T H E S I S

on

A STUDY OF INDEX NUMBERS FOR OREGON AGRICULTURAL COMMODITIES

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CHAPTER I.

A STUDY OF INDEX NUMBERS FOR OREGON AGRICULTURAL COMMODITIES

There are many definitions of index numbers--each theorist and computer of them offer their own interpretation. So a consideration of several such definitions may elucidate the subject of index numbers and make them more intelligible and useful. Allyn A. Young of Harvard defines Index Numbers as "series of numbers which measure or express the relative changes, as from time to time or from place to place in the magnitude of statistical groups or aggregates of variables."[1] This statement seems quite formidable at first, largely because it is designed to be inclusive and cover all forms and circumstances. Professor Irving Fisher, an eminent student of Index Numbers, in defining them in connection with prices, says "an index number of prices then, shows the average percentage change of prices from one point of time to another."[2] Most people have at least a rudimentary idea of a 'high cost of living' or of a 'low level of prices', especially agricultural, but usually very little idea of how the height of the 'high cost of living' or the lowness of the

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[1] Young, Allyn A., Handbook of Mathematical Statistics, Page 181

[2] Fisher, Irving, Making of Index Numbers, Page 3.

low level of prices is to be measured. It was to measure such magnitudes that index numbers were invented. Edgeworth, one of the pioneers in the field of index numbers, explicitly conveys this idea in his definition, "an index number is a number adapted by its variations to indicate the increase or decrease of a magnitude not susceptible to accurate measurement". There would be no difficulty in such measurement, and hence no need of index numbers if all prices or other variables moved up in perfect unison or down in perfect unison. But since, in actual practice, the prices of different articles move very differently, we must employ some sort of compromise or average of their divergent movements. Mr. Fisher offers an illustration and analogy for this that will make it clearer perhaps. "If we look at prices as starting at any time from the same point, they seem to scatter or disperse like the fragments of a bursting shell. But, just as there is a definite center of gravity of the shell fragments, as they move, so is there a definite average movement of the scattering prices. This average is the 'index number'."

Keynes' thought also seems to be that an index number is really a conception or idea of change expressed quantitatively. Lastly, I offer Frederich C. Mills' very comprehensive definition and aim, "The essential aim in all cases (of index number construction) is to secure

a single, simple figure which will indicate the net resultant of the forces acting on the constituent series".[1]

Though many more definitions by eminent authorities might be given, these will suffice for our interpretation. Not let us summarize the main points about index numbers in these specific statements:

First, an index number is a number or series of numbers.

Second, they measure and express changes or movements quantitatively (one 'single, simple figure' indicates the change).

Third, these changes or movements are between forces or quantities which we cannot observe directly. They are in the forms of 'magnitudes or statistical groups or aggregates of variables' as they occur between periods of time or between places.

Fourth, these changes are called relative or percentage as they are ratios of one thing to another. "Their fundamental concept is a ratio concept".[2] They may also be described as an average or resultant.

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[1] Mills, Frederich C., Statistical Method, Page 170.

[2] Kent, Elements of Statistics, Page 81.

Price Relatives.

There is a distinction between an index number and what is called a "relative', which is well to bear in mind. "Sometimes a series of numbers proportional to some other simple statistical series of numbers, not of groups, is called a series of index numbers. It is better, however, to refer to these simple proportional series as series of relative numbers or merely as series of relatives".[1] Day explains this statement a little more fully: "If the individual items of a simple time series are to be related to some particular point or base and the items are consequently converted into percentage relatives of the base item, the percentage figures thus obtained are preferably referred to as relatives--price relatives, if the original items are of prices, production relatives, if the original items are of production, and so on. Relatives of this sort are sometimes called index numbers, but it is better to give the latter the distinctive meaning indicated above".[2]

Statement and Delimitation of the Problem.

Index numbers may be used in many kinds and varieties of data. For example, they may apply to data on

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[1] Young, Allyn A., Handbook of Mathematical Statistics, Page 181

[2] Day, Statistical Analysis, Page 328.

price, production, yields, sales, wages, net and gross income, imports, exports, freight rates, bank clearings, taxes, and the like. Fisher says, "In Great Britain alone, three million laborers have their wages regulated annually by an index number of retail prices".[1]

Though it would indeed be interesting and perhaps useful to discuss index numbers for all these, this study will confine and limit itself largely to one group; namely, that of prices. This, however, is really a broad and basic type so the discussion will be further restricted to one phase of it--agricultural prices. And as there are three main types of prices even for most agricultural goods, the wholesale price, the retail price, and the farm or producer price, the writer proposes to consider only the latter form as distinguished from the others, also an index number for only those that pertain to Oregon commodities. This delimitation might almost be termed one of necessity since at present there is no alternative. We have only one real wholesale market in the state and it is not centrally located. It is also the only market in which retail prices are officially recorded. As we shall see later, there has been an attempt to collect farm prices throughout the state for many years.

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[1]Fisher, Making of Index Numbers, Page 368.

Outline of Procedure and Method of Attack

First the importance of the problem will be considered in detail. It will include the needs, purposes, and practical applications of index numbers. A historical survey will then be made. It will indicate the extent of the work already done in the field of index numbers with special emphasis given to other state agricultural indices.

We will be ready then to center our attention on the state of Oregon. Her special features and characteristics will be reviewed. Also her commodities and price data will be carefully analyzed and the reliability and adequacy of the data discussed. Then upon this fundamental basis and with the knowledge thus gained, the steps and problems of the construction of an appropriate index number will be reviewed and conclusions reached and advocated. As an aid and supplement to published material on index numbers that the writer has examined (see Bibliography) he has also included the questionnaire method and form. These questionnaires were sent to each State College, usually to the Department of Agricultural Economics.

In order to test the reliability and adequacy of the Oregon price data it has been desirable and necessary

to study all the statistics available on the subject and also what is back of them,--how they were collected, etc.

Special acknowledgment is here made to L. R. Breithaupt, Extension Specialist in Agricultural Economics at Oregon State College for material supplied concerning Oregon price data. The writer is also indebted to the State Agricultural Statistician in Portland, Oregon, who made available the records of his office for this study, and to the librarians of the State College Library who were untiring in their effort to assist in obtaining bibliographical references.

CHAPTER II.

IMPORTANCE AND USES

"An index number is a necessity, owing to the dispersion of prices", says Fisher. So the function and important part to be played by index numbers is, as someone has said, "To reduce to a common denominator the qualities of different factors or phenomena so as to allow comparison,--generally historical. It measures the change in some quantity we cannot observe directly, but which we know to have a definite influence on many other quantities which we can observe". Dr. Foster, in his Prefatory Note to Fisher's, "Making of Index Numbers", states the place and purpose of index numbers very well when he says, "All sciences are characterized by a close approach to exact measurement. In order to determine the pressure of steam, we do not take a popular vote, we consult a gauge. Concerning a patient's temperature, we do not ask for anybody's opinion, we read a thermometer. In economics, however, as in education, though the need for quantitative measurement is as great as in physics or medicine, we have been guided in the past largely by opinions and guesses. In the future we must substitute measurement for guess work."

This new method is especially needed in agriculture. We are well aware of the high correlation that has always

existed between prices of one season and the acreage and production of the following season. This method produces constant occilations in farm prices and lessens the producer's profit. It accelerates a period of inflation and also one of deflation when it starts. Without a measurement of any kind, but only by superstition, hunches, or by necessity, most farmers have proceeded aimlessly from year to year. Nor has there been any other alternative until recently when price data have been collected and analyzed.

Now to show how these data can help the farmer, the state, and the nation. First, through uses and interpretation of marketing information. There are three types of such information differing mainly in scope and time of issuance:

1. Outlook Reports. These are annual in form and apply more toward long-time situations and trends. They are being adopted for use in states now and could be quite effective and analytical by determining trends with the aid of index numbers.

2. The Agricultural Situation is a monthly paper or bulletin which gives current conditions and seasonal trends and averages. These are expressed and measured by index numbers also.

