TB-1536 (1976) USDA TECHNICAL BULLETINS UPDATA

THE DISTRIBUTION OF SHORTRUN COMMODITY PRICE MOVEMENTS.

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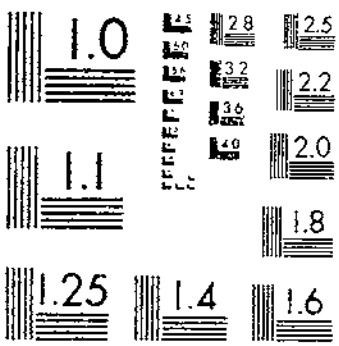

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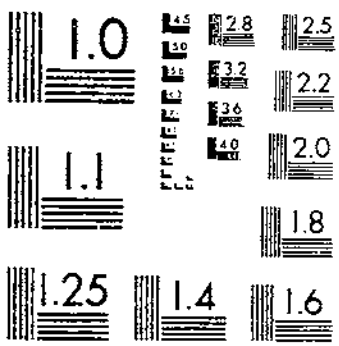

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The Distribution of Shortrun Commodity Price Movements

Economic Research Service U S Department of Agriculture Technical Bulletin Number 1 5 3 6

THE DISTRIBUTION OF SHORTRUN COMMODITY PRICE MOVEMENTS, By Jitendar S. Mann and Richard G. Heifner, National Economic Analysis Division, Economic Research Service. Technical Bulletin No. 1536.

ABSTRACT

The statistical properties of daily closing futures prices for nine commodities are studied. Two hypotheses are examined: Price changes are normally distributed, and prices follow a random walk process. Normality is tested by estimating kurtosis, the R/S statistic, and characteristic exponents. The Gaussian hypothesis is rejected in a large proportion of cases. Randomness is tested by using the turning point test and the phase length test. Both tests reject the random walk hypothesis.

Keywords: Futures prices, Gaussian distribution, stable Paretian distribution, random walk.

Washington, D.C. 20250 March 1976

PREFACE

This report presents results from a continuing program of research aimed at furthering understanding of the pricing process in agricultural markets. The work has been under the leadership of Allen B. Paul, Program Leader, Pricing, Policy, and Program Analysis, National Economic Analysis Division, Economic Research Service. The authors wish to acknowledge the contribution of J. Blake Imel, currently with the Commodity Futures Trading Commission, in overall planning of the conceptual framework for the study.

CONTENTS

SUMMARY

To enhance understanding of pricing on commodity markets, the statistical properties of the distribution of daily closing futures prices for corn, wheat, soybeans, soybean oil, soybean meal, shell eggs, frozen pork bellies, live cattle, and Maine potatoes were analyzed using data for 1959-71. Two main hypotheses were examined: Price changes have a normal distribution and price changes are serially independent.

The normality hypothesis was tested against infinite variance alternatives using three procedures. When kurtosis was estimated directly, the hypothesis of normality was rejected for over 78 percent of the futures contracts. A test based on the ratio of range to standard deviation led to the rejection of normality for about 66 percent of the contracts. The characteristic exponent for the stable Paretian family of distributions (of which the normal is a special case) was estimated for each contract. Out of 574 contracts, only 4 percent had an estimate of 2.0 for the characteristic exponent, the value for the normal distribution. Moreover, the estimates of the characteristic exponent based on sums of nonoverlapping observations did not tend toward 2.0 as the number of observations in each sum was increased. These results support the notion that the distributions of changes in daily futures prices have infinite variances, and imply that the classical statistical methods based on the normal distribution may not be applicable.

The hypothesis of randomness was tested by using two nonparametric tests: Turning point tests based on the number of peaks and troughs in the series and phase length tests based on the length of intervals between turning points. Both tests refute the hypothesis of serial independence and indicate systematic elements in futures prices. These results, combined with previous research, suggest that commodity futures prices do not adjust efficiently to new information in the short run. Instead, they appear to exhibit more or less regular patterns which are not directly the result of shifts in supply and demand. The methods employed in this study do not reveal whether reducing these pricing inefficiencies would be worth the cost. This is a matter calling for further study.

Two possible sources can be suggested for the lack of serial independence in price movements: Deliberate price manipulation by certain traders, and the tendency for groups of traders to unintentionally follow similar patterns in their trades. The latter type of behavior may arise when many traders follow the same technical advice or the same charting procedures. Further study is needed to determine whether the observed serial dependence results from deliberate actions of one or a few large traders or from the unintended parallel actions of many smaller traders.

THE DISTRIBUTION OF SHORTRUN COMMODITY PRICE MOVEMENTS

by

Jitendar S. Mann and Richard G. Heifner*

INTRODUCTION

The recent rapid movements in commodity prices emphasize the need for better understanding of the pricing process. This understanding may be sought in various ways, including econometric analysis of factors affecting price levels, evaluation of market structure and market institutions, and detailed examination of the time sequence of price movements. This report presents the results of a study of shortrun price movements. Findings from a number of recent studies pursuing the same course are reviewed, and new empirical evidence regarding the distribution of such price movements is presented.

Why study shortrun price behavior? First, there are pressing needs for identifying shortrun price aberrations, including those due to abuses, such as price manipulation. Second, detailed understanding of the pricing process is needed to modify and improve market institutions and the rules of trade. Price is an easily observed and widely followed market statistic. Prices are reported more frequently and with greater accuracy than are data on other economic variables such as production, utilization, and stocks. Furthermore, price is a key element in production and consumption decisions. Thus, there is reason to believe that economists, regulatory agencies, and others concerned with the functioning of markets will find analysis of shortrun price movements useful in appraising market performance and in searching for market imperfections.

A pricing aberration may be defined as a deviation in price from the level justified by supply and demand under competitive conditions. Paramount among the conditions for effective competition is the requirement that individual traders do not have the

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power to influence price through their own actions, but instead take the market price as given. This condition is violated by monopolistic or oligopolistic behavior. Such behavior takes one of its most direct forms in manipulation of futures prices.

Pricing aberrations may arise not only from deliberate attempts to manipulate price, but also from inadequacies in the market's information system or errors in traders' responses to information. A classic example is the cobweb phenomenon believed to partly explain the cyclical behavior of livestock production and prices. In the cobweb model, producers adjust their production levels in response to past prices regardless of current price prospects. This results in a cyclical pattern of output and prices which depends on the slopes of demand and supply curves and the time lags involved. Presumably, such fluctuations would be absent if producers' price expectations were accurate.

It seems likely that similar errors in expectations may contribute to other undesirable fluctuations in commodity prices. For example, if a large proportion of traders rely heavily on technical analysis or chart patterns, and if their decisions are based on similar interpretations of the same past price movements, their actions may introduce price fluctuations that economic conditions do not justify.

Economic theory provides a number of hypotheses about price behavior that also suggest ways of identifying pricing aberrations. For example, the idea that prices should reflect marginal costs of production under competition provides a starting point for determining if the price level is out of line. Similarly, the notion that in an efficient market all available information is reflected in the current price leads to certain testable hypotheses about price movements.

Two aspects of price behavior are anlayzed here: The shape of the probability distribution of price movements, and the degree of randomness or serial independence in price movements. The shape of the distribution, particularly its divergence from normality, is important in testing for serial independence, and it has far-reaching implications for other areas of price anlaysis. We are interested in serial dependence as a means to determine whether or not a market is responding efficiently to new information.

The empirical results reported here are for daily movements of commodity futures prices. Futures prices provide a good laboratory for studying shortrun price behavior. Being quotations for delivery at essentially a single point in time, they are largely free of the seasonality that characterizes cash prices for most agricultural commodities. Moreover, futures contracts do not involve dividend payments, thus, they do not reflect the consequent price effects that must be considered in studying shortrun movements of stock prices. Of course, futures prices are not entirely

free from complications. Among these are changes in the overall price level and the possible tendency for the price expected to prevail in the future to be discounted in current trades because of risk. But these do not present serious handicaps for the types of analyses performed in this study.

HYPOTHESES ABOUT PRICE MOVEMENTS

Our ideas about shortrun price movements can be formulated into testable hypotheses. These hypotheses are conveniently stated in terms of price changes. The importance of studying price changes, as opposed to price levels, has been emphasized by Working (37) and Roberts (29).1/ Our concern in this study is with day-to-day price changes, particularly the shape of their distribution and their dependence, if any, on past history.

Theory of Random Walk in Commodity Prices

Although the idea that prices behave as random walk was originated by Bachelier (2) in 1900, his work remained undiscovered by economists for many years. Holbrook Working, unaware of Bachelier's work, started investigating the random character of commodity prices in the 1920's. He generated "ideal behavior of a future price" by a cumulative sum of random numbers (35 and 36). His work is summarized in a paper presented to the American Statistical Association in 1949 and published recently (39).

The basic rationale for the random walk hypothesis in futures prices is outlined in Working's theory of anticipatory prices (38). It is argued that in an efficient competitive market, price is determined by the actions of many traders, each acting on the basis of his own expectations. Traders' expectations, in turn, are based on information arising from many diverse sources. Since prices reflect expectations, new information affects price only to the extent that it differs from what was previously anticipated. The price series evolves according to

$$P_t = P_{t-1} + \varepsilon_t$$

where ε_t is a random variable with zero mean and is drawn independently each period.

In the above formulation, the price-making mechanism starts with a certain opening price, and adds to it in each time interval a random factor ε_t, which encompasses the influence of all the new information available to generate the price for the next period. All the currently available information is incorporated into each

1/ Underlined numbers in parentheses refer to items in the Selected Bibliography, page 18.

successive price. The best expected price for the next period is the current price; past price history is irrelevant (Fama, 12).

The random walk hypothesis can be tested by estimating ε's by first differences of prices:2/

$$d_t = P_t - P_{t-1}$$

Then, the various tests can be applied to the first differences, d_t.

The martingale hypothesis provides a more precise statement of the requirement for an efficient market, one where all currently available information is taken into account in establishing price. A martingale is a stochastic sequence whereby the conditional expected value for the next period equals the value for the current period. The martingale hypothesis does not require successive price changes--the ε_t--to be drawn from the same distribution. For example, it admits random processes with changing variances as possible price generating mechanisms.

Samuelson (30) has shown that when spot prices are from a stationary series and futures prices are "set by competitive bidding at the now expected level of the terminal spot price," the futures prices will possess the martingale property. The market mechanism in this case is said to be a "fair game." Knowledge of current and past prices is of no value for predicting subsequent price levels in a price series that possess the martingale property. Thus, no trader can profit by basing buying and selling decisions solely on past prices.

Both the random walk hypothesis and the martingale hypothesis require expected price changes to be serially independent. Testing daily futures price changes for serial independence was a major purpose of this study. We did not test the further requirement that for a "fair game," the expected price change be zero. To do so would lead to the matter of bias in futures markets, which has been dealt with elsewhere in the literature.

The Stable Paretian Hypothesis

If successive price changes are viewed as random variables, and if we wish to make inferences about the serial independence of such price changes, we need to know the underlying probability distribution from which the price changes are drawn. If the price changes are from a Gaussian distribution with constant variance, classical statistical inference can be used. The rationale for

2/ The different hypotheses about price changes (Bachelier, 2; Mandelbrot, 26) are set up in terms of differences of logarithms of prices. Although the discussion in this section is presented in terms of price changes for the sake of simplicity, logarithmic transformation was made for statistical analysis.

assuming normality arises from the central limit theorem. This theorem states that the distribution of the sum or mean of a large number of independent random variables with finite variances approaches normality as the sample size becomes infinite, regardless of the form of the original distributions. Thus, if each price change can be viewed as the summation of a large number of individually negligible random effects with finite variances, we would expect price changes to be normally distributed. See Feller (15), Vol. II, Sec. VIII 4; and Preface in Gnedenko and Kolmogorov (16).

Bachelier (2) argued that prices are normally distributed. He set up a Chapman-Kolmogorov equation for probability of price z at moment $t_1 + t_2$, given the price was x at t_1. Then, he showed that a normal distribution satisfies the equation. He did not derive a general solution of the Chapman-Kolmogorov equation. It has been argued that a general solution might not lead to a Gaussian distribution.

Evidence is accumulating that price changes do not closely follow the Gaussian distribution. Since statistical tests for samples from distributions other than the Gaussian are generally not available, we are forced either to (a) employ distribution-free tests or (b) determine how the data diverge from normality and, if necessary, transform the data so that tests based on the normal distribution are valid.

In studying the distribution of price changes, Mandelbrot (26) found that most observed distributions are leptokurtic: they have a greater concentration of observations in the tails of the distribution than would be expected if the parent population were normal. He proposed the stable Paretian distribution as an alternative, more general distribution which could account for the observed data. The Gaussian distribution is a special case of the stable Paretian distribution, where one of the parameters assumes its limiting value (Fama and Roll, 13).

The non-Gaussian Stable Paretian distributions are characterized by infinite variances. Lack of a finite variance makes working with these distributions difficult. Many of our traditional statistical methods such as least squares are either inappropriate or of doubtful value in this case.

The stable Paretian family of distributions for a random variable u is defined (Gnedenko and Kolmogorov, 16, p. 164) by the logarithm of its characteristic function:

$$\log \phi(t) = \log E(e^{iut}) = i\delta t - \gamma|t|^{\alpha}\{1 + i\beta\frac{t}{|t|}w(t,\alpha)\}$$

where

$$w(t,\alpha) = \begin{cases} \tan(\pi\alpha/2) & \text{if } \alpha \neq 1 \\ (2/\pi)\log|t| & \text{if } \alpha = 1 \end{cases}$$

and $i = \sqrt{-1}$

A stable distribution has four parameters: α--the characteristic exponent which determines the height of the extreme tails of the distribution; δ--the location parameter; γ--the scale parameter; and β--an index of skewness. In most applications to price data, symmetric distributions are assumed so that $\beta=0$. The characteristic exponent α distinguishes between the different members of the family of stable distributions and measures the total probability contained in the extreme tails. When $\alpha=2$, the distribution is normal, which is the only stable distribution for which absolute moments of second and higher order exist. When α is less than 2, no moment of order higher than α is defined. The case where $\alpha=1$ is the Cauchy distribution and $\gamma=c$ is the semi-interquartile range. For distributions with α in the interval $0<\alpha<2$, more of the probability is in the extreme tails than for the Gaussian distribution because the total probability in the tails varies inversely with α.

The location parameter δ corresponds to the mean when $\alpha>1$ or the median (for all α). For the Gaussian distribution, δ is efficiently estimated by the sample mean. For other symmetric stable distributions, efficiency is gained by disregarding some of the extreme observations and utilizing the mean of the remaining observations as an estimate. Fama and Roll (13, pp. 826-833) recommend using the mean of the central half of the observations.

The scale parameter $\gamma=c^{\alpha}$ measures the dispersion of the distribution. For the normal distribution, c^2 equals one-half of the population variance. Fama and Roll (13, pp. 822-824) suggest using the distance between the .28 fractile and the .72 fractile to estimate c for symmetric stable distributions.

The most important property of the stable distributions is, as their name implies, their stability under addition (convolution of random variables). This means that the distributions of sums of independent, identically distributed, stable variables are themselves stable with the same characteristic exponent α and the same index of skewness, β. For a discussion of the statistical properties of stable distributions, see Fama (11); Granger and Orr (17); Gnedenko and Kolmogorov (16); and Feller, (15), Vol. II.

When data are inconsistent with a given hypothesis, it is necessary to adopt an alternative hypothesis. This frequently involves loosening one or more of the constraints on the original hypothesis or allowing one or more of the parameters to vary. The shift from the Gaussian to the stable Paretian hypothesis is such a change. An alternative approach would be to retain the Gaussian model, but assume that the variance shifts over time in some prescribed manner. Such shifting of the variance could, in some cases, as Stevenson and Bear (34, p. 69) point out, account for the excessive density in the tails of observed distributions of price changes.

PREVIOUS EMPIRICAL STUDIES

Although results have been mixed, most previous studies have produced evidence of nonrandomness in futures price movements. In 1953, Kendall (19) analyzed several economic time series, including weekly and monthly average cash prices of wheat at Chicago and monthly New York spot cotton prices. He calculated lagged serial correlations for the first differences of these prices and observed that the price change for cotton from month t to month t+1 was correlated with that from t+1 to t+2. He also noted that the distribution for price changes for wheat was leptokurtic. Alexander (1) pointed out that the correlation found by Kendall in cotton prices was due to averaging. He compared the observed and expected distributions of length of run of weekly cash prices of wheat at Chicago and concluded that the series was random.

Larson (23) attempted to measure randomness for changes on daily closing prices of Chicago corn futures for 1922-31 and 1949-58. He calculated autocorrelations with a lag of up to 60 days, but the results were not conclusive. He also calculated the index of continuity which had been developed by Working. The index, commonly known as the H statistic, is based on the ratio of the range of a series over an interval to the sum of its ranges over nonoverlapping subintervals (Brinegar, 5). From analyses using the H statistic, Larson concluded that the price changes followed a high-order, low-weight, moving average stochastic process.

Brinegar (5) applied Working's H statistic to wheat, corn, and rye futures prices for selected periods during 1924-51. For longer intervals, he found evidence of "price continuity"--that is, a tendency for price adjustments to be less than warranted by new information. For short intervals, there was a slight tendency toward "price reaction," or overadjustment to new information.

Smidt (32) applied alternative trading rules to daily high, low, and closing prices for May soybean futures for 1952-61. The buying and selling criterion used in the trading rules was the magnitude of the average price increase (or decrease) over a specified number of days. The trading rules produced significant profits, indicating serial dependence in price movements.

Stevenson and Bear (34) applied several tests to changes in closing prices of July corn and July soybeans. They estimated serial correlations with lags of 1 day, 2 days, and 5 days. The observed up and down runs of various lengths were compared with the expected values. Returns from different trading techniques with various sized filters (percentage price changes below which no trading is done) were calculated and compared with the returns from a buy and hold strategy. The study concluded that the random walk hypothesis is not a satisfactory explanation of these future prices.

Labys and Granger (21) applied spectral analysis to monthly, weekly, and daily futures price changes over selected intervals between 1950 and 1965 for a number of U.S. commodities. They found that the spectra were generally flat and only rarely could the random walk hypothesis be rejected.

Leuthold (24) investigated live beef cattle prices by using both spectral analysis and mechanical trading rules. The spectral analysis gave mixed results, showing a simple stochastic process to be consistent with 13 out of 30 contracts. The analysis based on mechanical trading rules used filters of 1, 2, 3, 4, 5, and 10 percent. The gross profits were adjusted for commission and margin requirements for each round trip. Results from the analysis of mechanical trading did not support the hypothesis that cattle futures prices behave randomly.

