying productive capacities of land (0.7 - 1.0) both wet and dry. Two important uses can be made of this information:

Weighted Earnings - By estimating the percentage of land of each type present on the block of land under consideration and weighting earnings "by"the percentages, figures can be obtained giving GM, NOM and NOM-SD for that block.

TABLE 11

EARNINGS PER ACRE BY PRODUCTIVE CAPACITY OF LAND

Productive Capacity Rating	Dry Land (Corn, Corn, Soya, Wheat)		Wet Land (Wheat, Wheat, Alfalfa, Alfalfa)	
	NOM	NOM-SD	NOM	NOM-SD
	--- dollars ---			
0.7	62.86	30.76	55.36	25.73
0.8	82.80	46.41	68.20	33.73
0.9	103.31	62.64	82.33	43.40
1.0	125.62	80.52	94.24	51.17

Effects of Drainage - If drainage is assumed to convert wet land to dry land capacity, an estimate can be obtained of the value of drainage and its effect on rental rates.

Table 12 gives estimates of the added GM and NOM as a result of drainage. The present value estimates of the results of drainage were based on the assumptions of perpetuity of income and an 8% discount rate. As drainage should add few extra costs for the tenant (except perhaps increased grain storage capacity) added GM approximates the extra rental that drainage may be worth.

Present value figures show whether the improvement is beneficial for the landlord. At present, drainage costs are approximately $400/acre (this may be reduced by tax write-offs). Thus any present value added GM

greater than the cost of drainage will be financially profitable for the landlord.

TABLE 12

THE EFFECT OF DRAINAGE ON EARNING CAPACITY OF SOILS
OF DIFFERENT PRODUCTIVITY

| Productive Capacity Rating	Added GM	Added NOM	Present Value Added GM	Added NOM
		--- dollars ---		
0.7	25.17	7.50	314.63	93.75
0.8	32.44	14.60	405.50	182.50
0.9	38.96	20.98	487.00	262.25
1.0	49.69	31.38	621.12	392.22

CONCLUSION

Although only a few of the possible factors influencing rental rates have been examined here, it is felt that they are of the greatest importance. Similar methods could be employed for any other factor that is of importance in a particular case.

The value of the technique lies in its detailed, explicit examination of the potential of the land under consideration and its ability to lay out guidelines for what is an acceptable range of rents within which the landlord and tenant may bargain.

One major cause of difficulty with rental contracts still remains, i.e. price uncertainty, and this will be examined in the next article.

