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ANALYSIS OF SEASONAL VARIATION IN PRICES OF LIVESTOCK

by

© ANNA SUM-YIN WEI

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

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FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "Analysis of Seasonal Variation in Prices of Livestock," submitted by Anna Sum-Yin Wei, in partial fulfilment of the requirements for the degree of Master of Science.

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Date ...April 26, 1973...

ABSTRACT

This study provides information on seasonal livestock price variations in Edmonton and Toronto at stockyard, wholesale, and retail levels. Information of this nature can aid producers in scheduling their production and marketing activities.

The basic components of livestock price series are the trend, cycle factors, seasonal variation, and other factors grouped under the term of random or irregular components. Isolating and analyzing all the factors generally, and the seasonal factor in particular, are essential for quantifying the pattern of total variation between the low and high price periods, the periods most likely to have lowest and highest prices, and the direction of price changes from one month to the next. In this study, time series analysis is applied to monthly price data for 1962-1971 to obtain the pattern of seasonal price movements. Basing future decisions on such patterns further requires some evidence of stability of the observed patterns. Such evidence is obtained by the technique of analysis of variance. A number of simple formulae for projecting monthly prices based on observed patterns are presented and illustrated.

Empirically, this study obtains: (1) average seasonal price patterns for the commodities considered; (2) evidence of any significant shifts in seasonal price movements; and (3) an evaluation of the reliability of the indexes of average seasonal variation.

In conclusion, major observations regarding seasonal price movements for livestock data in Edmonton and Toronto are summarized.

The highest seasonal prices of choice and good steers at the stockyard and wholesale level are in Spring and Summer. Prices for good

and choice lambs are highest in late Winter, Spring, and the beginning of Summer. For index 100 hogs and bacon, prices are highest in Summer. The highest prices for beef cuts are in Summer and Fall. For fresh pork loin and lamb the highest prices are in mid-Summer and Fall.

Regarding the reliability of the indexes of seasonal variation, the widest expected range of price variation for good and choice steers is in Winter and Fall. For good and choice lambs, the widest range is in Winter. The expected fluctuation range for bacon is narrow. The widest range for sirloin and round steak is in the late Spring and during October. There is no wide range for rib blade roast and hamburger. For fresh pork loins, the widest range is in the late Fall and early Winter. The widest range for Toronto lamb is in June and for Edmonton lamb, in March.

Those price series for which significant shifts in the seasonal pattern over time are indicated are stockyard prices of good steers (Edmonton), the wholesale price of bacon and choice lambs (Edmonton and Toronto), and the retail price of round steak (Toronto), sirloin steak, blade roast, hamburger and fresh pork loins (Edmonton and Toronto). It is important to note that the observed seasonal patterns are based on the product market and other economic conditions that prevailed during the period studied. Such patterns may be employed in combination with other types of market intelligence information to aid the functioning of the market for livestock over time. In particular, knowledge of the nature and extent of the impact of technological innovations, consumer tastes and preferences, and possibly interregional and international market conditions must be utilized in making livestock production and marketing decisions at the farm, wholesale, and retail

levels. These factors are not dealt with in the present study.

The conclusion emphasizes the need for regular reporting and the analysis of data pertaining to various factors that act in determining the outcomes in the livestock market.

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INTRODUCTION

Purposes of the Study

Farming is one occupation where seasonality in production and in prices is particularly evident. Prices farmers receive for their products vary considerably from one period of the year to the next. For this reason, it may well pay individual farmers to consider these seasonal price changes when they plan their production. It may be possible for them to benefit from information about price movements by changing their marketing and breeding dates, marketing weights, the grades of livestock they purchase and when and how they feed, and by making many other decisions related to raising, feeding, and marketing their products.

Seasonal movements in the price of an agricultural commodity are important to producers and to those who process and market the commodity. If the seasonal movement is uniform from year to year, individual producers may plan their production to take advantage of this and processing and storage may be carried out with low risk. If the seasonal movement varies greatly among years, considerable risk may be introduced into farming operations. Under these circumstances, it becomes important to judge what the seasonal movement in a particular year is likely to be.

The seasonal pattern of prices may be different at various stages of marketing. Retail prices generally tend to fluctuate less than do wholesale prices. Wholesale prices generally fluctuate less than do farm prices.

It is necessary to understand the importance of price in a competitive economy. Its importance lies in its ability to transfer

information from consumers to producers and vice versa. For example, when demand changes, the resulting change in price is a signal to producers to alter production. Interpretation of price information is essential in a market economy. If producers interpret short-run price movements as long-run trends, their reaction may worsen their situation. Interpretation of price information is the basis for planning production in the next period and deciding when and how to market the product. If producers ignore these price signals, poor production planning results. This is soon translated into reduced incomes. It is important that sellers and buyers have a knowledge of seasonal variations in prices and realize the underlying causes of these variations. Using this knowledge, they can plan their marketing and production activities towards improving their incomes.

Of more interest to most producers of livestock is the seasonal behavior of individual grades and classes. A farmer preparing to sell a load of hogs or cattle wants to know, not a general average, but the most likely price trend for the particular kinds of hogs or cattle he has for sale. Seasonal price patterns are by no means the same for different grades of a product.

A major barrier in present information services is lack of interpretation of existing data. Many producers do not have the necessary training or intuition to project past and current trends from raw statistics.

The purpose of this study is to provide some information about livestock price variations that will assist producers and others in planning their production and marketings. Such information can assist those involved in the production and marketing of agricultural commodities

to make decisions of a long- and/or short-term nature which are consistent with stable industry growth and prosperity.

Scope of the Study

Variations in the prices of livestock or any other commodity may be decomposed into four principal elements: changes in trend, cyclical changes, seasonal changes, and irregular changes. These four types of changes are also referred to as the major "time series components."

The trend component reflects the general direction of the movement of a statistical time series over a long period of time. A study of price fluctuations may be concerned with the analysis of either seasonal or cyclical fluctuations or both. By definition, a seasonal analysis is concerned with price fluctuations occurring within a twelve-month period. A cyclical analysis is generally concerned with price fluctuations occurring over longer time periods. Cyclical fluctuations may reflect movements in the general economy associated with periods of prosperity and depression; in the case of livestock, cyclical production and price fluctuations (known as livestock cycles) may prevail. The irregular component generally refers to that variation which is unexplained by trend, cyclical, or seasonal components. It is sometimes referred to as "random" or accidental change. This study will be limited to the study of seasonal price fluctuations for livestock, -- specifically, beef cattle, hogs, and lambs.

This study will attempt to answer the following basic questions with respect to seasonal price fluctuations:

1. How much total variation can be expected between the low

price period and the high price period.

2. When are the periods of lowest and highest prices most likely to occur during the year?

3. What is the likely direction of price change from one month to the next?

The study consists of: (1) the presentation of average seasonal price patterns for the commodities considered; (2) an examination of any significant shifts in seasonal price movements; (3) an evaluation of the reliability of average seasonal variation; and (4) a number of simple formula for projecting monthly prices based on observed patterns are presented and illustrated.

Data and Time Period Used for Analysis

The three types of information utilized in this study were prices of livestock at public stockyards, wholesale dressed meat prices, and consumer prices. Prices of livestock at public stockyards and wholesale dressed meat prices were obtained from the Livestock and Meat Trade Report.[1] Consumer prices for various meat cuts were obtained from the data bank maintained by the Department of Agricultural Economics and Rural Sociology, University of Alberta. The study covered price series at two centres -- Edmonton and Toronto. With respect to cattle, the prices analyzed were public stockyard prices of good steers and choice steers, wholesale prices of good steers and choice steers, and the retail prices for sirloin steak, round steak, rib roast, blade roast, and hamburger. With respect to hogs, the price series analyzed were the public stockyard prices of index 100 dressed hogs, the wholesale price

[1] Canada Department of Agriculture, Livestock and Meat Trade Report (Ottawa: CDA, Marketing Information Services, 1962-1971).

of bacon, and the retail prices for fresh pork loins. For lamb, the price series analyzed were the public stockyard prices of good lamb, the wholesale price of choice lamb, and the retail price of lamb. The two regional markets considered in each case were Edmonton and Toronto.

The original data series are available on a weekly basis. These were averaged into monthly series for the purpose of analysis. The period of analysis was from 1962 to 1971 for wholesale and public stockyard prices. For consumer prices, data was available from 1962 to 1969.

Methodology and Tools of Analysis

The method used for constructing the seasonal index was the ratio-to-moving average measure. This is a commonly accepted method used to compute a typical seasonal pattern. The method eliminates the trend, cyclical, and irregular components from the original data. This technique is applied to the data in Chapter IV.

Variance analysis can be used to indicate whether a seasonal pattern exists or does not exist in doubtful cases.[1] It was used to test the statistical significance of the change in seasonal price variation for every year between successive months.

The expected ranges of seasonal price variation were measured by use of the standard deviation. One standard deviation was conceived as an indicator of reliability of the average seasonal index.[2] With a normally distributed set of observations, 68 percent of the observations would lie within one standard deviation of the mean. Such a range (mean

[1] R.J. Foote and Karl A. Fox, Seasonal Variation: Methods of Measurement and Tests of Significance, Agriculture Handbook No. 48 (Washington, D.C.: Bureau of Agricultural Economics, USDA, September, 1952), p. 8.

[2] For a justification of this conception refer to p.12.

± one standard deviation), corresponding to a probability level of 68 percent is the smallest level that is required to capture more than half of the observations in a normal distribution. Hence all ranges were established on the probability level of 68 percent.

Limitations of Seasonal Price Analysis

There are some limitations involved in using any seasonal price measure. First, the seasonal factor is only one of several factors which influence prices. An average seasonal price variation index will represent the price movement during the year which may result if supply conditions are average and if the demand situation remains unchanged from year to year. Such conditions, of course, hardly become a realized fact in any one year. Price levels and fluctuations represent levels of change in supply and demand. In addition, the seasonal price measures are based on average monthly prices. They do not indicate the particular day or week when highest prices will occur.

It should be noted that average seasonal price indexes may change over time. These changes are usually brought about through changes in production or supply and demand conditions.

Some important precautions should, therefore, be noted in the use of seasonal indexes. According to Neter and Wasserman:

> 1. No technique can measure seasonal variation precisely. This is true of any technique based upon the conceptual approach in which an attempt is made to measure this variation by isolating it from the other movements in a time series. A pattern of seasonal variation is not an absolute distinct entity.
>
> 2. In developing a seasonal index, one obtains a series of measures -- a measure for January, a measure for February, and so forth -- each of which is generally expressed as a figure with a base of 100. If we obtain seasonal indexes for which the values are all close to

100 it may well be that no real monthly seasonal variation exists in the series and that the small differences from 100 are only due to random influences or imperfect measurement. Statistical techniques are available for helping to decide whether a time series really contains a pattern of seasonal variation.

3. Even if the computed index of seasonal variation indicates a pronounced pattern, it may have no significance for a particular year. Any seasonal index represents an average pattern over a number of years. If the seasonal pattern is not a stable one, any average pattern may be a poor representation of actual seasonal variation.

4. Seasonal price patterns are one of several factors that can be used in projecting future price movements. A seasonal index is based on past prices. The danger always exists that a past statistical relationship will not continue to hold in the future. Seasonal patterns, like other types of statistical relationships may change over time. For this reason, it may be necessary to frequently recalculate the seasonal index, incorporating latest data. In using these patterns for projection purposes, therefore, consideration must be given to any changes in supply and demand conditions that may cause this year's price pattern to vary from the average pattern of past years. Average seasonal patterns may be useful as price guides. However, they do not constitute a rule which will always prevail.[1]

Organization of the Study

Chapter II presents the ratio to moving average technique of measuring seasonal fluctuations in livestock prices. A method of projecting future monthly prices is also presented. A description of the test for significant shifts in seasonal price patterns and further price projection methods are given in Chapter III. Results of the analysis of various livestock price series for Edmonton and Toronto appear in Chapter IV and Chapter V contains a summary and conclusions and recommendations for further study.

[1] John Neter and William Wasserman, Fundamental Statistics for Business and Economics (Boston: Allyn and Bacon, Inc., 1961), p. 766.

CHAPTER II

SEASONAL FLUCTUATIONS OF LIVESTOCK PRICES: MEASUREMENT AND PROJECTIONS

This chapter first outlines the nature of seasonal price movements for agricultural commodities with specific reference to livestock prices. Next, the statistical technique of ratio-to-moving average for calculating average seasonal indexes is described. A need to calculate the variations in each monthly seasonal index is indicated. A simple price projection method using average seasonal indexes is noted.[1] The study then proposes some improvement of the simple price projection method.

Seasonal Movement of Agricultural Prices

Prices of most agricultural commodities fluctuate seasonally. Such fluctuations are due primarily to seasonality in supply and, possibly, in demand. The seasonal nature of production and supply itself is partly due to seasonal variations in weather conditions. In the case of livestock, reproduction periods and seasonal changes in pasture conditions and feed supplies are relevant factors giving rise to seasonal production changes.

Two general characteristics concerning seasonal variation may be noted. First, seasonal changes in prices tend to be greater for products with relatively short harvesting or marketing periods. Second, the more perishable a product, the greater the variation in prices is likely to be. Beef, pork, fruit and vegetables are such perishable and semi-perishable commodities.

[1] See P.14.

Agricultural price changes are by no means solely due to seasonality in production and marketing. Long-run price changes are caused by various additional forces such as changes in population, in disposable per capita incomes, and in the technology of production, processing and marketing. All such forces are outside the scope of this study. However, such forces must be borne in mind when interpreting empirical measurements of seasonal price changes.[1] Seasonal indexes of prices are calculated from statistical time series of prices by the ratio-to-moving average technique. Calculation and examination of seasonal indexes of prices for several years may reveal a certain pattern of seasonal indexes. Analysis of such a pattern helps to answer questions which were posed in the previous chapter of this study.[2]

The Ratio-to-Moving Average Method of Time Series Analysis

A statistical time series is a set of observed, time-ordered values of a variable such as price. A time series represents the combined effects of four separate (but not necessarily separable) groups of forces, namely:

1) secular trend or long-term tendency (T),

2) seasonal variation (S),

3) cyclical variation (C), and

4) residual or irregular variation (I).

These four components were defined above.[3] Time series analysis refers to methods of treating time series data in such a way as to separate the

[1] A good reference on various short- and long-run factors related to agricultural price movements is: G.S. Shepherd, Agricultural Price Analysis (Ames, Iowa: Iowa State University Press, 1963), pp. 3-43.

[2] Supra, pp. 3-4

[3] Supra, p. 3.

series into its four component parts. Applying this analysis to various series of prices on cattle, hogs, and lambs will consequently enable one to separate and examine the seasonal components and patterns of the prices of the commodities.

The ratio-to-moving average method is based on the following models:

$$Y = T \times S \times C \times I \qquad (2.1)$$

$$Y = T \times S \times I \qquad (2.2)$$

where Y represents the observed time series and T,S,C, and I represent, respectively, the trend, seasonal, cyclical, and irregular components. In model (2.2), T is called the trend cycle, which is a combination of T x C in model (2.1).

The basic assumptions of model (2.1) and (2.2) are:

1) that the seasonal variation, S, has a twelve-month period and that the shape of the variation is the same each year, and

2) that the residual variations, I, are independent for different periods (years).

If the above assumptions are acceptable, then, when a twelve-month moving average is applied to model (2.1) or (2.2), it will smooth out the S x I, leaving as a remainder the T x C. Using the moving average, T x C, one may find S x I as follows:

$$\frac{\text{Original data}}{\text{Moving-average}} = \frac{T \times S \times C \times I}{T \times C} = S \times I \qquad (2.3)$$

and S x I may then be used to obtain, for each month, a seasonal index which provides a numerical measure of typical seasonal behavior of a particular economic variable such as price. The steps used in deriving the seasonal indexes are given in Appendix C, p. 78.

The seasonal indexes computed by the ratio-to-moving average

method are in a sense indexes of average seasonal variation. That is, one obtains the seasonal indexes as an average pattern based on observed monthly data for a number of years. Yet another way to express this is to say that the seasonal indexes so obtained constitute an average inter-temporal pattern. If the assumptions underlying the ratio-to-moving average technique hold in practice, then the seasonal indexes and the seasonal pattern for all years will be identical.[1] The said assumptions, however, do not hold in practice. Prices of most agricultural commodities do reveal a regular seasonal movement within the season from a low price point during the peak harvest and marketing weeks to a high price point when supplies slacken. Further, such seasonal movements vary from year to year, from one commodity to another, and from one marketing centre to another. Consequently, a study designed to provide information on the pattern of seasonal movements of stockyard, wholesale, and retail prices of beef, pork, and lamb at Edmonton and Toronto must take into consideration the intra-temporal variation of seasonal indexes calculated by the ratio-to-moving average technique. Calculation of the standard deviations and standard errors of the seasonal indexes enables one to take this factor into account.

The Standard Deviations and Standard Errors of Seasonal Indexes

The standard deviations of an estimate such as the mean provides a measure of the range of variation about the mean. In a normal distribution, 68 percent of the individual items that make up the mean will differ from the mean itself by less than one standard deviation. To the extent that most of the individual items are included within the band of length one standard deviation around the mean, the standard deviation may

[1] The underlying assumptions have been listed above. Supra, p. 10.

be regarded as an index of reliability of the mean. Further, if a mean of several sample means is calculated, the theoretical sampling distribution of this "overall mean" can be closely approximated with a normal distribution. The standard deviation of the overall mean, called the standard error, may also be regarded as an index of reliability similar to the standard deviation of a mean.

Now the average seasonal indexes obtained by the ratio-to-moving average technique are similar to sample means since the indexes are calculated by successive averaging processes based on monthly data over a number of years. Specifying the standard deviations and standard errors of the indexes therefore enables one to provide measures of variation about the individual indexes, which in turn provide indexes of reliability of the seasonal indexes. Formally, let:

X_i = the seasonal index for month i and

$\bar{X} = \sum_{i=1}^{12} X_i/12$ = the average of twelve monthly seasonal indexes.

Then the standard deviation of the seasonal indexes is defined as:

$$S_{Xi} = \left[\frac{\sum_{j=1}^{N} X_{ij}^2 - \bar{X}_i \sum_{j=1}^{N} X_{ij}}{N-1} \right]^{1/2} \qquad (2.4)$$

and the standard error of the seasonal indexes is defined as:

$$S_{\bar{X}} = \frac{S_{Xi}}{\sqrt{N}} \qquad (2.5)$$

The standard error of the difference between two months may be calculated as:

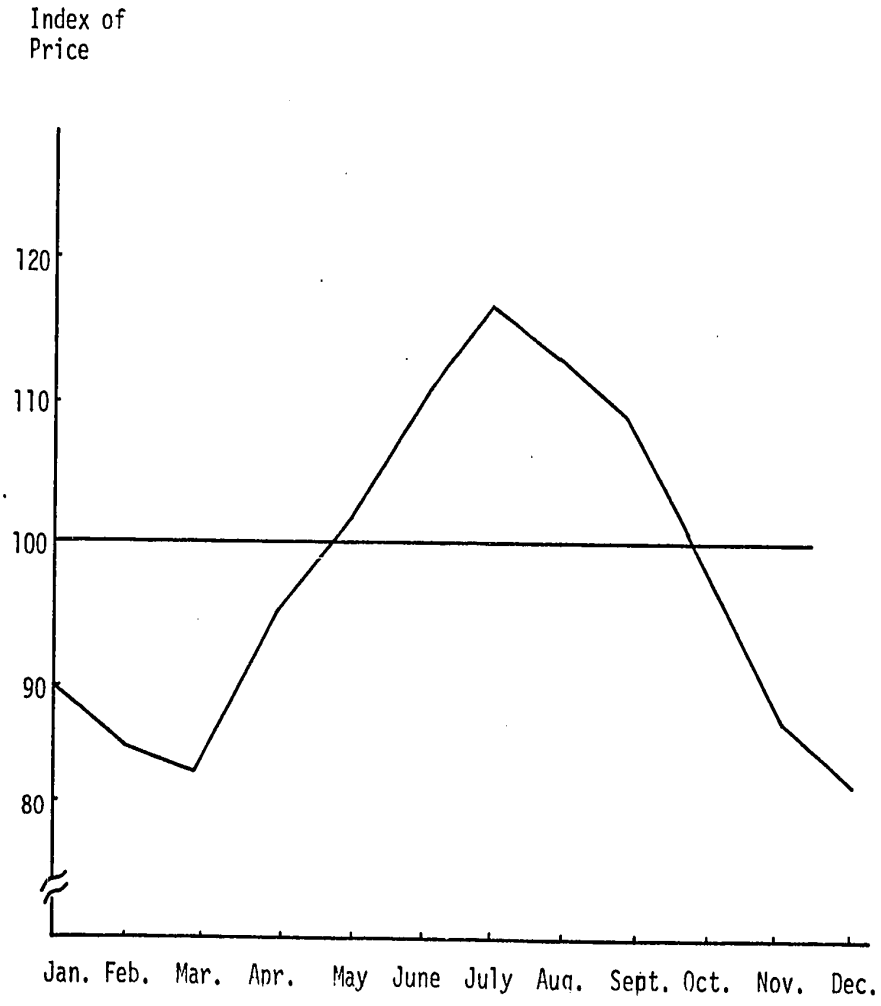
$$S_{(X_i - X_j)} = \sqrt{S_i^2 + S_j^2} \qquad (2.6)$$

where the subscripts i and j denote two different months.

Seasonal indexes may be used to project average monthly prices in the following manner. For some commodity, the seasonal price index plotted against the months of a year may reveal a pattern such as that depicted in the diagram below.