While a number of researchers have devoted considerable attention to the question of randomness, much less work has been done in testing for normality in commodity futures prices. From an analysis of the distribution of day-to-day changes in the logarithms of cotton prices, Houthakker (18) concluded that the distribution did not agree with the Gaussian hypothesis. Mandelbrot (26) plotted positive and negative tails of cotton prices (cash prices) on a double-log graph and compared them with the cumulative density function of a stable distribution. He was criticized by Cootner (7) for drawing hasty conclusions based on these graphs. Stevenson and Bear (34) plotted observations of price changes for July corn and July soybeans on normal probability paper, obtaining an S-shaped curve indicating leptokurtosis. Logan (25) has applied several tests, including Shapiro-Wilk, skewness, kurtosis, and the David-Hartley-Pearson test. A significant number of contracts are identified as not normally distributed.

STATISTICAL ANALYSIS

The results of statistical analysis of daily closing prices for nine commodities--corn, wheat, soybeans, soybean oil, soybean meal, shell eggs, frozen pork bellies, live beef cattle, and Maine potatoes--are reported in this study.3/ The analyses covered 574 separate contracts for the years 1959-71. This was a period when limit moves in futures prices were rare. All calculations (except the turning point and phase length tests) are based on the first differences of natural logarithms of daily closing prices over the life of each contract. The statistical theory for some of the analysis reported here is not fully developed to carry out all the steps of statistical inference. For example, the sampling distribution of the characteristic exponent is not known. We are reporting

3/ The contracts analyzed were traded at the Chicago Board of Trade, the Chicago Mercantile Exchange, and for Maine potatoes, the New York Mercantile Exchange.

the estimated values for these parameters in full awareness of the limitations of the state of the art in this area. Other researchers may want to interpret these estimates in the light of future developments in statistical theory and methodology.

Tests for Kurtosis

Since the doubts raised by Mandelbrot's stable Paretian hypothesis have important implications for the method used for examining serial dependence, it is appropriate to test for lepto-kurtosis before proceeding with the tests for randomness. A number of alternative methods have been suggested for distinguishing between the normal distribution and other stable distributions. In this study, three procedures were employed: direct estimation of kurtosis, estimation of α (the characteristic exponent in the stable distribution), and a test of the ratio of the range to the standard deviation.

Estimates of kurtosis were made using the following formula (Kendall and Stuart, 20, Vol. 1, p. 85):

$$b_2 = \frac{\frac{1}{n}\Sigma(d_i-\bar{d})^4}{[\frac{1}{n}\Sigma(d_i-\bar{d})^2]^2}$$

Under the hypothesis of normal distribution, the expected value of this index of kurtosis equals 3. The estimated values of kurtosis are summarized in table 1, and the estimates for each contract are

Table 1.--Estimates of kurtosis for the distribution of changes in logarithms of daily closing prices

Commodity	Number of contracts	Estimates of kurtosis		
		Minimum	Maximum	Number of cases significant at .01 level
Corn, Chicago	59	3.21	18.52	49
Wheat, Chicago	56	3.06	16.66	38
Soybeans	80	3.54	15.57	77
Soybean oil	94	3.05	76.20	60
Soybean meal	92	2.93	65.04	80
Shell eggs	70	2.77	20.15	56
Frozen pork bellies	36	2.58	8.18	14
Live cattle	41	3.20	19.56	35
Maine potatoes	46	3.29	15.33	42
All commodities	574	2.58	76.20	451

given in appendix tables 1-9. For a one-sided test of the normality hypothesis, the critical value of kurtosis for a sample of 200 is 3.98 at the .01 level of significance (Snedecor and Cochran, 33, p. 552). In over 78 percent of the contracts, the estimated kurtosis was significantly greater than 3.0. The sample estimate of kurtosis is not independent of the size of sample; it tends to increase as n increases (Mandelbrot, 26). Hence, these results can be taken only as an approximate test for leptokurtosis.

Estimates of the Characteristic Exponent

Unfortunately, elementary expressions for the density of stable variables are not known. However, Fama and Roll (13), using a series expansion suggested by Bergstrom (3), have approximated the cumulative distribution function of a standardized symmetric stable variable (standardized by subtracting δ, the location parameter, and dividing by c). Fama and Roll (14) have suggested a method based on fractiles for estimating the characteristic exponent, α, in the stable Paretian distribution. To calculate α using fractiles suggested by Fama and Roll, the scale parameter, c, is first estimated as

$$\hat{c} = \frac{1}{2(.827)} [\hat{x}_{.72} - \hat{x}_{.28}]$$

where $\hat{x}_{.72}$ and $\hat{x}_{.28}$ are the estimates of the 72nd and 28th fractiles, respectively. Then, the range between the 4th and 96th fractiles is calculated for the data and standardized by dividing by $2\hat{c}$. The characteristic exponent is then determined by searching table 2 in Fama and Roll (13, p. 822) to find the α that corresponds most closely with the calculated standardized interfractile range. The estimates of alpha are summarized in table 2 of the present report, and the results for each contract are given in appendix tables 1-9. Only 4 percent of the estimates of the characteristic exponent were equal to 2.0. About 33 percent of the estimates were between 1 and 1.5, and over 63 percent were greater than 1.5 and less than 2.0. It should, however, be pointed out again that the sampling distribution of alpha is not known. Therefore, we cannot apply a statistical test to determine how many of the estimates are significantly smaller than 2.0, the value for the normal distribution.

The R/S Tests

Finally, a test recommended by Fama and Roll for distinguishing between the normal and other members of the family of stable distributions was applied for each contract. Using Monte Carlo methods, they compared three procedures for distinguishing between normal distributions and other stable distributions: the Shapiro and Wilk test (31); the ratio of range to standard deviation as proposed by David, Hartley, and Pearson (9); and calcualtion of α by use of fractiles as described above. They conclude that "the studentized range...would seem to be a good general technique for goodness of fit tests of normality against non-normal stable alternatives."

Table 2.--Tests for normality in the distributions of changes in logarithms of daily closing prices

Commodity	Number of contracts	Estimates of Alpha, the characteristic exponent				R/S significant at .01 level
		Alpha = 1.0	1.0 < Alpha ≤ 1.5	1.5 < Alpha < 2.0	Alpha = 2.0	
Corn, Chicago	59	0	13	44	2	48
Wheat, Chicago	56	0	5	40	11	35
Soybeans	80	0	35	44	1	67
Soybean oil	94	0	17	73	4	48
Soybean meal	92	0	40	48	4	67
Shell eggs	70	0	36	32	2	37
Frozen pork bellies	36	0	12	24	0	11
Live cattle	41	0	14	27	0	30
Maine potatoes	46	0	16	30	0	39
All commodities	574	0	188	362	24	382

In this study, we shall call this the R/S test, following the terminology suggested by Mandelbrot (28), in order to distinguish it from the studentized range test in analysis of variance. The latter is based on a ratio of range of a sample to an independent estimate of standard deviation. In the R/S test used here, both range and standard deviation are estimated from the same sample.

Under the normal distribution, the upper critical point for 200 observations at the 1-percent level of significance is 6.85 for the R/S test (David and others, 9, p. 491). Larger calculated values of this statistic may be considered as evidence of leptokurtosis. The calculated value exceeded this critical level in over 66 percent of the cases (table 2), supporting the hypothesis of leptokurtosis.

In summary, these results strongly reinforce findings from previous studies indicating that futures price changes are not accurately described in terms of the normal distribution. In general, the probability density is considerably greater near midpoint and in the tails, and less in the middle ranges, than would be expected under the normal distribution.

Estimates of the Characteristic Exponent for Sums of Observations

Once it has been established that the distribution of price changes is leptokurtic--that is, has greater concentration in the tails than expected under normality--there remains the question of choosing between the stable Paretian hypothesis and the Gaussian hypothesis with changing variance. If the distribution is Paretian with infinite variance, the methods making use of the variance (such as correlogram analysis and spectral analysis) are not applicable. If, on the other hand, we find that the apparent leptokurtosis can be explained by shifts in the variance of the price changes, the possibility remains for employing such methods after suitably transforming the data. We might, for example, hypothesize that the variance of price changes slowly and systematically over time. For example, Samuelson has proposed the law of increasing volatility of a maturing futures contract. If such relationships could be established, they might be used for transforming the original series of price changes into a new series with a constant variance but otherwise identical characteristics, so that methods based on the Gaussian hypothesis could be employed.

As a criterion for choosing between the nonnormal stable and the normal distributions with changing variance, a test suggested by Fama and Roll (14, p. 337) was employed. This test involves estimating the characteristic exponent for nonoverlapping sums of observations drawn from the sample. If the underlying distribution is truly stable with infinite variance, the resulting estimates of the characteristic exponent should show no tendency to increase as the number of observations in each sum is increased. However, if

the observations are from a mixture of normal distributions, the estimates of the characteristic exponent derived from the sums should tend toward 2 (its value under the normal distribution) as the number of observations in each sum is increased. Table 3 summarizes the results of these calculations for sums of 2, sums of 4, and sums of 8 observations. Details for each contract are given in appendix tables 10-18. Although the results are mixed, in the majority of cases the estimated values of the characteristic exponent decrease as the number of observations in the summations is increased. Thus, these results favor the nonnormal stable hypothesis over the hypothesis of a normal distribution with changing variance.

Tests for Serial Independence

The most important part of this study is the testing for serial dependence in price movements. If no evidence of serial dependence is found, we would conclude that futures prices adjust to new information efficiently. On the other hand, if serial dependence is present, we would attempt to locate it more precisely and determine if it is related to other variables, such as the concentration of positions among traders.

In view of the accumulating evidence that distributions of price movements are non-Gaussian, it is necessary to consider statistical tests that do not require distributional assumptions. One group of such nonparametric tests for serial independence disregards the magnitude of price movements and uses only information on the direction of price change in successive observations. These include turning point tests and phase length tests, which are described by Kendall and Stuart (20, Vol. III, pp. 351-355).

Turning Point Tests

The idea behind the turning point test is to count the number of peaks and troughs in a series and compare these with the number that would be expected in a random series. Kendall and Stuart (20, Vol. III, pp. 351-352) show that the expected number of turning points in a random series of length n is:

$$E(p) = (2/3)X(n-2)$$

and the variance of the number of turning points is:

$$Var(p) = \frac{16n-29}{90}$$

They show that the distribution of the number of turning points tends rapidly toward normality as n increases.

Table 4 summarizes the results of applying turning point tests to daily closing future prices; details are in appendix tables 19-27. The hypothesis of randomness is rejected for over 97 percent

Table 3.--Estimates of characteristic exponent for sums of observations, changes in logarithms of daily closing prices

Commodity	Number of contracts	Characteristic exponent for sums of observations as compared to estimates for single observations					
		Sum of 2		Sum of 4		Sum of 8	
		Increase	Decrease	Increase	Decrease	Increase	Decrease
Corn, Chicago	59	30	27	27	30	12	44
Wheat, Chicago	56	20	32	15	37	17	35
Soybeans	80	37	38	30	49	29	46
Soybean oil	94	49	43	39	54	30	44
Soybean meal	92	37	53	37	53	25	42
Shell eggs	70	27	39	20	34	11	20
Frozen pork bellies	36	21	15	14	20	22	8
Live cattle	41	27	13	19	22	10	25
Maine potatoes	46	28	17	18	27	15	29
All commodities	574	276	277	219	326	171	293

Table 4.--Turning point test for daily closing prices

Commodity	Number of contracts	Cases significant at .01 level	Cases with observed less than expected
Corn, Chicago	59	59	59
Wheat, Chicago	56	56	56
Soybeans	80	77	80
Soybean oil	94	93	94
Soybean meal	92	91	92
Shell eggs	70	63	70
Frozen pork bellies	36	36	36
Live cattle	41	41	41
Maine potatoes	46	41	46
All commodities	574	557	574

of the contracts. In every case, the actual number of turning points was less than expected. These results tend to refute the random walk hypothesis and, instead, support the notion of continuity (Brinegar, 5) in price movements--that is, the tendency for price changes in successive periods to be in the same direction.

Phase Length Tests

The phase length test is based on the length of intervals between the turning points. The expected number of phases of length d in a series of n observations (Kendall and Stuart, 20, Vol. III, pp. 353-355) is:

$$N_d = \frac{2(n-d-2)(d^2 + 3d + 1)}{(d + 3)!}$$

The randomness hypothesis is tested by comparing the observed frequencies with the expected values. Since the lengths of the phases are not independent, a slight modification in the chi-square test is necessary. It is recommended that a three-way classification--d = 1, 2, $\geq$ 3--be tested with 2-1/2 degrees of freedom for an estimated chi-square $\geq$ 6.3. For smaller values, 6/7 X (estimated chi-square) can be tested with two degrees of freedom. The results for phase length tests are summarized in table 5; the details for each contract are in appendix tables 28-36. For over 90 percent of the contracts, the hypothesis of randomness is rejected. In general, fewer phases of length 1 and 2 and more phases of length 3 or greater were found than expected in a random series. Thus, the phase length tests corroborate the finding of the turning point test and indicate systematic forces in futures markets.

Table 5.--Phase length test for daily closing prices

Commodity	Number of contracts	Significant at .05 level
Corn, Chicago	59	56
Wheat, Chicago	56	55
Soybeans	80	70
Soybean oil	94	90
Soybean meal	92	89
Shell eggs	70	50
Frozen pork bellies	36	29
Live cattle	41	41
Maine potatoes	46	39
All commodities	574	519

IMPLICATIONS

The results reported here provide substantial evidence that daily changes in commodity futures prices do not follow the normal (Gaussian) probability distribution. More importantly, these price changes are not serially independent as one would expect in a market which adjusts efficiently to new information. These findings have serious implications for price analysis and for evaluating the performance of commodity markets.

As in several previous studies, price changes were found to be leptokurtic--that is, more of the price changes were either large or small and fewer were in the middle ranges than would be expected under the normal distribution. Although alternative explanations for the apparent leptokurtosis cannot be completely ruled out, the evidence favors the hypothesis that the observations were drawn from stable distributions with infinite variances. Unfortunately, this means that our most powerful statistical procedures, including correlation analysis, regression analysis, spectral analysis, and t tests, may not be applicable to such data since these methods assume finite variances. Moreover, if day-to-day price changes have stable distributions with infinite variances, so also do the price changes for longer intervals. And, because of their close correspondence to futures price changes, cash price changes are likely to have similar distributions. Thus, infinite variances must be considered a strong possibility and a potentially serious obstacle in almost any price analysis.

In dealing with infinite variance distributions, the analyst currently has two choices: either transform the data to make it approximately normal and use classical methods, or resort to distribution-free methods. Sometimes a distribution can be made

approximately normal simply by discarding the extreme observations. For example, Granger and Orr (17, pp. 275-285) suggest that the usual time series methods, correlogram analysis and spectral analysis, may be applicable if the series is "clipped"--that is, if the outlying observations are dropped. The distribution-free methods include those based on counts, such as chi-square, and those based on fractiles, medians, and absolute deviation. A modified regression method suitable for the stable Paretian case has been developed by Blattberg and Sargent (4). Methods based on counts were used to test for serial independence in this study.

The finding that successive price changes are not statistically independent strongly suggests that prices on commodity futures markets do not adjust efficiently to new information about supply and demand. Instead, they appear to exhibit more or less regular patterns which are not directly the result of shifts in supply and demand. The methods employed in this study do not reveal whether reducing these pricing inefficiencies would be worth the cost. This is a matter calling for further study.

Two possible sources can be suggested for the lack of serial independence in price movements: deliberate price manipulation by certain traders, and the tendency for groups of traders to unintentionally follow similar patterns in their trades. The latter type of behavior may arise when many traders follow the same technical advice or the same charting procedures. Further study is needed to determine whether the observed serial dependence results from deliberate actions of one or a few large traders or from the unintended parallel actions of many smaller traders. 4/

4/ Subsequent analysis of closing prices of raw sugar contract No. 11 gave results similar to those for the nine commodities reported here.

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Appendix table 1.--Tests for kurtosis in the distribution of daily price changes for Chicago corn

Contract	Number of observations	Kurtosis	Alpha	Range/ standard deviation
March 1960	183	3.90	1.47	6.29
May 1960	224	4.06	1.97	6.63
July 1960	244	16.31	1.92	12.27
September 1960	246	3.33	1.83	5.54
December 1960	244	6.07	1.43	8.87
March 1961	232	7.28	1.44	8.77
May 1961	231	5.38	1.36	6.88
July 1961	227	4.57	1.29	7.09
September 1961	213	4.11	1.58	6.87
December 1961	231	3.86	1.94	6.93
March 1962	245	3.21	1.80	6.24
May 1962	245	3.96	1.73	7.18
July 1962	245	4.60	1.57	7.80
September 1962	244	3.22	1.63	5.72
December 1962	243	8.81	2.00	9.65
March 1963	242	9.70	1.88	10.14
May 1963	243	12.62	1.80	10.99
July 1963	242	13.13	1.62	11.21
September 1963	243	9.69	1.65	9.68
December 1963	244	14.23	1.77	10.92
March 1964	244	13.41	1.79	10.68
May 1964	242	14.04	1.58	10.85
July 1964	244	18.52	1.57	13.08
September 1964	245	11.83	1.63	8.64
December 1964	245	4.11	1.87	6.91
March 1965	245	4.48	1.80	7.48
May 1965	243	4.08	1.84	7.10
July 1965	243	5.96	1.83	8.65
September 1965	244	5.07	1.77	8.19
December 1965	244	3.62	1.55	6.03
March 1966	245	4.46	1.98	7.68
May 1966	244	6.73	1.97	8.13
July 1966	244	8.15	2.00	8.66
September 1966	245	11.66	1.39	10.12
December 1966	244	6.70	1.51	8.47
March 1967	242	6.82	1.45	8.96
May 1967	242	5.42	1.56	7.89
July 1967	243	5.45	1.69	7.19
September 1967	241	4.32	1.72	6.51
December 1967	243	4.68	1.95	7.99
March 1968	244	4.73	1.75	7.60
May 1968	244	4.91	1.71	8.37
July 1968	244	3.69	1.74	6.55
September 1968	243	3.72	1.78	6.49
December 1968	243	6.55	1.59	7.15
March 1969	275	7.03	1.74	7.60
May 1969	242	6.37	1.61	7.10
July 1969	241	6.16	1.56	8.06
September 1969	241	7.90	1.52	9.41
December 1969	242	9.80	1.52	9.83
March 1970	302	9.27	1.59	9.99
May 1970	248	10.34	1.71	9.45
July 1970	250	12.56	1.68	9.84
September 1970	245	12.12	1.20	9.81
December 1970	250	7.72	1.22	8.12
March 1971	294	7.95	1.29	8.45
May 1971	211	6.04	1.45	7.17
July 1971	172	5.72	1.42	6.82
September 1971	129	3.77	1.40	5.70

Note: Number of observations = number of differences.