FIGURE 6   UPPER AND LOWER LIMITS OF EARNINGS PER ACRE
            AS PRODUCTIVE CAPACITY INCREASES FOR RELATIVELY
            WET AND DRY TILLABLE LAND
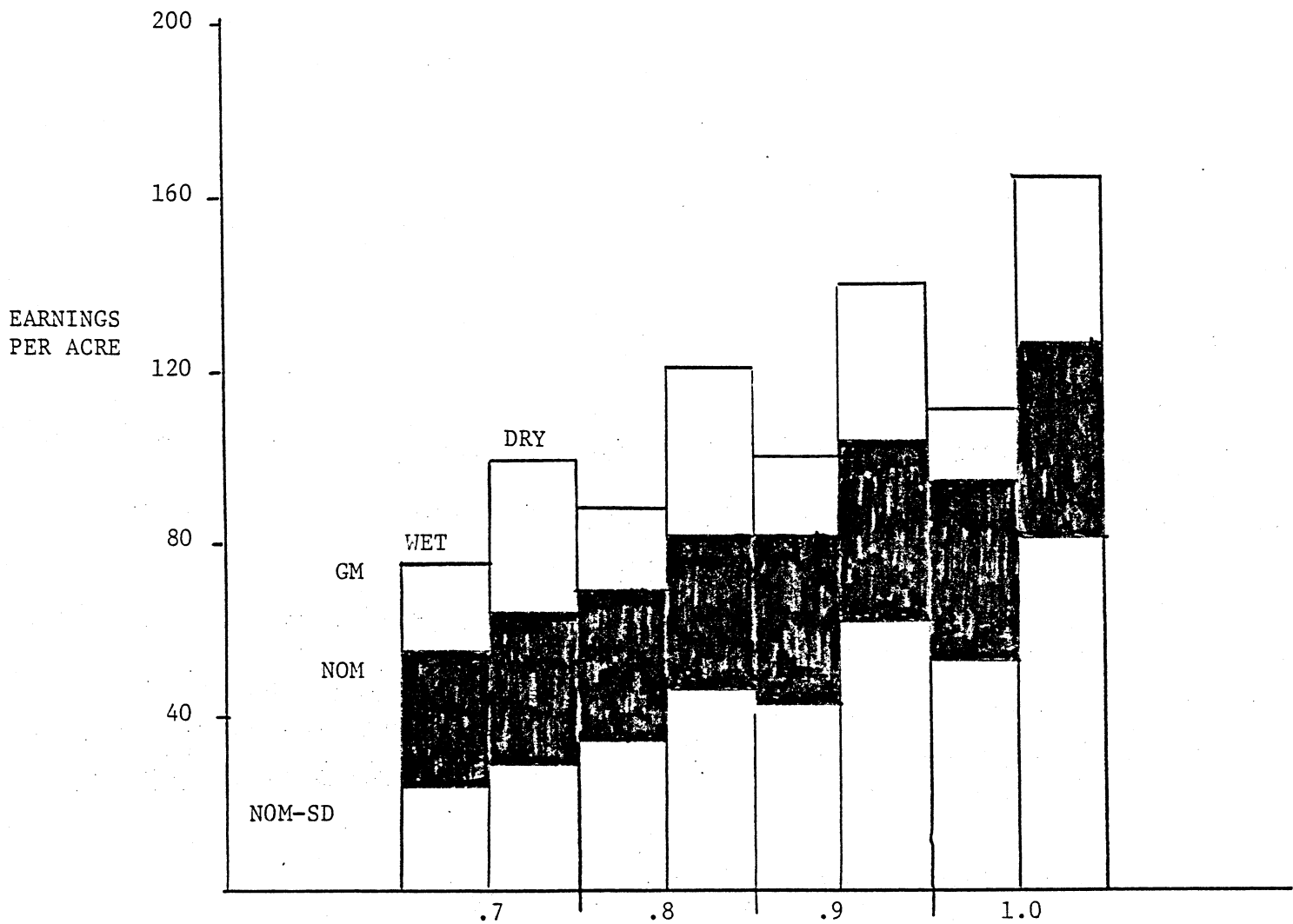
ADJUSTING RENTAL PAYMENTS FOR PRICE UNCERTAINTY

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We have seen in the previous article that rental rates for agricultural land usually have an allowance for risk built into the final agreement. The extent of this allowance depends, obviously, on the attitudes toward risk of both the landlord and tenant and their relative bargaining abilities. One major risk factor involved in agricultural production is price uncertainty. Both input and farm product prices are often subject to large and frequently unpredictable variations over a period of years. Factors such as petroleum pricing decisions made by OPEC, sales of wheat to the Soviet Union and policy changes by Federal and Provincial governments may all have a major effect on input/product prices.

The result of such uncertainty is a frequent unwillingness of tenants to enter into long-term leases for fear that they may become locked into a rent structure that, within two or three years, becomes financially untenable. One or two year leases or even leases based upon verbal agreements become common. This solution has disadvantages, however, for both tenant and landlord. For the tenant it means uncertainty about the future and, as a consequence, a frequent unwillingness to consider any investment that is long-term in nature - liming or drainage for example. For the landlord it means repeated renegotiation of rental agreements and continual long-term uncertainty. This article describes a method that may be used to adjust rental rates to take account of fluctuations in both product and input prices.