3. Market News. Though this term may be said to include the others too, it is most commonly used to give daily or weekly market news and conditions. It gives actual quotations, shipments, prices, etc. of the real transactions.

The factors of supply and demand cannot function efficiently when shrouded by ignorance. Only when those concerned know the facts can they control the situation. The Agricultural Situation as it is published in Oregon each month, disseminates specific information about conditions and trends in our state as well as in the United States. This can be greatly facilitated and extended by index numbers. For example, here are some specific illustrations from other states: "Some farm commodities since 1914 have been consistently as high as or even above the general level of prices, while others have been much lower. Milk, after the beginning of the War in 1914, lagged behind the general rise of prices until June, 1917. It was then nearly fifty points lower than the general price level. Farmers were getting rid of their cows. This brought on an acute milk shortage."[1] Such situations and cycles are in main due to the lack of market news and

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[1]Vermont Bulletin #33, 1924.

trends--otherwise, an acute shortage might have been averted. "The farm price of eggs has been very high for the past five years but a decline has now set in."[1] Upon what grounds can statements like that be made? It is because they made an index of the farm price level and then the ratio of each one to all the others was shown by the computed price relatives of the commodities.

Also, the writer found a very interesting example of the varied and multiple uses of index numbers in the Farm Economic Facts for May, 1928, a Massachusetts Agricultural College publication. It was a price index of a dairy ration. Statistics given were:

1927		1928		
March	April	Feb.	March	April
95	95	106	110	116

The ration was made up of six different goods with varying amounts of each. Now as we look at the row of index numbers for the corresponding months of each year, we get an accurate and instant conception of the trend of the cost. There was over 15% increase this year above the same months of last year. Wouldn't we be a little more careful with the ration, perhaps look for some

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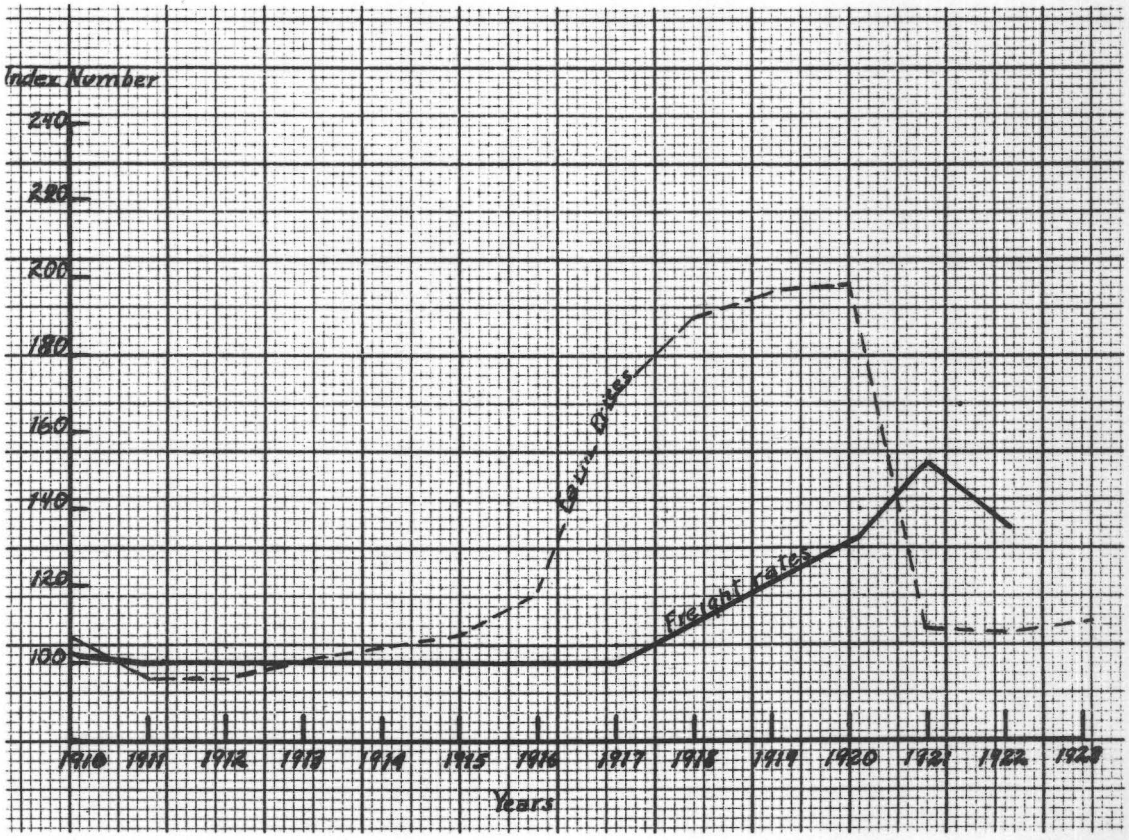
[1]Vermont Bulletin #33, 1924.

substitutes for those in the list of six which were highest, if the price we receive from our dairy products, which can also be told by index numbers, has not likewise increased?

In addition to use in Outlook Reports and Market News, farm price index numbers would be very valuable as a comparison with indices of other industries in the state. There must be as little maladjustment as possible if the whole state is to prosper to a maximum. Often court decisions and legislative acts are passed which are adverse to agriculture and beneficial to others, or vice versa. This is largely due to either no information or to inadequate data and measurements. For example, if the facts and trends had been known, is it logical to think that a 25% increase in freight rates for Pacific Coast States and a 33 1/3% increase for freight between sections in the United States would have been allowed on August 26, 1920, just when agricultural prices were dropping so precipitously. And, further, that they would have allowed such rates to be maintained at that level until 1922 before making any reduction. Then, only one was made for agricultural products, which amounted to just 10%; the other and a like amount was for non-agricultural products. Graph I on the following page shows the discrepancy of farm prices and freight rates in the western states as

GRAPH SHOWING INDEX NUMBERS
OF FARM PRICES AND FREIGHT RATES
IN THE WESTERN STATES*

* Bulletin #446 - Cornell University, Harry Gabriel


Index Number
240
220
200
180
160
140
120
100
Farm Prices
Freight rates
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
Years

revealed by index numbers.

There has been a rate hearing pending in Oregon this summer which would raise the rates on apples and other fruits. One counselor states that an increase is justifiable and in turn the Oregon Service Commission files a complaint saying that not only should an increase not be allowed but that the present rate is too high and should even be lowered. What common accurate measure have they to go by? None. Each side doubtless analyzes some specific case and arrives at its own conclusions. With state indices real comparisons could be made.

In the Journal of Farm Economics, July 1926, page 377, a most unique and noteworthy example of the value and extent to which an index number may be put is discussed. H. G. Weaver, of the General Motors Corporation, describes there an index he has developed and he calls it "a basic purchasing power index by counties". All heterogeneous county data;--population, income tax returns, value of the various products and resources, etc., is reduced to a common denominator or index of purchasing power by counties as it is called. What could be of more specific value to the General Motors Corporation for a guide to Production and output policy?

Similar cases might be drawn from the field of taxation.

As an example of recent legislative action not based on facts or a knowledge of existing trends was the Senate Bill #3845, introduced by Mr. Heflin of Alabama. Its provisions were to "prohibit predictions with respect to cotton or grain prices in any report, bulletin or other publication issued by any department or other establishment in the executive branch of the government." The authorization of any statement or interview of similar import is also forbidden. There is a penalty of fine of $15,000 or imprisonment of not more than five years for any violation of these provisions.

As opposed to such a radical political action as this bill, stand the actual facts and arguments recently published by Lloyd S. Tenny, Chief of the Bureau of Agricultural Economics, U. S. Department of Agriculture, in response to the charges made against the work of his department. I will quote a series of facts and supported statements from Mr. Tenny's report. These statements are included not necessarily because they refute the bill, but because our problem is closely related and dependent upon them. It shows the new scientific movement and policy as it is being applied to agriculture and also

the wonderful protective benefits it affords the producer. Though some phrases may seem to duplicate others given before or to be included later in the thesis, the writer believes that the selections will have their fuller meaning if given seriatim.