FIGURE 2.1

A HYPOTHETICAL GRAPH OF A SEASONAL PRICE INDEX



A month during which the graph is above the horizontal base line denoting an index value of 100 would be a good target marketing date for a producer. The best selling month is indicated by the highest point on the graph. In any month, the average price that may be expected to prevail in a future month may be estimated according to:

$$\hat{P}_j = P_i \frac{X_j}{X_i}, \quad j > i \tag{2.7}$$

where: $\hat{P}_j$ = estimated monthly average price in month j,

P_i = average price prevailing in month i when the estimation is made,

X_j = index of prices in month j, and

X_i = index of prices in month i.[1]

The decision whether or not to sell in a particular future month must of course depend on a number of other factors such as gain in weight and holding costs. A small numerical example illustrating the calculation involved is given in Appendix A.

The assumptions underlying the projection formula (2.7) are that the observed pattern of seasonal price indexes will continue to prevail and that cyclic-seasonal variations, if any, are negligible. These are highly simplified assumptions since an observed seasonal pattern may change over time and cyclic-seasonal variations are known to exist in agricultural product markets. To date, most studies of future price expectations have not attempted to relax the assumptions noted here. One step towards relaxing these assumptions would be to examine the pattern of average seasonal indexes for any signs of significant changes

[1] Glen R. Purnell and R.W. Robinson, Livestock Prices at Idaho Falls Auction Market, Bulletin 409 (Moscow: Idaho Agricultural Experiment Station, June, 1965), p. 7.

in the pattern and to take into account the intra-seasonal variations in the indexes. The latter may be done by utilizing the standard deviations and standard errors of average seasonal indexes discussed in this chapter.[1] A test for significant changes in seasonal pattern is described in the following chapter. The standard deviation concept is then used to propose an alternative price projection method.

[1] Supra, p. 12.

CHAPTER III

SHIFTS IN SEASONAL PRICE PATTERNS AND FURTHER METHODS OF PRICE PROJECTIONS

Time series data classified by months and years easily lend themselves to a two-way analysis of variance, which is a statistical method for testing whether variations across each of the two bases of classification are closely associated. Such a test performed on monthly series for a number of years would indicate whether or not a significant shift in the seasonal pattern of variations has occurred during the recorded number of years or during a certain subset of recorded years.

Testing for Significant Shifts in Seasonal Patterns

The test of significance based on analysis of variance is presented here in general form.[1]

Let P_{ij} represent the observed price of a commodity in the ith month and jth year.

$i = 1, \ldots\gamma$, $\gamma = 12$ since there are twelve months in a year

$j = 1, \ldots K$.

A given price series may then be arranged in a two-way classification table (see Table 3.1).

---

[1] Many texts on statistical methods deal with analysis of variance. A numerical example closely illustrating the formulation described in this study may be found in: Foote and Fox, Seasonal Variation: Methods of Measurement and Tests of Significance.

TABLE 3.1

MONTHLY PRICES OF A COMMODITY FOR YEARS 1,...K

Year (j) Month (i)	1	2		K	Row Total	Row Mean
January	P_{11}	P_{12}	-----	P_{1K}	$P_{1.}$	$\bar{P}_{1.}$
February	P_{21}	P_{22}		P_{2K}	$P_{2.}$	$\bar{P}_{2.}$
March	.			.		
April	.			.		
May	.			.		
June	.			.		
July	.			.		
August	.			.		
September	.			.		
October	.			.		
November	.			.		
December	$P_{12,1}$	$P_{12,2}$		$P_{12,K}$	$P_{r.}$	$\bar{P}_{r.}$
Column Total	P.1	P.2	----	P.K	T	$\bar{P}$
Column Mean	$\bar{P}$.1	$\bar{P}$.2	----	$\bar{P}$.K		

In the above table:

(1) All row totals are denoted by the row subscript followed by a dot, e.g., total for the first row = $\sum_{j=1}^{K} P_{1j} = P_{1.}$

(2) Row means are denoted with a similar subscript form, e.g., mean for the first row = $P_{1.}/K = \bar{P}_{1.}$

(3) Column totals are denoted by a dot followed by the column subscript, e.g., total for first column = $\sum_{i=1}^{\gamma} P_{i1} = P_{.1}$

(4) Column means are denoted with a similar subscript form, e.g., mean for the first column = $P_{.1}/12 = \bar{P}_{.1}$

(5) T = overall total = $\sum_{i=1}^{\gamma} P_{i.} = \sum_{j=1}^{K} P_{.j}$

(6) $\bar{\bar{P}}$ = overall mean = $\sum_{i=1}^{\gamma} \sum_{j=1}^{K} P_{ij}/N$

N = total number of observations.

The analysis of variance partitions the total variation in the data matrix, $[P_{ij}]$, and the degrees of freedom into the sources of variation as follows:

$$\sum_{i=1}^{\gamma=12} \sum_{j=1}^{K} (P_{ij}-\bar{\bar{P}})^2 = \sum\sum_{ij} (\bar{P}_{i.}-\bar{\bar{P}})^2 + \sum\sum_{ij} (\bar{P}_{.j}-\bar{\bar{P}})^2 + \sum\sum_{ij} (P_{ij}-\bar{P}_{i.}-\bar{P}_{.j}+\bar{\bar{P}})^2$$

Total variation	=	Variation between months	+	Variation between years	+	Interaction or remainder.

For brevity of notation, denote the total variation as V,

variation between months as V_m,

variation between years as V_y,

and the remainder as R.

The number of degrees of freedom associated with V is $(\gamma K-1) = 12K-1$;

with V_m is $(\gamma-1) = 11$;

with V_y is $(K-1)$;

and with R is $(\gamma-1)(K-1) = 11(K-1)$.

The calculated variations may then be summarized in the following analysis of variance table (Table 3.2).

TABLE 3.2

ANALYSIS OF VARIANCE OF MONTHLY PRICES OF A COMMODITY FOR YEARS 1,...K

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio
Months	11	V_m	$V_m^1 = V_m/11$	$F_m = V_m^1/R^1$
Years	K-1	V_y	$V_y^1 = V_y/(k-1)$	
Remainder	11(K-1)	R	$R^1 = R/11(k-1)$	
Total	12K-1	V		

The calculated F-ratio, F_m, is then compared with the theoretical (tabled) value of F using the degrees of freedom, {11, 11(k-1) }, and a prespecified level of significance, α. The test is calculated according to the criterion that the pattern of seasonal variation is significantly different if: $F_m > F^{\alpha}_{11,\ 11(k-1)}$.

Analysis of variance is a test of equality of means applied to homogeneous quantities. The technique and result, therefore, assume that the relevant individual commodities are strictly homogeneous. The seasonal patterns tested for significant changes were derived from broad aggregates that is, means for the separate commodities for the two representative regional points. Hence the results refer only to the specific aggregates and the specific areas. A different form of aggregation of the price series could conceivably alter the results of the analysis of variance.

Anderson and Bancroft[1] note that the application of analysis of variance to sequential price or production data infringes the assumption

[1] R.L. Anderson and T.A. Bancroft, Statistical Theory in Research, (New York: McGraw-Hill Book Company, 1952), pp. 221.

of randomization. However, as Foote and Fox[1] argue some effects to extend the simple calculation of seasonal indexes is worthwhile as a first approximation.

Basically, the above test of significance applied to a whole period of observations, or to parts of the period, provides additional information about the past behavior of the seasonal pattern of price movements. By itself, the test does not lend justification to any assumptions regarding the future pattern of seasonal indexes. Any such assumption, however, may be potentially strengthened or weakened by reference to existing empirical data. Existing data may also be further utilized to improve the reliability of estimated average prices in the future months. One may utilize the concepts of standard deviation and standard error of the seasonal indexes to generate more reliable projections of prices. Specifically, one may be able to provide a projected range of prices rather than single-valued estimates.

Projections of Price Ranges

Instead of writing the seasonal index for any month as a single-value one may use the form $X_i \pm S_{Xi}$, where X_i is the seasonal index for month i and S_{Xi} is its standard deviation calculated according to formula 2.4:

$$S_{Xi} = \left[\frac{\sum_{j=1}^{N} X_{ij}^2 - \bar{X}_i \sum_{j=1}^{N} X_{ij}}{N-1} \right]^{1/2}$$

Under the assumption of normality, the probability that more than half of the observed average seasonal indexes will lie in the interval

[1] Supra, p. 5.

$[X_i - S_{Xi}, X_i + S_{Xi}]$ is 68 percent. Formula 2.7 (the common projection method) may then be modified to provide a range of price estimates for a future month.

Thus: $\hat{P}_{j,L} = P_i \frac{(X_j - S_{Xj})}{X_i}$ = lower limit

and $\hat{P}_{j,u} = P_i \frac{(X_j + S_{Xj})}{X_i}$ = upper limit (3.1)

where $\hat{P}_{j,L}$ and $\hat{P}_{j,u}$ are the estimated lower and upper price in the base month, respectively; X_j and X_i are the average seasonal indexes for months j and i, respectively; and S_{Xj} is the standard deviation of X_j.

If, moreover, the standard deviations of monthly average prices are calculated, thus giving a range of prices $[P_i - S_{pi}, P_i + S_{Pi}]$ for the base month, four possible types of projections may be made for a single commodity in the future month j. These combinations are shown in Table 3.3.

TABLE 3.3

TYPES OF PRICE PROJECTIONS BASED ON ALTERNATIVE COMBINATIONS OF PAST PRICES AND EXPECTED INDEXES OF FUTURE PRICES

X_j / P_i	Expected Index: Low	Expected Index: High
Low	$\hat{P}_{j,1}$ Current price low Future index low	$\hat{P}_{j,2}$ Current price low Future index high
High	$\hat{P}_{j,3}$ Current price high Future index low	$\hat{P}_{j,4}$ Current price high Future index high

The formulas for the four different types of projected prices are thus:

$$\hat{P}_{j,1} = (P_i - S_{pi}) \frac{(X_j - S_{Xj})}{X_i} , \tag{3.2}$$

$$\hat{P}_{j,2} = (P_i - S_{Pi}) \frac{(X_j + S_{Xj})}{X_i} , \tag{3.3}$$

$$\hat{P}_{j,3} = (P_i + S_{Pi}) \frac{(S_j - S_{Xj})}{X_i} , \text{ and} \tag{3.4}$$

$$\hat{P}_{j,4} = (P_i + S_{Pi}) \frac{(X_j + S_{Xj})}{X_i} . \tag{3.5}$$

Calculations based on formulae (3.2), (3.3), (3.4), and (3.5) are illustrated in Appendix B.

Regardless of which formula is used in projecting a future month's price, sellers must consider other factors such as the extra feeding costs, the loss or gain in weight, and other costs of holding stock influencing the profitability of a transaction before deciding when to effect the transaction.

CHAPTER IV

RESULTS OF STATISTICAL ANALYSIS OF LIVESTOCK AND MEAT PRICES FOR EDMONTON AND TORONTO

The techniques presented in Chapters II and III were applied to stockyard, wholesale, and retail prices for beef, pork, and lamb in Edmonton and Toronto. The results of statistical analysis applied to the various price series of meat are presented and discussed in this chapter.

Types and Sources of Data

The meat price series examined in this study were collected for various species, grades, and regions in Canada so as to provide information on monthly price movement to producers and marketers. Prices in Edmonton and Toronto were used to represent the Western and Eastern areas of Canada, respectively. Stockyard prices, wholesale dressed meat prices, and retail prices represented prices obtained at different marketing stages. Stockyard prices represented prices paid by packers and other buyers for live animals. Wholesale prices were the packers' selling prices of dressed animals to butchers and retailers. Prices of three species of meat--beef, pork, and lamb--were studied. Table 4.1 summarizes the types and sources of data.

Result of Statistical Analysis of Price Series

Seasonal Indexes

The pattern of seasonal fluctuations of prices is established by seasonal price indexes as calculated by the ratio-to-moving average method. The seasonal indexes for various types of data analyzed in this study are tabulated in Appendix C, Table C.1 through Table C.4. The

TABLE 4.1

TYPES AND SOURCES OF DATA

Type of Data	Source	Period
Stockyard Price		
Choice Steers		
Good Steers		
Good Lambs		
Index 100, Dressed Hogs	Livestock and	
Wholesale Price	Meat Trade Report[1]	1962-1971
Choice Steers (500-700 lbs.)		
Good Steers (450-700 lbs.)		
Choice Lamb[2] (Fresh, 36-50 lbs.)		
Bacon (Side bacon)		
Retail Price		
Sirloin Steak	Data bank	
Round Steak	maintained by the	
Rib Roast	Department of	
Blade Roast	Agricultural Economics and	1962-1969
Hamburger	Rural Sociology,	
Fresh Pork Loins	University of Alberta	
Lamb		

[1] Canada Department of Agriculture, Livestock and Meat Trade Report, (Ottawa: CDA, Marketing Information Services, 1962-1971).

[2] 1962-1969.

same indexes and the emergent pattern of price fluctuations are depicted graphically in Figure 4.1 through 4.16. On these graphs the horizontal straight line at the index value of 100 is regarded as the average index. An index located above this line means that the price for the corresponding month is expected to be above average, and the price is below average if the index is located below the average index line. To facilitate examination of these graphs, each graph is accompanied by an insertion indicating the months when the seasonal peak price and lowest price was observed in Edmonton and Toronto. The figures in the insertions are expressed as percentages above or below the average index.

Reliability of Seasonal Indexes

As noted in Chapter II (p. 9), seasonal indexes are average constructs. The actual value of an index will likely be located within a certain range--the standard deviation--which must be taken into account as an indicator of the reliability of a seasonal index. Standard deviations and standard errors were calculated for the seasonal indexes of the species and grades of meat considered. The standard deviation shows the range within which the index for any given month in an individual year will fall 68 percent of the time. Usefulness of such generalizations depends on the adequacy of the sample period, the assumption that no major changes in marketing patterns will occur, and the assumption that net seasonal price changes are under consideration.[1] The standard error shows the range of the mean index (average for the period of years observed) expected for a given month. The standard deviations and standard errors

[1] Supra, p. 10.