THE INDEXING METHOD

One possible solution to the problem is to build an index into the rental agreement. This index would measure changes in input and product prices and divide the resulting extra costs or benefits between the two parties according to some previously agreed upon ratio. In the examples below it has been assumed that the division will be 50/50 but a 60/40

or even 75/25 split is equally possible. The ratio in any individual case would depend, of course, on the attitudes and bargaining strength of the two parties.

The indexing method adjusts the weighted Net Operating Margin (NOM) and NOM - SD (Standard Deviation) in accordance with the changes that have taken place in the general price levels of commodities and inputs. This is achieved through the following equation:

$$\frac{\Big[(NOM-SD) - (APPI(GR-SD) - FIPI(VC) - OH)\Big]}{2}$$

where: APPI = the ratio of the index of agricultural product prices in the crop year that has just ended over what the index was when rental negotiations took place.

FIPI = the ratio of the index of farm input prices in the crop year that just ended over what the index was when rental negotiations took place.

GR-SD = Gross Revenue - Standard Deviation [1]

VC = Variable Costs

OH = Overhead Costs

The APPI and FIPI are published agricultural indices.[2] The APPI and FIPI relate to all agricultural products and prices respectively. Subsets of these two indices are not published but can be obtained for special purposes under the proviso that they are not subsequently published. For example a subset of the APPI can now be obtained for corn, soybeans, wheat and oats and eventually it will be possible to obtain one without the oats. A subset of the FIPI for variable farm inputs will soon be available.

The base period of these two indices will soon be changed from 1961 to 1971. Let us suppose that after the base period is updated the appropriate subsets of the APPI and the FIPI both stand at 200 in 1978, the year of

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[1] Summation of the SD of each crop yield times its dollar value subtracted from overall gross revenue.

[2] Agricultural Statistics for Ontario 1977, Publication 20, Ministry of Agriculture and Food, Ontario, Tables 12 and 14, pp. 8 & 9.

rental negotiations. Now suppose the two indices change significantly by the end of the 1979 crop year. For instance, let the APPI and FIPI be 190 and 210 respectively, i.e. APPI=190/200; and FIPI=210/200. Using the previous equation, a rental adjustment can be determined for the particular block of land involved. Using the following figures based on an actual case:

(NOM-SD)=59.75;(GR-SD)=162.28; (VC)=67.04; (OII)=35.41; and a 50/50 split (thus the whole equation is divided by two).

$$\frac{[59.75 - (190/200(162.28) - 210/200(67.04) - 35.41)]}{2} = 5.69$$

The amount ($5.69) is an estimate of the per acre rental overpayment for the piece of land in 1979, which could be returned to the tenant in the form of a rental rebate. Similarly, per acre estimates of rental adjustments could be obtained for other parcels of land.

CONCLUSIONS

The example above shows a rebate to the tenant as a result of input prices rising faster than product prices. It must not be forgotten, however, that the index operates equally in the opposite direction. Where product prices rise faster than input costs the tenant would be required to pay the agreed upon share of his 'windfall' to the landlord.

The index then is not designed as a method of helping either party at the expense of the other - it is merely a method of achieving a more flexible and equitable arrangement of sharing price uncertainty between the landlord and the tenant. It will also allow a greater degree of long-term planning and confidence - something that should be of mutual benefit to both parties. It would serve to the mutual benefit of both parties so long as the underlying production coefficients do not change. If this occurs it would be necessary to renegotiate the basic rental rate periodically to ensure that the rate reflected the income effects of changes in technology.

INFORMATION NEEDS AND SOURCES FOR MEASURING RISK

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Risk assessments of future physical production responses, prices
and costs should be specific to the conditions on any particular farm.
However, cross-sectional data are required to obtain adequate numbers of
observations for developing probability distributions. In order to
maintain a high degree of relevance on any particular farm, it becomes
necessary to cluster farms into groupings of farms with similar
attributes so as to minimize interfarm differences in production response
potential due to differences in resources, technology and management.