Appendix table 2.--Tests for kurtosis for the distribution of daily price changes for Chicago wheat

Contract	Number of observations	Kurtosis	Alpha	Range/ standard deviation
May 1960	224	7.99	2.00	9.16
July 1960	266	3.28	2.00	6.45
September 1960	309	3.11	1.98	5.44
March 1961	243	4.25	1.68	6.50
May 1961	244	5.97	1.40	7.94
July 1961	244	7.37	1.55	8.67
September 1961	243	6.13	1.70	8.81
December 1961	244	5.64	1.71	7.79
March 1962	244	3.06	1.69	5.01
May 1962	245	3.33	1.46	6.05
July 1962	245	3.70	1.51	6.52
September 1962	244	4.83	1.84	8.16
December 1962	242	5.37	1.60	7.99
March 1963	241	4.43	1.65	7.40
May 1963	243	13.33	1.69	9.87
July 1963	206	6.20	1.88	8.39
September 1963	243	5.32	1.61	7.60
December 1963	244	6.42	1.57	8.58
March 1964	244	4.92	1.53	6.90
May 1964	243	4.73	1.50	7.26
July 1964	266	5.40	1.62	7.31
September 1964	308	5.50	1.56	7.31
December 1964	245	4.45	1.90	6.68
March 1965	235	3.70	1.60	6.14
May 1965	244	3.48	1.68	6.10
July 1965	242	6.09	1.75	8.98
September 1965	239	3.76	1.83	6.28
December 1965	243	4.73	2.00	7.60
March 1966	221	3.07	2.00	5.73
May 1966	245	3.62	2.00	7.03
July 1966	244	7.51	1.55	9.18
September 1966	243	5.33	1.69	8.02
December 1966	244	5.11	1.72	8.34
March 1967	242	4.50	1.75	7.37
May 1967	243	4.02	1.95	6.48
July 1967	243	3.73	1.97	6.25
September 1967	242	3.93	2.00	6.39
December 1967	243	4.71	2.00	7.25
March 1968	244	4.67	2.00	7.56
May 1968	244	3.19	2.00	5.97
July 1968	244	3.64	1.94	6.52
September 1968	243	3.96	1.82	6.64
December 1968	243	3.87	1.65	6.83
March 1969	242	3.86	1.88	6.58
May 1969	242	4.07	1.68	6.67
July 1969	242	3.63	1.80	6.12
September 1969	284	4.45	2.00	7.46
December 1969	242	7.06	2.00	8.62
March 1970	241	5.75	1.62	7.36
May 1970	248	5.82	1.75	7.67
July 1970	250	6.28	1.66	8.69
September 1970	245	16.66	1.42	12.74
December 1970	249	12.36	1.53	11.78
March 1971	251	11.32	1.61	11.37
May 1971	216	10.22	1.53	10.28
July 1971	165	10.96	1.46	8.86

Note: Number of observations = number of differences.

Appendix table 3.--Tests for kurtosis for the distribution of daily price changes for soybeans

Contract	Number of observations	Kurtosis	Alpha	Range/ standard deviation
January 1960	140	4.52	1.73	6.24
March 1960	183	4.88	1.69	7.05
May 1960	208	8.37	1.74	8.21
July 1960	209	8.55	1.65	8.52
September 1960	211	5.33	1.66	7.76
November 1960	210	5.69	1.79	7.79
January 1961	209	11.54	1.54	10.45
March 1961	209	6.74	1.20	6.90
May 1961	209	4.68	1.15	6.28
July 1961	207	3.54	1.30	5.18
September 1961	209	5.56	1.40	6.57
November 1961	238	8.44	1.50	8.96
January 1962	245	10.43	1.42	9.73
March 1962	245	8.86	1.41	9.53
May 1962	245	6.40	1.70	8.68
July 1962	243	6.20	1.59	8.06
August 1962	245	5.76	1.53	7.55
September 1962	238	7.42	1.63	8.87
November 1962	244	15.57	1.48	11.43
January 1963	242	13.83	1.61	11.22
March 1963	242	7.30	1.37	8.18
May 1963	243	6.09	1.43	7.32
July 1963	227	7.39	1.48	8.48
August 1963	238	7.05	1.57	8.31
September 1963	241	8.61	1.59	9.76
November 1963	243	6.90	1.41	7.80
January 1964	244	6.03	1.46	7.37
March 1964	243	5.32	1.44	7.13
May 1964	243	5.41	1.52	6.89
July 1964	245	6.76	1.40	7.89
August 1964	243	6.14	1.33	7.44
September 1964	231	8.19	1.48	8.11
November 1964	242	9.91	1.43	9.47
January 1965	243	7.13	1.63	9.21
March 1965	245	5.94	1.55	7.95
May 1965	244	4.84	1.53	7.44
July 1965	243	4.07	1.76	6.98
August 1965	242	4.27	1.73	7.16
September 1965	244	6.92	1.93	8.66
November 1965	249	5.98	2.00	8.19
January 1966	245	5.33	1.60	7.49
March 1966	245	4.25	1.58	6.37
May 1966	244	4.38	1.62	6.65
July 1966	244	5.64	1.56	6.99
August 1966	244	4.72	1.34	6.10
September 1966	245	5.27	1.30	6.50
November 1966	243	5.69	1.51	7.02
January 1967	244	5.65	1.44	7.00
March 1967	242	6.07	1.41	7.13
May 1967	242	6.56	1.32	7.26
July 1967	243	8.38	1.52	9.53
August 1967	243	8.69	1.39	9.10
September 1967	242	5.66	1.48	7.78
November 1967	244	8.05	1.61	9.43

Continued

Appendix table 3.--Tests for kurtosis for the distribution of daily price changes for soybeans--Continued

Contract	Number of observations	Kurtosis	Alpha	Range/ standard deviation
January 1968	245	8.58	1.65	9.03
March 1968	244	8.89	1.52	9.20
May 1968	244	10.44	1.63	10.21
July 1968	244	3.77	1.88	6.22
August 1968	242	4.43	1.67	6.99
September 1968	243	12.81	1.41	10.50
November 1968	242	5.92	1.48	8.02
January 1969	243	4.91	1.55	6.98
March 1969	243	5.03	1.43	7.45
May 1969	242	4.21	1.50	7.35
July 1969	242	4.26	1.61	6.96
August 1969	241	4.02	1.44	6.51
November 1969	242	6.20	1.66	7.88
January 1970	281	5.89	1.63	7.71
March 1970	245	4.79	1.63	7.43
May 1970	247	4.17	1.72	6.91
July 1970	250	9.51	1.59	9.29
August 1970	243	9.12	1.52	9.09
September 1970	245	7.75	1.37	8.21
November 1970	249	6.22	1.34	7.29
January 1971	250	5.62	1.47	7.66
March 1971	251	4.88	1.64	7.35
May 1971	216	4.46	1.49	6.85
July 1971	170	4.84	1.48	6.81
August 1971	149	5.02	1.60	7.27
September 1971	131	3.84	1.55	6.36

Appendix table 4.--Tests for kurtosis for the distribution of daily price changes for soybean oil

Contract	Number of observations	Kurtosis	Alpha	Range/ standard deviation
December 1959	120	4.16	1.49	6.57
January 1960	140	3.32	1.78	5.50
March 1960	183	3.28	1.71	5.60
May 1960	222	5.39	1.52	7.16
July 1960	208	3.79	1.54	5.83
September 1960	220	3.51	1.71	6.21
October 1960	187	3.88	1.65	6.32
December 1960	187	3.50	1.75	5.81
January 1961	201	4.66	1.50	6.71
March 1961	207	4.40	1.45	6.83
May 1961	222	4.73	1.44	6.92
July 1961	200	3.64	1.61	6.07
September 1961	226	4.26	1.58	6.84
October 1961	203	6.21	1.78	7.77
December 1961	222	4.11	1.81	7.32
January 1962	166	3.36	1.89	5.44
March 1962	185	3.15	1.92	5.11
May 1962	203	3.92	1.94	6.55
July 1962	208	5.89	1.68	8.45
August 1962	149	4.55	1.84	7.30
September 1962	182	4.99	1.69	7.51
October 1962	153	3.82	1.64	6.32
December 1962	174	4.70	1.95	7.18
January 1963	159	4.28	1.68	6.83
March 1963	179	4.56	2.00	7.03
May 1963	204	3.83	1.80	6.98
July 1963	222	4.07	1.68	7.06
August 1963	224	3.85	1.96	7.10
September 1963	202	9.05	1.52	8.01
October 1963	201	11.08	1.71	10.53
December 1963	203	31.23	1.39	13.14
January 1964	217	25.60	1.41	12.77
March 1964	239	25.24	1.41	12.39
May 1964	237	22.97	1.41	11.93
July 1964	237	22.09	1.43	11.89
August 1964	194	30.37	1.37	12.67
September 1964	219	25.37	1.57	11.78
October 1964	239	26.73	1.50	13.47
December 1964	235	4.56	1.75	7.19
January 1965	202	6.07	1.64	7.98
March 1965	243	6.11	1.65	8.25
May 1965	217	5.33	1.61	7.32
July 1965	223	4.35	2.00	6.81
August 1965	190	4.45	1.59	6.58
September 1965	238	5.20	1.67	7.96
October 1965	241	14.15	1.60	11.20
December 1965	237	3.07	1.76	5.34
January 1966	243	3.98	1.86	7.00
March 1966	245	3.35	1.75	6.04
May 1966	243	3.26	1.72	5.68
July 1966	222	4.14	1.78	6.63
August 1966	228	4.47	1.63	6.68
September 1966	243	13.28	1.59	10.77
October 1966	239	11.96	1.58	11.32
December 1966	243	13.21	1.67	11.39

Continued

Appendix table 4.--Tests for kurtosis for the distribution of daily price changes for soybean oil--Continued

Contract	Number of observations	Kurtosis	Alpha	Range/ standard deviation
January 1967	244	15.32	1.56	12.27
March 1967	242	16.11	1.53	12.54
May 1967	243	16.08	1.55	12.29
July 1967	243	24.87	1.63	13.95
August 1967	237	11.95	1.56	9.94
September 1967	233	3.45	1.50	5.66
October 1967	240	3.70	1.62	5.98
December 1967	232	4.53	1.54	7.09
January 1968	240	4.56	1.56	7.09
March 1968	244	4.10	1.70	6.76
May 1968	244	4.17	1.68	6.97
July 1968	227	3.82	1.70	6.06
August 1968	225	3.90	1.73	6.76
September 1968	237	4.71	1.55	6.86
October 1968	197	4.09	1.58	6.33
December 1968	237	4.98	1.54	6.91
January 1969	224	4.38	1.60	6.89
March 1969	243	3.15	1.85	5.65
May 1969	242	3.12	1.76	5.61
July 1969	241	3.05	1.66	5.85
August 1969	240	3.49	2.00	6.40
September 1969	240	76.20	1.50	14.06
October 1969	242	9.85	1.38	9.76
December 1969	245	7.57	1.40	8.83
January 1970	246	8.37	1.44	8.60
March 1970	242	9.30	1.44	10.01
May 1970	248	4.55	1.49	7.16
July 1970	244	3.34	1.80	6.05
August 1970	242	3.73	1.72	6.55
September 1970	245	3.16	1.71	5.41
October 1970	247	3.99	2.00	6.78
December 1970	249	3.73	1.78	6.08
January 1971	249	3.29	1.67	5.69
March 1971	251	3.38	1.68	5.98
May 1971	217	3.69	1.69	6.58
July 1971	173	3.18	1.78	5.45
August 1971	149	3.23	1.91	5.63
September 1971	131	3.13	1.65	5.28
October 1971	109	3.15	1.65	5.15

Note: Number of observations = number of differences.

Appendix table 5.--Tests for kurtosis for the distribution of daily price changes for soybean meal

Contract	Number of observations	Kurtosis	Alpha	Range/ standard deviation
March 1960	176	4.15	1.65	6.65
May 1960	191	2.93	2.00	5.39
July 1960	209	3.49	1.85	6.08
August 1960	200	3.92	1.80	6.47
October 1960	189	4.22	1.66	6.83
December 1960	155	4.67	1.50	6.57
January 1961	167	4.47	1.41	6.30
March 1961	205	14.55	1.29	11.93
May 1961	182	7.49	1.44	8.88
July 1961	205	4.98	1.36	7.65
August 1961	198	4.38	1.61	7.30
September 1961	177	3.39	1.78	6.01
October 1961	181	3.37	1.91	5.89
December 1961	179	3.81	1.99	6.39
January 1962	149	3.07	2.00	4.98
March 1962	160	4.30	1.88	6.44
May 1962	176	4.82	1.69	6.70
July 1962	208	8.17	1.49	9.34
August 1962	160	6.22	1.54	8.00
September 1962	141	6.49	1.23	6.99
October 1962	151	4.13	1.53	6.01
December 1962	134	6.73	1.66	8.06
January 1963	160	5.66	1.60	7.93
March 1963	176	4.91	1.51	7.14
May 1963	208	5.74	1.85	7.74
July 1963	223	12.17	1.66	9.27
August 1963	223	9.86	1.41	8.75
September 1963	219	14.10	1.58	10.29
October 1963	204	11.68	1.67	10.73
December 1963	221	11.75	1.66	9.80
January 1964	215	10.60	1.63	9.33
March 1964	229	10.39	1.72	9.30
May 1964	240	9.67	1.75	9.07
July 1964	240	10.97	1.83	10.37
August 1964	241	11.83	1.68	10.93
September 1964	227	16.82	1.57	11.65
October 1964	242	16.55	1.58	12.52
December 1964	239	8.15	1.55	9.16
January 1965	256	8.31	1.72	9.47
March 1965	245	6.70	1.67	8.77
July 1965	233	4.98	1.68	7.72
August 1965	221	3.99	1.57	5.82
September 1965	233	65.04	1.52	13.03
October 1965	240	15.17	1.42	12.32
December 1965	237	8.82	1.51	10.14
January 1966	245	6.11	1.55	8.43
March 1966	240	4.17	1.48	6.36
May 1966	227	4.08	1.75	6.65
July 1966	242	11.24	1.69	10.13
August 1966	242	6.91	1.53	8.09
September 1966	204	14.26	1.29	9.84
October 1966	203	7.68	1.56	8.39
December 1966	245	9.86	1.60	9.77

Continued

Appendix table 5.--Tests for kurtosis for the distribution of daily price changes for soybean meal--Continued

Contract	Number of observations	Kurtosis	Alpha	Range/ standard deviation
January 1967	243	10.16	1.49	10.11
March 1967	242	10.33	1.58	10.22
May 1967	243	11.86	1.44	10.17
July 1967	242	15.19	1.52	12.29
August 1967	241	23.25	1.47	13.95
September 1967	242	6.17	1.57	7.21
October 1967	240	12.60	1.25	11.38
December 1967	243	5.62	1.45	7.24
January 1968	243	5.22	1.46	7.38
March 1968	244	4.82	1.72	6.96
May 1968	244	6.16	1.74	9.29
July 1968	234	3.91	1.75	5.97
August 1968	226	6.62	1.69	8.82
September 1968	242	19.00	1.40	11.94
October 1968	196	7.90	1.29	7.75
December 1968	237	5.81	1.32	7.78
January 1969	242	4.03	1.46	6.41
March 1969	243	3.60	1.56	5.98
May 1969	242	3.25	1.60	5.46
July 1969	242	3.47	2.00	6.91
August 1969	241	6.47	2.00	9.03
September 1969	242	6.45	1.55	7.93
October 1969	240	9.18	1.46	9.20
December 1969	244	14.05	1.23	9.67
January 1970	245	19.30	1.15	12.00
March 1970	245	6.40	1.29	8.24
May 1970	248	5.61	1.47	7.83
July 1970	245	5.79	1.49	8.38
August 1970	243	9.86	1.48	10.27
September 1970	244	9.82	1.50	10.23
October 1970	249	8.91	1.43	9.62
December 1970	249	10.08	1.47	10.48
January 1971	250	10.71	1.48	10.52
March 1971	250	11.85	1.44	10.58
May 1971	217	11.73	1.43	10.72
July 1971	173	18.86	1.50	12.17
August 1971	144	3.66	1.69	5.52
September 1971	131	4.12	1.31	5.79
October 1971	108	3.87	1.48	5.28

Note: Number of observations = number of differences.

Appendix table 6.--Tests for kurtosis for distribution of daily price changes for shell eggs

Contract	Number of observations	Kurtosis	Alpha	Range/ standard deviation
September 1960	248	4.61	1.47	7.11
October 1960	247	5.90	1.69	6.92
November 1960	205	3.72	1.90	5.84
December 1960	206	3.27	1.81	5.65
January 1961	204	4.06	1.68	6.48
September 1961	239	5.67	1.82	7.57
October 1961	237	6.03	1.90	8.67
November 1961	219	5.14	2.00	7.32
December 1961	220	6.04	1.80	8.76
January 1962	239	8.05	1.61	9.46
September 1962	240	6.09	1.52	7.20
October 1962	229	5.85	1.41	8.10
November 1962	239	6.36	1.56	7.93
December 1962	227	9.25	1.57	9.91
January 1963	179	7.71	1.50	8.37
September 1963	245	4.94	1.75	7.40
October 1963	238	4.96	1.47	8.02
November 1963	229	4.88	1.57	7.45
December 1963	231	5.89	1.47	8.05
January 1964	189	12.15	1.36	8.52
September 1964	243	10.32	1.42	9.48
October 1964	225	6.26	1.71	8.28
November 1964	214	6.87	1.35	6.84
December 1964	145	3.75	1.56	5.74
January 1965	104	4.24	1.68	5.79
September 1965	244	6.40	1.27	7.64
October 1965	239	5.23	1.25	6.89
November 1965	216	6.11	1.38	8.00
December 1965	167	5.00	1.36	6.59
January 1966	154	4.77	1.30	6.09
September 1966	205	6.05	1.62	7.96
October 1966	222	6.73	1.44	8.23
November 1966	154	5.93	1.01	7.65
December 1966	192	20.15	1.21	12.90
January 1967	93	6.35	1.54	7.10
September 1967	240	9.99	1.49	10.75
October 1967	188	16.20	1.34	9.88
November 1967	193	5.64	1.28	7.16
December 1967	145	9.88	1.26	9.78
January 1968	77	3.98	1.79	5.26
September 1968	218	4.50	1.32	6.46
October 1968	195	4.14	1.49	6.25
December 1968	192	4.10	1.63	6.13
January 1969	116	3.59	1.87	5.67
March 1969	43	4.64	1.25	5.45
April 1969	75	3.25	1.47	5.28
May 1969	43	2.77	1.74	4.55
June 1969	48	4.64	1.39	5.17
July 1969	98	4.25	1.34	6.08
September 1969	220	5.43	1.48	7.37
October 1969	221	4.63	1.56	7.34
November 1969	205	4.75	1.94	7.89
December 1969	161	3.59	1.49	5.58
January 1970	159	4.47	1.23	5.55
February 1970	138	3.14	1.35	4.49
March 1970	135	3.50	1.15	4.82
April 1970	132	3.68	1.35	5.40
May 1970	133	4.50	1.59	6.35
June 1970	137	4.92	1.43	6.37
July 1970	62	4.00	1.34	5.13
September 1970	180	3.85	2.00	6.50
October 1970	182	4.75	1.53	6.57
November 1970	137	4.21	1.59	6.20
December 1970	202	4.40	1.69	6.31
January 1971	175	5.76	1.58	6.90
February 1971	80	5.49	1.49	6.68
March 1971	81	4.66	1.46	5.95
April 1971	72	3.55	1.58	5.24
May 1971	72	3.28	1.56	4.91
June 1971	71	3.18	1.36	4.90

Note: Number of observations = number of differences.