"Confidence is the basis of all industry and nothing is more conducive to manipulation in a futures market than the circulation of false rumors and unfounded reports".[1] This bill would abolish official forecasts of the conditions, leaving the producers in the dark and subject to rumors and false reports. "We (Dept. of Agriculture) maintain that farmers have as much right to know this essential information as have members of the trade. It has been stated that everyone in the cotton trade expected higher prices. The facts are that recognized cotton trade services issued forecasts between July 15 and September 14 indicating lower cotton prices. Then forecasts went to dealers, speculators and mills, but not to the cotton producers. Trade papers were replete with information about the unsound basis of the then existing prices, about the low mill demand, low export demand and large stocks. These conditions were known to all but the farmers and the

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[1]From the Introductory Summary, pages 1 - 3.

cotton 'fleeced' lambs. It has been charged that the Department's September 15 statement caused the great decline in prices. The facts are that the real break in the price of cotton came on the 8th of September, seven days before our Price Situation Statement was released.

"It has been charged that the September 15 statement caused farmers to lose hundreds of millions of dollars. The fact is that the statement advised farmers of an opportunity to sell their cotton for $125,000,000, more than they were likely to receive from the average price of the season. By calling farmers' attention to the fact that prices were likely to fall, we advised them of an opportunity to sell while selling was good and before prices reached the low points to which they were going. In the past ten years farmers could have added hundreds of millions of dollars to their income by planning their marketings in view of probable price changes.

"It has been stated that it is humanly impossible to forecast cotton prices. Our reply is that it can be done as it has been done. Prices are not accidents or chance, they are the results of the laws of supply and demand. We have made a thorough study of cotton prices and find it possible to estimate prices for a season and changes in

prices from one season to another on the basis of supply and demand conditions. The results of our studies have been successfully applied to indicating cotton price movements during the past three years. In fact, there is not in the seven years (period 1920-1926) any year in which the estimated average price is a half cent more or less than the actual average price. (Estimates of production, the carryover from preceding crops, the general commodi ty price level, business conditions, and the trend of cotton consumption provide a basis for determining the average price for the marketing season). It is a well recognized fact that the crop forecasts exert an important influence on prices at the time they are issued. This influence is not always in an upward direction as it sometimes happens that the forecasts indicate a larger crop than the preceding report and prices are affected adversely, but no one who gives the matter any consideration would contend that for this reason the crop forecasts should be abolished. .... The official crop reports are a protection to the farmers against the issuances of false and misleading reports. Exactly the same situation exists with respect to price forecasts. Large commercial agencies engaged in handling agricultural and other products employ highly paid statisticians and economists to analyze the

situation for them and guide them in their operations. The farmers are not organized and are therefore dependent upon the government to furnish this information to them. The final results of crop forecasts is to give some indications of the trend of prices but if the government should stop here, I do not feel it would be carrying out its full duty to the producers."[1]

Does not such a bill as this that would abolish the farmers' source of information and guide to marketing seem like an act of class legislation? For "traders cannot be expected to be interested in having the farmer informed as to the value of his cotton." They make their money out of commissions or variations in the market. "Speculation thrives on fluctuations in the market. When the market is steady andprices are stable, times are dull for them and income is low. When the market is jumpy--when few know where the price ought to be--speculation is intense and the successful speculator piles up profits. The well-informed speculator profits by playing against uncertainty and lack of knowledge on the part of others.

"Some of our critics wish the Department to publish all the facts, but should let farmers make their own interpretation. But is it sufficient? Facts without inter-

[1]From the Introductory Summary, pages 1 - 3.

pretation may mean nothing and without understanding they may mean more confusion. Farmers and farm leaders who know the needs of agriculture are demanding this service from us."[1]

So it was that on September 15 the Department of Agriculture made this forecast, "Should the present estimate of production be realized and past relationships between supply and price prevail, it is likely that prices will decline in the next few months." "This was our interpretation of the facts cited in the September cotton price situation statement and we published the conclusion to aid farmers in planning the marketing of their 1920 cotton crop."[2]

Mr. Tenny then proceeds to explain more fully each of these summary points and also show graphically the facts, the analysis, and why an interpretation is necessary and desirable.

And as the Editor of the Oklahoma Farm Stockman, October 1, 1927, concisely summarized his view of the decline: "In my judgment the price of cotton would have dropped just as much and just as fast without the

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[1]Introductory Summary, Mr. Tenny's Report.

[2]Ibid.

government's report, as with it. The only thing the report did was to tell the farm folks what to expect".

These statements and facts are quite pertinent and applicable to the thoughts and policy we are considering. This will be more evident by the following evaluation of purposes and uses of index numbers. In Part 3 of the questionnaire, the writer asked the various states to "Indicate by number in order of importance the purposes for which index numbers are constructed". Those purposes suggested were:

(a) A convenient statistical measure of the relative position of agriculture and other industries.

(b) A measurement of the relative position of the agricultural industry itself and of the several enterprises within the industry.

(c) A measurement of the relative farm situation in your state and in other states or countries.

(d) As an instrument for measuring and forecasting price trends.

(e) As an aid in determining farm management and organization policies.

(f) Others offered by other states.

(1) An instrument to measure fluctuations of prices of farm produce and to have a

general idea of agricultural situation in the state at a given time.

The replies as received from the various individual states and tabulated according to relative importance would appear as:

TABLE I.

Relative Importance

Purpose	1	2	3	4	5
a	1	6	4	3	1
b	7	2	5	1	1
c	1	4	4	3	4
d	3	2	1	6	2
e	3	3	2	1	5
f	1				

From this table we may infer and note that the primary purpose which states find index numbers of value is as a "measurement of the relative position of the agricultural industry itself and of the several enterprises within the industry." The purposes (d) and (e) are next in importance in column one. Then for second place, purpose (a) is the most outstanding. After that the re-

plies are fairly well scattered.

However, in analyzing the replies the writer finds this tendency; namely, that in the states just starting or intending to start state index numbers their first and fundamental purpose seems to be (b), then (a) and (c). (They all measure the relative position of agriculture for different uses). Then in the states which have already built up such a series they place their emphasis upon (d) and (e).--The measuring and forecasting of price trends and for determining farm management and organization policies. It is a procedure, so to speak, from the broad and extensive uses to the intensive ones. They seem to be almost in serial order. Thus it appears that the chief purpose and ultimate goal of such indices are found in these latter two (d) and (e) and that they are beginning to be attained to some extent at least. Mr. Tenny's review, given above, further substantiates this.

State Versus United States Index Number.

Thus far we have assumed the position that individual states may well develop separate index numbers. Now to substantiate this viewpoint: "With the limited number of important products in any given state, an unweighted United States figure may lack much of being a true re-

flector of conditions in that state."[1] Or again adjustments in freight rates may change and sometimes actually reverse the trend of prices for a certain product in a given district as compared to those in a district located differently, and the national index for that product perhaps remain unchanged. It is not that a national index number is defective in its structure or purpose. It does represent conditions in the country at large since with a large number of commodities and with the heavy movement from various states occurring at widely different times, such weightings and bias tend to offset each other and so affect the total very slightly.

But, on the other hand, in any given state the variations in the relative price position of major crops and products may make the United States figures very unrepresentative of conditions there. For example, taking the United States as a whole, cotton is a very important product, in fact it is the most important one which a farmer sells outside of foods. Wages were still very high in 1922-1923 and there was little unemployment and as a result the demand for cotton was great. Not only was the price boosted by the large consumer demand, but allied

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[1] Journal of Farm Economics, July, 1926, page 356.

forces worked in conjunction with it by greatly reducing the supply. It was the boll weevil. "In fact, the rise in the price of cotton increased the index numbers of prices of all farm products in 1923 to such an extent that it was believed by many that the agricultural depression was over. Just as the short corn and wheat crops were hailed in 1924 as ending the depression."[1] The average monthly index of prices paid to farmers for all farm products increased from 124 where it had been for nearly two years up to 137.