FIGURE 4.1

SEASONAL PRICE VARIATION INDEX OF CHOICE STEERS AT PUBLIC STOCKYARDS, 1962-1971

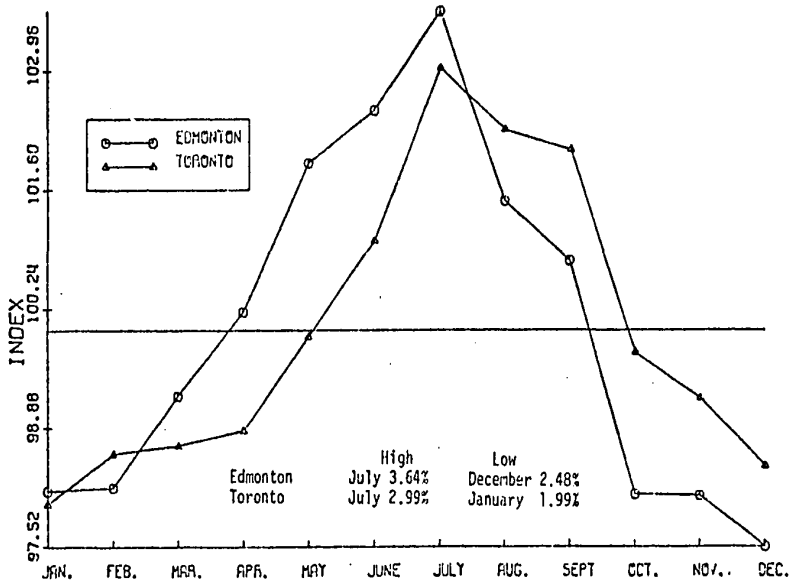


FIGURE 4.2

SEASONAL PRICE VARIATION INDEX OF GOOD STEERS AT PUBLIC STOCKYARDS, 1962-1971

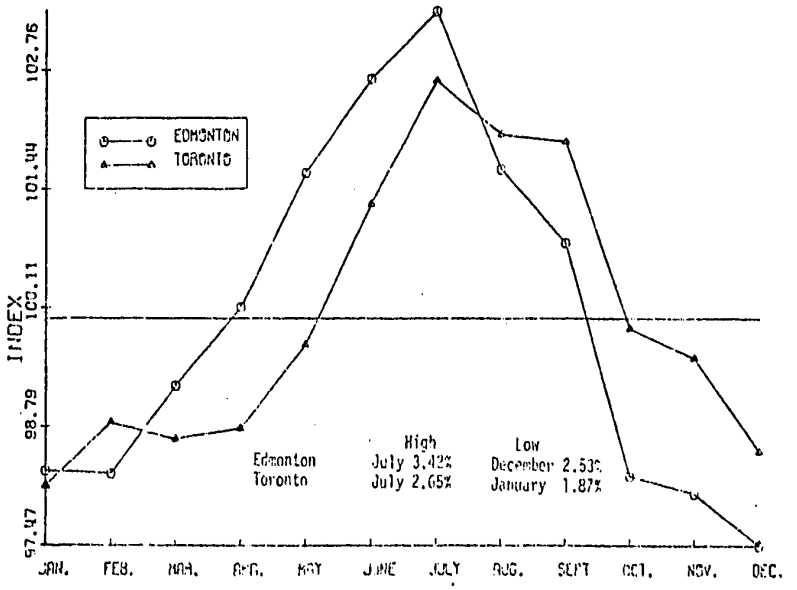


FIGURE 4.3

SEASONAL PRICE VARIATION INDEX OF GOOD LAMBS AT PUBLIC STOCKYARDS, 1962-1971

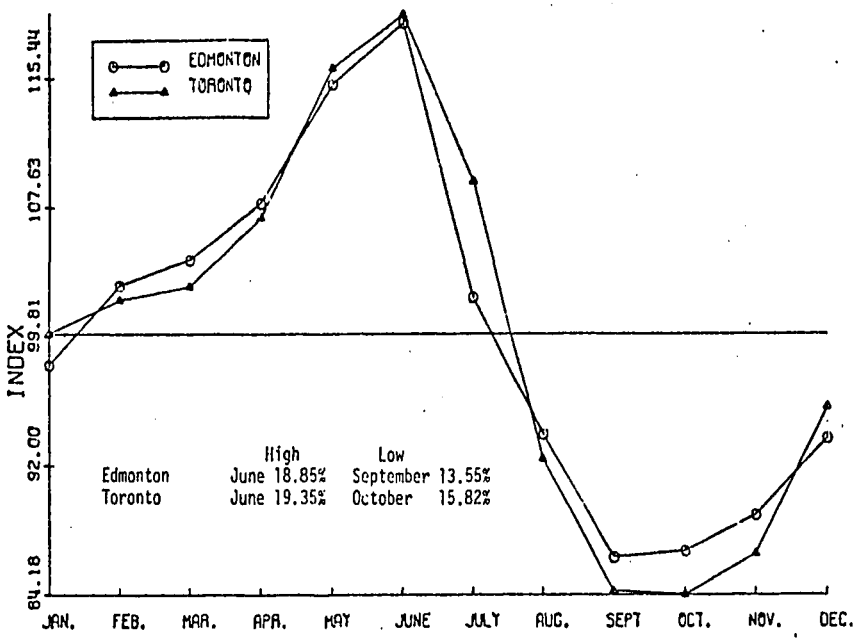


FIGURE 4.4

SEASONAL PRICE VARIATION INDEX OF INDEX 100 DRESSED HOGS AT PUBLIC STOCKYARDS, 1962-1971

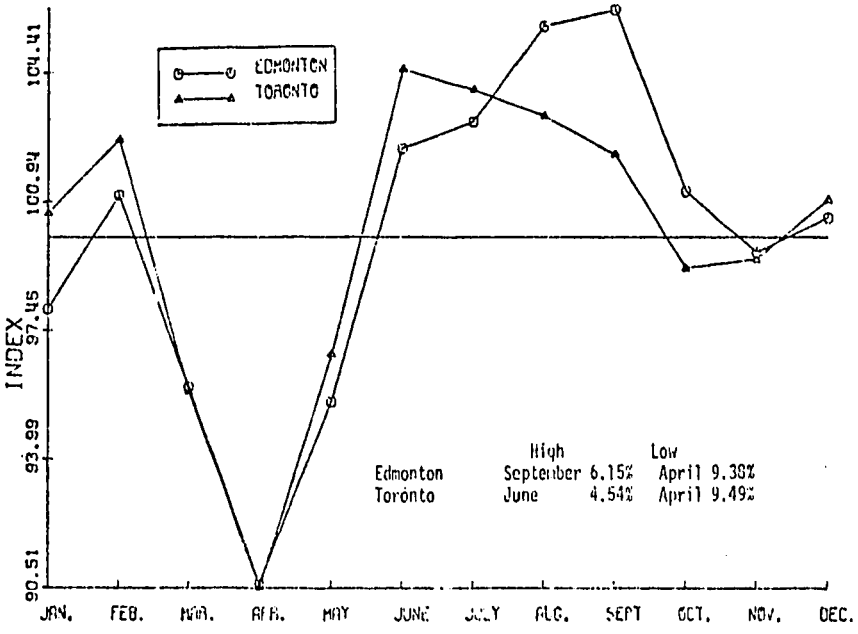


FIGURE 4.5

WHOLESALE PRICE SEASONAL VARIATION INDEX FOR CHOICE STEERS, 1962-1971

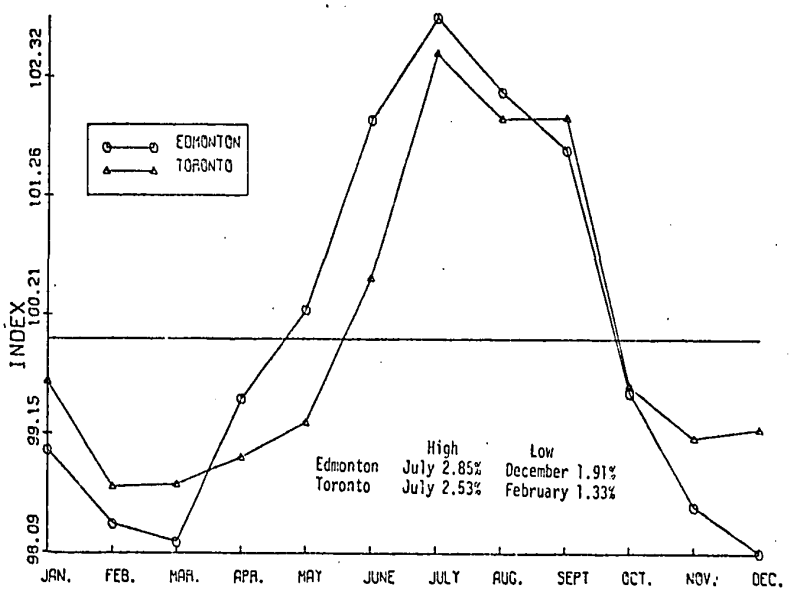


FIGURE 4.6

WHOLESALE PRICE SEASONAL VARIATION INDEX FOR GOOD STEERS, 1962-1971

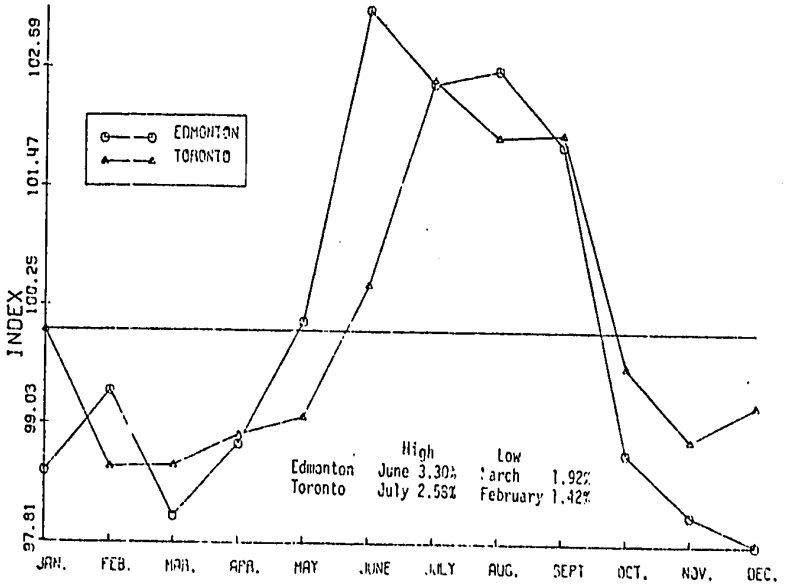


FIGURE 4.7

WHOLESALE PRICE SEASONAL VARIATION INDEX FOR CHOICE LAMBS, 1962-1969

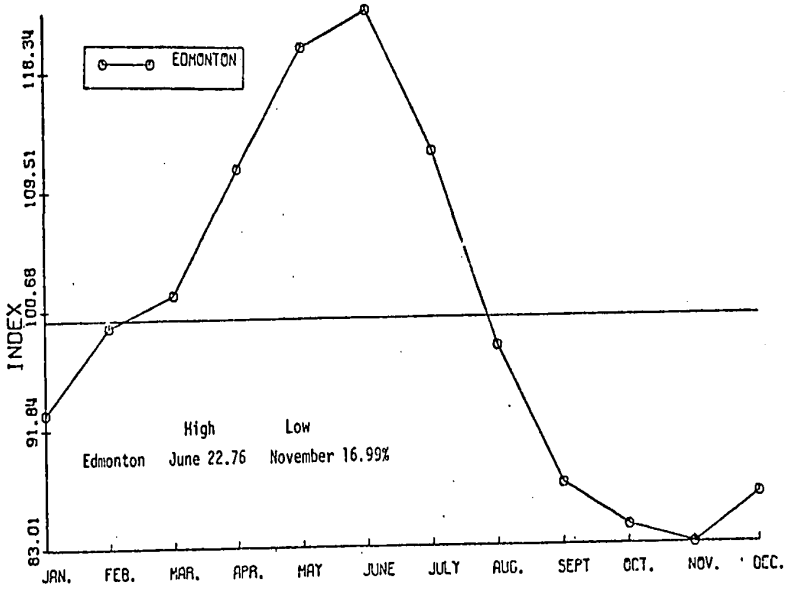


FIGURE 4.8

WHOLESALE PRICE SEASONAL VARIATION INDEX FOR CHOICE LAMBS, 1962-1971

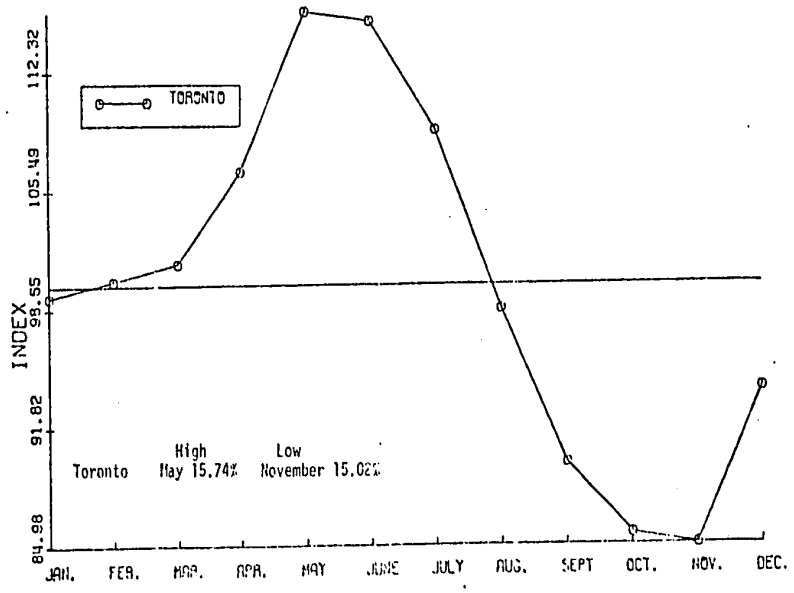


FIGURE 4.9

WHOLESALE PRICES SEASONAL VARIATION INDEX FOR BACON, 1962-1971

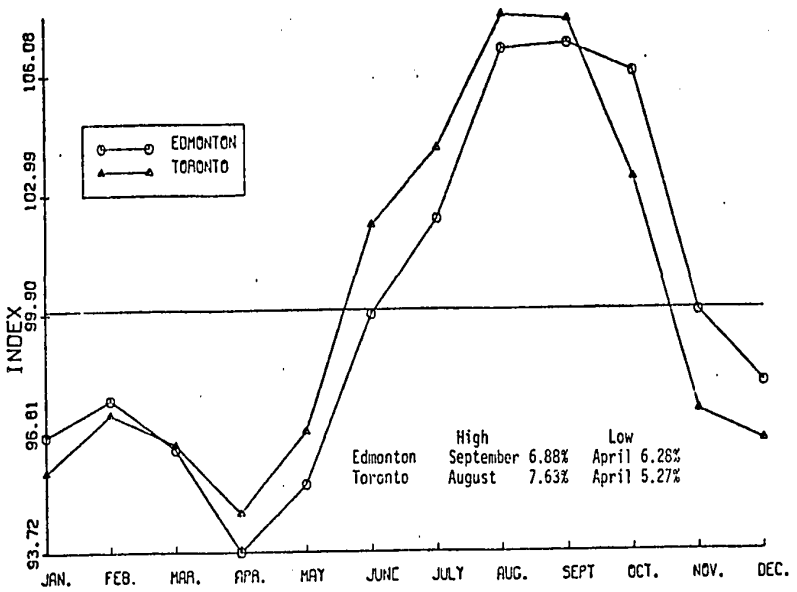


FIGURE 4.10

CONSUMER PRICE SEASONAL VARIATION INDEX FOR SIRLOIN STEAK, 1962-1969

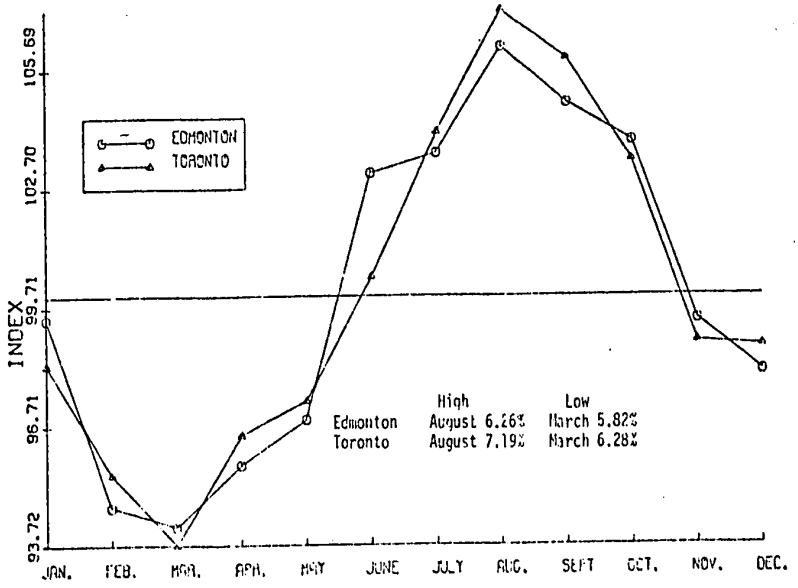


FIGURE 4.11

CONSUMER PRICE SEASONAL VARIATION INDEX FOR ROUND STEAK, 1962-1969

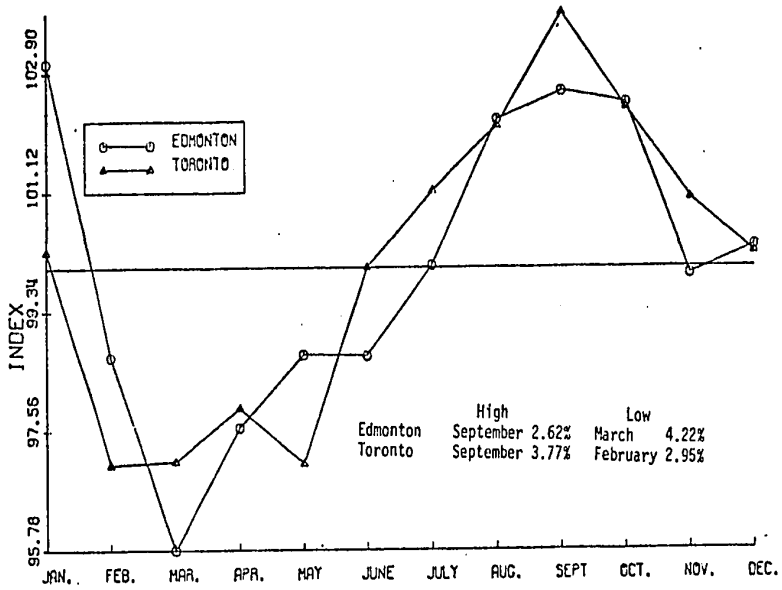


FIGURE 4.12

CONSUMER PRICE SEASONAL VARIATION INDEX FOR RIB ROAST, 1962-1969

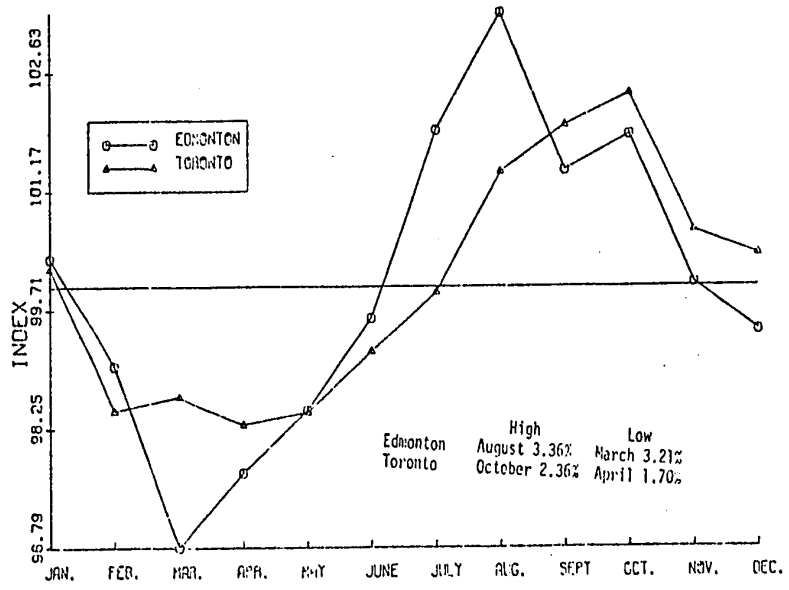


FIGURE 4.13

CONSUMER PRICE SEASONAL VARIATION INDEX FOR BLADE ROAST, 1962-1969

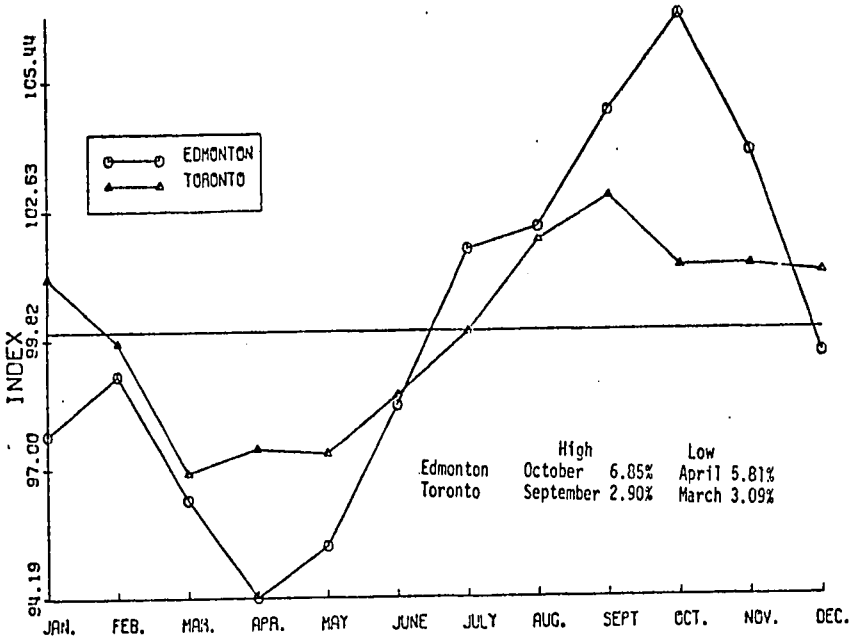


FIGURE 4.14

CONSUMER PRICE SEASONAL VARIATION INDEX FOR HAMBURGER, 1962-1969

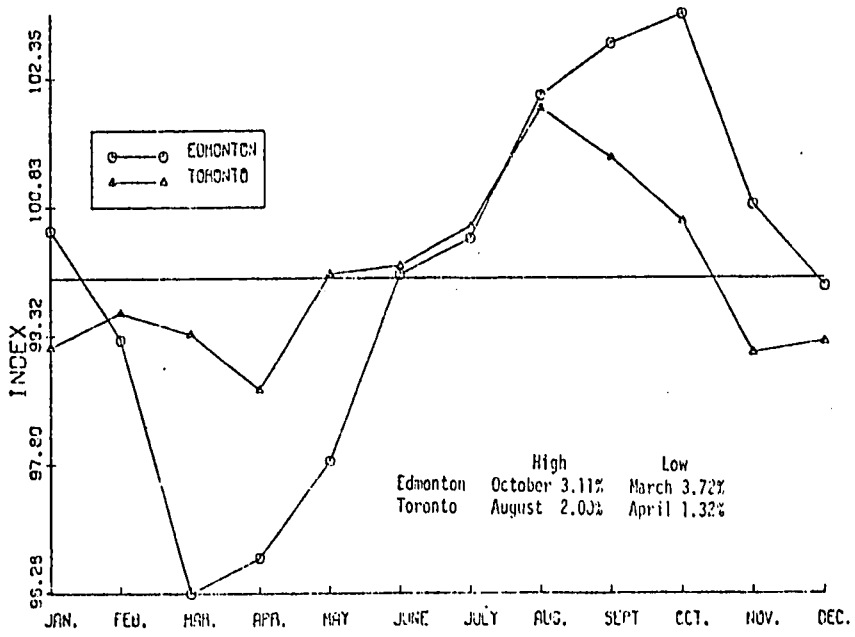


FIGURE 4.15

CONSUMER PRICE SEASONAL VARIATION INDEX FOR FRESH PORK LOINS, 1962-1969

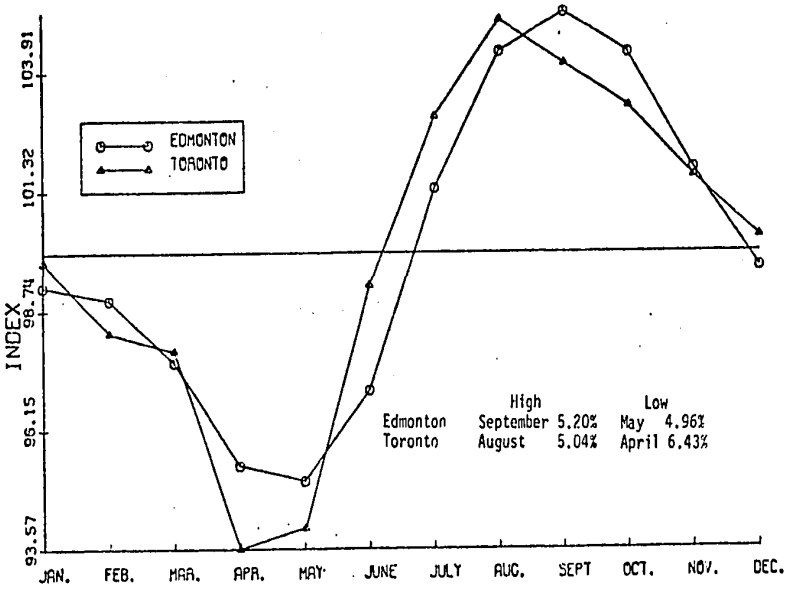
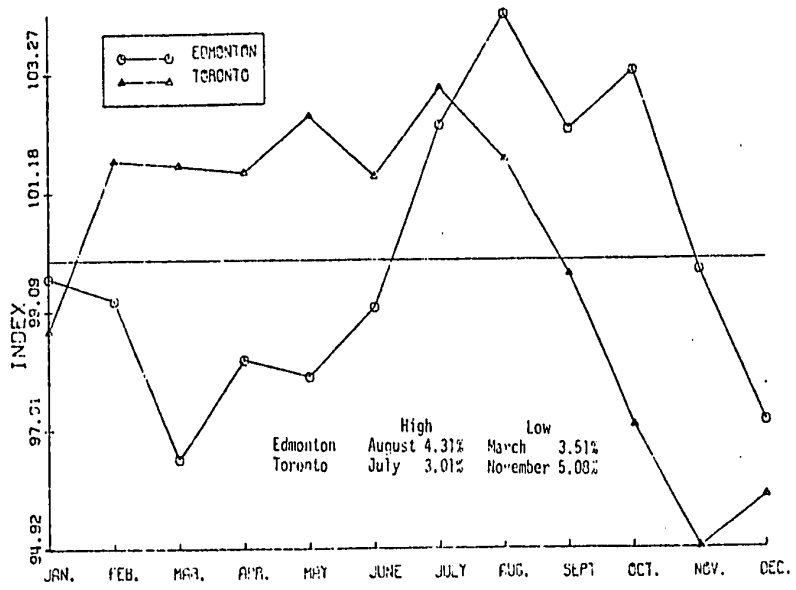


FIGURE 4.16

CONSUMER PRICE SEASONAL VARIATION INDEX FOR LAMB, 1962-1969



are tabulated in Appendix C, Tables C.5 to C.19 and are depicted graphically in Fugure 4.17 through Figure 4.46. In these graphs the standard deviation is depicted as a cross-hatched area (the wide band) and the standard error as a plain, unmarked area (the narrow band). The plain area might be more appropriate for long-run consideration while the cross-hatched area might be more appropriate for a decision to store or sell in a particular year.

All the indexes presented in this section describe the most common seasonal pattern; the most likely to occur in a "normal" year. Most seasonal trends in livestock are fairly regular. They are approximately repeated in enough years to be of value in anticipating changes in prices for the short-run future.

The graphs in Figures 4.17 through 4.46 and Tables C.5 through C.19 (Appendix C) reveal expected variations of monthly indexes in terms of standard deviations. To gain a better insight into the nature of these variations, the standard deviations in percentage terms were converted into dollar values based on the average price data presented in Table 4.2. Descriptions of price deviations in dollar values for the months revealing the highest variations are provided below for various commodities.

Seasonal Variation of Stockyard Prices

Choice Steers

In Edmonton, during February, September, and October, the variation of indexes exceeded ± 5.5 percent (Figure 4.17; Appendix C, Table C.5). Based on the average price of $26.03 per cwt.[1] for the 1962-1971

[1] Table 4.2.