Appendix table 7.--Tests for kurtosis for the distribution of daily price changes for pork bellies

Contract	Number of observations	Kurtosis	Alpha	Range/ standard deviation
July 1964	152	5.87	1.35	7.35
August 1964	184	6.09	1.37	7.49
March 1965	170	8.18	1.50	9.01
May 1965	227	4.67	1.65	7.37
July 1965	245	3.54	1.56	5.65
August 1965	245	3.33	1.62	5.84
February 1966	193	2.65	1.97	4.99
March 1966	215	3.39	1.78	6.60
May 1966	242	3.34	1.77	6.57
July 1966	246	2.58	1.79	4.76
August 1966	247	2.65	1.80	4.68
February 1967	238	3.50	1.78	5.95
March 1967	215	3.72	1.54	5.77
May 1967	240	4.64	1.49	6.90
July 1967	243	3.40	1.46	5.06
August 1967	241	3.47	1.49	5.41
February 1968	224	3.55	1.54	5.67
March 1968	245	3.71	1.73	5.98
May 1968	245	3.31	1.84	5.31
July 1968	245	4.24	1.77	6.66
August 1968	242	4.94	1.53	7.00
February 1969	223	4.28	1.71	6.17
March 1969	244	4.19	1.66	6.21
May 1969	238	3.56	1.72	5.63
July 1969	243	3.57	1.54	5.44
August 1969	241	3.60	1.43	5.54
February 1970	230	3.19	1.57	5.15
March 1970	238	3.54	1.44	5.33
May 1970	238	3.78	1.37	5.57
July 1970	245	3.63	1.33	5.38
August 1970	245	3.53	1.43	5.39
February 1971	229	5.44	1.47	8.19
March 1971	247	5.17	1.54	7.77
May 1971	210	5.22	1.60	7.59
July 1971	165	5.04	1.58	7.13
August 1971	145	6.18	1.58	7.81

Note: Number of observations = number of differences.

Appendix table 8.--Tests for kurtosis for the distribution of daily price changes for live cattle

Contract	Number of observations	Kurtosis	Alpha	Range/ standard deviation
June 1965	139	4.25	1.41	6.05
August 1965	180	3.34	1.48	5.38
October 1965	224	19.56	1.41	11.02
December 1965	229	4.53	1.41	6.32
February 1966	183	7.45	1.48	8.92
April 1966	212	8.33	1.35	9.05
June 1966	188	7.20	1.82	7.73
August 1966	182	4.57	1.78	6.98
October 1966	203	4.80	1.80	7.18
December 1966	244	3.55	1.68	6.41
February 1967	241	3.20	1.76	6.13
Arpil 1967	240	3.42	1.82	6.47
June 1967	217	3.23	1.89	5.94
August 1967	241	6.36	1.79	8.89
October 1967	279	4.34	1.53	7.00
December 1967	324	3.54	1.90	6.10
February 1968	357	4.33	1.59	7.26
April 1968	318	4.78	1.57	7.76
June 1968	321	4.15	1.60	6.76
August 1968	280	4.37	1.59	6.61
October 1968	223	4.68	1.61	6.77
December 1968	242	6.49	1.68	8.84
February 1969	241	5.84	1.54	7.09
April 1969	241	12.45	1.50	9.87
June 1969	237	10.39	1.42	9.44
August 1969	212	5.87	1.43	7.51
October 1969	247	6.27	1.58	8.44
December 1969	243	6.93	1.63	8.92
February 1970	241	7.11	1.88	9.04
April 1970	273	6.21	1.74	9.35
June 1970	313	6.15	1.73	9.80
August 1970	331	6.78	1.65	10.16
October 1970	291	6.29	1.76	8.89
December 1970	333	6.80	1.69	10.07
February 1971	320	8.16	1.53	8.71
April 1971	286	7.36	1.29	8.70
June 1971	335	6.95	1.24	8.62
August 1971	224	7.97	1.49	8.62
October 1971	211	5.79	1.59	8.22
December 1971	212	4.49	1.41	6.94
February 1972	172	6.57	1.30	7.70

Note: Number of observations = number of differences.

Appendix table 9.--Tests for kurtosis for the distribution of daily price changes for Maine potatoes

Contract	Number of observations	Kurtosis	Alpha	Range/ standard deviation
March 1960	175	3.43	1.89	6.03
April 1960	197	3.95	1.55	5.76
May 1960	216	3.98	1.65	7.00
November 1960	209	4.99	1.26	7.15
March 1961	237	4.44	1.73	7.17
April 1961	233	4.78	1.51	7.00
May 1961	238	6.79	1.59	8.54
November 1961	238	10.20	1.57	9.50
March 1962	229	6.64	1.28	8.23
April 1962	239	10.41	1.47	10.01
May 1962	238	10.93	1.52	10.59
November 1962	227	8.33	1.36	9.64
March 1963	235	4.71	1.67	7.01
April 1963	236	4.78	1.55	7.02
May 1963	237	5.47	1.59	7.49
November 1963	238	3.53	1.73	5.52
March 1964	236	6.59	1.55	8.37
April 1964	237	7.72	1.27	7.76
May 1964	235	9.86	1.31	8.32
November 1964	219	10.20	1.48	10.72
March 1965	237	5.15	1.81	8.19
April 1965	237	4.74	1.81	7.41
May 1965	237	3.29	1.81	5.95
November 1965	237	5.31	1.71	8.00
March 1966	236	6.04	1.85	8.27
April 1966	235	4.50	1.86	6.84
May 1966	237	5.56	1.53	8.04
November 1966	238	15.15	1.29	10.83
March 1967	249	7.62	1.43	8.87
April 1967	251	5.73	1.40	7.70
May 1967	251	4.33	1.45	6.33
November 1967	250	10.83	1.48	9.62
March 1968	248	7.37	1.57	8.52
April 1968	250	8.00	1.54	9.20
May 1968	249	7.36	1.32	8.12
November 1968	246	8.48	1.57	8.34
March 1969	246	7.80	1.49	9.13
April 1969	246	5.94	1.67	7.64
May 1969	245	5.31	1.57	6.82
March 1970	248	15.33	1.21	10.82
April 1970	249	11.70	1.35	9.01
May 1970	243	9.11	1.57	9.00
November 1970	229	5.87	1.87	8.81
March 1971	248	6.02	1.81	8.55
April 1971	244	5.74	1.71	8.47
May 1971	223	5.41	1.69	7.68

Note: Number of observations = number of differences.

Appendix table 10.--Estimates of the characteristic exponent for sums of observations for daily price changes for Chicago corn

Contract	Characteristic exponent			
	Single observations	Sums of 2	Sums of 4	Sums of 8
March 1960	1.47	1.56	2.00	--
May 1960	1.97	2.00	1.58	1.44
July 1960	1.92	1.58	1.83	1.60
September 1960	1.83	1.66	2.00	1.52
December 1960	1.43	1.65	1.54	1.31
March 1961	1.44	1.61	1.38	1.72
May 1961	1.36	1.33	1.26	1.18
July 1961	1.29	1.47	1.60	1.48
September 1961	1.58	1.58	1.68	1.29
December 1961	1.94	1.84	1.85	2.00
March 1962	1.80	1.66	1.73	2.00
May 1962	1.73	1.81	1.75	1.57
July 1962	1.57	2.00	1.65	2.00
September 1962	1.63	1.67	2.00	2.00
December 1962	2.00	1.71	1.66	1.91
March 1963	1.88	2.00	1.87	2.00
May 1963	1.80	1.75	1.80	1.65
July 1963	1.62	1.78	1.62	1.35
September 1963	1.65	1.72	1.39	1.30
December 1963	1.77	1.36	1.30	1.43
March 1964	1.79	1.57	1.20	1.67
May 1964	1.58	1.48	1.32	1.61
July 1964	1.57	1.53	1.58	1.29
September 1964	1.63	1.67	1.37	1.32
December 1964	1.87	2.00	1.65	1.44
March 1965	1.80	1.74	2.00	1.39
May 1965	1.84	1.62	2.00	1.44
July 1965	1.83	1.51	1.48	1.39
September 1965	1.77	1.61	1.86	1.53
December 1965	1.55	1.79	1.67	1.48
March 1966	1.98	1.90	1.56	1.48
May 1966	1.97	1.64	2.00	1.94
July 1966	2.00	1.49	1.40	1.19
September 1966	1.39	1.30	1.45	1.29
December 1966	1.51	1.39	1.94	1.32
March 1967	1.45	1.58	1.47	1.28
May 1967	1.56	1.97	1.36	1.55
July 1967	1.69	1.81	2.00	1.66
September 1967	1.72	1.78	1.41	1.55
December 1967	1.95	1.64	2.00	1.62
March 1968	1.75	1.41	1.29	1.44
May 1968	1.71	1.69	1.96	2.00
July 1968	1.74	1.85	1.60	1.54
September 1968	1.78	1.78	1.97	1.22
December 1968	1.59	1.64	1.56	1.57
March 1969	1.74	1.77	1.47	1.36
May 1969	1.61	1.37	1.38	1.55
July 1969	1.56	1.52	2.00	1.55
September 1969	1.52	1.46	1.15	1.72
December 1969	1.52	1.59	1.76	1.41
March 1970	1.59	1.63	2.00	1.49
May 1970	1.71	1.81	1.66	1.19
July 1970	1.68	1.52	1.52	1.55
September 1970	1.20	1.22	1.30	1.08
December 1970	1.22	1.43	1.08	1.14
March 1971	1.29	1.43	1.30	1.35
May 1971	1.45	1.54	1.68	1.60
July 1971	1.42	1.50	1.33	--
September 1971	1.40	1.45	1.10	--

Note: --means that not enough observations are available to calculate the characteristic exponent.

Appendix table 11.--Estimates of the characteristic exponent for sums of observations for daily price changes for Chicago wheat

Contract	Characteristic exponent			
	Single observations	Sums of 2	Sums of 4	Sums of 8
May 1960	2.00	1.60	2.00	1.55
July 1960	2.00	1.69	1.66	1.67
September 1960	1.98	1.69	1.91	1.42
March 1961	1.68	1.55	1.60	1.30
May 1961	1.40	1.27	1.51	1.27
July 1961	1.55	1.47	1.37	1.13
September 1961	1.70	1.57	1.75	1.61
December 1961	1.71	2.00	2.00	1.76
March 1962	1.69	2.00	2.00	1.78
May 1962	1.46	1.72	1.35	2.00
July 1962	1.51	1.79	1.59	2.00
September 1962	1.84	1.84	1.49	1.66
December 1962	1.60	1.48	1.27	1.46
March 1963	1.65	1.60	1.45	1.66
May 1963	1.69	1.71	1.42	1.10
July 1963	1.88	1.56	1.53	1.28
September 1963	1.61	1.48	1.37	1.30
December 1963	1.57	1.46	1.51	1.34
March 1964	1.53	1.58	1.44	1.30
May 1964	1.50	1.81	1.38	1.29
July 1964	1.62	1.70	1.54	1.69
September 1964	1.56	1.69	1.68	1.74
December 1964	1.90	1.87	1.82	2.00
March 1965	1.60	1.82	1.62	2.00
May 1965	1.68	1.86	1.36	1.49
July 1965	1.75	1.77	1.46	1.89
September 1965	1.83	1.56	1.63	1.77
December 1965	2.00	1.80	1.74	2.00
March 1966	2.00	1.70	1.72	1.72
May 1966	2.00	1.88	1.47	2.00
July 1966	1.55	1.72	1.83	1.31
September 1966	1.69	2.00	1.70	1.46
December 1966	1.72	1.71	1.45	1.49
March 1967	1.75	1.74	1.33	1.35
May 1967	1.95	1.80	1.59	1.49
July 1967	1.97	1.95	1.72	1.91
September 1967	2.00	1.71	1.53	1.81
December 1967	2.00	2.00	1.37	1.69
March 1968	2.00	2.00	2.00	1.37
May 1968	2.00	2.00	1.88	2.00
July 1968	1.94	1.79	1.46	2.00
September 1968	1.82	1.74	1.75	1.79
December 1968	1.65	1.57	2.00	2.00
March 1969	1.88	1.58	1.94	2.00
May 1969	1.68	1.53	1.71	1.43
July 1969	1.80	1.69	2.00	2.00
September 1969	2.00	1.86	2.00	1.60
December 1969	2.00	1.66	2.00	1.37
March 1970	1.62	1.90	1.65	1.70
May 1970	1.75	1.83	1.64	1.64
July 1970	1.66	1.62	1.57	1.61
September 1970	1.42	1.40	1.30	1.21
December 1970	1.53	1.96	1.49	1.74
March 1971	1.61	2.00	1.34	1.56
May 1971	1.53	1.56	1.91	1.95
July 1971	1.46	1.64	1.40	--

Note: --means that not enough observations are available to calculate the characteristic exponent.

Appendix table 12.--Estimates of the characteristic exponent for sums of observations for daily price changes for soybeans

Contract	Characteristic exponent			
	Single observations	Sums of 2	Sums of 4	Sums of 8
January 1960	1.73	1.62	1.15	--
March 1960	1.69	1.49	1.60	--
May 1960	1.74	1.62	1.89	1.32
July 1960	1.65	1.67	1.79	2.00
September 1960	1.66	1.48	1.56	1.44
November 1960	1.79	1.73	1.55	1.21
January 1961	1.54	1.34	1.28	1.16
March 1961	1.20	1.43	1.23	1.07
May 1961	1.15	1.28	1.17	1.14
July 1961	1.30	1.37	1.52	1.21
September 1961	1.40	1.50	2.00	2.00
November 1961	1.50	1.81	2.00	1.78
January 1962	1.42	1.41	1.20	1.51
March 1962	1.41	1.40	1.58	1.73
May 1962	1.70	1.52	1.51	1.56
July 1962	1.59	1.45	1.49	1.64
August 1962	1.53	1.73	1.49	1.31
September 1962	1.63	1.54	1.33	1.50
November 1962	1.48	1.48	1.60	1.45
January 1963	1.61	1.49	1.37	1.48
March 1963	1.37	1.31	1.00	1.41
May 1963	1.43	1.43	1.56	1.33
July 1963	1.48	1.53	1.51	1.47
August 1963	1.57	1.60	1.37	1.67
September 1963	1.59	1.46	1.25	1.23
November 1963	1.41	1.35	1.19	1.27
January 1964	1.46	1.36	1.14	2.00
March 1964	1.44	1.45	1.30	2.00
May 1964	1.52	1.42	1.45	1.38
July 1964	1.40	1.43	1.14	1.36
August 1964	1.33	1.43	1.25	1.30
September 1964	1.48	1.48	1.58	1.20
November 1964	1.43	1.48	1.68	1.52
January 1965	1.63	1.78	1.75	1.73
March 1965	1.55	1.76	1.44	1.57
May 1965	1.53	1.67	1.61	1.56
July 1965	1.76	2.00	1.74	2.00
August 1965	1.73	2.00	1.64	2.00
September 1965	1.93	1.47	1.44	1.64
November 1965	2.00	1.50	1.79	1.80
January 1966	1.60	1.65	1.28	1.72
March 1966	1.58	1.48	1.48	1.26
May 1966	1.62	1.47	1.66	1.36
July 1966	1.56	1.48	1.38	1.14
August 1966	1.34	1.44	1.32	1.56
September 1966	1.30	1.24	1.39	1.17
November 1966	1.51	1.45	1.80	1.49
January 1967	1.44	1.49	1.46	1.13
March 1967	1.41	1.60	1.38	1.14
May 1967	1.32	1.38	1.33	1.09
July 1967	1.52	1.80	1.50	1.53
August 1967	1.39	1.47	1.77	1.11
September 1967	1.48	1.41	1.46	2.00
November 1967	1.61	1.56	1.47	1.39
January 1968	1.65	1.58	1.28	1.21
March 1968	1.52	1.57	1.19	1.22
May 1968	1.63	1.44	1.50	1.66
July 1968	1.88	1.77	1.49	1.96
August 1968	1.67	1.52	1.50	1.82
September 1968	1.41	1.62	1.15	1.09
November 1968	1.48	1.62	1.68	1.91

Continued

Appendix table 12.--Estimates of the characteristic exponent for sums of observations for daily price changes for soybeans -- Continued

Contract	Characteristic exponent			
	Single observations	Sums of 2	Sums of 4	Sums of 8
January 1969	1.55	1.32	1.72	1.32
March 1969	1.43	1.43	1.33	1.48
May 1969	1.50	1.67	1.75	1.67
July 1969	1.61	1.54	1.57	1.48
August 1969	1.44	1.43	1.60	1.77
November 1969	1.66	1.75	1.43	1.74
January 1970	1.63	1.33	1.41	1.59
March 1970	1.63	1.54	1.59	1.34
May 1970	1.72	1.83	1.53	1.65
July 1970	1.59	1.78	1.43	1.26
August 1970	1.52	1.61	1.35	1.13
September 1970	1.37	1.36	1.31	1.08
November 1970	1.34	1.32	1.34	1.30
January 1971	1.47	1.55	1.56	1.44
March 1971	1.64	1.69	1.52	1.58
May 1971	1.49	1.78	2.00	1.63
July 1971	1.48	1.53	2.00	--
August 1971	1.60	1.60	2.00	--
September 1971	1.55	1.53	1 73	--

Note: --means that not enough observations are available to calculate the characteristic exponent.