So, while such an index does truly represent the measure of farm prices in the United States, it loses its particular use and advantage when applied specifically in a state like Oregon which raises no cotton. In fact, it may be erroneous and give entirely the wrong picture of our state affairs. Here are a few state indices of prices as published by Cornell University for the year 1926. Note their wide variations, 119 in Alabama and 177 in Vermont.

State	Conn.	Vt.	Penn.	Ohio	Iowa	S.D.	Utah	Ore.	Ala.	Texas	U.S.
Index No. (1926)	153	177	160	155	140	147	132	136	119	126	142

[1] Warren and Pearson, Page 64, Agricultural Situation.

And so with United States and state indices, the former is general and not applicable for specific comparisons. This may be further illustrated by the trend in relative prices of commodities in different states.

TABLE II

The Trend of Prices[1]

Wheat Price, East and West of Miss. River

	West cents (aver.)	East cents (aver.)	Difference in cents
1912	76.8	97.6	20.8
1911	90.2	94.1	3.9
1910	88.8	95.1	6.3
1909	93.6	100.2	16.6
1908	87.9	96.7	8.8

In some years the price of wheat averages more than 25% higher East of the Mississippi than it does West of the Mississippi; in other years, less than 5% higher. So how applicable is a United States average when applied to specific regions.

Further to consider some states and their price differences:

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[1]Nat Murray, Journal of Farm Economics, April, 1921, Page 79.

TABLE III

Relative Farm Price of Wheat

Three of Mid-western States, North Dakota, Nebraska, and Texas

1908-1914 = 100 December price[1]

	Texas		Nebraska		North Dakota	
	Wheat	Oats	Wheat	Oats	Wheat	Oats
March	112	130	109	113	109	117
April	113	128	111	115	111	120
May	113	128	113	118	113	123
June	107	127	109	118	112	125
July	100	107	102	117	112	126
August	100	100	100	108	109	128
September	102	106	100	104	102	108
October	104	109	101	103	100	101
November	106	111	101	100	100	101
December	107	113	102	103	102	102

"We then see that the seasonal trend or cycle of prices has a geographical variation". Note advance of 2% in Texas in August and a contemporary decline of 7% in North Dakota. In case of oats, also note in Texas the price is lowest when in North Dakota it is highest. These

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[1] Journal of Farm Economics, pages 75-76.

state statistics have a vital bearing upon the question as to whether a farmer should hold or sell his crop at harvest time.

"This seasonal cycle is much wider in the case of some crops than of others." Taking the United States farm price average, the range from monthly low to high is only about 9% for wheat, but 13% for oats, 27% for corn, 30% for potatoes, and 75% for eggs. In general, the variation is least with non-perishable crops and wider with perishables--difficult to hold. This is of much importance to Oregon, for it has many specialties which are largely perishable.

Finally, we should consider the advisability of constructing state indices by noting the attitude of the agricultural economists in the various states towards index numbers. This also provides an argument favorable to their construction as is shown by the questionnaire.

Part 5 of the questionnaire stated: "What difficulties or objections have you found? The suggested answers were:

(a) Basic data inadequate and unreliable.

(b) Cost of construction and maintaining them.

(c) Others.

Several states which now compute state index numbers stated that (a) was a slight weakness or handicap in

extending their use over a longer period of time, or over a wider range of commodities. Iowa, which has done considerable work with them, answered (b) by saying the cost is very slight, almost negligible. No other objections were given by states either constructing or not constructing indices. The only other difficulties found were lack of time and the availability of a man to undertake such work. I will quote from a typical sample letter from one of the states not constructing indices to show their regard and desire for them. This letter happens to be from the University of Montana and states: "We do not issue any publications of index numbers in this state. We should like very much to do so and hope that we can add one man to our staff this coming year, who can get time to do just this sort of thing".

CHAPTER III

Historical Survey of the Field

General index numbers may be said to be over 150 years old, since the first one was published before our Revolutionary War as Professor Mitchell has found. However, their use and construction may well be included among the achievements of the present generation, and especially of the last decade. It is a noteworthy incident that the last annual December meeting of the American Statistical Society was almost entirely devoted to papers on index numbers and to discussion of their problems and application.

Nearly every country has one or more series of them. One has even been constructed for Poland since the War. Again, though they are both troublesome and expensive to compute, there are in the United States alone today some ten leading index number series; namely, (1) Bradstreet's, (2) Dun, (3) Bureau of Labor, (4) Gibson, (5) Babson, (6) Annalist, (7) Federal Reserve, (8) Harvard, (9) Irving Fisher, (10) Bureau of Agricultural Economics. The most elaborate one is that published by the United States Government in the Bureau of Labor Statistics. They now issue both a wholesale and a retail number; the other

private and individual concerns are restricted to wholesale prices. Only since the World War has the construction of agricultural indices of farm prices, etc., received much attention. Their development has been remarkable.

State index numbers are even much more recent. In fact, there was only one (New York) regularly computed until within the last five years, when some three or four others started. Since then the number has increased until now over a third of the states have already constructed some of them and at least another third are planning to as soon as they are able. The agricultural economists in these states have found that general (national) index numbers of farm prices do not describe conditions in their own states with sufficient accuracy. In fact, this general index number except by accident never describes conditions anywhere with much accuracy as we noted above.

During and since the war when prices and values fluctuated so greatly and became maladjusted the need of index numbers has become manifest. They have also been facilitated by several other important changes in our business organization which have made real comparisons possible and accurate.

1. The grading and standardization of commodities.

Heretofore, the quality of articles were apt to change from year to year and even from place to place within the same season. Prices did not mean the same thing in two places or two different seasons and thus were not comparable.

2. Improvement in statistical method and technique in the social sciences. Better methods of sampling and the regularity and accuracy of results are now known and possible.

3. Better and more systematic records, both public and private are being kept now, thus affording a larger and more reliable number of quotations.

4. Increase in commercial and trade newspapers and journals, also Outlook Reports, and the Agricultural Situation Bulletins, has created a medium through which they can reach those who need and desire them.

These factors have not only increased the usefulness and accuracy of the existing index numbers, but have increased the applicability and desirability of more intensified and detailed index numbers as well. Large business houses and corporations are constructing them for their own departments. In fact, business indices and forecasting have greatly stabilized business and is an example for the agricultural industry to consider.

Wholesale prices have recently become near enough normal so that the Bureau of Labor Statistics have changed the base period for their index numbers from 1913 to 1926.

From the questionnaire, the writer finds that the following states are now constructing index numbers (including price relatives): New York, Ohio, New Jersey, Penn., South Dakota, North Dakota, Minnesota, Missouri, North and South Carolinas, Virginia and West Virginia, Alabama, Iowa, Utah, Rhode Island, Maine (price relative), Conn., and Vermont.

Some of those planning or now engaged in the work are Maryland, Colorado, Kentucky, Montana, Kansas, New Mexico, Indiana, Nebraska.

"Index numbers of farm prices in representative states throughout the country are currently published by the Department of Agricultural Economics and Farm Management at Cornell University. The states included are Penn., Ohio, Iowa, N. Dakota, Utah, Oregon, Kentucky, Georgia, Alabama, and Texas. Oregon was included on their list as representing the Pacific Coast. This is one phase of the work Warren and Pearson have been carrying on for several years. They were the real pioneers in state indices and have developed quite an elaborate array of them. Following are some of their state

indices:[1]

(a) Index number of prices paid the farmer for farm products.

(b) Price relatives of individual commodities.

(c) Prices (cost) of feed.

(d) Index number of prices paid to farmers in different parts of New York State.

(e) Index number of farm taxes in New York.

(f) Cost of distributing goods.

These, together with the other state indices and government index have been published in a monthly bulletin called Farm Economics.

Many might say now, why bother about constructing an index number for Oregon when one is already computed. Such an argument is not tenable as can be seen from the following facts:

Their source of data is only that of the United States government. It is not immediately available and the index numbers are not published monthly and usually only annually in the February issue. And furthermore, they have not published any since the February number of 1927, in which they gave the indices of the selected states by months during 1926. So there are no indices available from that source since then.