FIGURE 4.17

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL PRICE VARIATION

FOR CHOICE STEERS AT PUBLIC STOCKYARD, EDMONTON, 1962-1971

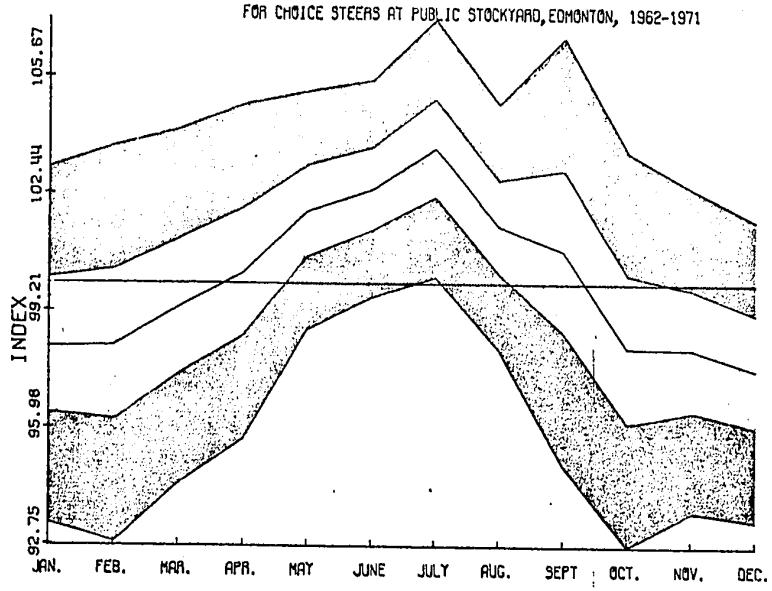


FIGURE 4.18

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL PRICE VARIATION

FOR CHOICE STEERS AT PUBLIC STOCKYARD, TORONTO, 1962-1971

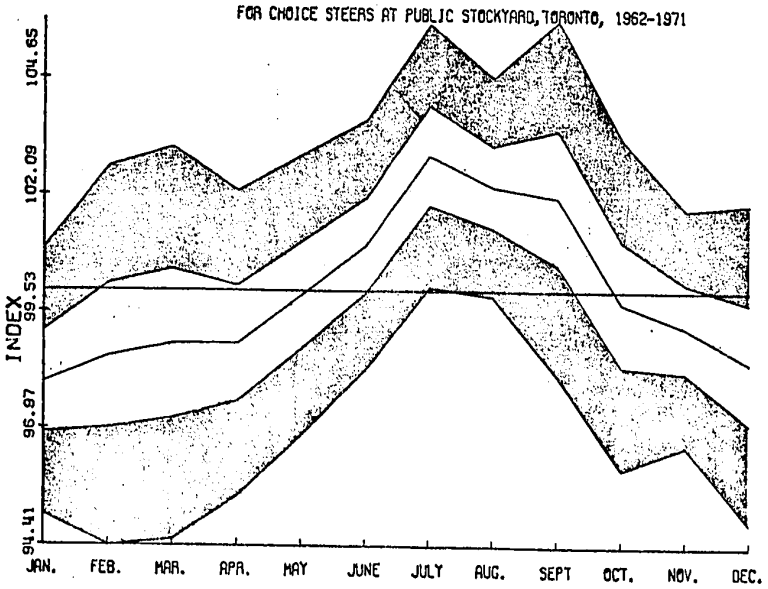


FIGURE 4.19

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL PRICE VARIATION

FOR GOOD STEERS AT PUBLIC STOCKYARD, EDMONTON, 1962-1971

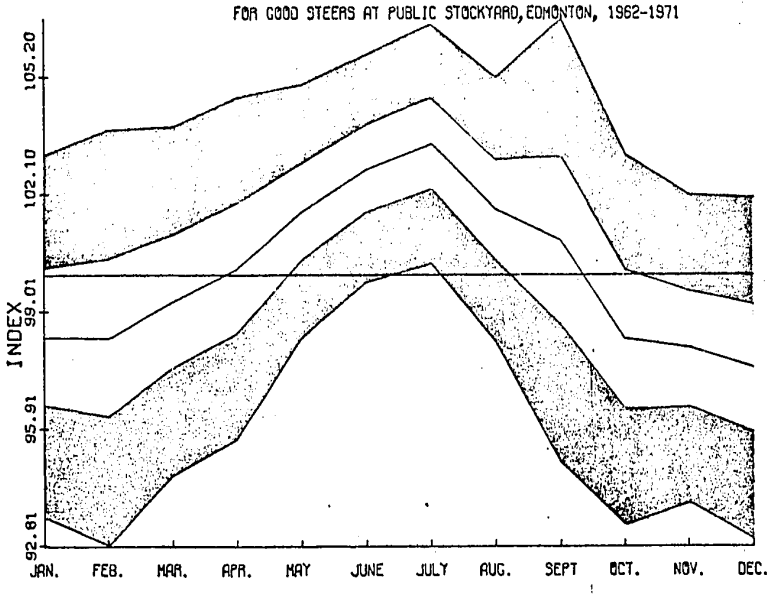


FIGURE 4.20

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL PRICE VARIATION

FOR GOOD STEERS AT PUBLIC STOCKYARD, TORONTO, 1962-1971

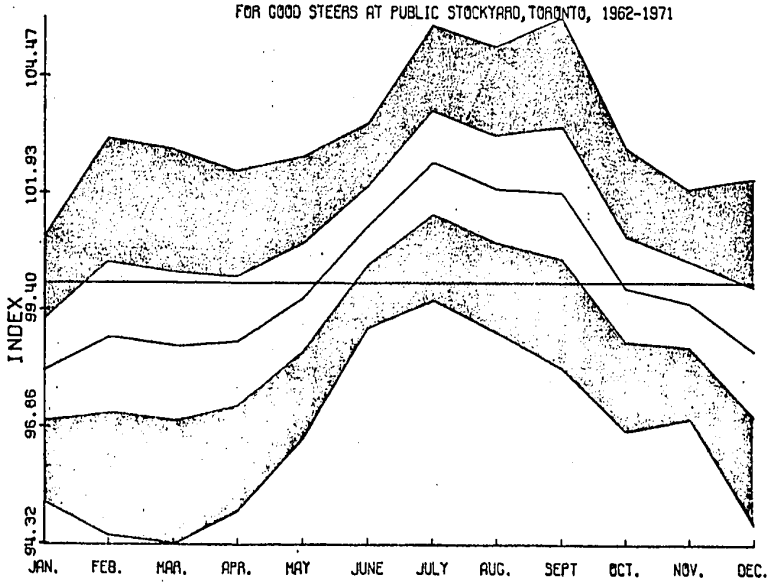


FIGURE 4.21

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL PRICE VARIATION

FOR GOOD LAMB AT PUBLIC STOCKYARD, EDMONTON, 1962-1971

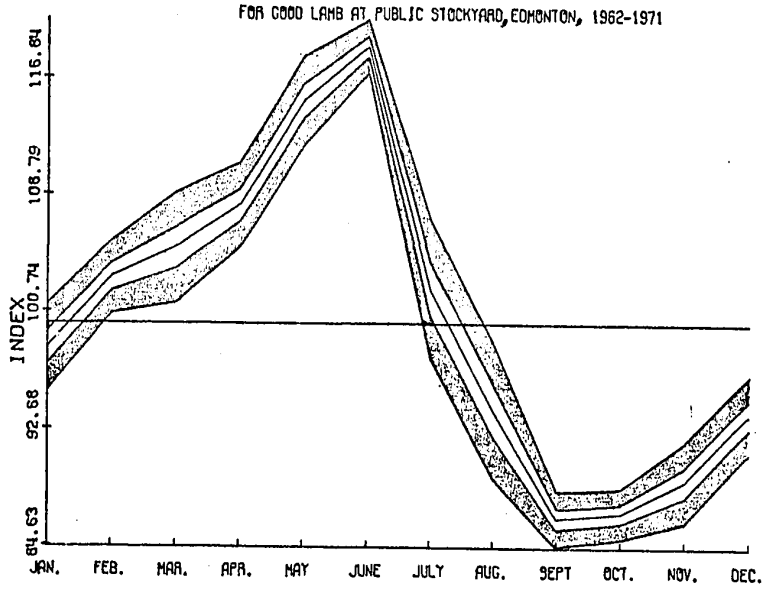


FIGURE 4.22

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL PRICE VARIATION

FOR GOOD LAMB AT PUBLIC STOCKYARD, TORONTO, 1962-1971

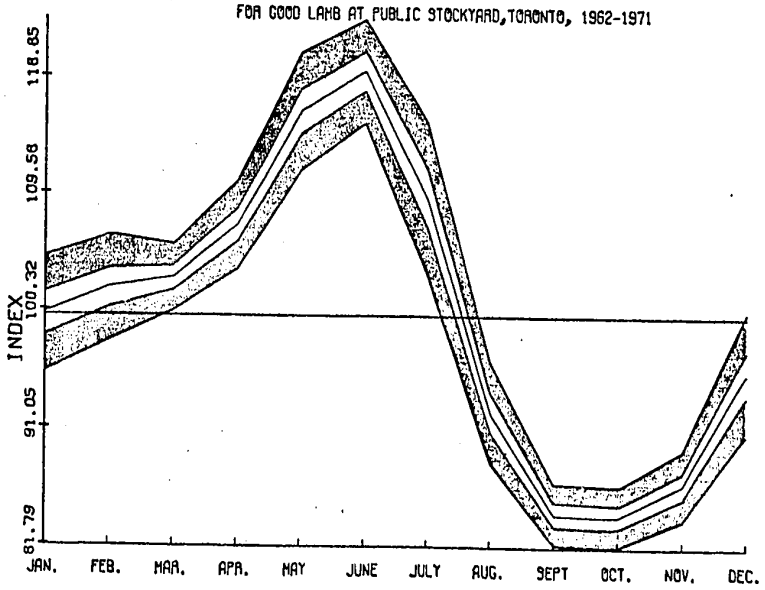


FIGURE 4.23

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL PRICE VARIATION

FOR INDEX 100 DRESSED HOGS AT PUBLIC STOCKYARD, EDMONTON, 1962-1971

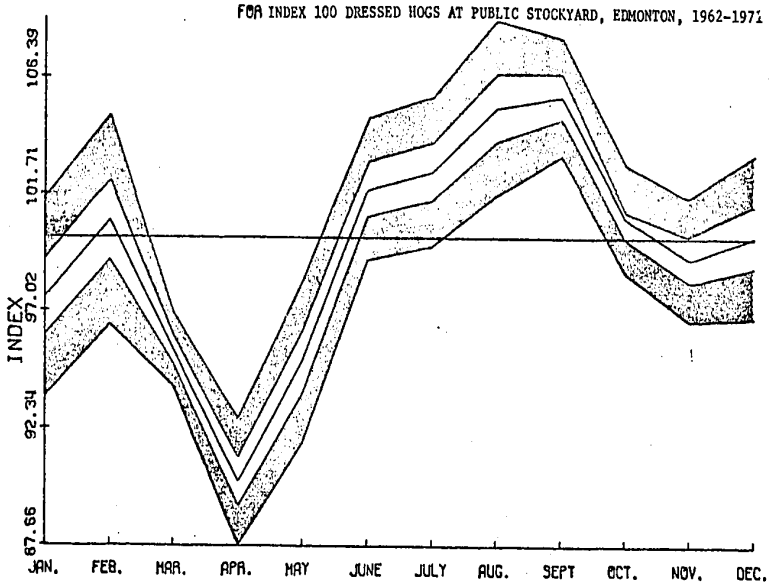


FIGURE 4.24

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL PRICE VARIATION

FOR INDEX 100 DRESSED HOGS AT PUBLIC STOCKYARD, TORONTO, 1962-1971

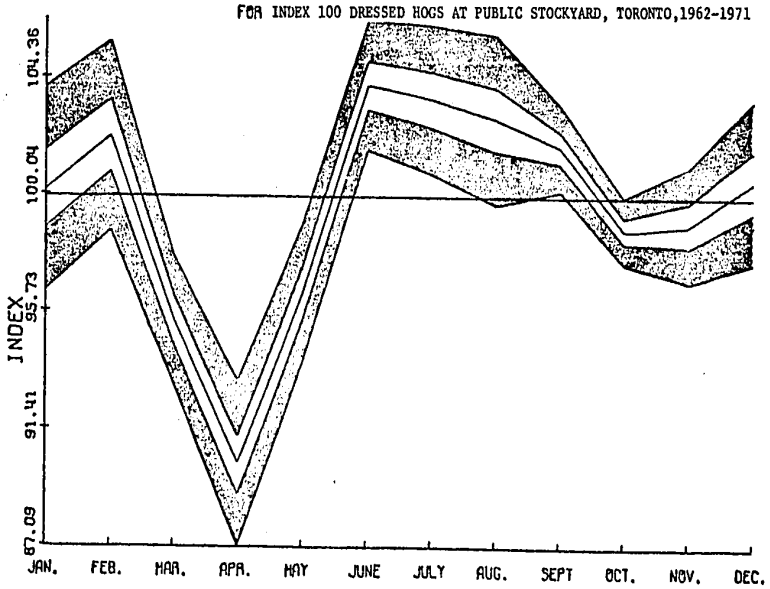


FIGURE 4.25

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL WHOLESALE PRICE VARIATION FOR CHOICE STEERS, EDMONTON, 1962-1971

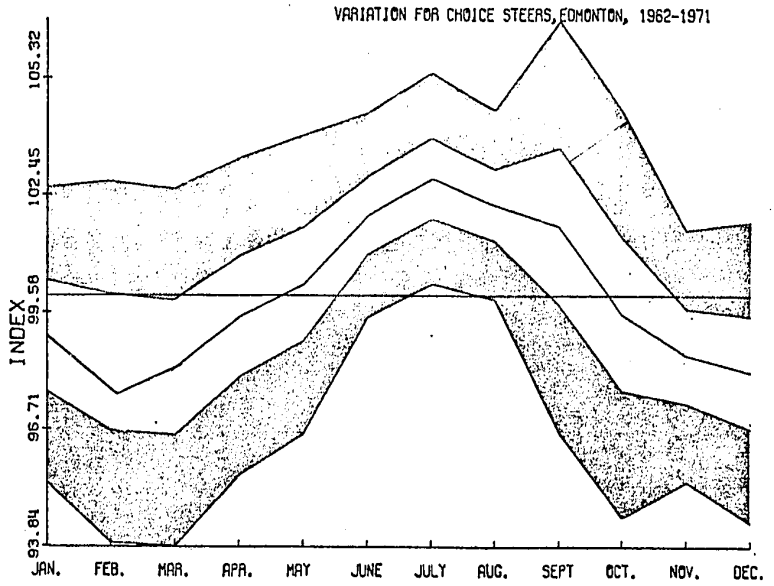


FIGURE 4.26

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL WHOLESALE PRICE VARIATION FOR CHOICE STEERS, TORONTO, 1962-1971

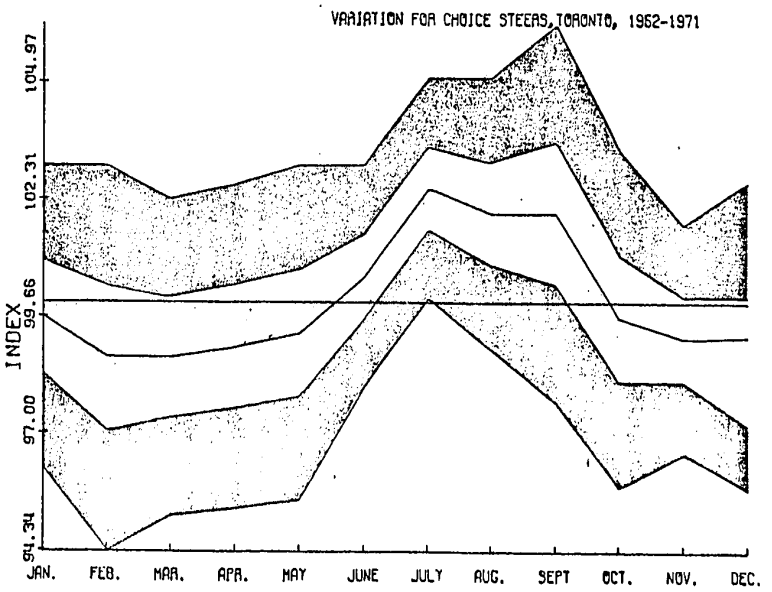


FIGURE 4.27

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL WHOLESALE PRICE VARIATION FOR GOOD STEERS, EDMONTON, 1962-1971

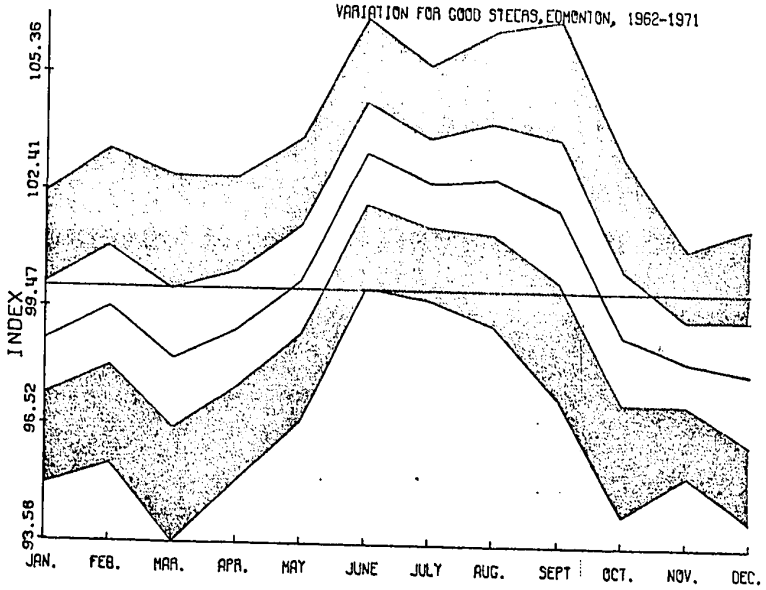


FIGURE 4.28

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL WHOLESALE PRICE VARIATION FOR GOOD STEERS, TORONTO, 1962-1971

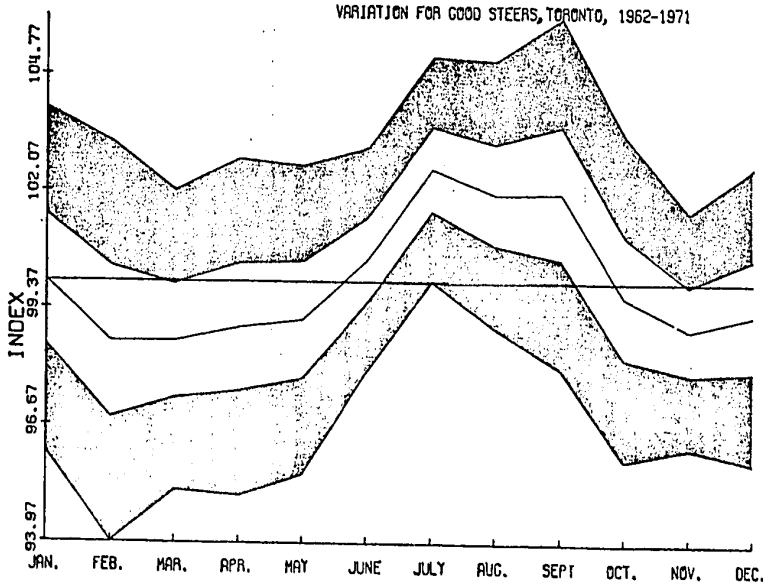


FIGURE 4.29

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL WHOLESALE PRICE VARIATION FOR CHOICE LAMB, EDMONTON, 1962-1969