Appendix table 13.--Estimates of the characteristic exponent for sums of observations for daily price changes for soybean oil

Contract	Characteristic exponent			
	Single observations	Sums of 2	Sums of 4	Sums of 8
December 1959	1.49	2.00	1.68	--
January 1960	1.78	2.00	1.59	--
March 1960	1.71	1.79	1.84	--
May 1960	1.52	1.77	1.95	1.56
July 1960	1.54	1.89	2.00	1.70
September 1960	1.71	1.90	1.64	1.95
October 1960	1.65	1.65	1.39	--
December 1960	1.75	1.92	1.86	--
January 1961	1.50	1.49	1.42	1.49
March 1961	1.45	1.33	1.36	1.55
May 1961	1.44	1.40	1.29	1.35
July 1961	1.61	1.50	1.76	1.32
September 1961	1.58	1.54	1.77	1.66
October 1961	1.78	1.72	1.59	2.00
December 1961	1.81	1.75	1.62	1.62
January 1962	1.89	1.59	1.54	--
March 1962	1.92	1.72	1.87	--
May 1962	1.94	1.80	1.82	1.85
July 1962	1.68	1.88	1.60	1.12
August 1962	1.84	2.00	1.27	--
September 1962	1.69	1.60	1.50	--
October 1962	1.64	1.45	1.63	--
December 1962	1.95	1.77	1.99	--
January 1963	1.68	1.61	1.88	--
March 1963	2.00	1.45	1.55	--
May 1963	1.80	1.75	1.49	2.00
July 1963	1.68	1.67	2.00	1.83
August 1963	1.96	1.78	1.54	1.28
September 1963	1.52	1.78	1.40	1.61
October 1963	1.71	1.58	1.56	1.43
December 1963	1.39	1.34	1.42	1.08
January 1964	1.41	1.36	1.20	1.08
March 1964	1.41	1.34	1.23	1.00
May 1964	1.41	1.50	1.45	1.16
July 1964	1.43	1.46	1.42	1.18
August 1964	1.37	1.68	1.50	--
September 1964	1.57	1.50	2.00	1.00
October 1964	1.50	1.75	2.00	1.18
December 1964	1.75	1.78	1.50	1.79
January 1965	1.64	1.70	1.68	1.32
March 1965	1.65	1.66	1.51	1.42
May 1965	1.61	1.63	1.50	1.72
July 1965	2.00	1.75	2.00	1.84
August 1965	1.59	1.69	1.18	--
September 1965	1.67	1.88	1.45	1.71
October 1965	1.60	1.55	1.90	1.45
December 1965	1.76	2.00	2.00	1.91
January 1966	1.86	1.76	1.53	1.34
March 1966	1.75	1.95	1.71	1.46
May 1966	1.72	2.00	1.68	1.42
July 1966	1.78	2.00	2.00	1.20
August 1966	1.63	1.59	1.34	1.37
September 1966	1.59	1.97	1.44	1.03
October 1966	1.58	1.84	1.51	1.65
December 1966	1.67	1.79	1.65	1.38
January 1967	1.56	1.69	1.45	1.37
March 1967	1.53	1.85	1.60	1.50
May 1967	1.55	1.71	1.53	1.47
July 1967	1.63	2.00	1.96	1.47
August 1967	1.56	1.72	2.00	1.44
September 1967	1.50	1.81	1.98	1.64
October 1967	1.62	2.00	1.83	2.00
December 1967	1.54	1.85	2.00	1.95

Continued

Appendix table 13.--Estimates of the characteristic exponent for sums of observations for daily price changes for soybean oil--Continued

Contract	Characteristic exponent			
	Single observations	Sums of 2	Sums of 4	Sums of 8
January 1968	1.56	1.83	1.78	1.72
March 1968	1.70	1.74	1.54	1.50
May 1968	1.68	1.70	2.00	2.00
July 1968	1.70	1.74	1.60	1.71
August 1968	1.73	1.70	1.55	2.00
September 1968	1.55	1.48	1.63	1.50
October 1968	1.58	1.72	1.49	---
December 1968	1.54	1.63	1.19	1.29
January 1969	1.60	1.75	1.55	1.97
March 1969	1.85	1.57	1.55	2.00
May 1969	1.76	1.91	1.88	2.00
July 1969	1.66	1.72	2.00	1.55
August 1969	2.00	1.82	1.64	1.78
September 1969	1.50	1.70	1.31	1.00
October 1969	1.38	1.32	1.32	1.06
December 1969	1.40	1.37	1.34	1.17
January 1970	1.44	1.39	1.29	1.11
March 1970	1.44	1.23	1.31	1.49
May 1970	1.49	1.08	1.36	1.83
July 1970	1.80	1.38	1.55	1.27
August 1970	1.72	1.90	1.91	1.59
September 1970	1.71	1.41	1.51	2.00
October 1970	2.00	1.54	1.45	1.62
December 1970	1.78	1.71	1.79	1.70
January 1971	1.67	2.00	1.86	2.00
March 1971	1.68	1.85	1.89	2.00
May 1971	1.69	1.80	2.00	1.87
July 1971	1.78	1.63	2.00	---
August 1971	1.91	1.57	2.00	---
September 1971	1.65	1.65	2.00	---
October 1971	1.65	1.57	2.00	---

Note: --means that not enough observations are available to calculate the characteristic exponent.

Appendix table 14.--Estimates of the characteristic exponent for sums of observations for daily price changes for soybean meal

Contract	Characteristic exponent			
	Single observations	Sums of 2	Sums of 4	Sums of 8
March 1960	1.65	2.00	1.80	---
May 1960	2.00	1.97	1.37	---
July 1960	1.85	1.74	2.00	1.56
August 1960	1.80	1.77	1.61	2.00
October 1960	1.66	1.46	1.46	---
December 1960	1.50	1.40	1.43	---
January 1961	1.41	1.76	1.91	---
March 1961	1.29	1.40	1.30	1.71
May 1961	1.44	1.59	1.59	---
July 1961	1.36	1.45	1.58	1.51
August 1961	1.61	1.52	1.92	---
September 1961	1.78	1.71	1.44	---
October 1961	1.91	1.91	1.56	---
December 1961	1.99	1.74	1.70	---
January 1962	2.00	1.53	1.59	---
March 1962	1.88	1.53	2.00	---
May 1962	1.69	1.48	1.78	---
July 1962	1.49	1.38	1.80	1.72
August 1962	1.54	1.51	1.17	---
September 1962	1.23	1.73	1.53	---
October 1962	1.53	1.48	1.35	---
December 1962	1.66	1.43	1.86	---
January 1963	1.60	1.62	1.40	---
March 1963	1.51	1.79	1.23	---
May 1963	1.85	1.65	1.75	1.29
July 1963	1.66	1.56	1.56	1.55
August 1963	1.41	1.55	1.39	1.76
September 1963	1.58	1.66	1.17	1.20
October 1963	1.67	1.50	1.41	1.55
December 1963	1.66	1.45	1.48	1.67
January 1964	1.63	1.45	1.76	2.00
March 1964	1.72	1.59	2.00	2.00
May 1964	1.75	1.59	1.54	2.00
July 1964	1.83	1.53	1.79	1.73
August 1964	1.68	1.70	1.73	1.50
September 1964	1.57	1.35	1.64	1.12
October 1964	1.58	1.56	1.52	1.83
December 1964	1.55	1.56	1.63	1.53
January 1965	1.72	1.68	1.79	1.47
March 1965	1.67	1.61	2.00	1.77
July 1965	1.68	1.75	2.00	1.82
August 1965	1.57	1.89	1.71	2.00
September 1965	1.52	1.37	1.37	1.00
October 1965	1.42	1.44	1.28	1.77
December 1965	1.51	1.55	1.45	1.34
January 1966	1.55	1.35	1.29	1.36
March 1966	1.48	1.86	1.52	1.36
May 1966	1.75	1.69	1.93	1.42
July 1966	1.69	1.57	1.54	1.16
August 1966	1.53	1.58	1.49	1.33
September 1966	1.29	1.30	1.26	1.13
October 1966	1.56	1.32	1.80	1.18
December 1966	1.60	1.49	1.48	1.47

Continued

Appendix table 14.--Estimates of the characteristic exponent for sums of observations for daily price changes for soybean meal --Continued

Contract	Characteristic exponent			
	Single observations	Sums of 2	Sums of 4	Sums of 8
January 1967	1.49	1.53	1.47	1.27
March 1967	1.58	1.56	1.62	1.29
May 1967	1.44	1.46	1.58	1.69
July 1967	1.52	1.56	1.48	1.82
August 1967	1.47	1.62	1.46	1.00
September 1967	1.37	1.43	1.26	1.47
October 1967	1.25	1.32	1.43	1.39
December 1967	1.43	1.42	1.29	1.72
January 1968	1.46	1.36	1.31	1.64
March 1968	1.72	1.60	1.44	1.64
May 1968	1.74	1.65	1.82	1.74
July 1968	1.75	1.66	1.64	1.84
August 1968	1.69	1.52	1.60	1.51
September 1968	1.40	1.38	1.26	1.00
October 1968	1.29	1.01	1.00	---
December 1968	1.32	1.19	1.23	1.22
January 1969	1.46	1.48	1.46	1.43
March 1969	1.36	1.49	1.96	1.56
May 1969	1.60	1.63	1.88	1.48
July 1969	2.00	1.46	1.73	1.44
August 1969	2.00	1.43	1.76	1.22
September 1969	1.53	1.56	2.00	1.36
October 1969	1.46	1.50	1.37	1.32
December 1969	1.23	1.11	1.00	1.00
January 1970	1.13	1.00	1.00	1.00
March 1970	1.29	1.08	1.00	1.00
May 1970	1.47	1.47	1.61	1.36
July 1970	1.49	1.45	1.53	1.45
August 1970	1.48	1.61	1.91	1.88
September 1970	1.50	1.30	1.37	1.42
October 1970	1.43	1.24	1.27	1.19
December 1970	1.47	1.51	1.44	1.21
January 1971	1.48	1.60	1.44	2.00
March 1971	1.44	1.42	1.38	1.28
May 1971	1.43	1.55	1.43	1.47
July 1971	1.50	1.51	1.22	---
August 1971	1.69	1.63	1.79	---
September 1971	1.31	1.64	2.00	---
October 1971	1.48	1.93	1.83	---

Note: -- means that not enough observations available to calculate the characteristic exponent.

Appendix table 15.--Estimates of the characteristic exponent for sums of observations for daily price changes for shell eggs

Contract	Characteristic exponent			
	Single observations	Sums of 2	Sums of 4	Sums of 8
September 1960	1.47	1.45	1.71	1.41
October 1960	1.69	1.57	1.65	1.98
November 1960	1.90	1.57	1.48	1.26
December 1960	1.81	1.59	1.54	2.00
January 1961	1.68	1.63	2.00	1.87
September 1961	1.82	1.55	1.35	1.49
October 1961	1.90	1.42	1.31	1.65
November 1961	2.00	1.59	1.76	2.00
December 1961	1.80	1.43	1.28	2.00
January 1962	1.61	1.29	1.15	1.17
September 1962	1.52	1.48	1.40	1.17
October 1962	1.41	1.60	1.47	1.10
November 1962	1.56	1.44	1.19	1.37
December 1962	1.57	1.51	1.63	1.45
January 1963	1.50	1.66	1.89	---
September 1963	1.75	1.71	1.59	2.00
October 1963	1.47	1.54	2.00	2.00
November 1963	1.57	1.53	1.49	1.48
December 1963	1.47	1.35	1.47	1.30
January 1964	1.36	1.13	1.27	---
September 1964	1.42	1.64	1.47	1.11
October 1964	1.71	1.83	1.46	1.48
November 1964	1.35	1.24	1.12	1.00
December 1964	1.56	1.46	1.48	---
January 1965	1.68	1.06	1.27	---
September 1965	1.27	1.68	1.41	1.76
October 1965	1.25	1.29	1.31	1.37
November 1965	1.38	1.33	1.53	1.47
December 1965	1.36	1.32	1.35	---
January 1966	1.30	1.44	1.19	---
September 1966	1.62	1.26	1.14	1.21
October 1966	1.44	1.64	1.39	1.30
November 1966	1.01	1.07	1.05	---
December 1966	1.21	1.25	1.09	---
January 1967	1.54	1.80	---	---
September 1967	1.49	1.37	1.38	1.40
October 1967	1.34	1.28	1.23	---
November 1967	1.28	1.31	1.28	---
December 1967	1.26	1.60	1.55	---
January 1968	1.79	1.70	---	---
September 1968	1.32	1.52	1.82	1.30
October 1968	1.49	1.48	1.60	---
December 1968	1.63	1.71	1.92	---
January 1969	1.87	2.00	1.63	---
March 1969	1.25	---	---	---
April 1969	1.47	1.63	---	---
May 1969	1.74	---	---	---
June 1969	1.39	---	---	---
July 1969	1.34	1.52	---	---
September 1969	1.48	1.77	2.00	2.00
October 1969	1.56	1.64	1.58	1.33
November 1969	1.94	1.61	1.74	2.00
December 1969	1.49	1.42	1.49	---
January 1970	1.23	1.26	1.06	---
February 1970	1.35	1.33	1.44	---
March 1970	1.15	1.21	1.34	---
April 1970	1.35	1.26	1.33	---
May 1970	1.59	1.29	1.51	---
June 1970	1.43	1.29	1.36	---
July 1970	1.34	1.33	---	---
September 1970	2.00	2.00	1.64	---
October 1970	1.53	1.56	1.34	---
November 1970	1.59	1.70	1.66	---
December 1970	1.69	1.76	1.56	1.53
January 1971	1.58	1.78	1.46	---
February 1971	1.49	1.20	---	---
March 1971	1.46	1.31	---	---
April 1971	1.58	1.13	---	---
May 1971	1.56	1.52	---	---
June 1971	1.36	1.88	---	---

Note: --means that not enough observations are available to calculate the characteristic exponent.

Appendix table 16.--Estimates of characteristic exponents for sums of observations for daily price changes for pork bellies

Contract	Characteristic exponent			
	Single observations	Sums of 2	Sums of 4	Sums of 8
July 1964	1.35	1.41	1.31	---
August 1964	1.37	1.55	1.30	---
March 1965	1.50	1.68	1.53	---
May 1965	1.64	1.58	1.61	1.45
July 1965	1.56	1.60	1.60	2.00
August 1965	1.62	1.57	1.65	1.68
February 1966	1.97	1.67	1.60	---
March 1966	1.78	1.49	1.57	1.83
May 1966	1.77	1.43	1.50	2.00
July 1966	1.79	1.45	2.00	1.87
August 1966	1.80	1.56	1.80	2.00
February 1967	1.78	2.00	1.57	1.88
March 1967	1.54	1.63	1.44	1.69
May 1967	1.49	1.88	1.99	1.43
July 1967	1.46	1.61	1.46	1.22
August 1967	1.49	1.51	1.34	1.39
February 1968	1.54	1.90	1.98	1.74
March 1968	1.73	1.47	1.69	2.00
May 1968	1.84	1.60	1.69	2.00
July 1968	1.77	1.31	1.44	1.73
August 1968	1.53	1.43	1.35	1.28
February 1969	1.71	1.62	1.52	2.00
March 1969	1.66	1.91	1.58	1.68
May 1969	1.72	1.52	1.00	1.00
July 1969	1.54	1.69	1.51	1.55
August 1969	1.43	1.66	1.58	1.73
February 1970	1.57	1.56	1.49	1.43
March 1970	1.44	1.71	1.93	1.49
May 1970	1.37	1.63	1.95	1.63
July 1970	1.33	1.65	2.00	1.61
August 1970	1.43	1.44	1.47	1.53
February 1971	1.47	1.56	1.50	2.00
March 1971	1.54	1.57	1.71	1.61
May 1971	1.60	1.62	1.68	1.98
July 1971	1.58	1.68	1.38	---
August 1971	1.58	1.57	1.28	---

Note: --means that not enough observations are available to calculate the characteristic exponent.

Appendix table 17.--Estimates of the characteristic exponent for sums of observations for daily price changes for live cattle

Contract	Characteristic exponent			
	Single observations	Sums of 2	Sums of 4	Sums of 8
June 1965	1.41	1.58	1.63	---
August 1965	1.48	2.00	1.76	---
October 1965	1.41	1.41	1.52	1.08
December 1965	1.41	1.45	1.75	1.28
February 1966	1.48	1.62	1.30	---
April 1966	1.35	1.21	1.70	1.07
June 1966	1.82	1.34	1.60	---
August 1966	1.78	1.76	1.34	---
October 1966	1.80	1.95	1.54	1.44
December 1966	1.68	1.56	1.59	1.83
February 1967	1.76	1.96	1.68	1.70
April 1967	1.82	2.00	2.00	1.54
June 1967	1.89	1.73	2.00	2.00
August 1967	1.79	1.90	1.45	1.75
October 1967	1.53	1.79	1.71	1.66
December 1967	1.90	2.00	1.51	1.34
February 1968	1.59	1.70	1.70	1.33
April 1968	1.57	1.73	1.68	1.22
June 1968	1.60	1.88	2.00	1.64
August 1968	1.59	1.61	1.44	1.31
October 1968	1.61	1.59	1.38	1.36
December 1968	1.68	1.76	1.52	1.36
February 1969	1.54	1.58	1.55	1.55
April 1969	1.50	1.42	1.28	1.06
June 1969	1.42	1.66	1.58	2.00
August 1969	1.43	1.38	1.35	1.73
October 1969	1.58	1.48	1.53	1.23
December 1969	1.63	1.51	1.39	1.12
February 1970	1.88	1.38	1.69	1.28
April 1970	1.74	1.77	1.45	1.41
June 1970	1.73	1.79	1.55	1.56
August 1970	1.65	1.66	2.00	1.48
October 1970	1.76	1.91	1.45	1.52
December 1970	1.69	1.60	1.41	1.20
February 1971	1.53	1.30	1.38	1.25
April 1971	1.29	1.49	1.58	1.59
June 1971	1.24	1.36	1.45	1.26
August 1971	1.49	1.60	1.67	1.40
October 1971	1.59	2.00	1.44	1.47
December 1971	1.41	1.75	2.00	2.00
February 1972	1.30	1.58	1.47	---

Note: --means that not enough observations are available to calculate the characteristic exponent.

Appendix table 18.--Estimates of the characteristic exponent for sums of observations for daily price changes for Maine potatoes

Contract	Characteristic exponent			
	Single observations	Sums of 2	Sums of 4	Sums of 8
March 1960	1.89	1.90	2.00	--
April 1960	1.55	2.00	1.57	--
May 1960	1.65	1.68	1.53	1.61
November 1960	1.26	1.52	1.46	1.29
March 1961	1.73	1.73	1.46	1.20
April 1961	1.51	1.60	1.54	1.43
May 1961	1.59	1.63	1.53	2.00
November 1961	1.57	1.45	1.30	1.12
March 1962	1.28	1.40	1.39	1.89
April 1962	1.47	1.53	1.20	1.62
May 1962	1.52	1.40	1.31	1.24
November 1962	1.36	1.84	1.41	1.56
March 1963	1.67	1.96	2.00	1.64
April 1963	1.55	1.70	1.76	1.36
May 1963	1.59	1.76	1.62	1.66
November 1963	1.73	1.72	1.72	1.39
March 1964	1.55	1.85	1.35	1.83
April 1964	1.27	1.46	1.57	1.49
May 1964	1.31	1.40	1.27	1.00
November 1964	1.48	1.75	1.39	1.28
March 1965	1.81	1.61	1.67	1.39
April 1965	1.81	1.60	1.77	1.50
May 1965	1.81	1.88	1.74	1.39
November 1965	1.71	1.87	1.41	1.58
March 1966	1.85	1.66	2.00	1.29
April 1966	1.86	1.70	2.00	1.61
May 1966	1.53	1.64	1.49	1.23
November 1966	1.29	1.52	1.57	1.13
March 1967	1.43	1.54	1.50	2.00
April 1967	1.40	1.69	1.23	1.31
May 1967	1.45	1.74	1.49	1.70
November 1967	1.48	1.80	1.52	1.39
March 1968	1.57	1.34	1.47	1.47
April 1968	1.54	1.38	1.27	1.59
May 1968	1.32	1.25	1.32	1.21
November 1968	1.57	1.45	1.40	1.64
March 1969	1.49	1.63	1.31	1.65
April 1969	1.67	1.42	1.52	1.19
May 1969	1.57	1.51	1.34	1.55
March 1970	1.21	1.27	1.30	1.53
April 1970	1.35	1.40	1.22	1.04
May 1970	1.57	1.38	1.40	1.68
November 1970	1.87	1.77	1.97	1.64
March 1971	1.81	1.54	1.57	1.43
April 1971	1.71	1.66	1.69	1.61
May 1971	1.69	1.95	1.60	1.51

Note: --means that not enough observations are available to calculate the characteristic exponent.