[1] Farm Economics, March, 1928.

Then it is well to note, and it is really an example for Oregon to consider, the series of index numbers that were computed for the state of Iowa by New York down to 1924. In that year Iowa began her own price work. The last comparative state table made by Cornell University published the series of index numbers as computed by Iowa and it did not show the present and previous computations for Iowa that they had made. The disparity between the two lists is readily apparent when one sees the following table and the graph of their differences:

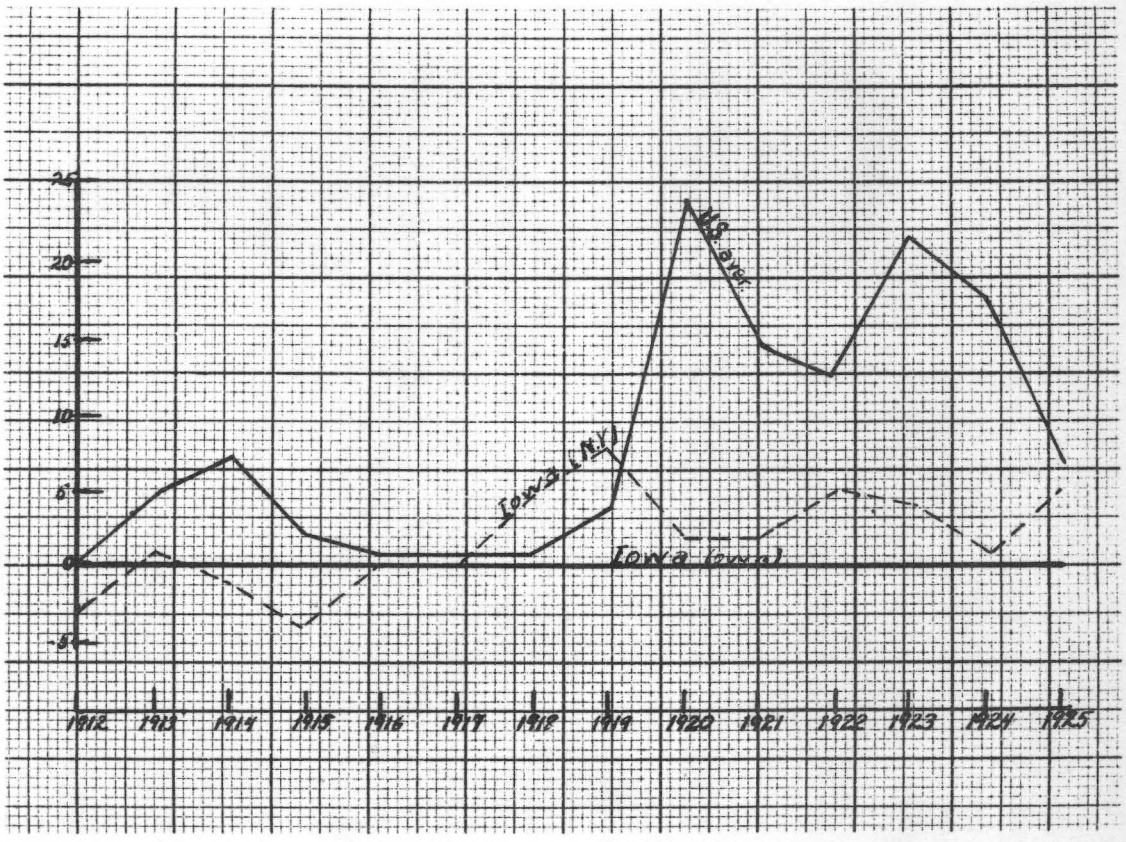
Table IV

Table of Index Number - Farm Prices

	Iowa (own)	Iowa (N.Y.)	Iowa Difference -	Iowa Difference +	U. S.	Iowa (own) and U. S. aver. Dif.
1910	102	98		4	104	-2
11	87	87			94	-7
12	99	102	3		99	0
13	104	103		1	99	5
14	108	109	1		101	7
15	103	107	4		101	2
16	120	120			119	1
17	181	181			180	1
18	207	202		5	206	1
19	219	211		8	215	4
20	189	187		2	214	25
21	104	102		2	119	15
22	111	106		5	124	13
23	115	113		4	137	22
24	122	121		1	140	18
25	147	142		5	154	7

GRAPH SHOWING THE DEVIATIONS OF
IOWA'S TWO INDEX NUMBERS AND ALSO
THE ONE FOR THE WHOLE UNITED STATES

(IOWA (OWN) INDEX NUMBER IS USED AS A BASE)


25
20
15
10
5
0
-5
US. prod.
Iowa (nom.)
Iowa (prod.)
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925

The men at Iowa are doing some fine work with index numbers. They endeavor to make an annual census and some $100,000 is appropriated each year to carry on this work. There were about 213,000 farms in Iowa in 1925 so that though such an appropriation may seem large, the state is investing less than 50¢ per farm to get reliable and adequate data, which may save or bring millions to their agriculture. (North Carolina also reports that they take an annual state census of agriculture and find it very beneficial. Some 170,000 farms were recorded there in 1927).

Iowa, of course, has been systematically collecting price data for years. Also their agricultural commodities are relatively few and standardized. (Some ten commodities represent 95% of the farmer's annual income). So if such a disparity existed there between indices computed by them and those computed by Cornell for them, surely then in a state like Oregon, which has a wide diversity of products and specialties and also has only recently made an effort to systematically gather price data, we would need to use those indices rather cautiously and sparingly that have been already published.

CHAPTER IV

Oregon

But let us now proceed to a specific study of the state of Oregon considering her special features and characteristics, and also to a detailed analysis of her price series to see how reliable and adequate they really are. Then we will be better prepared and able to consider the problem of constructing a state index, knowing exactly the present status of data and obstacles and handicaps to overcome.

Oregon is predominantly an agricultural state. The industry was introduced here 100 years ago. In fact, agriculture not only ranks first now among all productive industries in Oregon, but in addition its yearly value and income is greater than all of the others combined.

TABLE V.

Comparative Value of the Productive Industries of Oregon-1919 Census

Agriculture	$209,459,266
Lumber	95,264,000
Fishing	1,255,689[1]
Mining	1,885,000

[1] 1922 Census-Statistical Abstract, page 694.

Though total value figures are often of dubious value and their accuracy questionable, yet for a mere relative position and comparison of industries they provide the most appropriate measure and serve very well.

Two significant contrasts may be noted in the development of our agriculture during its 100-year period. They are:

First,--Physical expansion in volume and production of the same types of agriculture. Shafer's History of the Pacific Northwest refers to one farm about the year 1828. (Dr. McLaughlins'). Now there are nearly sixty thousand farms. All livestock in Oregon one hundred years ago, cattle, hogs, horses, goats, etc., numbered less than 600 head. Some large farms have that much now. Then the field crops (cereals) were for local consumption. In fact, Oregon agriculture had not yet developed a market. The commodities had practically no price or purchasing power for they were not exchanged.

Second,--The extension of the kinds of agriculture. The only crops then were cereals, as wheat, oats,

and barley. Peas and a few vegetables soon appeared in small lots. The abundance of wild grasses and luxuriant meadows and ranges made hay and forage crops rather slow to come under cultivation. Fruit was not added until some score of years later. In fact, it was such a scarcity that even in 1851 it is reported four bushels of apples were sold in San Francisco for $500.00. These were harvested from a farm near the present site of Milwaukie, Oregon.

Following is a list of agricultural commodities now raised in the state of Oregon. This list is taken from a sample census questionnaire of Oregon agriculture. Note the extent and diversity.

Field Crops:

Wheat, oats, barley, rye, corn, hops, flax seed, flax fiber, alfalfa, clover, grass, vetch, other hay, mixed ensilage, peas, field beans, sugar beets, root crops.