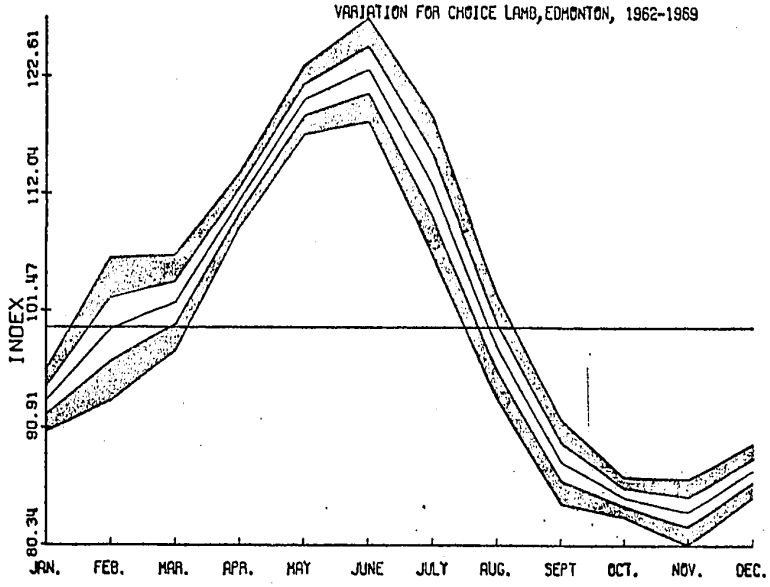


FIGURE 4.30

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL WHOLESALE PRICE VARIATION FOR CHOICE LAMB, TORONTO, 1962-1971

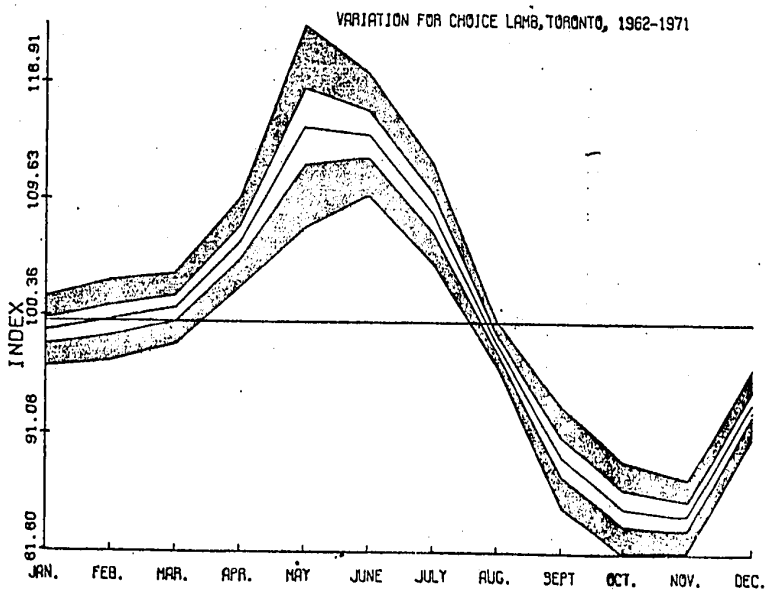


FIGURE 4.31

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL WHOLESALE PRICE

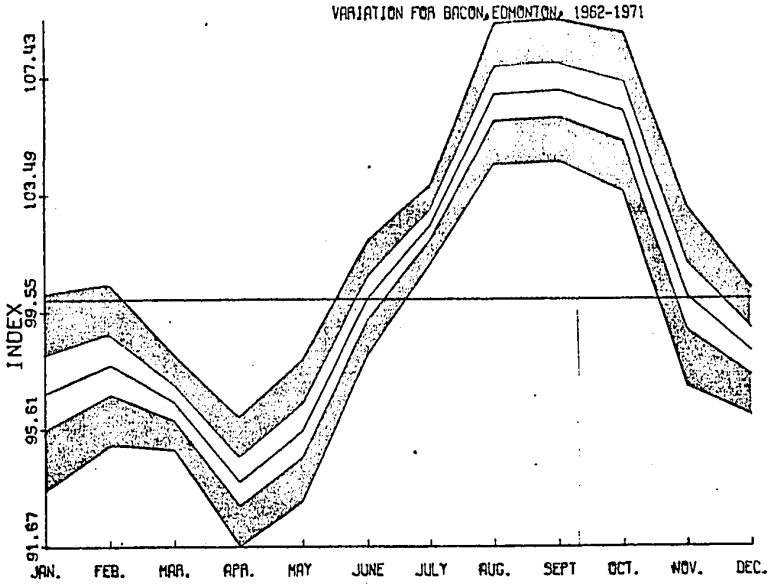


FIGURE 4.32

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL WHOLESALE PRICE

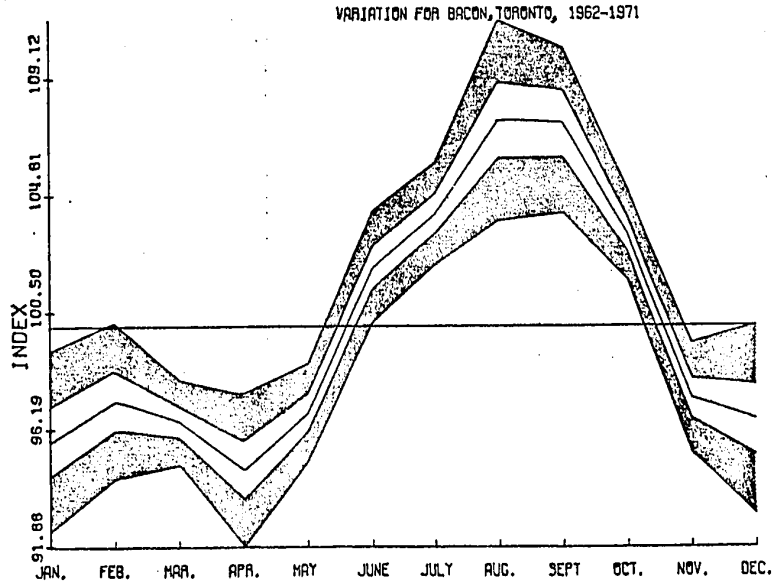


FIGURE 4.33

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL CONSUMER PRICE VARIATION FOR SIRLOIN STEAK, EDMONTON, 1962-1969

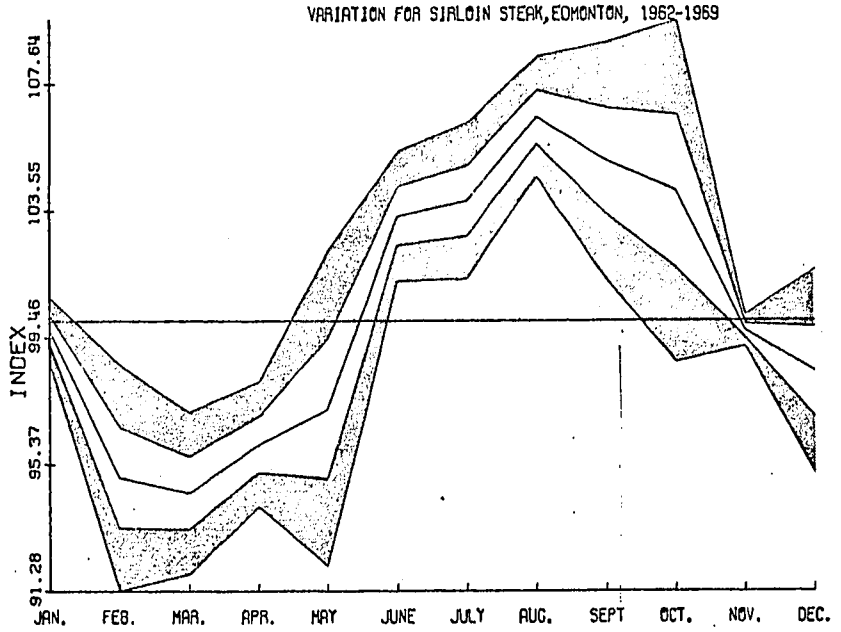


FIGURE 4.34

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL CONSUMER PRICE VARIATION FOR SIRLOIN STEAK, TORONTO, 1962-1969

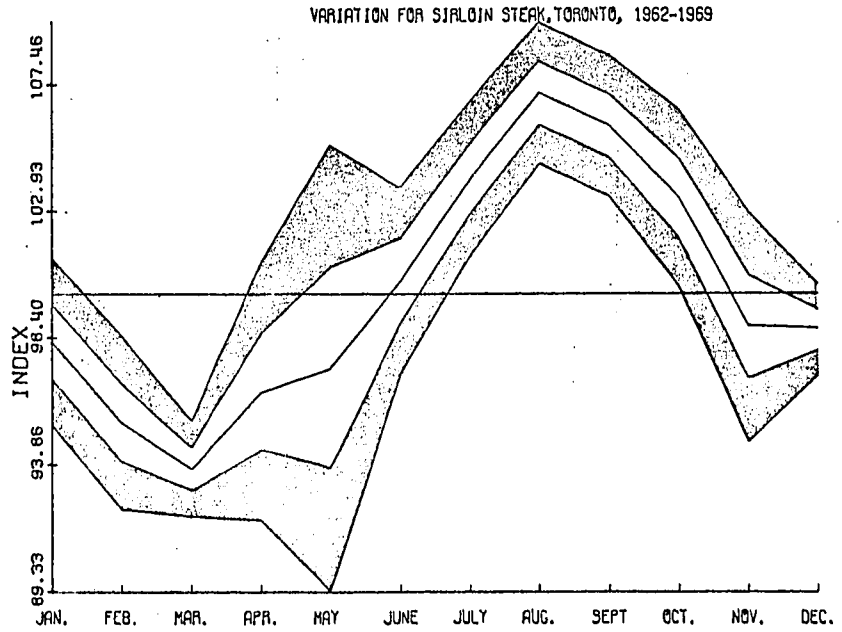


FIGURE 4. 35

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL CONSUMER PRICE VARIATION FOR ROUND STEAK, EDMONTON, 1962-1969

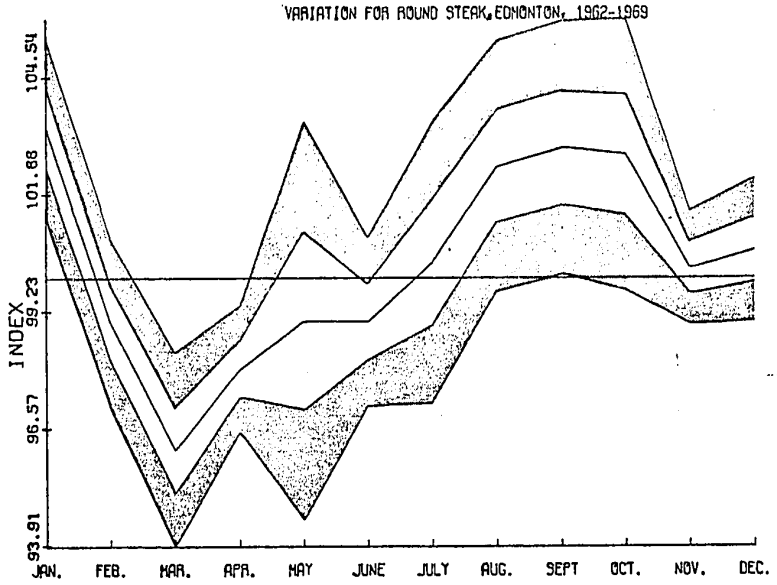


FIGURE 4.36

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL CONSUMER PRICE VARIATION FOR ROUND STEAK, TORONTO, 1962-1969

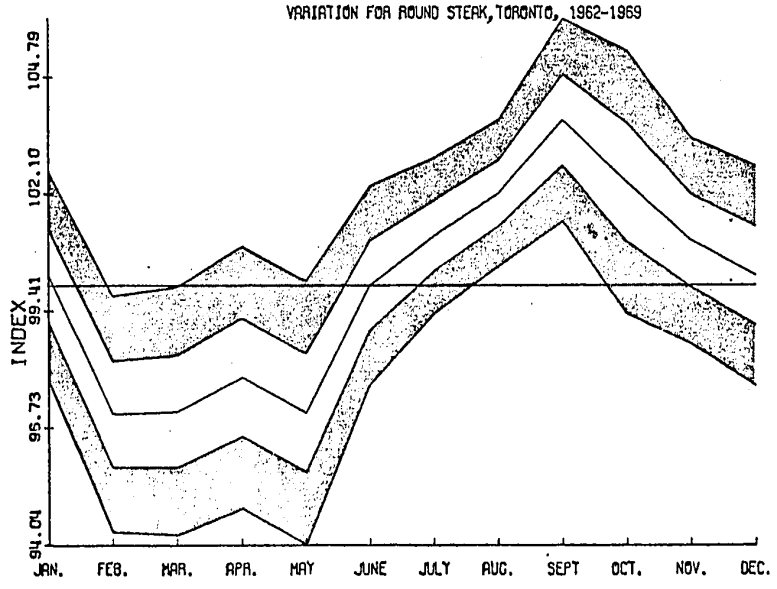


FIGURE 4.37

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL CONSUMER PRICE VARIATION FOR RIB ROAST, EDMONTON, 1962-1969

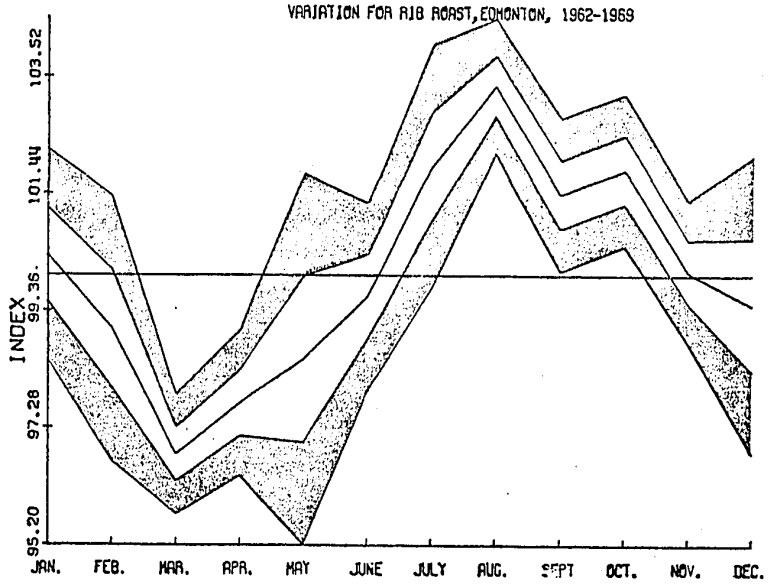


FIGURE 4.38

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL CONSUMER PRICE VARIATION FOR RIB ROAST, TORONTO, 1962-1969

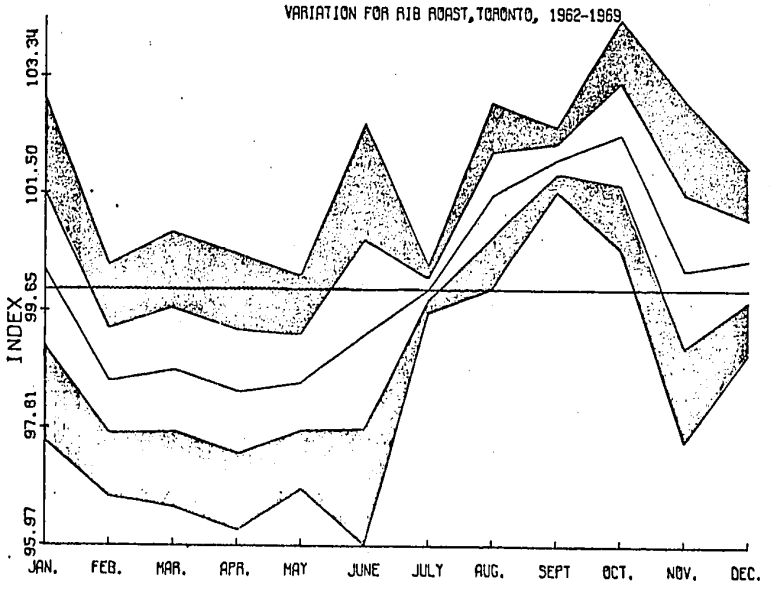


FIGURE 4.39

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL CONSUMER PRICE VARIATION FOR BLADE ROAST, EDMONTON, 1962-1969

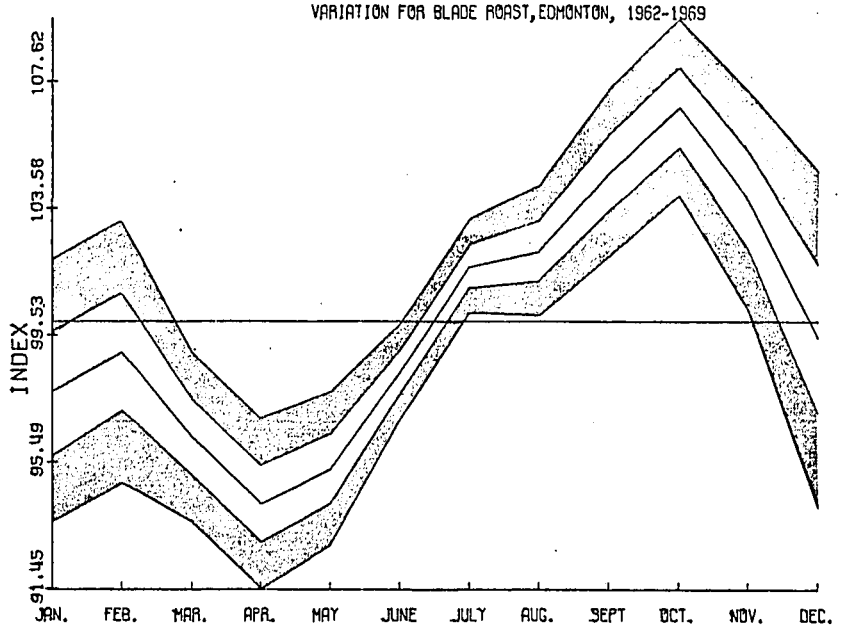


FIGURE 4.40

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL CONSUMER PRICE VARIATION FOR BLADE ROAST, TORONTO, 1962-1969

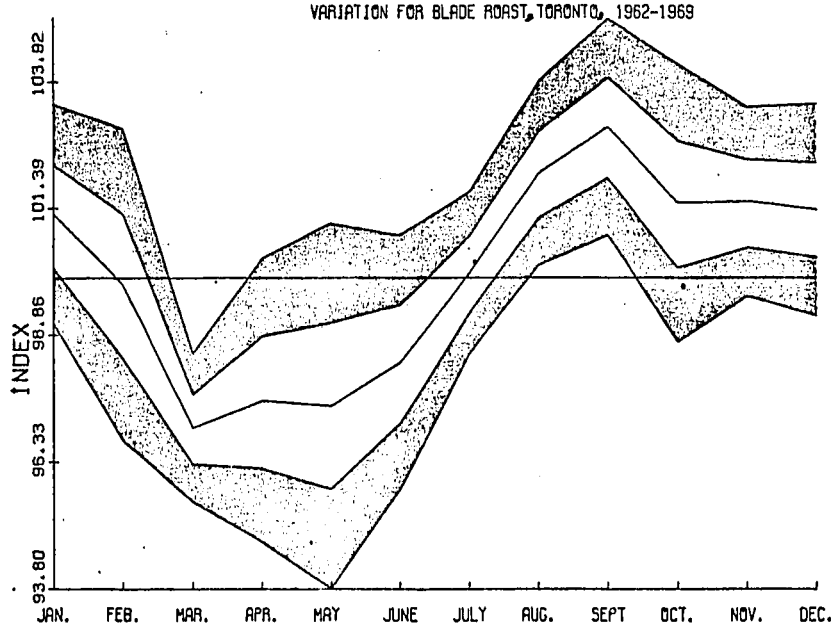


FIGURE 4.41

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL CONSUMER PRICE VARIATION FOR HAMBURGER, EDMONTON, 1962-1969

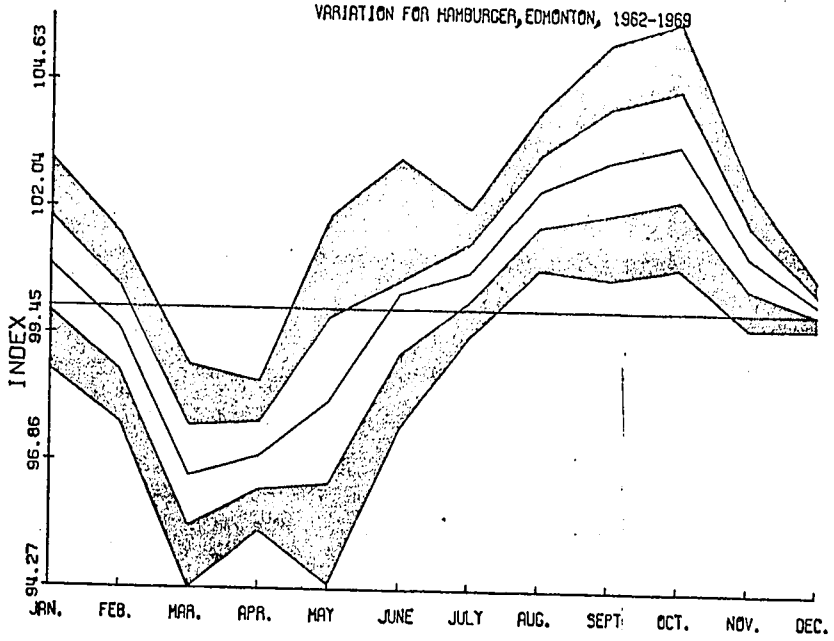


FIGURE 4.42

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL CONSUMER PRICE VARIATION FOR HAMBURGER, TORONTO, 1962-1969

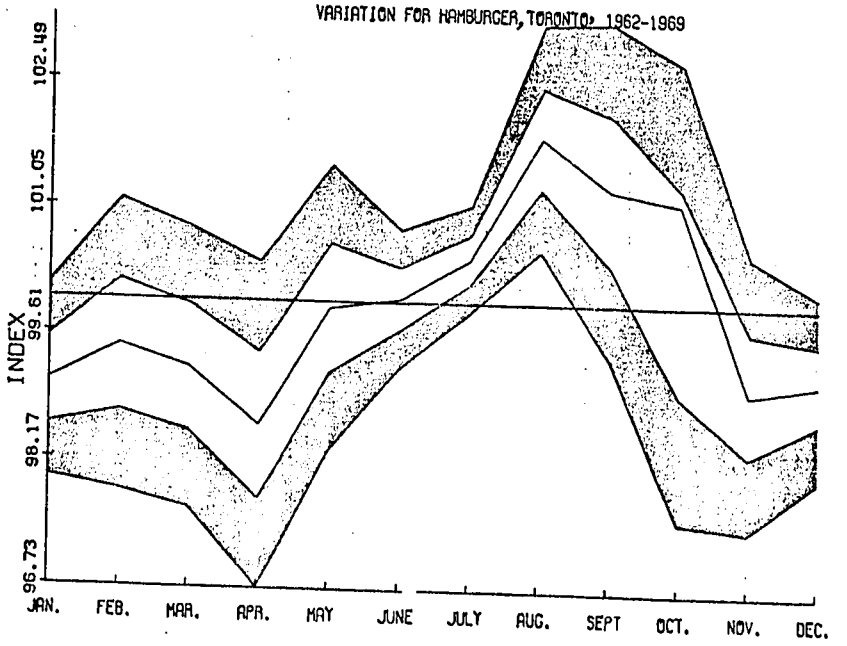


FIGURE 4.43

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL CONSUMER PRICE VARIATION FOR FRESH PORK LOINS, EDMONTON, 1962-1969