Appendix table 19.--Turning point test for daily closing prices
Chicago corn

Contract	Number of observations	Number of turning points	Expected value of turning points	Standard error of turning points	Test statistic
March 1960	161	83	106.00	5.32	-4.32
May 1960	192	107	126.67	5.81	-3.38
July 1960	212	102	140.00	6.11	-6.22
September 1960	210	112	138.67	6.08	-4.38
December 1960	204	96	134.67	6.00	-6.45
March 1961	207	112	136.67	6.04	-4.08
May 1961	205	111	135.33	6.01	-4.05
July 1961	208	108	137.33	6.05	-4.84
September 1961	198	95	130.67	5.91	-6.04
December 1961	225	102	148.67	6.30	-7.41
March 1962	234	115	154.67	6.42	-6.17
May 1962	233	109	154.00	6.41	-7.02
July 1962	224	119	148.00	6.28	-4.61
September 1962	217	115	143.33	6.19	-4.58
December 1962	225	118	148.67	6.30	-4.87
March 1963	229	109	151.33	6.36	-6.66
May 1963	227	112	150.00	6.33	-6.01
July 1963	224	114	148.00	6.28	-5.41
September 1963	227	109	150.00	6.33	-6.48
December 1963	220	117	145.33	6.23	-4.55
March 1964	234	111	154.67	6.42	-6.80
May 1964	225	105	150.00	6.33	-7.11
July 1964	226	110	149.33	6.31	-6.23
September 1964	223	106	147.33	6.27	-6.59
December 1964	224	93	148.00	6.28	-8.75
March 1965	217	95	143.33	6.19	-7.81
May 1965	228	111	150.67	6.34	-6.26
July 1965	223	111	147.33	6.27	-5.79
September 1965	222	113	146.67	6.26	-5.38
December 1965	215	111	142.00	6.16	-3.74
March 1966	226	119	149.33	6.31	-4.80
May 1966	227	116	150.00	6.33	-5.37
July 1966	224	123	148.00	6.28	-3.98
September 1966	228	114	150.67	6.34	-5.78
December 1966	226	120	149.33	6.31	-4.65
March 1967	228	117	150.67	6.34	-5.31
May 1967	227	119	150.00	6.33	-4.90
July 1967	234	126	154.67	6.42	-4.46
September 1967	228	120	150.67	6.34	-4.84
December 1967	234	121	154.67	6.42	-5.24
March 1968	229	121	151.33	6.36	-4.77
May 1968	226	106	148.33	6.31	-6.86
July 1968	225	107	148.67	6.30	-6.61
September 1968	227	105	150.00	6.33	-7.11
December 1968	226	103	149.33	6.31	-7.34
March 1969	253	124	167.33	6.68	-6.48
May 1969	227	118	150.00	6.33	-5.06
July 1969	215	114	142.00	6.16	-4.55
September 1969	222	117	146.67	6.26	-4.74
December 1969	229	127	151.33	6.36	-3.83
March 1970	285	155	188.67	7.10	-4.74
May 1970	225	109	148.67	6.30	-6.30
July 1970	230	117	152.00	6.37	-5.50
September 1970	225	122	148.67	6.30	-4.23
December 1970	235	127	155.33	6.44	-4.00
March 1971	280	153	185.33	7.03	-4.60
May 1971	206	111	136.00	6.02	-4.15
July 1971	167	92	110.00	5.42	-3.32
September 1971	129	66	78.00	4.56	-2.63

Note: Number of observations are after elimination of ties.

Appendix table 20.--Turning point test for daily closing prices for Chicago wheat

Contract	Number of observations	Number of turning points	Expected value of turning points	Standard error of turning points	Test statistic
May 1960	199	98	131.33	5.92	-5.63
July 1960	228	125	150.67	6.34	-4.05
September 1960	256	134	169.33	6.72	-5.26
March 1961	225	111	148.67	6.30	-5.98
May 1961	220	107	145.33	6.23	-6.15
July 1961	221	104	146.00	6.24	-6.73
September 1961	216	100	142.67	6.17	-6.91
December 1961	222	100	146.67	6.26	-7.46
March 1962	224	119	148.00	6.28	-4.61
May 1962	224	118	148.00	6.28	-4.77
July 1962	222	115	146.67	6.26	-5.06
September 1962	223	109	147.33	6.27	-6.11
December 1962	230	105	152.00	6.37	-7.38
March 1963	228	113	150.67	6.34	-5.94
May 1963	231	99	152.67	6.38	-8.41
July 1963	187	92	123.33	5.74	-5.46
September 1963	218	101	144.00	6.20	-6.94
December 1963	227	98	150.00	6.33	-8.22
March 1964	233	111	154.00	6.41	-6.71
May 1964	233	105	154.00	6.41	-7.64
July 1964	252	118	166.67	6.67	-7.30
September 1964	291	144	192.67	7.17	-6.79
December 1964	233	112	154.00	6.41	-6.55
March 1965	214	104	141.33	6.14	-6.08
May 1965	228	117	150.67	6.34	-5.31
July 1965	224	108	148.00	6.28	-6.36
September 1965	223	113	147.33	6.27	-5.48
December 1965	228	111	150.67	6.34	-6.26
March 1966	214	102	141.33	6.14	-6.40
May 1966	235	122	155.33	6.44	-5.18
July 1966	236	121	156.00	6.45	-5.42
September 1966	233	112	154.00	6.41	-6.55
December 1966	236	128	156.00	6.45	-4.34
March 1967	237	120	156.67	6.47	-5.67
May 1967	239	121	158.00	6.49	-5.70
July 1967	241	134	159.33	6.52	-3.88
September 1967	240	129	158.67	6.51	-4.56
December 1967	236	125	156.00	6.45	-4.80
March 1968	234	117	154.67	6.42	-5.86
May 1968	233	115	154.00	6.41	-6.08
July 1968	231	109	152.67	6.38	-6.84
September 1968	233	105	154.00	6.41	-7.64
December 1968	234	102	154.67	6.42	-8.20
March 1969	231	107	152.67	6.38	-7.15
May 1969	225	105	148.67	6.30	-6.93
July 1969	228	112	150.67	6.34	-6.10
September 1969	274	136	181.33	6.96	-6.52
December 1969	234	118	154.67	6.42	-5.71
March 1970	226	119	149.33	6.31	-4.80
May 1970	234	119	154.67	6.42	-5.55
July 1970	240	115	158.67	6.51	-6.71
September 1970	229	119	151.33	6.36	-5.09
December 1970	232	127	153.33	6.40	-4.12
March 1971	237	121	156.67	6.47	-5.52
May 1971	209	110	138.00	6.07	-4.61
July 1971	155	82	102.00	5.22	-3.83

Note: Number of observations are after elimination of ties.

Appendix table 21.--Turning point test for daily closing prices for soybeans

Contract	Number of observations	Number of turning points	Expected value of turning points	Standard error of turning points	Test statistic
January 1960	138	73	90.67	4.92	-3.59
March 1960	180	99	118.67	5.63	-3.49
May 1960	199	108	131.33	5.92	-3.94
July 1960	200	104	132.00	5.94	-4.72
September 1960	202	99	133.33	5.97	-5.76
November 1960	194	105	128.00	5.85	-3.93
January 1961	197	102	130.00	5.89	-4.75
March 1961	198	107	130.67	5.91	-4.01
May 1961	202	97	133.33	5.97	-6.09
July 1961	200	94	132.00	5.94	-6.40
September 1961	202	103	133.33	5.97	-5.08
November 1961	225	110	148.67	6.30	-6.14
January 1962	237	127	156.67	6.47	-4.59
March 1962	227	122	150.00	6.33	-4.43
May 1962	231	114	152.67	6.38	-6.06
July 1962	225	109	148.67	6.30	-6.30
August 1962	221	113	146.00	6.24	-5.29
September 1962	214	109	141.33	6.14	-5.26
November 1962	216	93	142.67	6.17	-8.05
January 1963	222	115	146.67	6.26	-5.06
March 1963	228	122	150.67	6.34	-4.52
May 1963	227	115	150.00	6.33	-5.53
July 1963	216	104	142.67	6.17	-6.27
August 1963	228	122	150.67	6.34	-4.52
September 1963	227	114	150.00	6.33	-5.69
November 1963	235	120	155.33	6.44	-5.49
January 1964	237	131	156.67	6.47	-3.97
March 1964	234	131	154.67	6.42	-3.68
May 1964	234	120	154.67	6.42	-5.40
July 1964	237	126	156.67	6.47	-4.74
August 1964	234	131	154.67	6.42	-3.68
September 1964	219	115	144.67	6.21	-4.77
November 1964	234	117	154.67	6.42	-5.86
January 1965	230	116	152.00	6.37	-5.65
March 1965	240	119	158.67	6.51	-6.10
May 1965	243	125	160.67	6.55	-5.45
July 1965	242	122	160.00	6.53	-5.82
August 1965	236	132	156.00	6.45	-3.72
September 1965	223	122	147.33	6.27	-4.04
November 1965	234	126	154.67	6.42	-4.46
January 1966	234	125	154.67	6.42	-4.62
March 1966	239	144	158.00	6.49	-2.16
May 1966	235	138	155.33	6.44	-2.69
July 1966	236	134	156.00	6.45	-3.41
August 1966	236	130	156.00	6.45	-4.03
September 1966	238	132	157.33	6.48	-3.91
November 1966	231	115	152.67	6.38	-5.90
January 1967	238	124	157.33	6.48	-5.14
March 1967	231	120	152.67	6.38	-5.12
May 1967	232	120	153.33	6.40	-5.21
July 1967	229	119	151.33	6.36	-5.09
August 1967	228	118	150.67	6.34	-5.15
September 1967	229	110	151.33	6.36	-6.50
November 1967	222	118	146.67	6.26	-4.58

Continued

Appendix table 21.--Turning point test for daily closing prices for soybeans --Continued

Contract	Number of observations	Number of turning points	Expected value of turning points	Standard error of turning points	Test statistic
January 1968	226	110	149.33	6.31	-6.23
March 1968	227	115	150.00	6.33	-5.53
May 1968	229	116	151.33	6.36	-5.56
July 1968	233	107	154.00	6.41	-7.33
August 1968	227	121	150.00	6.33	-4.58
September 1968	225	110	148.67	6.30	-6.14
November 1968	223	107	147.33	6.27	-6.43
January 1969	233	118	154.00	6.41	-5.62
March 1969	218	107	144.00	6.20	-5.97
May 1969	217	107	143.33	6.19	-5.87
July 1969	221	109	146.00	6.24	-5.93
August 1969	218	96	144.00	6.20	-7.74
November 1969	223	106	147.33	6.27	-6.59
January 1970	249	123	164.67	6.63	-6.29
March 1970	226	120	149.33	6.31	-4.65
May 1970	238	125	157.33	6.48	-4.99
July 1970	236	125	156.00	6.45	-4.80
August 1970	233	125	154.00	6.41	-4.52
September 1970	235	134	155.33	6.44	-3.31
November 1970	239	128	158.00	6.49	-4.62
January 1971	238	134	157.33	6.48	-3.60
March 1971	244	139	161.33	6.56	-3.40
May 1971	211	112	139.33	6.10	-4.48
July 1971	167	95	110.00	5.42	-2.77
August 1971	144	89	94.67	5.03	-1.13
September 1971	127	81	83.33	4.72	-0.49

Note: Number of observations are after elimination of ties.

Appendix table 22.--Turning point test for daily closing prices for soybean oil

Contract	Number of observations	Number of turning points	Expected value of turning points	Standard error of turning points	Test statistic
December 1959	103	52	67.33	4.24	-3.62
January 1960	128	67	84.00	4.74	-3.59
March 1960	175	83	115.33	5.55	-5.83
May 1960	195	99	128.67	5.86	-5.06
July 1960	188	93	124.00	5.75	-5.39
September 1960	205	97	135.33	6.01	-6.38
October 1960	172	82	113.33	5.50	-5.70
December 1960	174	89	114.67	5.53	-4.64
January 1961	183	86	120.67	5.68	-6.11
March 1961	194	92	128.00	5.85	-6.16
May 1961	212	105	140.00	6.11	-5.73
July 1961	196	99	129.33	5.88	-5.16
September 1961	217	115	143.33	6.19	-4.58
October 1961	199	97	131.33	5.92	-5.80
December 1961	209	97	138.00	6.07	-6.76
January 1962	151	74	99.33	5.15	-4.92
March 1962	171	82	112.67	5.48	-5.59
May 1962	193	85	127.33	5.83	-7.26
July 1962	196	90	129.33	5.88	-6.69
August 1962	141	61	92.67	4.97	-6.37
September 1962	173	76	114.00	5.52	-6.89
October 1962	142	60	93.33	4.99	-6.68
December 1962	167	71	110.00	5.42	-7.20
January 1963	150	73	98.67	5.13	-5.00
March 1963	172	85	113.33	5.50	-5.15
May 1963	189	92	124.67	5.77	-5.66
July 1963	212	110	140.00	6.11	-4.91
August 1963	211	108	139.33	6.10	-5.14
September 1963	186	90	122.67	5.72	-5.71
October 1963	185	99	122.00	5.71	-4.03
December 1963	192	101	126.67	5.81	-4.41
January 1964	206	108	136.00	6.02	-4.65
March 1964	230	116	152.00	6.37	-5.65
May 1964	219	101	144.67	6.21	-7.03
July 1964	227	109	150.00	6.33	-6.48
August 1964	175	92	115.33	5.55	-4.21
September 1964	208	111	137.33	6.05	-4.35
October 1964	228	113	150.67	6.34	-5.94
December 1964	225	107	148.67	6.30	-6.61
January 1965	197	88	130.00	5.89	-7.13
March 1965	230	111	152.00	6.37	-6.44
May 1965	212	103	140.00	6.11	-6.05
July 1965	214	96	141.33	6.14	-7.38
August 1965	176	82	116.00	5.56	-6.11
September 1965	225	113	148.67	6.30	-5.66
October 1965	229	107	151.33	6.36	-6.98
December 1965	225	118	148.67	6.30	-4.87
January 1966	228	114	150.67	6.34	-5.78
March 1966	230	112	152.00	6.37	-6.28
May 1966	233	112	154.00	6.41	-6.55
July 1966	219	106	144.67	6.21	-6.22
August 1966	216	111	142.67	6.17	-5.13
September 1966	232	111	153.33	6.40	-6.62
October 1966	225	113	148.67	6.30	-5.66
December 1966	233	122	154.00	6.41	-4.99
January 1967	226	108	149.33	6.31	-6.55
March 1967	230	114	152.00	6.37	-5.97

Continued

Appendix table 22.--Turning point test for daily closing prices for soybean oil --Continued

Contract	Number of observations	Number of turning points	Expected value of turning points	Standard error of turning points	Test statistic
May 1967	232	117	153.33	6.40	-5.68
July 1967	232	103	153.33	6.40	-7.87
August 1967	222	97	146.67	6.26	-7.94
September 1967	216	89	142.67	6.17	-8.70
October 1967	214	95	141.33	6.14	-7.54
December 1967	209	95	138.00	6.07	-7.09
January 1968	222	100	146.67	6.26	-7.46
March 1968	216	99	142.67	6.17	-7.08
May 1968	231	103	152.67	6.38	-7.78
July 1968	216	102	142.67	6.17	-6.59
August 1968	204	102	134.67	6.00	-5.45
September 1968	217	106	143.33	6.19	-6.04
October 1968	177	77	116.67	5.58	-7.11
December 1968	224	104	148.00	6.28	-7.00
January 1969	208	97	137.33	6.05	-6.66
March 1969	223	109	147.33	6.27	-6.11
May 1969	224	114	148.00	6.28	-5.41
July 1969	226	119	149.33	6.31	-4.80
August 1969	225	113	148.67	6.30	-5.66
September 1969	218	99	144.00	6.20	-7.26
October 1969	219	105	144.67	6.21	-6.38
December 1969	231	122	152.67	6.38	-4.80
January 1970	231	123	152.67	6.38	-4.65
March 1970	225	114	148.67	6.30	-5.50
May 1970	234	134	154.67	6.42	-3.22
July 1970	235	131	155.33	6.44	-3.78
August 1970	237	129	156.67	6.47	-4.28
September 1970	238	127	157.33	6.48	-4.68
October 1970	239	122	158.00	6.49	-5.54
December 1970	238	128	157.33	6.48	-4.53
January 1971	240	135	158.67	6.51	-3.64
March 1971	245	138	162.00	6.58	-3.65
May 1971	212	118	140.00	6.11	-3.60
July 1971	169	87	111.33	5.45	-4.46
August 1971	141	77	92.67	4.97	-3.15
September 1971	130	68	85.33	4.77	-3.63
October 1971	108	66	70.67	4.34	-1.07

Note: Number of observations are after elimination of ties.