Vegetables:

Onions, corn, cauliflower, broccoli, cabbage, celery, lettuce, peas, beans, tomatoes, asparagus, carrots, beets, squash and pumpkin, watermelons, cantaloupes and muskmelons, cucumbers, spinach, rhubarb, parsnips, other vegetables, such as sweet potatoes, egg plants, peppers, etc.

Fruits, Nuts, Berries, Hops, Peppermint, Commercial.

Apples, Cherries, Peaches, Pears, Prunes and Plums, other tree fruits, such as Apricots, Figs, etc., Walnuts, Filberts, other nuts, Blackberries, Cranberries, Gooseberries, Loganberries, Raspberries, Strawberries, Grapes, other small fruits such as Currants, etc., Peppermint, flower bulbs, nursery plants.

Livestock and poultry

Horses, mules, cattle, sheep, goats, swine, chickens, turkeys, geese, ducks, pigeons, rabbits, and fur animals.

Twenty field crops are listed. Twenty-one or more different vegetables are harvested commercially now. Twenty-one different kinds of fruits and nuts are commercially grown and some fifteen kinds of livestock are noted. This makes a total of some seventy-five kinds of crops and livestock produced commercially in our state now and this is exclusive of those various other important agricultural products derived from some of them, the dairy and poultry products (butter, milk, eggs, cheese, etc.)

Farm Prices in Oregon.

A compendium of prices of farm products received by producers in Oregon has recently been issued by the U. S. Department of Agriculture, in its statistical bulle-

tin #17, March, 1927.

In order to know and understand how these prices are arrived at, which is the first test, the writer will present a brief review of Mr. Sarle's introduction to this bulletin and also quote from his bulletin #1480 (Reliability and Adequacy of Farm Price Data). "The date published by the U. S. Department of Agriculture are too often taken for granted by the research worker, largely because the reliability and adequacy of the data have never been fully analyzed."[1] To show the necessity of due care and consideration in handling such statistics and the danger of taking even their reliability for granted, the writer wishes to quote from Dr. Davis' paper: "Some Observations on Federal Agricultural Statistics",[2] and cite the table he used. Though Mr. Sarle would probably not appreciate this example and follow-up of his statement, it is entirely appropos and will illustrate his warning, the writer believes. "Some short-comings in basic data.--Among the most basic data are those on crop acreage and production. Here, if anywhere, the consumer of statistics must rely heavily

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[1] Bulletin #1480, Page 24.

[2] Journal of American Statistical Association, March, 1928.

on the census. I regret to say that careful investigation shakes one's confidence in these census figures as available over a period of sixty years. There is evidence of material variation in completeness from state to state and from census to census. ..... Thus the raw material for historical studies of many kinds--price analysis, and indices cannot safely be used for such purposes, and many such studies already made are weak in their very foundations. ..... Further, it is worth while to consider what must be the situation with figures for counties and other geographical areas if the United States' total is assumed to be short as much as 10%. These observations lead to a suggestion--it is quite desirable that historic statistical studies be made that will lead to carefully checked and reasonably reliable revisions, state by state, for a considerable series of past years. Table VI shows some of the discrepancies.

TABLE VI

Price Data

U. S. D. A. Statistics. Discrepancies

Acreage and Production of Certain Crops in 1924[1]

Crop	Area Harvested (1000 Acres)			Production (1000 bus.)		
	Census	U.S.D.A.	Dif. (%)	Census	U.S.D.A.	Dif. (%)
Winter Wheat	34,360	35,656	+3.8	553,377	592,259	+7.0
Spring Wheat	16,530	16,879	+2.3	247,499	272,169	+10.0
Total Wheat	50,862	52,535	+3.3	800,877	864,428	+ 7.9
Rye	3,744	4,150	+10.8	55,674	65,466	+17.6
Barley	6,767	6,925	+ 2.3	159,139	181,575	+14.1
Oats	40,819	42,110	+ 3.2	1304,599	1,502,529	+15.2
Flaxseed	3,435	3,469	+ 1.0	28,246	31,547	-11.7
Rice	744	850	14.2	29,526	32,498	10.1
Peanuts	1,105	1,187	7.4	26,899	745,059	25.9
Hay	74,096	76,352	3.0	88,384*	112,481[b]	27.3
Cotton	39,204	41,360	15.5	1106,340[a]	1,251,343[a]	-0.4
Tobacco	1,538	1,706	10.9	13,683[c]	13,628[c]	13.1
Potatoes	3,911	3,327	14.3	352,462	421,585	19.6
Sweet Potatoes	467	688	47.3	37,444	53,912	44.0

* Data from Census of Agriculture, 1925 and Crops and Markets, Monthly Supplement, December, 1926

(a) 1000 lbs. (b) 1000 tons (c) 1000 bales

Joseph Davis -- "Some Observations on Federal Agricultural Statistics, March, 1928, p. 7 (")

[1] Census Reports and Revised Estimates of the Department of Agriculture.

Now, just what is back of this farm price data--how and when are they collected, and what are their most obvious limitations? Before trying to use them in a basic problem like constructing index numbers of them this is a most interesting, worthwhile and necessary study.

Prices received by producers in their local markets have been collected for a number of years and have been published as 'farm prices' as distinguished from 'wholesale prices' of farm products at the central markets. From 1866 to 1908 the prices of major crops and livestock values were collected annually. Since January, 1908, prices of the more important farm products have been collected monthly in addition to the yearly prices. "The prices reported to the Department of Agriculture are the prices at which the products first changed hands when sold by the producer, usually the price the farmer receives in his local market. For most of the farm products there is no price 'at the farm', the prices called such including the variable item of cost to the farm of transporting the product to the place where it changes hands." The prices quoted are for no specific grade or quality which, no doubt, accounts for much of the variability in the average prices. This makes the

question of the adequacy of the data a vital one.

The Reliability and Adequacy of the Data

"The reliability of an average depends on the size of the sample and on the dispersion or variation within the sample. The greater the dispersion the larger the number of reports that are needed."

Let us then consider first this sampling process. Absolute accuracy of a reported price would, of course, mean that every product and quantity sold in a given period would have been reported and the price computed on that basis. This is because the more nearly the index covers 100% of the items, the more representative of the group it is. The law of averages states that "the greater the number of cases comprised within an average, the more closely does that average approach the value representing the type to which the cases belong." But to obtain such reports is manifestly impossible for records are seldom available for all and such computations would be extremely laborious anyway. So sampling which Karl Pearson calls "the central problem of all statistics" is resorted to. Good sampling is invaluable and is really sufficient for prices--production sampling must be more extensive and intensive than

prices, however. As ordinarily conceived reliable sampling depends upon randomness and yet that hardly seems like a feasible condition in the assembling of the data used in making index numbers. Specific selection rather than random sampling must govern the collecting of data for an index number since in using samples the collection of data must be made with the utmost care. For the most part the special price reporters which the Department of Agriculture has used in its selected sampling process have been country merchants or dealers at country shipping points. A few well informed farmers are included. Now the state of Oregon is cooperating with the Bureau of Agricultural Economics in gathering all of her price schedules. It is the only state to use its own schedules at present. The new schedules now in use contain almost twice as many commodities as the older ones did. It is thought and believed that an individual state and her leaders at the State College, and also the various county agents can, by their more personal contacts throughout the state, thus obtain not only a more carefully selected group of reporters, but also a larger number of them. So, from now on at least, it would seem that the methodology and processes of sampling should afford as high a degree of accuracy as is necessary and

obtainable. It may be suggested here that though a large number of reports is really desirable, if the sample reporters are very well selected and representative the number is not so important as the kind of sample.

One other thing, a warning note as it were, might be mentioned in connection with the selective process of sampling as distinguished from pure random. Dr. Davis suggested it in his paper, referred to above, on Federal Statistics. It is that such a method is often subject to a possible human bias, even though there is no prejudice or intention to do so. One constantly working in the Agricultural Department and interested in it, may even unconsciously develop a sympathy for its welfare that will influence the kind and quality of statistics gathered and used.