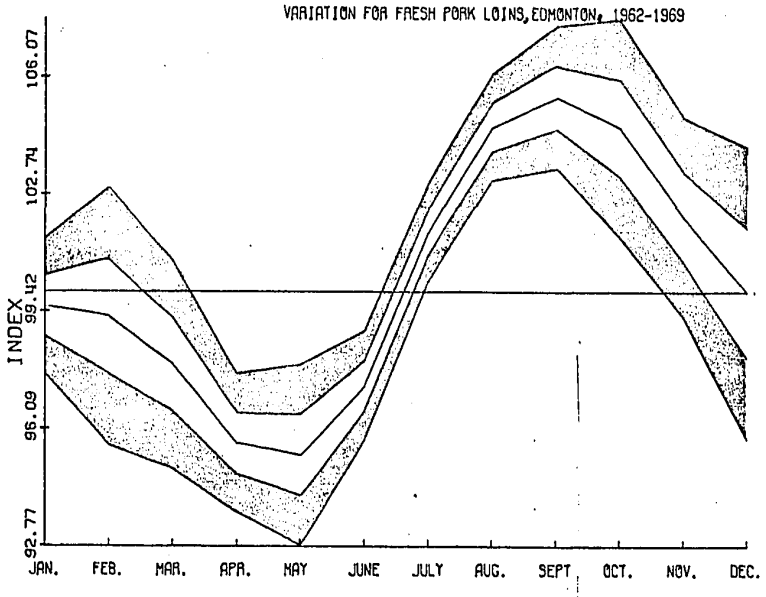


FIGURE 4.44

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL CONSUMER PRICE VARIATION FOR FRESH PORK LOINS, TORONTO, 1962-1969

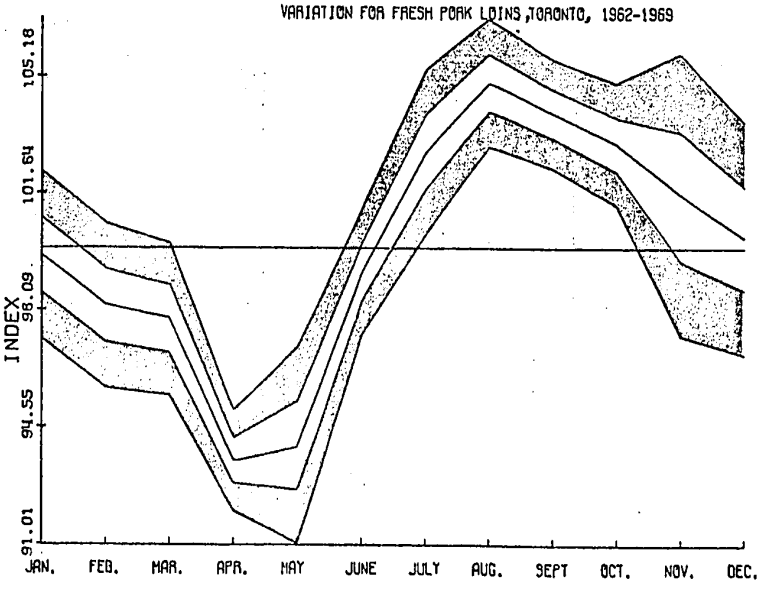


FIGURE 4.45

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL CONSUMER PRICE VARIATION FOR LAMB, EDMONTON, 1962-1969

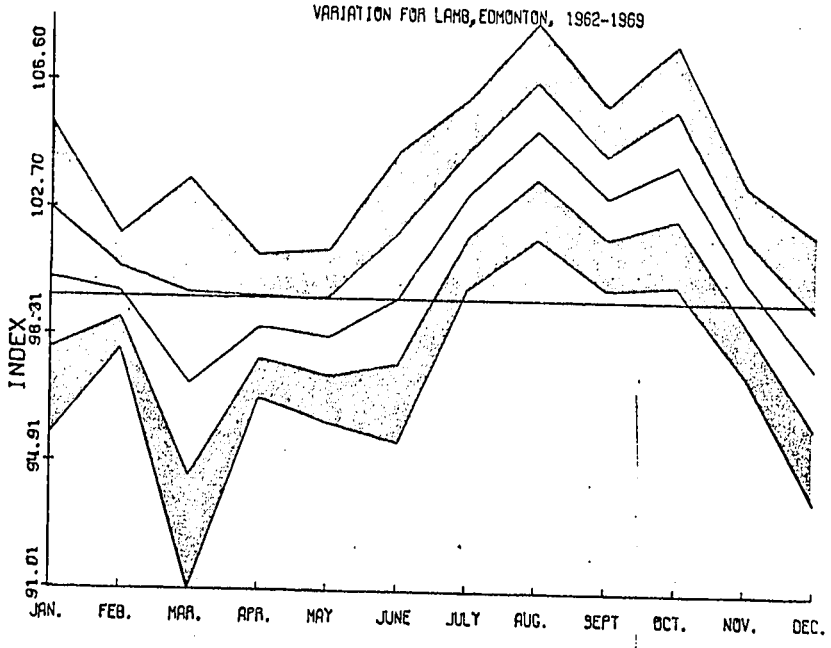


FIGURE 4.46

EXPECTED RANGES OF MEANS AND INDIVIDUAL YEAR INDEXES OF SEASONAL CONSUMER PRICE VARIATION FOR LAMB, TORONTO, 1962-1969

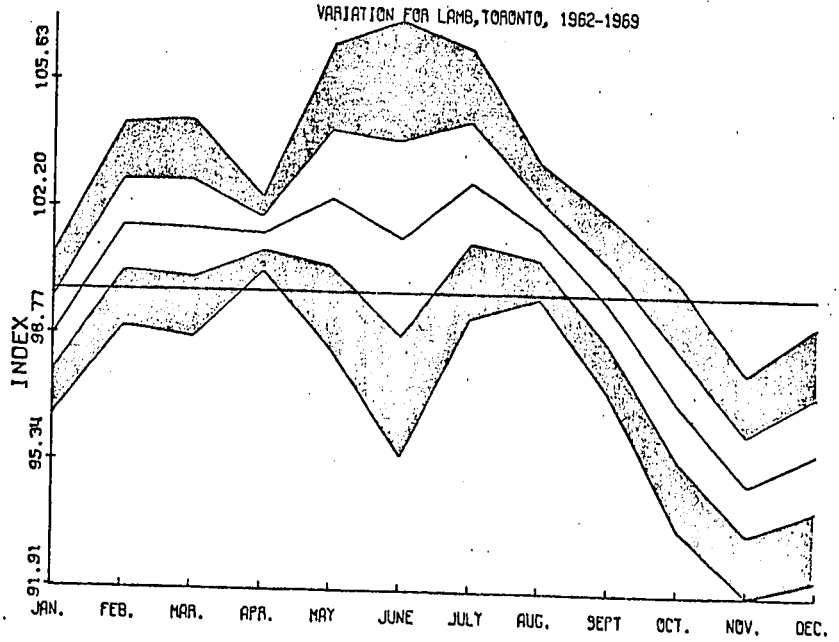


TABLE 4.2

AVERAGE PRICES OF CATTLE, LAMB, AND HOGS BY CLASS AND GRADE

	Edmonton	Toronto
Prices at Stockyard (1962-1971)	(Dollars per hundred pounds)	
Choice Steers	26.03	28.32
Good Steers	24.95	27.06
Good Lambs	22.38	28.32
Index 100 Dressed Hogs	27.72	31.05
Wholesale Price (1962-1971)		
Choice Steers	47.38	47.75
Good Steers	46.66	46.66
Choice Lamb	52.30*	67.04
Bacon	73.85	72.22
Consumer Price (1962-1969)	(Dollars per pound)	
Sirloin Steak	1.05	1.09
Round Steak	0.93	1.07
Rib Roast	0.86	0.97
Blade Roast	0.54	0.68
Hamburger	0.78	0.79
Fresh Pork Loins	0.49	0.51
Lamb	0.80	0.86

*1962-1969.

period the total dollar range for the month of the greatest variability was $2.86 per cwt.

The variation of price indexes was less than ± 5 percent during every month in Toronto (Figure 4.18; Appendix C, Table C.5). In fact, only in February (± 4.21 percent) and March (± 4.35 percent) did the variation of the indexes exceed ± 4 percent. Based on the avarage price of $28.32 per cwt.,the dollar range for the month of the greatest variability was $2.27 per cwt., as compared with $2.86 per cwt. for choice steers in Edmonton.

Good Steers

In Edmonton, during February and September, the variation of the indexes for good steers exceeded ± 5.6 percent (Figure 4.19; Appendix C, Table C.6). Based on the average price of $24.95 per cwt., the dollar range for the month of the greatest variability was $2.79 per cwt. In February (± 4.88 percent) and March (± 4.35 percent) in Toronto, the indexes exceeded ± 4 percent (Figure 4.20; Appendix C, Table C.6). Based on the average price of $27.06 per cwt., the dollar range for the month of greatest variability was $2.16 per cwt. in Toronto.

The seasonal variation range of choice and good steers for Edmonton, was wider than for Toronto. The widest range of fluctuation occurred in the Fall in Edmonton and in the Winter in Toronto.

Good Lambs

The variation of the monthly indexes for good lambs in Edmonton never exceeded ± 5 percent. The widest range for good lambs in Edmonton was ± 4.61 percent in July (Figure 4.21; Appendix C, Table C.7). The range was equivalent to $2.06 per cwt. based on the average price of $22.38 per cwt. for Edmonton.

In Toronto, the variation of the indexes was quite large for July; that is ± 5.51 percent (Figure 4.22; Appendix C, Table C.7). Based on the average price of $28.32 per cwt., the widest range was $3.12 per cwt. in July.

The seasonal amplitude of good lamb in Toronto was larger than that of Edmonton good lamb. The largest amplitude of the season was during the Summer for the two markets.

Index 100 Dressed Hogs

The variation of the indexes for a given month over the period was less than ± 4 percent, except in February when it was ± 4.16 percent (Figure 4.23; Appendix C, Table C.8) for Edmonton. The range in terms of dollars in February was $2.31 per cwt. based on the average price of $27.72. In Toronto, the largest variation was in January at ± 3.83 percent (Figure 4.24; Appendix C, Table C.8) or about $2.38 per cwt., based on the average price of $31.05 per cwt.

There was no obvious difference in the range of seasonal fluctuation between the two markets for Index 100 Dressed Hogs. The widest range of fluctuation for Edmonton and Toronto was during the Winter.

Seasonal Variation of Wholesale Prices

Choice Steers

The variation of the indexes for choice steer prices in Edmonton was less than ± 5 percent, except in September (± 4.97 percent) and October (± 5.01 percent) (Figure 4.25; Appendix C, Table C.9). In dollar terms, the widest range, ± 5 percent, was $4.74 per cwt. based on the average price of $47.38 per cwt. for Edmonton. In Toronto, the variation of indexes was around ± 3 percent (Figure 4.26; Appendix C,

Table C.9) or about $2.87 per cwt. based on the average price of $47.75.

Good Steers

The variation of the indexes for good steer prices in Edmonton was wide for September, ± 4.67 percent (Figure 4.27; Appendix C, Table C.10) or about $4.36 per cwt. based on the average price of $46.66 per cwt. As shown in Figure 4.28 and in Appendix C, Table C.10, the variation of the indexes for Toronto was around ± 3 percent or equivalent to about $2.80 per cwt., based on the average price of $46.66.

The seasonal variation range of choice and good steers in Edmonton was a little wider than in Toronto. The largest seasonal amplitude was during the Fall and Winter for the two markets.

Choice Lamb

The variation of the indexes for choice lamb prices in Edmonton was the largest in February at ± 6.50 percent, and lowest in October, at ± 2.10 percent (Figure 4.29; Appendix C, Table C.11). The range in terms of dollars was $6.80 per cwt. and $2.19 per cwt., respectively, based on the average price of $52.30.

In Toronto, the largest variation of the price indexes occurred in May with ± 7.0 percent and the lowest variation occurred in August with ± 1.73 percent (Figure 4.30; Appendix C, Table C.11). Based on average price of $67.04 this was equivalent to a variation of $9.40 per cwt. and $2.35 per cwt., respectively.

The seasonal fluctuation range for choice lamb had an obvious difference between Edmonton and Toronto. The widest range for Edmonton occurred during the Summer and the month of February. In Toronto, the largest amplitude occurred during May, June, and July.

Bacon

The variation of the indexes for bacon prices in Edmonton was quite small, less than ± 3 percent (Figure 4.31; Appendix C, Table C.12). Only in January and November was the variation of the indexes greater than ± 3 percent, or about $4.43 per cwt. based on the average price of $73.85 per cwt. The variation of the indexes in Toronto was small also. The largest range was in August with ± 3.43 percent (Figure 4.32; Appendix C, Table C.12) or about $4.95 per cwt., based on the average price of $72.22 per cwt.

The seasonal fluctuation range for bacon was narrow in the two markets. Winter was the time of wide fluctuation for both markets. For Toronto, there was also a sizeable amplitude during August and September.

Seasonal Variation of Retail Prices

Sirloin Steak

The variation of the indexes for sirloin steak prices in Edmonton was less than ± 4 percent. The widest range was ± 5.29 percent in October and ± 5.22 percent in May (Figure 4.33; Appendix C, Table C.13); or about $0.12 per pound and $0.10 per pound based on the average price of $1.05 per pound. The variation of the indexes for Toronto was largest in May, at ± 8 percent (Figure 4.34; Appendix C, Table C.13); this was equivalent to $0.18 per pound based on the average price of $1.09 per pound (Table 4.2). The narrowest range of variation of the indexes was during March, at ± 1.84 percent, and December, at ± 1.66 percent, or about $0.04 per pound based on the average price of $1.09 per pound.

The seasonal variation range fluctuated from month to month. The widest range of fluctuation in Toronto surpassed that of Edmonton in late Spring. In Edmonton, there was a second period of large

amplitude in October.

Round Steak

The variation of the indexes for round steak in Edmonton was less than ± 3 percent. The widest range was ± 4.56 percent in May (Figure 4.35; Appendix C, Table C.14); or about $0.08 per pound based on the average price of $0.93 per pound. The variation of the indexes for Toronto was small, around ± 2.5 percent (Figure 4.36; Appendix C, Table C.14); or equivalent to about $0.05 per pound based on the average price of $1.07 per pound.

The seasonal fluctuation range for round steak was not considerable. The largest amplitude occurred in late Spring and there was a second wide range in October.

Rib Roast

The variation of the indexes of rib roast prices in Edmonton was less than for other meats like sirloin or round steak (Figure 4.37; Appendic C, Table C.15). The widest range in May was ± 3.3 percent or about $0.007 per pound based on the average price of $0.86 per pound. The variation of the indexes for Toronto was small. The widest range occurred in June with ± 3.3 percent (Figure 4.38; Appendix C, Table C.15); or about $0.06 per pound based on the price of $0.97 per pound.

There was no wide fluctuation for rib roast.

Blade Roast

The variation of the indexes for blade roast prices in Edmonton was greater than for rib roast. The widest range occurred in December at ± 5.36 percent (Figure 4.39; Appendix C, Table C.16); or about $0.06 per pound based on the average price of $0.54 per pound. The variation

of the indexes of prices in Toronto was much smaller than that of prices in Edmonton. The largest range, occurring in May, was ± 3.74 percent (Figure 4.40; Appendix C, Table C.16); or about $0.05 per pound based on the price of $0.68 per pound.

The widest variation range for blade roast in Edmonton exceeded that of Toronto during the Winter. There was no particularly large range of fluctuation for Toronto blade roast.

Hamburger

The variation of the indexes for hamburger prices in Edmonton was less than ± 3 percent. The largest range occurred in May with ± 3.84 percent (Figure 4.41; Appendix C, Table C.17); this represented $0.06 per pound based on the average price of $0.78 per pound. The variation of the index of prices in Toronto was very small and less than ± 2 percent. Only in October was this exceeded with ± 2.60 percent (Figure 4.42; Appendix C, Table C.17); this represented $0.04 per pound based on the average price of $0.79.

The seasonal fluctuation range for hamburger has been narrow from month to month during the last ten years.

Fresh Pork Loins

The variation of the indexes for fresh pork loins in Edmonton was less than ± 3 percent except during February, October, and December (Figure 4.43; Appendix C, Table C.18). The widest range was in December at ± 4.16 percent, or about $0.04 per pound based on the average price of $0.49. The variation of the indexes of prices in Toronto was less than ± 3 percent also. The widest range was in November at ± 4.22 percent (Figure 4.44; Appendix C, Table C.18); or about $0.04 per pound based on the average price of $0.51 per pound.

There were two periods of large seasonal amplitudes for fresh pork loins in Edmonton; one was in February, the other was in December. For the other months the variation in the monthly indexes was not major. The largest seasonal amplitude was in November and December for Toronto fresh pork loins.

Lamb

The variation of the indexes for lamb prices in Edmonton for January, June, and December was greater than ± 4 percent (Figure 4.45; Appendix C, Table C.19). The largest range was in March at ± 6.48 percent; this was equivalent to $0.10 per pound based on the average price of $0.80 per pound. The variation of the price indexes in Toronto was less than ± 4 percent (Figure 4.46; Appendix C, Table C.19). The widest range was in June at ± 5.82 percent or about $0.10 per pound based on the average price of $0.86 per pound.

For lamb seasonal fluctuations varied from month to month and the range had a wide difference. The widest range occurred during different months for the two markets. The widest variation for Edmonton was in March; for Toronto, it was in June.

Difference Between Successive Months

Seasonal changes from one month to the next may be analyzed as "equal to," "greater than," or "less than" the normal seasonal change.

We know that the standard error of the mean is equal to $S_{\bar{X}} = \frac{S_{Xi}}{\sqrt{N}}$

Thus, assuming that we have a normal distribution, 68 percent of all possible sample means of size 100 drawn from this population would lie within $S_{\bar{X}}$ of the true mean. That is to say, if we take a 68 percent

confidence interval, the confidence limits are defined by $\bar{X} \pm ZS_{\bar{X}}$ where, in this case Z = 1.[1]

A specific example of this procedure based on the Edmonton stockyard prices of good lamb is instructive. These prices decline more or less than seasonally from June to July. The average seasonal price indexes for these months are 119 and 102 respectively (Appendix C, Table C.7) and the standard error of the difference between them for these months is 2.5. The probability that the true seasonal fall from June to July is somewhere between 14.5 and 19.5 index points is therefore about 68 percent.[2] In 68 percent of the samples, a band of about 2.5 index points above and below the sample mean difference will include the true mean difference or seasonal change. We would therefore say that a June to July decline of less than 12.18 percent (14.5 ÷ 119) was "less than seasonal" and a decrease of more than 16.39 (19.5 ÷ 119) is "more than seasonal".

Evidence of Shifts in Seasonal Patterns

Seasonal patterns established by the analysis of observed time series cannot be assumed to prevail completely unchanged in the future. Economic administrative policies pertaining to production and marketing are liable to change the seasonal pattern of agricultural price fluctuations. To the extent that seasonal patterns may be altered by policy measures, projection of future monthly prices based on observed patterns

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[1] Assuming a normal probability distribution exists, the standard normal deviate is defined by $Z = \frac{\bar{X} - \mu}{S_{\bar{X}}}$ where $\bar{X}$ is the sample mean, μ is the population mean, and $S_{\bar{X}}$ is the standard error of the sample mean.

[2] The mean difference, $\bar{X}$, is equal to 119-102, Z = 1.0, and $S_{\bar{X}}$ = 2.5.

becomes a highly conjectural task. Some insight into the extent of changes in seasonal patterns may be gained by scrutinizing observed data for evidence of any significant changes in seasonal patterns in the past. The analysis of variance was noted to be a useful method for such scrutiny (Chapter III, p. 19). A summary of the results of the test applied to test for any significant shift in the seasonal pattern of price changes is contained in Table 4.3. This table summarizes the results of the analysis of variance test at 2.5 percent level of significance. Detailed calculations of the variances and analysis of variance tables are given in Appendix D.

TABLE 4.3

SHIFTS IN SEASONAL PATTERN: TEST OF SIGNIFICANT RESULTS (α = 0.025)

Price	Edmonton	Toronto
Stockyard Price		
Choice Steers	N	N
Good Steers	S	N
Index 100 Dressed Hogs	N	N
Wholesale Price		
Choice Steers	N	N
Good Steers	N	N
Bacon	S	S
Choice Lambs	S	S
Retail Price		
Sirloin Steaks	S	S
Round Steaks	N	S
Rib Roast	N	N
Blade Roast	S	S
Hamburger	S	S
Fresh Pork Loins	S	S
Lamb	N	N

LEGEND: N = no significant shift in seasonal patterns.

S = significant shift in seasonal patterns.

α = level of significance.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary and Conclusions

A seasonal pattern marks the production and marketing of most kinds of livestock. For beef, lamb, and hogs the production cycle begins with the majority of animals being born in the Spring. Marketings tend to be highest in Spring and Fall. Seasonal fluctuation thus appears in the number of livestock slaughtered and in the flow of meat to consumers with meat supply is most plentiful in Fall and Winter and least plentiful in Spring and Summer. Prices of both meat animals and red meats follow seasonal ups and downs responding to these seasonal variation in supplies and to some seasonal differences in demand. Knowledge of these changes can be helpful to producers and others in identifying the most common or typical patterns. This information can be important as an aid to ranchers, feeders and others engaged in the livestock business to assist them in adjusting their buying and selling operations to the most advantageous times. Seasonal price information can be used as a general guideline in making management decisions regarding breeding dates, feeding programs, and target marketing periods.

A seasonal price index may indicate a typical price movement pattern which can be used as a standard for comparison. In this study, indexes were computed from data available from 1962. Indexes were derived by the ratio-to-moving average method and were adjusted to a base of 100. This calculation eliminates most of the price variation generated by non-seasonal factors. The indexes show the general price pattern and indicate when prices are likely to be highest and lowest

during the year.