Appendix table 23.--Turning point test for daily closing prices for soybean meal

Contract	Number of observations	Number of turning points	Expected value of turning points	Standard error of turning points	Test statistic
March 1960	171	90	112.67	5.48	-4.13
May 1960	183	95	120.67	5.68	-4.52
July 1960	200	111	132.00	5.94	-3.54
August 1960	185	100	122.00	5.71	-3.86
October 1960	169	89	111.33	5.45	-4.10
December 1960	147	76	96.67	5.08	-4.07
January 1961	151	82	99.33	5.15	-3.37
March 1961	190	105	125.33	5.78	-3.52
May 1961	177	80	116.67	5.58	-6.57
July 1961	194	87	128.00	5.85	-7.01
August 1961	192	96	126.67	5.81	-5.27
September 1961	171	80	112.67	5.48	-5.96
October 1961	175	91	115.33	5.55	-4.39
December 1961	174	84	114.67	5.53	-5.54
January 1962	144	71	94.67	5.03	-4.71
March 1962	154	71	101.33	5.20	-5.83
May 1962	166	77	109.33	5.40	-5.98
July 1962	195	79	128.67	5.86	-8.47
August 1962	148	69	97.33	5.10	-5.56
September 1962	132	62	86.67	4.81	-5.13
October 1962	143	74	94.00	5.01	-3.99
December 1962	163	80	107.33	5.35	-5.11
January 1963	153	64	100.67	5.18	-7.07
March 1963	169	79	111.33	5.45	-5.93
May 1963	200	99	132.00	5.94	-5.56
July 1963	207	107	136.67	6.04	-4.91
August 1963	217	97	143.33	6.19	-7.49
September 1963	206	96	136.00	6.02	-6.64
October 1963	199	88	131.33	5.92	-7.32
December 1963	212	102	140.00	6.11	-6.22
January 1964	210	100	138.67	6.08	-6.36
March 1964	225	109	148.67	6.30	-6.30
May 1964	233	121	154.00	6.41	-5.15
July 1964	236	126	156.00	6.45	-4.65
August 1964	229	125	151.33	6.36	-4.14
September 1964	208	106	137.33	6.05	-5.18
October 1964	223	124	147.33	6.27	-3.72
December 1964	231	121	152.67	6.38	-4.96
January 1965	228	112	150.67	6.34	-6.10
March 1965	231	116	152.67	6.38	-5.74
July 1965	224	110	148.00	6.28	-6.05
August 1965	216	106	142.67	6.17	-5.94
September 1965	224	115	148.00	6.28	-5.25
October 1965	225	122	148.67	6.30	-4.23
December 1965	218	125	144.00	6.20	-3.06
January 1966	228	125	150.67	6.34	-4.05
March 1966	232	125	153.33	6.40	-4.43
May 1966	216	113	142.67	6.17	-4.81
July 1966	230	109	152.00	6.37	-6.75
August 1966	233	115	154.00	6.41	-6.08
September 1966	192	103	126.67	5.81	-4.07
October 1966	197	93	130.00	5.89	-6.28
December 1966	230	123	152.00	6.37	-4.55
January 1967	235	110	155.33	6.44	-7.04
March 1967	229	116	151.33	6.36	-5.56
May 1967	228	111	150.67	6.34	-6.26
July 1967	237	113	156.67	6.47	-6.75
August 1967	235	112	155.33	6.44	-6.73

Continued

Appendix table 23.--Turning point test for daily closing prices for soybean meal --Continued

Contract	Number of observations	Number of turning points	Expected value of turning points	Standard error of turning points	Test statistic
September 1967	230	114	152.00	6.37	-5.97
October 1967	222	118	146.67	6.26	-4.58
December 1967	219	107	144.67	6.21	-6.06
January 1968	233	120	154.00	6.41	-5.30
March 1968	229	117	151.33	6.36	-5.40
May 1968	227	110	150.00	6.33	-6.32
July 1968	217	109	143.33	6.19	-5.55
August 1968	211	106	139.33	6.10	-5.47
September 1968	226	110	149.33	6.31	-6.23
October 1968	176	99	116.00	5.56	-3.05
December 1968	215	107	142.00	6.16	-5.69
January 1969	219	104	144.67	6.21	-6.54
March 1969	218	107	144.00	6.20	-5.97
May 1969	221	115	146.00	6.24	-4.97
July 1969	227	124	150.00	6.33	-4.11
August 1969	229	119	151.33	6.36	-5.09
September 1969	221	108	146.00	6.24	-6.09
October 1969	213	95	140.67	6.13	-7.45
December 1969	229	102	151.33	6.36	-7.76
January 1970	227	99	150.00	6.33	-8.06
March 1970	232	111	153.33	6.40	-6.62
May 1970	240	115	158.67	6.51	-6.71
July 1970	240	123	158.67	6.51	-5.48
August 1970	232	122	153.33	6.40	-4.90
September 1970	228	115	150.67	6.34	-5.62
October 1970	237	130	156.67	6.47	-4.12
December 1970	241	123	159.33	6.52	-5.57
January 1971	237	125	156.67	6.47	-4.90
March 1971	239	128	153.00	6.49	-4.62
May 1971	213	119	140.67	6.13	-3.54
July 1971	162	86	106.67	5.34	-3.87
August 1971	138	80	90.67	4.92	-2.17
September 1971	116	59	76.00	4.51	-3.77
October 1971	101	52	66.00	4.20	-3.33

Note: Number of observations are after elimination of ties.

Appendix table 24.--Turning point test for daily closing prices for shell eggs

Contract	Number of observations	Number of turning points	Expected value of turning points	Standard error of turning points	Test statistic
September 1960	235	128	155.00	6.44	-4.25
October 1960	236	133	156.00	6.45	-3.56
November 1960	197	118	130.00	5.89	-2.04
December 1960	203	126	134.00	5.98	-1.34
January 1961	191	107	126.00	5.80	-3.28
September 1961	228	129	150.67	6.34	-3.42
October 1961	225	130	148.67	6.30	-2.96
November 1961	210	111	138.67	6.08	-4.55
December 1961	202	108	133.33	5.97	-4.25
January 1962	191	88	126.00	5.80	-6.55
September 1962	223	131	147.33	6.27	-2.60
October 1962	219	135	144.67	6.21	-1.56
November 1962	220	121	145.33	6.23	-3.91
December 1962	197	99	130.00	5.89	-5.26
January 1963	157	83	103.33	5.25	-3.87
September 1963	220	124	145.33	6.23	-3.43
October 1963	217	116	143.33	6.19	-4.42
November 1963	190	97	125.33	5.78	-4.90
December 1963	180	94	118.67	5.63	-4.38
January 1964	144	62	94.67	5.03	-6.50
September 1964	210	111	138.67	6.08	-4.55
October 1964	190	99	125.33	5.78	-4.55
November 1964	152	79	100.00	5.17	-4.06
December 1964	126	67	82.67	4.70	-3.33
January 1965	95	49	62.00	4.07	-3.19
September 1965	201	101	132.67	5.95	-5.32
October 1965	179	85	118.00	5.61	-5.88
November 1965	166	81	109.33	5.40	-5.24
December 1965	151	76	99.33	5.15	-4.53
January 1966	132	68	86.67	4.81	-3.88
September 1966	184	88	121.33	5.69	-5.86
October 1966	202	94	133.33	5.97	-6.59
November 1966	98	43	.00	4.14	-5.08
December 1966	150	79	9..67	5.13	-3.83
January 1967	79	40	50.67	3.68	-2.90
September 1967	196	110	129.33	5.88	-3.29
October 1967	151	81	99.33	5.15	-3.56
November 1967	145	68	95.33	5.05	-5.42
December 1967	102	52	66.67	4.22	-3.48
January 1968	75	34	48.67	3.61	-4.07
September 1968	180	88	118.67	5.63	-5.45
October 1968	183	84	120.67	5.68	-6.46
December 1968	173	89	114.00	5.52	-4.53
January 1969	112	54	73.33	4.43	-4.37
March 1969	43	22	27.33	2.71	-1.97
April 1969	69	31	44.67	3.46	-3.95
May 1969	39	18	24.67	2.57	-2.59
June 1969	40	15	25.33	2.61	-3.97
July 1969	77	28	50.00	3.66	-6.02
September 1969	213	122	140.67	6.13	-3.05
October 1969	203	112	134.00	5.98	-3.68
November 1969	183	83	120.67	5.68	-6.64
December 1969	152	72	100.00	5.17	-5.42
January 1970	132	50	86.67	4.81	-7.62
February 1970	115	57	75.33	4.49	-4.09
March 1970	120	57	78.67	4.58	-4.73
April 1970	124	60	81.33	4.66	-4.58
May 1970	126	65	82.67	4.70	-3.76
June 1970	131	72	86.00	4.79	-2.92
July 1970	61	27	39.33	3.24	-3.80
September 1970	172	85	113.33	5.50	-5.15
October 1970	167	81	110.00	5.42	-5.35
November 1970	131	71	86.00	4.79	-3.13
December 1970	195	98	128.67	5.86	-5.23
January 1971	161	85	106.00	5.32	-3.95
February 1971	76	35	49.33	3.63	-3.12
March 1971	79	46	51.33	3.70	-1.44
April 1971	66	39	42.67	3.38	-1.09
May 1971	67	36	43.33	3.40	-2.15
June 1971	61	27	39.33	3.24	-3.80

Note: Number of observations are after elimination of ties.

Appendix table 25.--Turning point test for daily closing prices for frozen pork bellies

Contract	Number of observations	Number of turning points	Expected value of turning points	Standard error of turning points	Test statistic
July 1964	146	69	96.00	5.06	-5.33
August 1964	176	85	116.00	5.56	-5.57
March 1965	156	81	102.67	5.24	-4.14
May 1965	226	122	149.33	6.31	-4.33
July 1965	239	118	158.00	6.49	-6.16
August 1965	240	119	158.67	6.51	-6.10
February 1966	187	87	123.33	5.74	-6.33
March 1966	215	94	142.00	6.16	-7.80
May 1966	234	119	154.67	6.42	-5.55
July 1966	242	133	160.00	6.53	-4.13
August 1966	243	133	160.67	6.55	-4.23
February 1967	232	126	153.33	6.40	-4.27
March 1967	203	113	134.00	5.98	-3.51
May 1967	223	124	147.33	6.27	-3.72
July 1967	238	130	157.33	6.48	-4.13
August 1967	231	135	152.67	6.38	-2.77
February 1968	220	128	145.33	6.23	-2.78
March 1968	236	138	156.00	6.45	-2.79
May 1968	237	136	156.67	6.47	-3.20
July 1968	237	131	156.67	6.47	-4.00
August 1968	235	126	155.33	6.44	-4.56
February 1969	222	120	146.67	6.26	-4.26
March 1969	240	128	158.67	6.51	-4.71
May 1969	236	133	156.00	6.45	-3.56
July 1969	237	127	156.67	6.47	-4.59
August 1969	239	132	157.00	6.49	-4.00
February 1970	227	129	150.00	6.33	-3.32
March 1970	219	127	144.67	6.21	-2.84
May 1970	232	131	153.33	6.40	-3.49
July 1970	237	136	156.67	6.47	-3.20
August 1970	235	126	155.33	6.44	-4.56
February 1971	222	124	146.67	6.26	-3.62
March 1971	244	137	161.33	6.56	-3.71
May 1971	197	101	130.00	5.89	-4.92
July 1971	165	79	106.00	5.32	-5.08
August 1971	141	65	92.67	4.97	-5.56

Note: Number of observations are after elimination of ties.

Appendix table 26.--Turning point test for daily closing prices for live cattle

Contract	Number of observations	Number of turning points	Expected value of turning points	Standard error of turning points	Test statistic
June 1965	122	55	80.00	4.62	-5.41
August 1965	163	68	107.33	5.35	-7.35
October 1965	196	85	129.33	5.88	-7.55
December 1965	192	85	126.67	5.81	-7.17
February 1966	159	67	104.67	5.29	-7.13
April 1966	163	81	107.33	5.35	-4.92
June 1966	168	80	110.67	5.44	-5.64
August 1966	176	78	116.00	5.56	-6.83
October 1966	185	82	122.00	5.71	-7.01
December 1966	224	94	148.00	6.28	-8.59
February 1967	220	103	145.33	6.23	-6.80
April 1967	223	111	147.33	6.27	-5.79
June 1967	205	87	135.33	6.01	-8.04
August 1967	227	100	150.00	6.33	-7.90
October 1967	246	111	162.67	6.59	-7.84
December 1967	287	137	190.00	7.12	-7.44
February 1968	296	151	196.00	7.23	-6.22
April 1968	272	116	180.00	6.93	-9.23
June 1968	267	137	176.67	6.87	-5.78
August 1968	233	124	154.00	6.41	-4.68
October 1968	194	87	128.00	5.85	-7.01
December 1968	207	100	136.67	6.04	-6.07
February 1969	201	89	132.67	5.95	-7.34
April 1969	212	97	140.00	6.11	-7.03
June 1969	212	95	140.00	6.11	-7.36
August 1969	194	93	128.00	5.85	-5.99
October 1969	227	102	150.00	6.33	-7.59
December 1969	223	112	147.33	6.27	-5.63
February 1970	224	115	148.00	6.28	-5.25
April 1970	261	129	172.67	6.79	-6.43
June 1970	285	138	188.67	7.10	-7.14
August 1970	295	152	195.33	7.22	-6.00
October 1970	264	132	174.67	6.83	-6.25
December 1970	295	157	195.33	7.22	-5.31
February 1971	267	143	176.67	6.87	-4.90
April 1971	239	123	158.00	6.49	-5.39
June 1971	278	155	184.00	7.01	-4.14
August 1971	208	112	137.33	6.05	-4.18
October 1971	189	98	124.67	5.77	-4.62
December 1971	172	86	113.33	5.50	-4.97
February 1972	122	52	80.00	4.62	-6.06

Note: Number of observations are after elimination of ties.

Appendix table 27.--Turning point test for daily closing prices for Maine potatoes

Contract	Number of observations	Number of turning points	Expected value of turning points	Standard error of turning points	Test statistic
March 1960	157	85	103.33	5.25	-3.49
April 1960	182	90	120.00	5.66	-5.30
May 1960	201	106	132.67	5.95	-4.48
November 1960	154	91	101.33	5.20	-1.99
March 1961	200	102	132.00	5.94	-5.05
April 1961	210	107	138.67	6.08	-5.21
May 1961	217	110	143.33	6.19	-5.39
November 1961	175	96	115.33	5.55	-3.48
March 1962	199	100	131.33	5.92	-5.29
April 1962	211	106	139.33	6.10	-5.47
May 1962	214	107	141.33	6.14	-5.59
November 1962	187	97	123.33	5.74	-4.59
March 1963	199	113	131.33	5.92	-3.10
April 1963	198	98	130.67	5.91	-5.53
May 1963	209	105	138.00	6.07	-5.44
November 1963	169	92	111.33	5.45	-3.55
March 1964	183	93	120.67	5.68	-4.87
April 1964	202	94	133.33	5.97	-6.59
May 1964	203	103	134.00	5.98	-5.18
November 1964	183	108	120.67	5.68	-2.23
March 1965	210	115	138.67	6.08	-3.89
April 1965	216	114	142.67	6.17	-4.65
May 1965	233	118	154.00	6.41	-5.62
November 1965	208	110	137.33	6.05	-4.51
March 1966	210	106	138.67	6.08	-5.37
April 1966	218	117	144.00	6.20	-4.36
May 1966	222	118	146.67	6.26	-4.58
November 1966	205	118	135.33	6.01	-2.88
March 1967	235	126	155.33	6.44	-4.56
April 1967	228	123	150.67	6.34	-4.36
May 1967	241	123	159.33	6.52	-5.57
November 1967	200	118	132.00	5.94	-2.36
March 1968	225	128	148.67	6.30	-3.28
April 1968	235	126	155.33	6.44	-4.56
May 1968	231	134	152.67	6.38	-2.92
November 1968	196	121	129.33	5.88	-1.42
March 1969	221	113	146.00	6.24	-5.29
April 1969	228	126	150.67	6.34	-3.89
May 1969	232	123	153.33	6.40	-4.74
March 1970	203	106	134.00	5.98	-4.68
April 1970	216	116	142.67	6.17	-4.32
May 1970	222	114	146.67	6.26	-5.22
November 1970	187	109	123.33	5.74	-2.50
March 1971	220	120	145.33	6.23	-4.07
April 1971	205	112	135.33	6.01	-3.88
May 1971	205	101	135.33	6.01	-5.71

Note: Number of observations are after elimination of ties.

Appendix table 28.--Phase length test for daily closing prices for Chicago corn

Contract	Number of observations	Chi-square statistic	
		Unadjusted	Adjusted
March 1960	184	14.73	12.63
May 1960	225	12.96	11.11
July 1960	245	29.36	25.17
September 1960	247	24.02	20.59
December 1960	245	37.29	21.96
March 1961	237	29.40	25.20
May 1961	232	14.67	12.58
July 1961	228	19.68	16.87
September 1961	214	46.78	40.10
December 1961	244	74.89	64.19
March 1962	246	42.25	36.22
May 1962	246	57.12	48.96
July 1962	246	23.58	20.22
September 1962	245	22.99	19.71
December 1962	244	24.33	20.86
March 1963	243	33.13	28.40
May 1963	244	26.45	22.67
July 1963	243	18.79	16.10
September 1963	244	34.62	29.67
December 1963	245	20.35	17.44
March 1964	245	34.24	29.35
May 1964	243	46.53	39.88
July 1964	245	51.33	44.00
September 1964	246	38.99	33.42
December 1964	246	64.41	55.21
March 1965	246	61.32	52.56
May 1965	244	35.52	30.45
July 1965	244	32.87	28.18
September 1965	245	26.46	22.68
December 1965	245	12.70	10.88
March 1966	246	25.72	22.04
May 1966	245	33.71	28.89
July 1966	245	16.99	14.56
September 1966	246	39.00	32.91
December 1966	245	25.46	21.82
March 1967	243	37.74	32.35
May 1967	243	29.44	25.23
July 1967	244	25.42	21.78
September 1967	242	24.41	20.92
December 1967	244	24.70	21.17
March 1968	245	23.96	20.54
May 1968	245	46.09	39.51
July 1968	245	40.30	34.55
September 1968	244	36.83	31.57
December 1968	244	50.39	43.19
March 1969	276	40.54	34.74
May 1969	243	20.99	18.00
July 1969	242	20.67	17.71
September 1969	242	21.95	18.82
December 1969	243	8.22	7.05
March 1970	303	11.62	9.96
May 1970	249	31.79	27.25
July 1970	251	27.54	23.60
September 1970	246	19.99	17.14
December 1970	251	25.14	21.55
March 1971	298	20.99	17.99
May 1971	212	19.25	16.50
July 1971	173	9.67	8.28
September 1971	130	8.46	7.25

Appendix table 29.--Phase length test for daily closing prices for Chicago wheat

Contract	Number of observations	Chi-square statistic	
		Unadjusted	Adjusted
May 1960	225	29.41	25.21
July 1960	267	14.86	12.73
September 1960	310	42.24	36.20
March 1961	244	37.63	32.26
May 1961	245	36.87	31.61
July 1961	245	45.19	38.74
September 1961	244	51.74	44.35
December 1961	245	57.26	49.08
March 1962	245	24.17	20.72
May 1962	246	18.23	15.62
July 1962	246	23.58	20.21
September 1962	245	30.64	26.26
December 1962	243	60.07	51.49
March 1963	242	51.63	44.25
May 1963	244	54.47	46.69
July 1963	207	24.75	21.22
September 1963	244	29.04	24.89
December 1963	245	56.58	48.50
March 1964	245	30.64	26.27
May 1964	244	53.69	46.02
July 1964	267	39.67	34.00
September 1964	309	49.20	42.17
December 1964	246	35.21	30.18
March 1965	236	29.55	25.33
May 1965	245	23.65	20.27
July 1965	243	35.81	30.69
September 1965	240	20.09	17.22
December 1965	244	43.92	37.64
March 1966	222	38.53	33.03
May 1966	246	24.69	21.16
July 1966	245	31.91	27.35
September 1966	244	30.35	26.01
December 1966	245	19.64	16.83
March 1967	243	31.21	26.75
May 1967	244	35.18	30.16
July 1967	244	12.93	11.08
September 1967	243	22.41	19.21
December 1967	244	29.90	25.63
March 1968	245	37.30	31.97
May 1968	245	32.95	28.25
July 1968	245	44.21	37.90
September 1968	244	61.45	52.67
December 1968	244	62.53	53.60
March 1969	243	46.36	39.74
May 1969	243	50.31	43.12
July 1969	243	42.81	36.69
September 1969	285	56.02	48.02
December 1969	243	33.82	28.98
March 1970	242	31.75	27.21
May 1970	249	27.48	23.55
July 1970	251	47.07	40.34
September 1970	246	20.16	17.28
December 1970	250	12.93	11.08
March 1971	252	32.71	28.04
May 1971	217	20.17	17.29
July 1971	166	9.79	8.39