As we have considered the nature of the reporting service, let us now turn to its actual functions and results--the number of reports. As we noted above, the "reliability of an average depends upon the size of the sample and the dispersion or variation within that sample." If the number of reports has been ample in the past to give a stable average, then the kind of reporters or sample may really be overlooked and also their

representativeness of the state at large and of its geographical divisions or areas. Table VII (a) shows the number of schedules received on the 14th of the month from May to December, 1925 and March and May, 1926. Table VII (b) gives some in 1927 and 1928 for Oregon alone. Table VII (a) gives the schedules received for the month of May, 1928 in each of the western states for a present comparison.[1] Though a complete list by months would be interesting and perhaps more desirable, this sample well indicates the conditions. The number of schedules was not tabulated prior to those given in Table VII (a) and would have to be derived from the monthly work sheets in Washington.[2]

As we look at the last list, that of May, 1928, we may well be pleased with the position of Oregon, not only that she is far ahead of the other states, but that it would seem that such a large number of reports should afford a fair representation of the divisions and conditions of the state. In fact, since February the number has remained uniformly large. Those for 1927 that the writer was able to determine, though not as large in number, still merit consideration. But as we look at the

[1] Letter from Mr. Sarle.
[2] Obtained by the writer from his research investigation in the State Statistician's Office in Portland.

list for 1925 and 1926, the dearth and meagerness exhibited there seems most disheartening. Throughout that period, Oregon had the least of any of the states.

Yet, as many might say, is not 9 or 15 reports enough? Let us see. Nine was the total number of schedules received in May, 1925. A sample schedule that is sent out each month now is given in the appendix (b). There are forty-four commodities listed on it and it states "return schedule even though you can report for only one or two commodities." Now if there had even been nine reports on each commodity, we might grant it some accuracy, but few schedules include answers to even the most important ones. The writer has examined hundreds of them and finds that they usually average reports on one-fourth to one-third of the questions and those are for the basic products. The others receive answers about one in ten or less. So if all wheat (which in 1925 represented about 15% of the total estimated value of Oregon agriculture) received four reports, a high percent for the usual replies, the state average would be determined from that. Wheat price differentials may run as much as 50¢ or more as the individual schedules show, when one part of the state is compared with another and with different grades. Now what part

TABLE VII (a)

Number of Schedules Received, 15th of the Month
May to January, 1925 and March and May, 1926
In the Four Western States, Idaho, Washington, Oregon and California

State	1925 May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	1926 March	May
Idaho	33	34	36	38	40	32	33	53	40	44	51
Wash.	20	30	46	36	34	41	38	56	70	40	50
Oregon	9	14	15	13	14	30	13	34	29	37	32
Calif.	36	57	72	53	62	71	53	108	65	108	91

TABLE VII (b)

Number of Schedules Received, 15th of the Month
in Oregon Alone
August -November, 1927 and January- June, 1928

	1927				1928	
Oregon	113	192	104	243		

	1928										
Oregon	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	April
	314	285							128	311	241

TABLE VII (c)

Number of Schedules Received on May 15, 1928 in the Eleven Western States

Montana	132	Utah	39
Idaho	49	Nevada	10
Wyoming	61	Washington	102
Colorado	148	California	175
New Mexico	28	Oregon	314
Arizona	33		

of the vast state of Oregon would these four schedules come from and could they possibly be representative of the whole state. Umatilla county ordinarily produces about 30% of the total amount of wheat in the state, and district 2, which includes it, produces over half of the state's total.

The United States Department of Agriculture, in order to try and make the farm price fairly well represent the average price received by producers in any given state, have tried to distribute the samples so as to include and represent both surplus and deficit producing areas. The farm price in surplus producing areas, it is to be noted, tends to be the primary market price less the costs of marketing which arise from the time it leaves the producer until it reaches the primary or central market. The price in a deficit area has been termed[1] to be roughly equivalent to the price in the farthest surplus-producing region from which the deficit area must draw its surplus, plus the cost of handling and transporting the product to the deficit area. Thus arises, especially in a large and diversified state like Oregon, considerable price differentials. Then for

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[1] #1480 - page 3.

weighting purposes, the Department of Agriculture has divided each state into about nine crop-reporting districts. And to determine the state farm price of an important commodity like wheat, the price reports from each district are averaged and those averages weighted by the percent of the state total that that district represents for that crop. That sounds fine, but just how can four or five reports for a whole state be averaged in nine districts and weighted accordingly. Then, too, if they always represented the main producing district like #2, it might pass, but in examining scores of county reports, the writer finds that in the past, Umatilla county especially, and also the others represented in district 2 have been among the weakest reporting ones in the state. So, no doubt, probably not more than one, if any, of those schedules came from Umatilla county, but perhaps Lane or Baker, which each represent about 2% of the state's total in wheat, gave those replies, since these counties have been among the best to reply. So can we honestly rely on the price $1.53 for May, 1925 as a true and representative average price for the state of Oregon. Wyoming's quoted price for the same month was $1.12. It is far more characteristic of a deficit area than Oregon is, so that their price should tend to be

higher if anything than ours. Yet it is 31¢, or 20%, lower than that of Oregon.

The writer has just used wheat as one example. It is our most stable and standardized crop as well as the most important and characteristic one in the state. If such disparity exists with it, then what must be the state of affairs with all of the other Oregon commodities. Hay, in turn, which represents practically the same per cent of estimated value, stands for a different thing in almost every county, with differences running as much as 200-300% in price, depending upon the kind of hay and where grown. Again, granting that there would be as many reports for it as for wheat, would or could a state average be much better than a mere guess. Compare that with the hay crop prices and reports for May, 1928 as given in Table VIII.

TABLE VIII

	Kinds of Hay Crop	Number of Reports
1.	Hay, all, loose	113
2.	Hay, all bailed	93
3.	Alfalfa	74
4.	Clover	48
5.	Vetch	38
6.	Grain	61
7.	Prairie	22
		449

Each kind of hay, then, had from 3 - 10 times as many reports as for the whole month three years ago. The average price constructed then would not even be comparable with the one as constructed now. The total number of reports on hay this last May was 449, or 100 times as many as the same month then.

Apples are a very important specialty in Oregon. Consider the ratio of replies received during May and June this year to the total number. May was 1/9 and June 1/11. The same ratio applied three years ago to May, 1925, would give one report at most. The variations in prices of apples attributable to kind and quality as also to the method of selling makes the sale average price much less reliable than the state average of wheat or hay. So, reasoning thus, how reliable does the price of even $2.00 for May, 1925, seem, or what would it mean? Let us say there were two reports for the whole state. Were they for boxed apples, and were they for extra fancy, or only culls? One might have been for a direct sale to a consumer, so it would really be a retail price instead of an actual farm price. Could one safely and legitimately use such a figure so made up for any price analysis work, price relatives, purchasing power, or input indices?

Then consider the other and for the most part, less important commodities, for which this statistical bulletin offered prices that month: rye, corn, oats, barley, cabbage, onions, potatoes, beans, cows, calves, milk and butter, hogs, sheep, lambs and wool. Nine schedules gave prices on all of these. Some producers have only grain, others only livestock, fruit or hay, so could give only prices on those products. The majority of the prices of the products in this list were doubtless based on from 1 - 2, or possibly 3 reports at most. Some may not even have had one report and the price listed has been an estimate of it.

Again, in considering the December monthly price as compared with the December 1 price of crops that has been gathered since 1867, the writer finds large discrepancies quite frequent. Even in wheat, a world commodity which fluctuates little especially in a month like December had in 1924, the December monthly price average $1.44, while the December 1 reported price was $1.29. Here is 15¢ difference. In checking over the December 1 schedules collected by the state statistician each year, the writer finds that they range in number from 50 - 150 for the past few years and are quite representative of the state also. Then the government has likewise made its estimate separately and checked it with the above so that

December 1 price has been based upon a much larger number of reports than the monthly price and so should be much more accurate.