One use of seasonal price indexes is to estimate the profitability of holding stock. This may be done by comparing the current month's price with the price anticipated in a future month. One should note, however, that a decision to hold stock to the future month has to be based on other factors as well; namely, the extra feeding costs, the loss or gain in weight, and other costs of holding stock. An example using a simple projection model illustrating such a decision-making process is presented in Appendix A. Alternative projection models are presented in Appendix B.

Although the average seasonal price pattern can be important in analyzing future markets, it must be realized that the selection of the most advantageous day for selling requires careful day-to-day study of market developments. Any changes in supply and demand conditions may cause this year's pattern to vary from the average and thus it must be considered. Indexes of seasonality are a good starting point for anticipating the short-run future prices of meat animals provided that current information on any differences from the "normal" seasonal pattern of supply and demand is also employed.

Since the measurement of the degree of seasonality is merely an application of the measurements of dispersion, it is essential for those who use the indexes to find how closely actual price does conform to normal, or, in other words, to find how reliable the indexes are in describing seasonal price behavior. Two ways in which to measure variation in the indexes are the standard deviation of the individual items for each month and the standard error of the average of the items for each month. Both these measures are applied to the price data used

in the study.

The technique of analysis of variance was applied to the price data. Using this technique, the total variation in a series can be divided into its component parts. The total variation is computed by squaring the difference between the average prices for each month and the average for all months in all years and adding these together. Because prices may vary greatly during a period of years due to changes in supply and demand, this method tends to minimize the importance of seasonal variation and to show any significant shifts in seasonal price movements. It also provides more reliable projections of seasonal prices.

Prices of livestock change from month to month. The pattern and magnitude of these changes vary widely depending on the class and the quality of animal. There have been obvious seasonal patterns in beef, hog, and lamb price series studied over the last ten years. The seasonal fluctuation of stockyard prices of good and choice cattle was similar. The pricesof choice and good steers at the stockyard and wholesale level tend to be highest in the Spring and Summer. Prices for good and choice lamb are highest in late Winter, Spring, and the beginning of Summer. In Summer seasonal prices are highest for index 100 hogs and bacon. The highest seasonal prices for beef cuts (sirloin, round steak, rib, blade roast, and beef hamburger) are in Summer and Fall. The highest prices for fresh pork loin and lamb occur in mid-Summer and Fall. Generally, the turning points in wholesale price indexes are observed to precede those at retail levels. The reason for this lag may be related to both to physical lags in movement of the commodity and also to the structure of the industry which may enable the relatively fewer firms to monitor and react to market forces faster than firms at the retail level.

Results showed that within any given year the expected variations of monthly indexes for stockyard and wholesale prices of good and choice steers at Edmonton are wider than at Toronto. That is, the average pattern of variation in Edmonton is less reliable than in Toronto. The widest expected range of price variation for good and choice steers was during the Winter and Fall. For good and choice lambs, the widest range of the seasonal price fluctuation usually occurred in Winter. The variation range for bacon was narrow. The widest range for sirloin and round steak was in the late Spring and the month of October. There was no wide range for rib, blade roast and hamburger. For fresh pork loins, the widest range was in the late Fall and early Winter. The retail price of Toronto lamb showed a three-month lag when compared to Edmonton lamb. The widest range of seasonal variation for lambs sold in Edmonton was in March.

Over the past ten years, significant shifts[1] in seasonal price movements have occurred in the stockyard price of good steers (Edmonton), the wholesale price of bacon and choice lambs (Edmonton and Toronto), and the retail price of round steaks (Toronto), sirloin steaks, blade roast, hamburger and fresh pork loins (Edmonton and Toronto).

Seasonal fluctuation in livestock prices changes from month to month. The standard errors of change between months may be utilized to detect from one month to the next whether the change is "equal to", "greater than", or "less than" the normal seasonal variation. Data (standard error of the mean) enabling such calculations are presented in the study (Appendix C). An illustration of the necessary calculations based on the Edmonton stockyard prices of good lamb was presented in Chapter IV.

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[1]Significant at the 2.5% level.

Successful use of livestock price patterns requires more than just a knowledge of these trends. Consideration must be given to the stage of the livestock cycle that applies, to other information to determine if prices are following the usual seasonal pattern, and to what adjustments may be needed to meet the current situation.

Recommendations For Further Research

Knowledge of prices and other market information play an essential role in helping the marketing system to function properly and at low cost. Accurate, timely, and comprehensive market information has a price stabilization effect.

The seasonal price pattern is market information that provides an approximate guide to the behavior of prices in any one year. The presence of a strong seasonal pattern in prices does not mean that prices observed in the market during any particular year will always follow the exact seasonal pattern. Adherence to the seasonal pattern depends on the relative strength of forces causing seasonal variations and those causing other types of price movements. The stronger the influence of seasonal factors relative to other factors, the greater the probability that prices will conform to a seasonal pattern.

In this study, a basic assumption in the computation of an index of seasonal variation was that the seasonal pattern is stable enough to be averaged in order to secure the typical seasonal pattern. When this is true and there is no evidence that any pronounced change is occurring, this typical seasonal pattern provides a reasonable forecast of the variation for the coming year. Large random price variations caused by an abnormally large or small shipment of livestock in any given week or

month, any change in government policy, labor unrest at the packing plants, floods, snow-storms, droughts, or disease outbreaks, may change the normal price pattern. Therefore, the average seasonal price movements can be of much use when supplemented by a study of changing seasonal patterns and erratic forces at work each year for each commodity. Recommended for further study is the observation of patterns to detect both abrupt and gradual changes in the seasonal pattern and the accurate measurement of these changes; such information can be particularly useful when combined with analysis of trend and cyclical components.

Seasonal fluctuations in livestock production and marketing are partially amenable to human control. Such controls may be instituted by devising various stabilization policies. To develop well founded stabilization policies, however, requires regular and extensive collection and analysis of data in a manner such as indicated in this study.

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APPENDIX A

A NUMERICAL EXAMPLE ILLUSTRATING THE USE OF SEASONAL INDEXES

As noted in Chapter II (p.14), seasonal indexes may be used to estimate average prices in a future month while deciding on the time at which a most profitable sale can be made.

One simple formula proposed for estimating a future price is:

$$\text{Present Average Price for This Month} \times \frac{\text{Future Monthly Index}}{\text{Present Monthly Index}}$$

$$= \text{Estimated Future Monthly Average Price.}^{1}$$

Assume that in March a rancher is trying to decide whether to sell his (good grade) steers now at $33.50 per hundred weight or to wait until July. Using Figure 4.1 for choice steers, the March index is 99.25 (Edmonton) and the July index (best selling month) is 103.64 (Appendix C, Table C.1). Using the formula, he may estimate the price on the basis of the expected seasonal pattern for July as follows:

$$\frac{\$33.50 \times 103.64}{99.25} = \$34.98 \text{ per hundred weight.}$$

This indicates that, if prices follow the usual seasonal pattern, the price for choice steers in July will be $1.48 per hundred weight higher than in March.

To determine whether or not holding these cattle until July would be profitable, the rancher will need also to estimate the gain in weight from March to July and the total cost of gain. Assuming the steers average two pounds of gain per day and averaged 815 pounds in March, they would gain 240 pounds in 120 days for a total weight of 1,055 pounds. Assuming a total cost of gain of 23 cents per pound, the situation would be as follows:

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[1] Glen R. Purnell and R.W. Robinson, Livestock Prices at Idaho Falls Auction Market, Bulletin 409 (Moscow: Idaho Agricultural Experiment Station, June, 1963), p. 7.

Sale value per head in July: $34.98 per cwt x 10.55 = $369.04

Sale value per head in March: $33.50 per cwt x 8.15 = $273.03

Total gross gain in value due to higher price and gain in weight

= $369.04 - $273.03 = $96.01

Cost of gain (23 cents per pound x 240 pounds) = $55.20

Net gain per head = $96.01 - $55.20 = $40.81

This shows that it would pay the rancher to wait until July to sell his cattle.

Livestock men are interested in net income. The seasonal index figures used in conjunction with present prices can be used to arrive at dollar values in the future.[1] These dollar values can provide information which help livestock men and those who process and market the meat animals to decide when to buy and sell.

[1] Ibid., p. 9.

APPENDIX B

ALTERNATIVE PROJECTIONS OF PRICES OF CHOICE GRADE STEERS FOR THE MONTH OF JULY USING THE MONTH OF MARCH AS THE BASE MONTH

The following example illustrates the use of formulas (3.1) to (3.5) presented in Chapter III. These projections represent an interval of estimates prices rather than point estimates. The underlying point here is that interval estimates are more reliable than point estimates.

Let the subscript i denote the month of March and j the month of July; X denotes the seasonal index; S_{Xj} denotes the standard deviation of the July seasonal index; P denotes the average price; and S_{pi} denotes the standard deviation of average price in March.

Formula (3.1) enables one to estimate an upper and a lower unit for a future month's price using the standard deviation of the future month's seasonal index as an index of reliability. Thus, the estimated lower price limit for July is:

$$\hat{P}_{j,l} = P_i \frac{(X_j - S_{xj})}{X_i} = \$33.5 \text{ X } \frac{103.64 - 4.39}{99.25} = 33.5 \text{ per hundred weight.}$$

The estimated upper price limit for July is:

$$\hat{P}_{j,u} = P_i \frac{(X_j + S_{xj})}{X_i} = \$33.5 \text{ X } \frac{103.64 + 4.39}{99.25} = \$36.46 \text{ per hundred weight.}$$

Formulas (3.2) to (3.5) represent projections which incorporate a conception of whether current prices were above or below average (by the amount of the standard deviation of prices) and whether the price index in the future month will be above or below the average seasonal index (by the amount of the standard deviation). Thus, estimated prices for a future month may be a result of various combinations of views of current prices and the future index (refer to Table 3.3, pg. 21).

One may have realized low prices and expect the future month's average index to be low also, consequently making a "conservative" estimate using formula (3.2).

$$\hat{P}_{j,1} = (P_i - S_{pi}) \frac{(X_j - S_{xj})}{X_i} = (33.5 - 3.81) \frac{103.64 - 4.39}{99.25}$$

= \$29.69 per hundred weight.

Formulas (3.3) and (3.4), respectively, represent a combination of low current price, high future index and high current price, low future index, giving:

$$\hat{P}_{j,2} = (P_i - S_{pi}) \frac{(X_j + S_{xj})}{X_i} = (33.5 - 3.81) \frac{103.64 + 4.39}{99.25}$$

= \$32.32 per hundred weight, and

$$\hat{P}_{j,3} = (P_i + S_{pi}) \frac{(X_j - S_{xj})}{X_i} = (33.5 + 3.81) \frac{103.64 - 4.39}{99.25}$$

= \$37.31 per hundred weight.

Finally, formula (3.5) is an "optimistic" estimate using a high current price and a high expected future index, giving:

$$\hat{P}_{j,4} = (P_i + S_{pi}) \frac{(X_j + S_{xj})}{X_i} = (33.5 + 3.81) \frac{103.64 + 4.39}{99.25}$$

= \$40.61 per hundred weight.

The formulas illustrated above introduce a certain amount of flexibility in estimating future monthly prices since the formulas take into account individual seller's experiences and views of the future.

APPENDIX C

CALCULATED INDEXES AND VARIABILITY OF INDEXES

The following steps are used in calculating the seasonal indexes using the ratio-to-moving average method:

1) Calculate successive twelve-month moving averages.

2) Center the successive moving averages calculated in step 1 between June and July for each year.

3) Center these moving averages on the midyear point.

4) Divide the original data by the corresponding centered twelve-month average. Each result is expressed as a percentage of the twelve-month centered moving average. The values obtained in this step are termed the unadjusted seasonal indexes.

5) For each month omit the highest and lowest values as being influenced by irregular factors to obtain the modified means.

6) Adjust each of the twelve modified means by a factor equal to the sum of the modified means divided by twelve hundred.

7) The adjusted modified means represent the seasonal index for each month.

TABLE C.1

INDEX OF SEASONAL VARIATION OF PRICES AT PUBLIC STOCKYARDS, 1962-1971

Month	Choice Steers		Good Steers		Good Lamb		Index 100 Hogs	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	98.16	98.01	98.30	98.13	98.11	100.03	98.05	100.64
February	98.20	98.58	98.27	98.84	102.94	102.07	101.13	102.62
March	99.25	98.86	99.25	98.65	104.98	102.88	95.93	95.81
April	100.21	98.85	100.12	98.77	107.93	107.07	90.62	90.51
May	101.91	99.92	101.62	99.70	115.12	116.12	95.54	96.83
June	102.51	101.02	102.76	101.27	118.85	119.35	102.40	104.54
July	103.64	102.99	103.42	102.65	102.22	109.23	103.12	103.99
August	101.47	102.99	101.66	102.05	93.91	92.40	105.71	103.27
September	100.79	102.06	100.84	101.97	86.45	84.40	106.15	102.23
October	98.12	99.74	98.24	99.89	86.82	84.18	101.23	99.15
November	98.10	99.22	98.05	99.56	88.99	86.68	99.58	99.38
December	97.52	98.44	97.47	98.52	93.68	95.55	100.53	101.01
Range from high to low	6.12	4.98	5.95	4.52	32.40	35.17	15.53	14.03

TABLE C.2

INDEX OF SEASONAL VARIATION IN WHOLESALE PRICES, 1962-1971

Month	Choice Steers		Good Steers		Choice Lamb		Bacon	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
					(1962-1969)			
January	99.00	99.61	98.54	99.99	93.03	99.36	96.73	95.79
February	98.34	98.67	99.37	98.58	99.44	100.26	97.68	97.30
March	98.18	98.69	98.08	98.60	101.81	101.24	96.38	96.51
April	99.46	98.93	98.83	98.92	111.09	106.51	93.72	94.73
May	100.25	99.24	100.09	99.10	120.07	115.74	95.47	96.84
June	101.94	100.53	103.30	100.47	122.76	115.17	98.88	102.19
July	102.85	102.53	102.54	102.58	112.27	108.87	102.35	104.17
August	102.19	101.95	102.68	101.99	97.83	98.59	106.75	107.63
September	101.67	101.36	101.90	102.02	87.57	89.68	106.88	107.51
October	99.51	99.58	98.74	99.63	84.37	85.63	106.15	103.39
November	98.50	99.11	98.11	98.88	83.01	84.98	99.93	97.35
December	98.09	99.19	97.81	99.24	86.74	93.95	98.08	96.57
Range from high to low	4.76	3.86	5.49	4.87	39.75	30.76	13.16	12.90

TABLE C.3

INDEX OF SEASONAL VARIATION IN CONSUMER PRICES, 1962-1969

Month	Sirloin Steak		Round Steak		Rib Roast		Blade Roast	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	99.42	98.26	103.05	100.24	100.34	100.22	97.95	101.16
February	94.68	95.49	98.66	97.05	99.02	98.47	99.04	99.75
March	94.18	93.72	95.78	97.10	96.79	98.64	96.33	96.91
April	95.74	96.49	97.61	97.90	97.71	98.30	94.19	97.43
May	96.88	97.34	98.70	97.07	98.48	98.45	95.31	97.33
June	103.08	100.47	98.68	100.00	99.61	99.20	98.38	98.59
July	103.58	104.10	100.03	101.14	101.92	99.92	101.77	98.97
August	106.26	107.19	102.20	102.10	103.36	101.40	102.25	101.96
September	104.84	105.98	102.62	103.79	101.42	101.97	104.77	102.90
October	103.88	103.40	102.45	102.37	101.86	102.36	106.85	101.37
November	99.38	98.82	99.89	101.02	100.04	100.68	103.87	101.40
December	98.08	98.72	100.31	100.21	99.45	100.39	99.48	101.23
Range from high to low	12.08	13.47	7.27	6.74	6.57	4.06	12.66	5.99

TABLE C.4

INDEX OF SEASONAL VARIATION IN CONSUMER PRICES, 1962-1969

Month	Hamburger		Fresh Pork Loins		Lamb	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	100.56	99.18	99.26	99.80	99.68	98.75
February	99.27	99.59	98.97	98.27	99.28	101.74
March	96.28	99.34	97.62	97.87	96.49	101.66
April	96.70	98.68	95.38	93.57	98.24	101.54
May	97.84	100.04	95.04	94.02	97.94	102.53
June	100.04	100.14	97.01	99.28	99.16	101.46
July	100.47	100.61	101.38	102.93	102.36	103.01
August	102.15	102	104.35	105.04	104.31	101.76
September	102.76	101.41	105.20	104.09	102.28	99.74
October	103.11	100.66	104.32	103.16	103.31	97.07
November	100.86	99.11	101.80	101.64	93.80	94.92
December	99.90	99.24	99.66	100.33	97.14	95.82
Range from high to low	6.83	3.32	10.16	11.47	7.82	8.09

TABLE C.5

CHOICE STEER PRICES AT PUBLIC STOCKYARDS: STANDARD ERROR OF SEASONAL INDEX FOR EACH MONTH AND OF THE CHANGE FROM ONE MONTH TO THE NEXT, 1962 - 1971

Month	Seasonal Index		Standard Deviation of Index		Standard Error of Mean of Indexes		Standard Error of Change From Preceding Month	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	98.24	98.00	4.91	2.93	1.86	1.11	2.78	1.92
February	98.28	98.56	5.46	4.15	2.06	1.57	2.76	2.62
March	99.33	98.84	4.87	4.30	1.84	1.63	2.53	2.06
April	100.29	98.83	4.59	3.33	1.73	1.26	2.13	1.71
May	101.99	99.90	3.26	3.07	1.23	1.16	1.67	1.55
June	102.59	100.99	2.97	2.73	1.12	1.03	1.75	1.50
July	103.73	102.96	3.55	2.90	1.34	1.09	1.85	1.42
August	101.55	102.26	3.38	2.40	1.28	0.91	2.57	1.73
September	100.87	102.03	5.91	3.90	2.24	1.47	3.04	2.01
October	98.20	99.72	5.45	3.63	2.06	1.37	2.67	1.68
November	98.18	99.2	4.48	2.58	1.69	0.98	2.31	1.64
December	97.60	98.42	4.17	3.50	1.57	1.32	2.43	1.72

TABLE C.6

GOOD STEER PRICES AT PUBLIC STOCKYARDS: STANDARD ERROR OF SEASONAL INDEX FOR EACH MONTH AND OF THE CHANGE FROM ONE MONTH TO THE NEXT, 1962 - 1971

Month	Seasonal Index		Standard Deviation of Index		Standard Error of Mean of Indexes		Standard Error of Change From Preceding Month	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	98.34	98.10	4.79	2.89	1.81	1.09	2.75	1.97
February	98.30	98.81	5.49	4.83	2.07	1.64	2.70	2.30
March	99.29	98.61	4.59	4.29	1.74	1.62	2.43	2.13
April	100.16	98.73	4.50	3.68	1.70	1.39	2.12	1.81
May	101.66	99.66	3.33	3.05	1.26	1.15	1.69	1.42
June	102.80	101.23	3.00	2.21	1.13	0.84	1.65	1.40
July	103.46	102.61	3.16	2.99	1.20	1.13	1.78	1.63
August	101.70	102.01	3.49	3.11	1.32	1.17	2.58	1.86
September	100.88	101.93	5.87	3.81	2.22	1.44	2.89	1.85
October	98.28	99.85	4.91	3.08	1.86	1.16	2.41	1.50
November	98.04	99.52	4.08	2.49	1.54	0.94	2.30	1.7
December	97.51	98.49	4.53	3.75	1.71	1.42	2.49	1.79

TABLE C.7

GOOD LAMB PRICES AT PUBLIC STOCKYARDS: STANDARD ERROR OF SEASONAL INDEX FOR EACH MONTH OF THE CHANGE FROM ONE MONTH TO THE NEXT, 1962 - 1971

Month	Seasonal Index		Standard Deviation of Index		Standard Error of Mean of Indexes		Standard Error of Change From Preceding Month	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	98.24	100.03	3.05	4.63	1.15	1.75	1.51	2.37
February	103.08	102.07	2.57	4.24	0.97	1.60	1.76	1.89
March	105.12	102.88	3.87	2.68	1.46	1.01	1.85	1.68
April	108.07	107.07	2.99	3.56	1.13	1.34	1.64	2.24
May	115.27	116.12	3.13	4.74	1.18	1.79	1.38	2.38
June	119.01	119.35	1.87	4.13	0.71	1.56	1.92	2.76
July	102.35	109.24	4.72	6.02	1.78	2.28	2.51	2.73
August	94.03	92.40	4.66	3.97	1.76	1.50	1.91	2.12
September	86.56	92.40	1.93	3.97	0.73	1.50	1.00	1.75
October	86.93	84.18	1.80	2.39	0.68	0.90	1.27	1.40
November	89.11	86.68	2.83	2.84	1.07	1.07	1.48	2.12
December	93.80	95.55	2.70	4.84	1.02	1.83	1.54	2.53

TABLE C.8

GRADE A HOG PRICES AT PUBLIC STOCKYARDS: STANDARD ERROR OF SEASONAL INDEX FOR EACH MONTH AND OF THE CHANGE FROM MONTH TO THE NEXT, 1962 - 1971