Appendix table 30.--Phase length test for daily closing prices for soybeans

Contract	Number of observations	Chi-square statistic	
		Unadjusted	Adjusted
January 1960	141	12.23	10.48
March 1960	184	11.82	10.13
May 1960	209	13.12	11.24
July 1960	210	22.76	19.51
September 1960	212	31.17	26.72
November 1960	211	16.43	14.09
January 1961	210	23.34	20.01
March 1961	210	22.58	19.36
May 1961	210	39.79	34.10
July 1961	208	24.66	21.14
September 1961	210	21.36	18.31
November 1961	239	33.74	28.92
January 1962	246	15.53	13.31
March 1962	246	18.05	15.47
May 1962	246	45.11	38.66
July 1962	244	45.67	39.14
August 1962	246	33.40	28.62
September 1962	239	30.11	25.81
November 1962	245	67.51	57.86
January 1963	243	28.57	24.48
March 1963	243	18.55	15.90
May 1963	244	27.61	23.67
July 1963	228	33.48	28.70
August 1963	239	20.34	17.43
September 1963	242	27.59	23.65
November 1963	244	24.55	21.04
January 1964	245	15.08	12.93
March 1964	244	12.77	10.94
May 1964	244	28.71	24.61
July 1964	246	24.18	20.73
August 1964	244	17.84	15.29
September 1964	232	21.19	18.17
November 1964	243	35.87	30.74
January 1965	244	26.20	22.46
March 1965	246	29.86	25.60
May 1965	245	25.62	21.96
July 1965	244	27.98	23.99
August 1965	243	9.61	8.24
September 1965	245	17.48	14.98
November 1965	250	17.09	14.65
January 1966	246	18.80	16.11
March 1966	246	3.86	3.31
May 1966	245	4.21	3.61
July 1966	245	5.44	4.66
August 1966	245	12.79	10.96
September 1966	246	8.94	7.66
November 1966	244	32.09	27.51

Continued

Appendix table 30.--Phase length test for daily closing prices for soybeans --Continued

Contract	Number of observations	Chi-square statistic	
		Unadjusted	Adjusted
January 1967	245	29.79	25.53
March 1967	243	29.17	25.01
May 1967	243	27.84	23.86
July 1967	244	25.00	21.42
August 1967	244	25.33	21.71
September 1967	243	33.11	28.38
November 1967	245	16.49	14.13
January 1968	246	31.30	26.83
March 1968	245	24.17	20.72
May 1968	245	24.26	20.80
July 1968	245	42.75	36.65
August 1968	243	19.81	16.98
September 1968	244	36.39	31.20
November 1968	243	41.55	35.62
January 1969	244	40.73	34.91
March 1969	244	39.84	34.15
May 1969	243	37.45	32.10
July 1969	243	32.80	28.11
August 1969	242	54.62	46.82
September 1969	243	26.21	22.47
November 1969	243	40.10	34.37
January 1970	282	37.36	32.02
March 1970	246	26.71	22.90
May 1970	248	28.14	24.12
July 1970	251	25.36	21.74
August 1970	244	21.34	18.29
September 1970	246	14.84	12.72
November 1970	250	18.56	15.91
January 1971	251	9.04	7.75
March 1971	252	8.51	7.29
May 1971	217	15.32	13.13
July 1971	171	8.18	7.01
August 1971	150	3.07	2.63
September 1971	132	.40	.34

Appendix table 31.--Phase length test for daily closing prices for soybean oil

Contract	Number of observations	Chi-square statistic	
		Unadjusted	Adjusted
December 1959	121	8.72	7.47
January 1960	141	14.19	12.17
March 1960	184	23.37	20.03
May 1960	223	20.16	17.28
July 1960	209	28.19	24.17
September 1960	221	46.07	39.48
October 1960	188	30.63	26.26
December 1960	188	14.44	12.38
January 1961	202	25.66	21.99
March 1961	208	25.49	21.85
May 1961	223	31.52	27.01
July 1961	201	27.60	23.66
September 1961	227	23.31	19.98
October 1961	204	27.36	23.46
December 1961	223	33.41	28.64
January 1962	167	17.75	15.21
March 1962	186	22.27	19.09
May 1962	204	37.16	31.85
July 1962	209	27.76	23.80
August 1962	150	29.35	25.16
September 1962	183	40.55	34.75
October 1962	154	44.83	38.43
December 1962	175	36.73	31.48
January 1963	160	23.18	19.87
March 1963	180	22.97	19.69
May 1963	205	29.53	25.31
July 1963	223	19.91	17.07
August 1963	225	19.31	16.55
September 1963	203	27.46	23.54
October 1963	202	16.05	13.76
December 1963	204	20.63	17.68
January 1964	218	16.76	14.37
March 1964	240	28.38	24.33
May 1964	238	39.66	33.99
July 1964	238	25.62	21.96
August 1964	195	19.11	16.38
September 1964	220	11.17	9.58
October 1964	240	28.39	24.34
December 1964	236	37.86	32.45
January 1965	203	30.05	25.75
March 1965	244	29.24	25.07
May 1965	218	21.05	18.04
July 1965	224	35.93	30.80
August 1965	191	22.81	19.56
September 1965	239	38.84	33.29
October 1965	242	35.69	30.59
December 1965	238	22.28	19.09

Continued

Appendix table 31.--Phase length test for daily closing prices for soybean oil --Continued

Contract	Number of observations	Chi-square statistic	
		Unadjusted	Adjusted
January 1966	244	35.43	30.37
March 1966	246	20.63	17.69
May 1966	244	26.98	23.13
July 1966	225	46.85	40.15
August 1966	229	22.53	19.31
September 1966	244	42.58	36.50
October 1966	240	28.58	24.41
December 1966	244	28.29	24.25
January 1967	245	42.49	36.42
March 1967	243	36.02	30.88
May 1967	244	35.53	30.45
July 1967	244	52.25	44.78
August 1967	238	53.34	45.72
September 1967	254	56.73	48.63
October 1967	241	52.13	44.69
December 1967	233	32.09	27.50
January 1968	241	43.00	36.86
March 1968	215	34.77	29.81
May 1968	245	45.98	39.42
July 1968	228	30.92	26.50
August 1968	226	29.22	25.05
September 1968	238	36.21	31.04
October 1968	198	44.92	38.50
December 1968	238	42.81	36.69
January 1969	225	42.22	36.19
March 1969	244	28.19	24.16
May 1969	243	21.51	18.44
July 1969	242	24.03	20.60
August 1969	241	35.85	30.73
September 1969	241	61.58	52.78
October 1969	243	36.37	31.17
December 1969	246	17.69	15.16
January 1970	247	14.48	12.41
March 1970	243	20.00	17.15
May 1970	249	17.38	14.90
July 1970	245	16.28	13.95
August 1970	243	16.18	13.87
September 1970	246	17.97	15.40
October 1970	248	22.96	19.68
December 1970	250	11.76	10.08
January 1971	250	6.91	5.92
March 1971	252	10.22	8.76
May 1971	218	8.07	6.92
July 1971	174	11.82	10.13
August 1971	150	12.78	10.95
September 1971	132	10.45	8.96
October 1971	110	.72	.62

Appendix table 32.--Phase length test for daily closing price for soybean meal

Contract	Number of observations	Chi-square statistic	
		Unadjusted	Adjusted
March 1960	177	10.50	9.00
May 1960	192	16.74	14.35
July 1960	210	21.42	18.36
August 1960	201	11.96	10.26
October 1960	190	11.73	10.06
December 1960	156	20.60	17.66
January 1961	168	13.00	11.14
March 1961	206	13.06	11.19
May 1961	183	44.27	37.95
July 1961	204	39.87	34.17
August 1961	199	27.24	23.35
September 1961	178	18.49	15.85
October 1961	182	16.35	14.01
December 1961	180	26.34	22.58
January 1962	150	18.05	15.47
March 1962	161	22.50	19.29
May 1962	177	28.99	24.85
July 1962	209	46.34	39.72
August 1962	161	26.65	22.85
September 1962	142	33.90	29.06
October 1962	152	15.45	13.24
December 1962	175	31.36	26.88
January 1963	161	49.48	42.41
March 1963	177	38.06	32.63
May 1963	209	39.76	34.08
July 1963	224	27.68	23.72
August 1963	224	71.04	60.89
September 1963	220	58.25	49.93
October 1963	205	45.84	39.29
December 1963	222	35.92	30.79
January 1964	216	38.67	33.15
March 1964	230	33.76	28.94
May 1964	241	28.95	24.81
July 1964	241	14.96	12.83
August 1964	242	10.67	9.15
September 1964	228	30.18	25.87
October 1964	243	16.37	14.03
December 1964	240	20.97	17.98
January 1965	237	31.17	26.71
March 1965	246	27.92	23.93
July 1965	234	29.22	25.05
August 1965	222	28.24	24.20
September 1965	234	17.02	14.59
October 1965	241	17.43	14.94
December 1965	238	5.58	4.78

Continued

Appendix table 32.--Phase length test for daily closing prices for soybean meal --Continued

Contract	Number of observations	Chi-square statistic	
		Unadjusted	Adjusted
January 1966	246	13.49	11.56
March 1966	241	23.48	20.13
May 1966	228	17.22	14.76
July 1966	243	34.84	29.86
August 1966	243	26.32	22.56
September 1966	205	10.46	8.96
October 1966	204	28.09	24.08
December 1966	244	27.32	23.42
January 1967	244	51.81	44.41
March 1967	243	44.37	38.03
May 1967	244	38.94	33.38
July 1967	243	43.22	37.05
August 1967	242	44.43	38.08
September 1967	243	35.63	30.54
October 1967	241	24.09	20.65
December 1967	244	39.53	33.89
January 1968	244	25.16	21.56
March 1968	245	25.61	21.95
May 1968	245	51.27	43.95
July 1968	235	34.10	29.22
August 1968	227	33.71	28.89
September 1968	243	30.30	25.97
October 1968	197	8.03	6.88
December 1968	238	38.89	33.33
January 1969	243	55.84	47.87
March 1969	244	39.46	33.82
May 1969	243	25.88	22.18
July 1969	243	21.14	18.12
August 1969	242	32.36	27.74
September 1969	243	45.43	38.94
October 1969	241	21.01	18.01
December 1969	245	42.35	36.30
January 1970	246	53.20	45.60
March 1970	246	33.01	28.30
May 1970	249	40.86	35.03
July 1970	246	24.85	21.30
August 1970	244	23.52	20.16
September 1970	245	38.41	32.92
October 1970	250	17.25	14.79
December 1970	250	30.90	26.49
January 1971	251	17.57	15.06
March 1971	251	25.60	21.94
May 1971	218	17.80	15.26
July 1971	174	13.94	11.95
August 1971	145	6.39	5.48
September 1971	132	16.97	14.55
October 1971	109	8.51	7.29

Appendix table 33.--Phase length test for daily closing prices for shell eggs

Contract	Number of observations	Chi-square statistic	
		Unadjusted	Adjusted
September 1960	249	21.02	18.02
October 1960	248	13.51	11.58
November 1960	206	7.10	6.09
December 1960	207	4.20	3.60
January 1961	205	8.03	6.88
September 1961	240	9.78	8.38
October 1961	238	9.77	8.37
November 1961	220	15.57	13.35
December 1961	221	16.01	13.73
January 1962	240	28.06	24.05
September 1962	241	6.53	5.59
October 1962	230	3.42	2.93
November 1962	240	12.06	10.33
December 1962	228	11.43	9.80
January 1963	180	19.30	16.54
September 1963	246	15.07	12.91
October 1963	239	18.63	15.96
November 1963	230	26.01	22.30
December 1963	232	14.64	12.55
January 1964	190	19.85	17.02
September 1964	244	21.88	18.75
October 1964	226	21.69	18.59
November 1964	215	14.23	12.19
December 1964	144	11.22	9.62
January 1965	105	5.71	4.89
September 1965	245	33.64	28.84
October 1965	240	25.53	21.88
November 1965	217	24.15	20.70
December 1965	168	15.06	12.90
January 1966	155	18.09	15.51
September 1966	206	35.15	30.13
October 1966	223	33.33	28.57
November 1966	155	17.65	15.13
December 1966	193	13.11	11.24
January 1967	94	7.03	6.02
September 1967	241	7.72	6.62
October 1967	189	6.84	5.86
November 1967	194	18.17	15.57
December 1967	146	10.49	8.99
January 1968	78	13.09	11.22
September 1968	219	30.24	25.92
October 1968	196	37.81	32.41
December 1968	193	15.89	13.62
January 1969	117	23.66	20.28
March 1969	44	2.27	1.95
April 1969	76	14.13	12.11
May 1969	44	2.77	2.37
June 1969	49	7.36	6.31
July 1969	99	19.64	16.84
September 1969	221	12.25	10.50
October 1969	222	10.79	9.25
November 1969	206	35.04	30.04
December 1969	162	24.21	20.75
January 1970	160	30.21	25.89
February 1970	139	7.72	6.62
March 1970	136	12.36	10.60
April 1970	133	29.27	25.09
May 1970	134	12.17	10.43
June 1970	138	9.38	8.04
July 1970	63	6.37	5.46
September 1970	181	28.94	24.81
October 1970	183	22.56	19.34
November 1970	138	12.92	11.07
December 1970	203	20.45	17.53
January 1971	176	10.72	9.19
February 1971	81	8.13	6.97
March 1971	82	2.09	1.79
April 1971	73	3.33	2.85
May 1971	73	5.65	4.84
June 1971	72	17.72	15.19

Appendix table 34.--Phase length test for daily closing prices for frozen pork bellies

Contract	Number of observations	Chi-square statistic	
		Unadjusted	Adjusted
July 1964	153	26.40	22.63
August 1964	185	22.45	19.24
March 1965	171	16.29	13.96
May 1965	228	22.09	18.94
July 1965	246	34.35	29.44
August 1965	246	36.44	31.24
February 1966	194	30.91	26.50
March 1966	216	44.71	38.32
May 1966	243	35.44	30.38
July 1966	247	20.20	17.31
August 1966	248	18.45	15.82
February 1967	239	13.68	11.73
March 1967	216	6.90	5.91
May 1967	241	7.92	6.79
July 1967	244	14.29	12.25
August 1967	242	6.66	5.71
February 1968	225	9.85	8.44
March 1968	246	12.39	10.62
May 1968	246	11.72	10.05
July 1968	246	23.06	10.77
August 1968	243	25.55	21.90
February 1969	224	18.68	16.01
March 1969	245	17.85	15.30
May 1969	239	13.73	11.77
July 1969	244	19.74	16.92
August 1969	242	16.31	13.98
February 1970	231	10.96	3.40
March 1970	239	7.84	6.72
May 1970	239	11.77	10.09
July 1970	246	8.49	7.28
August 1970	246	12.97	11.12
May 1971	211	24.36	20.88
July 1971	166	24.51	21.01
August 1971	146	31.45	26.96
February 1972	42	11.09	9.51
March 1972	38	5.07	4.34

Appendix table 35.--Phase length test for daily closing prices for live cattle

Contract	Number of observations	Chi-square statistic	
		Unadjusted	Adjusted
June 1965	140	16.58	14.21
August 1965	181	39.29	33.68
October 1965	225	38.56	33.05
December 1965	230	37.86	32.45
February 1966	184	44.49	38.14
April 1966	213	24.00	20.57
June 1966	189	27.74	23.77
August 1966	183	49.74	42.63
October 1966	204	50.68	43.44
December 1966	245	71.10	60.94
February 1967	242	43.30	37.12
April 1967	241	37.06	31.77
June 1967	218	63.57	54.49
August 1967	242	48.92	41.93
October 1967	280	55.39	47.47
December 1967	325	49.55	42.48
February 1968	358	42.04	36.04
April 1968	319	65.66	56.28
June 1968	322	25.75	22.07
August 1968	281	19.64	16.83
October 1968	224	40.50	34.71
December 1968	243	34.69	29.74
February 1969	242	60.64	51.98
April 1969	242	40.71	34.90
June 1969	238	37.38	32.04
August 1969	213	24.85	21.30
October 1969	248	45.81	39.27
December 1969	244	33.77	28.95
February 1970	242	26.41	22.64
April 1970	274	44.47	38.12
June 1970	314	56.71	48.60
August 1970	332	55.74	47.77
October 1970	292	25.25	21.64
December 1970	334	14.58	12.49
February 1971	321	19.68	16.87
April 1971	287	18.45	15.81
June 1971	336	19.96	17.11
August 1971	225	19.27	16.51
October 1971	212	20.09	17.22
December 1971	213	14.00	12.00
February 1972	173	31.05	26.61

Appendix table 36.--Phase length test for daily closing prices for Maine potatoes

Contract	Number of observations	Chi-square statistic	
		Unadjusted	Adjusted
March 1960	176	12.68	10.87
April 1960	198	31.95	27.38
May 1960	217	24.52	21.02
November 1960	210	6.03	5.17
March 1961	238	18.68	16.01
April 1961	234	23.76	20.37
May 1961	239	17.74	15.21
November 1961	239	10.61	9.10
March 1962	230	27.69	23.74
April 1962	240	29.35	25.16
May 1962	239	35.83	30.71
November 1962	228	20.15	17.27
March 1963	236	9.24	7.92
April 1963	237	36.30	31.12
May 1963	238	26.93	23.08
November 1963	239	10.41	8.92
March 1964	237	21.95	18.81
April 1964	238	34.11	29.23
May 1964	236	34.56	29.63
November 1964	220	1.95	1.67
March 1965	238	12.29	10.53
April 1965	238	17.14	14.69
May 1965	238	20.06	17.19
November 1965	238	15.82	13.56
March 1966	237	30.73	26.34
April 1966	236	13.80	11.83
May 1966	238	18.52	15.88
November 1966	239	15.16	13.00
March 1967	250	16.60	14.23
April 1967	252	18.18	15.59
May 1967	252	26.71	22.89
November 1967	251	9.16	7.85
March 1968	249	15.52	13.30
April 1968	251	21.14	18.12
May 1968	250	6.78	5.81
November 1968	247	4.18	3.58
March 1969	247	25.20	21.60
April 1969	247	14.08	12.07
May 1969	246	20.61	17.66
March 1970	249	20.86	17.88
April 1970	250	27.65	23.70
May 1970	244	31.55	27.04
November 1970	230	9.74	8.35
March 1971	249	15.67	13.43
April 1971	245	22.82	19.56
May 1971	224	36.28	31.09

END