On an exploratory basis in one region characterized by similar
attributes such as heat units, soil class and drainage it has been
demonstrated that the technology used in a farm enterprise can be used as
a basis for clustering dairy farms into production settings characterized
by relatively homogeneous physical production response potential. Addit-
ionally, it has been indicated that within each of these clusters, manage-
ment profiles can be established to explain the differences between
realized performance and potential. If physical measures of efficiency
(i.e. volume of output per unit of input) tend to be related to management
profiles, then a classification framework for data collection based on
technology and productivity can be established for a single region. Further,
if these relationships should hold in clustering other farm types in other
regions, then a generalized data collection system could be designed.

At the present time data clustered so as to be specific to the
conditions on any particular Ontario farm or group of farms are not available
Additionally, to develop such data would involve a complex study designed
to ensure that interfarm differences (as discussed above) were not the
major causes of variability in crop and livestock production. This would
be both expensive and time consuming - but possible if there were sufficient
demand for it.

DATA AVAILABILITY

One of the major sources of historical county data on average yields and prices has been the Ontario Ministry of Agriculture and Food, Publication 20, "Agricultural Statistics for Ontario" compiled by the Economics Branch. With the increasing demand particularly for data on yield variability, the Economic Branch has begun to investigate several potential sources of data for computing this information on a county and/or regional basis.

The sources considered are discussed below:

1. October Yield and Price Survey

   Each year Statistics Canada sends survey forms to Ontario farmers asking them to report crop acres harvested, yield per acre, and price received. Typically between 1400 and 1600 farmers respond to the survey. Using data for those farms which reported, in both 1977 and 1978, yield information similar to that shown in Table 13 for grain corn was generated for soybeans, winter wheat, barley, oats and mixed grain.

TABLE 13

GRAIN CORN YIELDS ONTARIO 1977 and 1978

	Average	Standard Deviation	Minimum	Maximum
		- bushels per acre -		
Brant 1977	99.8	8.2	80	125
1978	80.8	11.9	50	105
Elgin 1977	114.7	20.9	60	150
1978	91.9	16.7	55	120
Essex 1977	120.6	24.2	75	160
1978	78.5	19.7	50	140
Kent 1977	115.2	17.1	80	150
1978	102.4	19.2	50	140
S.Ontario 1978	88.1	17.4	40	140
W.Ontario 1978	86.3	20.2	29	140
C.Ontario 1978	78.7	8.2	45	100
E.Ontario 1978	85.0	13.6	18	140

2. Crop Insurance Data

    The Ontario Crop Insurance Commission keeps records on annual average yields and acreages of crops grown for all farmers insured with them. Five years of data for winter wheat and soybeans is being processed for comparison with the yield and price survey data. It is anticipated that there will be more farms included in the Crop Insurance data and, certainly, the five years data will improve the number of observations.

3. Chatham Corn and Soybean Cash Prices

    The Economics Branch office in Chatham, has been compiling daily cash prices offered for corn and soybeans in Chatham for the period 1951 to the present. These data will be analyzed to determine which particular marketing strategy appears most profitable for Ontario farmers.

CONCLUSIONS

The above sources of risk assessment information can be generated at a relatively low cost and therefore should receive attention. However, attention should also be focussed on the longer term investigation into farm clustering. While this latter approach is more expensive it would provide a full range of farm specific risk assessment information and at the same time, offer additional information for farm and regional economic analysis and farm management advisory services.

Certain programs to help farmers contend with risks are now available. For example, the Farm Credit Corporation feels that risk-shared credit could be available to farmers within its present terms of reference. Crop insurance is another public program farmers may use to minimize the risk of low crop yields.

Shared price uncertainty is consistent with the concept of stabilization over the longer term. Price supports may help provide short term stability but may engender longer term instability. The effectiveness of risk-shared credit in dealing with risk is dependent on the availability

of the appropriate data and the willingness of landlords and tenants to negotiate rental terms on this basis.

In conclusion it is apparent that relevant data bases and appropriate policy instruments are essential if farmers are to be assisted in assessing risks and in developing the appropriate strategies to contend with them. The achievement of these requisites will require the collaboration and interaction of extension personnel, researchers and policy-makers.