Month	Seasonal Index		Standard Deviation of Index		Standard Error of Mean of Indexes		Standard Error Of Change From Preceding Month	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	97.59	100.23	3.97	3.74	1.50	1.41	2.18	1.93
February	100.66	102.20	4.19	3.49	1.59	1.32	1.68	1.60
March	95.48	95.42	1.51	2.40	0.57	0.91	1.11	1.47
April	90.2	90.14	2.53	3.05	0.96	1.15	1.55	1.51
May	95.01	96.43	3.24	2.57	1.22	0.97	1.62	1.33
June	101.92	104.11	2.82	2.41	1.06	0.91	1.55	1.39
July	102.64	103.57	2.97	2.77	1.12	1.05	1.74	1.59
August	105.21	102.85	3.58	3.15	1.33	1.19	1.61	1.33
September	105.65	101.82	2.38	1.60	0.90	0.60	1.22	0.76
October	100.76	98.75	2.20	1.24	0.83	0.47	1.25	0.93
November	99.11	98.97	2.48	2.12	0.94	0.80	1.55	1.38
December	100.06	100.60	3.26	2.99	1.23	1.13	1.94	1.81

TABLE C.9

CHOICE STEER WHOLESALE PRICES: STANDARD ERROR OF SEASONAL INDEX FOR EACH MONTH AND OF THE CHANGE FROM ONE MONTH TO THE NEXT, 1962 - 1971

Month	Seasonal Index		Standard Deviation of Index		Standard Error of Mean of Indexes		Standard Error Of Change From Preceding Month	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	99.02	99.66	3.61	3.44	1.36	1.30	2.16	2.11
February	98.36	98.72	4.44	4.38	1.68	1.65	2.36	2.14
March	98.23	98.74	4.38	3.58	1.66	1.35	2.21	1.94
April	99.48	98.98	3.87	3.66	1.46	1.38	2.01	1.99
May	100.27	99.29	3.65	3.79	1.38	1.43	1.67	1.72
June	101.96	100.58	2.50	2.51	0.95	0.95	1.36	1.34
July	102.87	102.58	2.59	2.50	0.98	0.94	1.31	1.50
August	102.21	102.00	2.32	3.09	0.88	1.17	2.10	2.00
September	101.69	102.01	5.06	4.30	1.91	1.62	2.68	2.18
October	99.53	99.63	4.99	3.84	1.88	1.45	2.22	1.75
November	98.52	99.16	3.09	2.60	1.17	0.98	1.82	1.65
December	98.11	99.24	3.69	3.50	1.39	1.32	1.95	1.86

TABLE C.10

GOOD STEERS WHOLESALE PRICES: STANDARD ERROR OF SEASONAL INDEX FOR EACH MONTH AND OF THE CHANGE FROM ONE MONTH TO THE NEXT, 1962 - 1971

Month	Seasonal Index		Standard Deviation of Index		Standard Error of Mean of Indexes		Standard Error Of Change From Preceding Month	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	98.67	100.02	3.66	3.99	1.38	1.51	2.04	2.31
February	99.50	98.6	3.96	4.63	1.50	1.75	2.30	2.18
March	98.20	98.63	4.62	3.46	1.75	1.31	2.26	1.97
April	98.96	98.94	3.81	3.89	1.44	1.47	1.97	1.99
May	100.22	99.12	3.55	3.56	1.34	1.35	1.86	1.66
June	103.43	100.50	3.41	2.58	1.29	0.98	1.71	1.39
July	102.67	102.61	2.96	2.60	1.12	0.98	1.80	1.53
August	102.81	102.02	3.72	3.10	1.41	1.17	2.29	1.93
September	102.03	102.05	4.77	4.07	1.80	1.54	2.48	2.09
October	98.87	99.65	4.50	3.76	1.70	1.42	2.01	1.75
November	98.23	98.90	2.84	2.76	1.08	1.03	1.77	1.65
December	97.93	99.26	3.70	3.42	1.40	1.29	1.97	1.98

TABLE C.11

CHOICE LAMB WHOLESALE PRICES: STANDARD ERROR OF SEASONAL INDEX FOR EACH MONTH AND OF THE CHANGE FROM ONE MONTH TO THE NEXT, 1962 - 1969

Month	Seasonal Index		Standard Deviation of Index		Standard Error of Mean of Indexes		Standard Error Of Change From Preceding Month	
	Edmonton	Toronto [1]	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	93.37	99.12	2.82	2.83	1.26	1.07	3.16	1.64
February	99.80	100.01	6.49	3.27	2.90	1.24	3.49	1.64
March	102.18	100.99	4.34	2.85	1.94	1.08	2.24	1.74
April	111.50	106.25	2.49	3.60	1.11	1.36	1.80	3.35
May	120.51	115.45	3.15	8.10	1.41	3.06	2.52	3.57
June	123.21	114.87	4.68	4.85	2.09	1.83	3.49	2.36
July	112.68	108.60	6.24	3.94	2.79	1.49	3.49	1.63
August	98.19	98.33	4.68	1.73	2.09	0.65	2.69	1.64
September	87.89	89.45	3.79	3.99	1.69	1.51	1.87	2.03
October	84.68	85.41	1.78	3.61	0.80	1.37	1.55	1.75
November	83.31	84.76	2.97	2.88	1.33	1.09	1.72	1.51
December	87.06	93.71	2.45	2.76	1.09	1.04	1.67	1.49

[1] 1962-1971.

TABLE C.12

BACON WHOLESALE PRICES: STANDARD ERROR OF SEASONAL INDEX FOR EACH MONTH AND OF THE CHANGE FROM ONE MONTH TO THE NEXT, 1962 - 1971

Month	Seasonal Index		Standard Deviation of Index		Standard Error of Mean of Indexes		Standard Error Of Change From Preceding Month	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	96.85	95.75	3.30	3.30	1.25	1.25	1.61	1.65
February	97.80	97.26	2.70	2.87	1.02	1.08	1.19	1.23
March	96.51	96.47	1.62	1.57	0.61	0.59	1.02	1.21
April	93.84	94.69	2.17	2.80	0.82	1.06	1.21	1.26
May	95.59	96.80	2.36	1.78	0.89	0.67	1.15	1.02
June	100.01	102.14	1.91	2.02	0.72	0.76	0.88	1.04
July	102.48	104.12	1.31	1.86	0.50	0.70	1.02	1.56
August	106.88	107.58	2.35	3.69	0.89	1.39	1.27	1.87
September	107.01	107.46	2.40	3.30	0.91	1.25	1.36	1.40
October	106.28	103.34	2.69	1.69	1.02	0.64	1.54	1.00
November	100.06	97.31	3.04	2.02	1.15	0.76	1.41	1.52
December	98.2	96.53	2.16	3.48	0.82	1.32	1.49	1.81

TABLE C.13

SIRLOIN STEAK CONSUMER PRICES: STANDARD ERROR OF SEASONAL INDEX FOR EACH MONTH AND OF THE CHANGE FROM ONE MONTH TO THE NEXT, 1962 - 1969

Month	Seasonal Index		Standard Deviation of Index		Standard Error of Mean of Indexes		Standard Error Of Change From Preceding Month	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	99.7	98.25	1.06	3.01	0.47	1.35	1.70	1.94
February	94.94	95.36	3.66	3.14	1.64	1.40	2.01	1.60
March	94.44	93.71	2.61	1.73	1.17	0.77	1.47	2.21
April	96.01	96.48	2.01	4.63	0.90	2.07	2.44	4.13
May	97.15	97.33	5.08	8.00	2.27	3.58	2.46	3.87
June	103.37	100.46	2.09	3.33	0.93	1.49	1.46	1.93
July	103.87	104.09	2.51	2.76	1.12	1.23	1.42	1.68
August	106.56	107.18	1.94	2.55	0.87	1.14	1.92	1.61
September	105.13	105.97	3.84	2.55	1.72	1.14	3.01	1.83
October	104.17	103.39	5.52	3.19	2.47	1.43	2.48	2.34
November	99.66	98.81	0.50	4.14	0.22	1.85	1.48	1.99
December	98.35	98.71	3.27	1.64	1.46	0.73	1.54	1.53

TABLE C.14

ROUND STEAK CONSUMER PRICES: STANDARD ERROR OF SEASONAL INDEX FOR EACH MONTH AND OF THE CHANGE FROM ONE MONTH TO THE NEXT, 1962 - 1969

Month	Seasonal Index		Standard Deviation of Index		Standard Error of Mean of Indexes		Standard Error Of Change From Preceding Month	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	103.38	100.23	2.02	2.41	0.90	1.08	1.24	1.62
February	98.98	97.04	1.91	2.71	0.85	1.21	1.29	1.76
March	96.09	97.10	2.18	2.84	0.97	1.27	1.16	1.85
April	97.92	97.89	1.42	3.02	0.63	1.35	2.12	1.91
May	99.02	97.06	4.52	3.02	2.02	1.35	2.19	1.71
June	99.00	99.99	1.90	2.29	0.85	1.02	1.66	1.30
July	100.35	101.13	3.19	1.79	1.42	0.80	1.91	1.10
August	102.53	102.1	2.83	1.68	1.27	0.75	1.80	1.29
September	102.95	103.79	2.87	2.34	1.28	1.04	1.88	1.71
October	102.78	102.36	3.08	3.03	1.38	1.36	1.49	1.72
November	100.21	101.02	1.29	2.38	0.58	1.06	0.92	1.55
December	100.63	100.21	1.61	2.53	0.72	1.13	1.16	1.56

TABLE C.15

RIB ROAST CONSUMER PRICE: STANDARD ERROR OF SEASONAL INDEX FOR EACH MONTH AND OF THE CHANGE FROM ONE MONTH TO THE NEXT, 1962 - 1969

Month	Seasonal Index		Standard Deviation of Index		Standard Error of Mean of Indexes		Standard Error Of Change From Preceding Month	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	100.35	100.3	1.87	2.70	0.84	1.21	1.35	1.46
February	99.04	98.55	2.37	1.83	1.06	0.82	1.16	1.27
March	96.80	98.73	1.06	2.17	0.48	0.97	0.75	1.38
April	97.72	98.38	1.29	2.18	0.58	0.98	1.58	1.23
May	98.50	98.53	3.30	1.68	1.48	0.75	1.65	1.66
June	99.62	99.29	1.66	3.32	0.74	1.48	1.22	1.49
July	101.93	100.00	2.16	0.37	0.97	0.16	1.10	0.67
August	103.37	101.48	1.19	1.46	0.53	0.65	0.81	0.69
September	101.43	102.05	1.36	0.51	0.61	0.23	0.86	0.84
October	101.87	102.44	1.35	1.82	0.60	0.81	0.83	1.46
November	100.05	100.30	1.27	2.70	0.57	1.21	1.31	1.37
December	99.46	100.47	2.65	1.46	1.18	0.65	1.45	1.37

TABLE C.16

BLADE ROAST CONSUMER PRICES: STANDARD ERROR OF SEASONAL INDEX FOR EACH MONTH AND OF THE CHANGE FROM ONE MONTH TO THE NEXT, 1962 - 1969

Month	Seasonal Index		Standard Deviation of Index		Standard Error of Mean of Indexes		Standard Error Of Change From Preceding Month	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	97.77	101.28	4.17	2.20	1.87	0.98	2.64	1.70
February	99.01	99.87	4.17	3.11	1.86	1.39	2.23	1.54
March	96.30	97.02	2.72	1.47	1.22	0.66	1.72	1.42
April	94.16	97.55	2.71	2.82	1.21	1.26	1.63	2.06
May	95.28	97.44	2.42	3.65	1.08	1.63	1.28	1.99
June	98.35	98.31	1.52	2.54	0.68	1.14	0.95	1.35
July	101.74	100.09	1.48	1.61	0.66	0.72	1.14	1.09
August	102.22	102.08	2.07	1.84	0.93	0.82	1.51	1.27
September	104.74	103.02	2.66	2.16	1.19	0.97	1.73	1.58
October	106.82	101.49	2.82	2.78	1.26	1.24	2.01	1.51
November	103.84	101.52	3.50	1.90	1.57	0.85	2.86	1.27
December	99.45	101.35	5.34	2.12	2.39	0.95	3.03	1.37

TABLE C.17

HAMBURGER CONSUMER PRICES: STANDARD ERROR OF SEASONAL INDEX FOR EACH MONTH AND OF THE CHANGE FROM ONE MONTH TO THE NEXT, 1962 - 1969

Month	Seasonal Index		Standard Deviation of Index		Standard Error of Mean of Indexes		Standard Error Of Change From Preceding Month	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	100.85	99.07	2.16	1.11	0.97	0.49	1.29	0.89
February	99.56	99.48	1.92	1.66	0.86	0.74	1.34	1.03
March	96.56	99.23	2.29	1.60	1.02	0.72	1.23	1.10
April	96.98	98.58	1.53	1.86	0.68	0.83	1.82	1.10
May	98.12	99.93	3.77	1.62	1.68	0.73	2.09	0.80
June	100.33	100.04	2.75	0.78	1.23	0.35	1.36	0.44
July	100.76	100.50	1.30	0.61	0.58	0.27	0.93	0.64
August	102.45	101.89	1.62	1.29	0.73	0.58	1.30	1.03
September	103.06	101.30	2.41	1.91	1.08	0.86	1.56	1.45
October	103.41	100.15	2.51	2.61	1.12	1.17	1.30	1.36
November	101.15	99.01	1.46	1.56	0.65	0.70	0.69	0.83
December	100.19	99.14	0.49	0.99	0.22	0.44	0.99	0.67

TABLE C.18

FRESH PORK LOIN CONSUMER PRICES: STANDARD ERROR OF SEASONAL INDEX FOR EACH MONTH AND OF THE CHANGE FROM ONE MONTH TO THE NEXT, 1962 - 1969

Month	Seasonal Index		Standard Deviation of Index		Standard Error of Mean of Indexes		Standard Error Of Change From Preceding Month	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	99.56	99.76	1.92	2.57	0.86	1.15	1.85	1.61
February	99.27	98.23	3.67	2.53	1.64	1.13	2.11	1.54
March	97.82	97.83	2.98	2.35	1.33	1.05	1.60	1.25
April	95.67	93.53	1.97	1.53	0.88	0.69	1.44	1.50
May	95.33	93.98	2.56	2.97	1.14	1.33	1.33	1.58
June	97.31	99.24	1.54	1.91	0.69	0.86	0.93	1.40
July	101.69	102.89	1.40	2.49	0.63	1.11	0.92	1.41
August	104.67	105.00	1.50	1.95	0.67	0.87	1.12	1.15
September	105.52	104.05	2.02	1.68	0.90	0.75	1.65	1.12
October	104.64	103.12	3.10	1.87	1.39	0.84	1.89	2.09
November	102.11	101.60	2.86	4.29	1.28	1.92	2.26	2.49
December	99.96	100.29	4.16	3.55	1.86	1.59	2.05	1.96

TABLE C.19

LAMB CONSUMER PRICES: STANDARD ERROR OF SEASONAL INDEX FOR EACH MONTH AND OF THE CHANGE FROM ONE MONTH TO THE NEXT, 1962 - 1969

Month	Seasonal Index		Standard Deviation of Index		Standard Error of Mean of Indexes		Standard Error Of Change From Preceding Month	
	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto	Edmonton	Toronto
January	100.54	98.74	4.8	2.17	2.15	0.97	2.29	1.56
February	100.14	101.72	1.76	2.73	0.79	1.22	2.93	1.80
March	97.32	101.64	6.31	2.95	2.82	1.32	2.99	1.39
April	99.09	101.52	2.19	1.00	0.98	0.45	1.54	1.91
May	98.8	102.51	2.66	4.15	1.19	1.86	2.33	3.23
June	100.02	101.44	4.47	5.91	2.00	2.64	2.38	3.11
July	103.24	102.99	2.90	3.66	1.30	1.64	1.98	1.83
August	105.22	101.74	3.33	1.85	1.49	0.83	1.96	1.37
September	103.17	99.72	2.83	2.43	1.27	1.09	2.09	1.86
October	104.20	97.05	3.72	3.38	1.66	1.51	2.12	2.02
November	100.67	94.90	2.94	3.00	1.32	1.34	2.26	2.04
December	97.98	95.81	4.12	3.43	1.84	1.54	2.83	1.82

APPENDIX D

RESULTS OF VARIANCE ANALYSIS

TABLE D.1

ANALYSIS OF VARIANCE OF LIVESTOCK PRICES AT PUBLIC STOCKYARDS, 1962-1971

Source of Variation	Species, classes and Grades	Degree of Freedom	Sum of Squares								Mean Square							
			Choice Steers		Good Steers		Good Lambs		Index 100 Hogs		Choice Steers		Good Steers		Good Lambs		Index 100 Hogs	
			Ed.	Tor.	Ed.	Tor.	Ed.	Tor.	Ed.	Tor.	Ed.	Tor.	Ed.	Tor.	Ed.	Tor.	Ed.	Tor.
Total		119	1341.97	1371.91	1426.93	1347.65	1809.17	3203.61	2388.22	2278.31								
Between Means of Years		9	1115.68	1162.32	1172.93	1104.52	1108.72	1731.54	1357.32	1328.51	123.96	11.53	130.33	122.72	123.19	192.39	150.81	147.61
Between Means of Months		11	36.42	34.95	52.84	40.53	528.34	1089.77	148.80	154.31	3.31	129.15	4.80	3.68	48.03	99.07	13.53	14.03
Remainder, Interaction		99	189.87	174.64	201.16	202.61	172.11	382.31	882.09	795.49	1.92	1.76	2.03	2.04	1.74	3.86	8.91	8.04

TABLE D.2

F-RATIO OF LIVESTOCK PRICES AT PUBLIC STOCKYARDS, 1962-1971

Region	Choice Steers	Good Steers	Good Lambs	Index 100 Hogs
Edmonton	1.73	2.36	27.63	1.52
Toronto	1.80	1.80	25.65	1.75

TABLE D.3

ANALYSIS OF VARIANCE OF WHOLESALE PRICES, 1962-1971

Source of Variation	Species, classes and Grades Degree of Freedom[1]	Sum of Squares								Mean Square							
		Choice Steers		Good Steers		Choice Lambs		Bacon		Choice Steers		Good Steers		Choice Steers		Bacon	
		Ed.	Tor.	Ed.	Tor.	Ed.[2]	Tor.	Ed.	Tor.	Ed.	Tor.	Ed.	Tor.	Ed.	Tor.	Ed.	Tor.
Total	119	4922.46	4660.58	4673.48	4768.67	10461.01	20988.62	11457.02	15090.09								
Between Means of Years	9	4234.79	4060.63	4031.97	4126.02	5889.86	15936.45	7756.05	10630.31	470.53	451.18	448.0	458.45	841.41	1770.72	861.78	1181.15
Between Means of Months	11	122.47	89.07	107.88	103.33	3790.60	4077.79	1079.23	873.00	11.13	8.10	9.81	9.39	344.60	370.71	98.11	79.36
Remainder, Interaction	99	565.21	510.88	533.63	539.32	780.55	974.38	2621.75	3586.78	5.71	5.17	5.39	5.45	10.14	9.84	26.48	36.23

[1] For all entries except Edmonton, choice lambs.

[2] Edmonton, 1962-1969, Degree of Freedom are 95, 7, 11, 77 respectively for each item.

TABLE D.4

F-RATIO OF WHOLESALE PRICES, 1962-1971

Region	Choice Steers	Good Steers	Choice Lambs	Bacon
Edmonton	1.95	1.82	33.99*	3.70
Toronto	1.57	1.72	37.67	2.19

*Edmonton, 1962-1969.

TABLE D.5

ANALYSIS OF VARIANCE OF CONSUMER PRICES,
1962-1969

Source of Variation (Beef Classes and Grades)	Degree of Freedom	Sum of Squares								Mean Square							
		Sirloin Steak		Round Steak		Rib Roast		Blade Roast		Sirloin Steak		Round Steak		Rib Steak		Blade Roast	
		Ed.	Tor.	Ed.	Tor.	Ed.	Tor.	Ed.	Tor.	Ed.	Tor.	Ed.	Tor.	Ed.	Tor.	Ed.	Tor.
Total	95	1.81	1.49	0.60	1.25	0.62	0.22	0.38	0.45								
Between Means of Years	7	1.28	0.97	0.40	1.02	0.48	0.08	0.24	0.35	0.18	0.14	0.0006	0.15	0.07	0.01	0.0004	0.05
Between Means of Months	11	0.18	0.20	0.03	0.08	0.02	0.02	0.03	0.04	0.02	0.02	0.06	0.01	0.002	0.002	0.003	0.003
Remainder, Interaction	77	0.35	0.33	0.17	0.16	0.12	0.12	0.11	0.06	0.005	0.004	0.003	0.002	0.001	0.001	0.003	0.001

TABLE D.6

F-RATIO OF CONSUMER PRICES,
1962-1969

Region	Sirloin Steaks	Round Steaks	Rib Roast	Blade Roast
Edmonton	3.57	1.23	1.25	2.14
Toronto	4.17	3.59	1.09	4.15

TABLE D.7

ANALYSIS OF VARIANCE OF CONSUMER PRICES,
1962-1969

Source of Variation	Species, Classes and Grades Degree of Freedom	Sum of Squares						Mean Square					
		Hamburger		Fresh Pork Loins		Lamb		Hamburger		Fresh Pork Loins		Lamb	
		Ed.	Tor.	Ed.	Tor.	Ed.	Tor.	Ed.	Tor.	Ed.	Tor.	Ed.	Tor.
Total	95	0.54	0.40	2.23	2.59	0.85	0.52						
Between Means of Years	7	0.47	0.37	1.76	2.08	0.51	0.23	0.07	0.05	0.25	0.30	0.07	0.03
Between Means of Months	11	0.02	0.01	0.15	0.18	0.04	0.02	0.001	0.001	0.01	0.02	0.003	0.002
Remainder, Interaction	77	0.05	0.02	0.32	0.34	0.30	0.27	0.001	0.0002	0.004	0.004	0.004	0.003

TABLE D.8

F-RATIO OF CONSUMER PRICES
1962-1969

Region	Hamburger	Fresh Pork Loins	Lamb
Edmonton	2.39	3.36	0.91
Toronto	4.03	3.81	0.56