Thus we see how extensive and reliable are our price series for some sample months. And furthermore, remember this was just three years ago, in 1925, when there had been more work and effort to secure state monthly prices. The price series go back as far as 1908-1910 in this bulletin recently issued for the western states. What must have been the basis of prices during that fifteen years or so previous to 1925, which we know something about and have discussed. It stands to reason that they were not any more adequate then and it is probable that not even nine reports per month were received.

It is also well to remember that this was not an issue or agricultural outlook policy then and the statistics that were gathered and tabulated were no doubt done so in a more or less haphazard and unsystematic manner. State indices, price analysis and forecasting were practically unknown during that period. There was really no incentive or reason to guard such data as precious and valuable bits of information.

The outlook is different now. The change may be readily inferred from the most remarkable increase in

number and quality of reports from May, 1925 to May, 1928--from nine to three hundred fourteen respectively. Even from last fall, the increase is marked by the number being trebled. There were 104 reports in October. The methodology was in operation in this instance, however. We are starting a new era now it would seem. Their need and use is becoming not only more extensive, but also more intensive. County and district averages are now beginning to be thought of and desired. We must plan our methods and system to afford us those statistics which we shall soon have need of.

A Research Project Needed.

Cannot more adequate and reliable data be provided for our earlier years and down to the present? Is it too late to supply additional information and to revise and check the existing sources? How could it best be done? These are very timely questions since we noted how 'wanting' our present price series are when weighed in the balance of reliability and adequacy. We then noted the fine results being attained at the present time and for a few months back. Perhaps some of our earlier information is not as far off as we might infer; perhaps some of it is worse. We will never know until a

thorough study and check is made.

Such a project is possible and feasible. It has been done in most every state which now constructs state indices and those states planning to construct them intend first to check or revise their data. Such were the answers to the questionnaire, part 4, a. 4 (1) Did you ever revise the data for your state and (2) Do you intend to do so?

As we have noted, anyone working with any statistics and index numbers realizes the importance of the data,--that it be accurate and representative. Jerome, in discussing the Criteria of a Good Index Number, well states this point. "The accuracy and usefulness of an index number rests primarily on the character of the price quotations on which it is based. If these are unreliable or not representative, no amount of care in the subsequent steps in the computation will produce a satisfactory index number."[1]

Other sources:

There are many sources which should yield valuable information if someone could be vested with the necessary authority and remunerated for the time and travel required.

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[1]Jerome, Statistical Methods, page 190.

Such are farm and store accounts, mill records, court records, newspapers, banks, etc. all over the state. A study of their books and records should yield and afford valuable checks not only for farm price data, but retail price series, income, marketings, etc. could also be made at the same time. The Merchants' Exchange at Portland has a record of grains and a complete one of wheat for many years, and of produce for 2 - 3 years. Knowing the freight differentials and receipts, the prices and weighting could be quite accurately determined. The Oregon Journal at Portland has also been making a price study and report for several years. Further information could no doubt be obtained from the U. S. Department of Agriculture if a project were authorized. The writer has personally made many acquaintances and contacts with such organizations and with dealers and they seem quite willing to cooperate and are interested in such a project. The writer had first hoped to carry out part of this survey in his thesis, but the vast extent of the territory to cover, the shortness of time, and the expense also made it prohibitive for such a study.

Now as to how this could be best done. The writer thinks it should be and could be best done as a project

of the State College. Here is a tentative outline of such a project:

Name of Project--A Study of Oregon Farm Price Series.

Object--(a) To check and revise the farm price series data as published since 1908 and to collect additional data for other commodities during that period and prior to it.

(b) Obtain the cost of input goods (prices for articles used in production, and the wages paid for labor).

(c) Gather retail prices of farm goods and also those which the farmer buys.

Method of Procedure

1. Locate and collect prices and wage data from records kept by farmers, mills, grain and livestock dealers, country store merchants, etc.
2. Construct comparable series and index numbers of farm prices, gross income, production, purchasing power and input goods.
3. Publish a bulletin of all Oregon price series by commodities and by months, and also give the state indices made from them.

Perhaps the cooperation of the United States

Department of Agriculture and the Purnell funds could be secured not only for part expenses, but for other information in their files at Washington. Several states have and are now pursuing projects in that manner; e.g., Virginia, Maryland, Colorado, and South Dakota.

It would take the full time of one man at least, for a year to canvass the state systematically and adequately and to publish the bulletin. Some have suggested making a revision of price series by the separate commodities. But the large number of commodities would require some 10 - 20 projects (depending upon some combinations of like ones). The length of time required for each research project would make it prohibitive to index number construction for many years. In the meantime many of the original sources might be destroyed. Also such a method involves so many duplications, such as traveling, etc. A man in the one trip could get the data on all commodities while going over the records and sources, as well as for just the one article in his project.

In conclusion to this discussion of a desired project, the writer would like to use some phrases from the "Report of the Committee on Basic Statistics to the

Western Farm Economics Association at Berkeley, California, July 6-7, 1928. They sum up our situation very well:

"Statistics are the raw material without which research, extension, and resident instruction in agricultural economics can make little progress. There is a great dearth of well authenticated statistical data bearing on the agricultural industry in the western states."....So, "would it not be unfortunate and embarrassing too, if steps were not taken to improve these statistical series while the work in agricultural economics in the West is yet young?"

CHAPTER V.

STEPS AND PROBLEMS IN THE CONSTRUCTION OF AN INDEX NUMBER

As Professor Mitchel says, "Making an index number involves several distinctive operations, and at each one of the successive steps choice must be made among alternatives that range in number from two to thousands. The possible combinations among the alternatives chosen are infinitely numerous. Hence, there is no assignable limit to the possible varieties of index numbers and in practice no two of the known series are exactly alike in construction. To canvass even the important variations of method actually in use is not a simple task."

Adapting in part from Fisher[1], Jerome[2], and Day[3], the varieties of methods used or the construction "attributes" as Fisher calls them, the writer finds the following steps and decisions necessary to consider in our study here:

1. The definition of the purpose of the index.

2. Selection of the data to be employed in constructing the index and the determination of the size of

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[1] Fisher, Making of Index Numbers, page 81.

[2] Jerome, Statistical Method, Page 190.

[3] Day, Statistical Analysis, Page 334.

sample or number of commodities to be used.

3. Determining how the commodities should be weighted in order to represent their relative importance to the constituent variables.

4. Determining the point of reference or base to which changes in the group of variables are to be referred.

5. The selection of the type of aggregate or average through which the movements of the group are to be expressed.

Purpose.

The first point to be settled in the construction of an index number is the purpose to be served. It really acts as a guide and is necessary because the selection of data and the weighting of the constituent series in the actual compilation of the index depend upon it directly.

In his questionnaire, the writer listed five forms or purpose indices; namely,--

a. Indices of prices of farm commodities.

1. Individual commodity price relatives.

2. General index number of all commodities.

b. Farm income--gross or net

c. Indices of agricultural production

d. Index of farm purchasing power

e. Index of prices of commodities or services farmers buy (input goods).

All of these are very desirable indices, though some are much more difficult to construct than others.

To review briefly which of these indices other states are using, the writer finds that all the states making index numbers compute (a) 1 and 2. Maine and Massachusetts, also Montana, compute (a) 1. (d) is also computed in most every case and some part of (e) likewise. But few have adequate indices of income or of production. Among those having the former are Iowa, New Jersey, New York, Ohio, Virginia, and South Dakota. All use gross income. Ohio has a production index, also one of wages and Mr. Falconer of Ohio State writes me that with the next issue of their bulletin, they will publish an index of value of marketings.

Now the specific use or purpose as applied to each of these forms should be first considered.

It is 1,(a) in which we are especially interested. The price relatives are a very sensitive form. They are for individual commodities and will tend to give us the relative status or position of each one in an agricultural

industry as far as such can be reflected through the price. An economic policy of international trade is that each county produce that or those commodities with which it can secure the best relative trade or exchange. This is due to the fact that often those products which are capable of being produced most abundantly, cannot be bargained with most effectively. A relative exchange is the guide for trade. Now a price relative form should help to exhibit the trend or cycle in which the commodity is moving. As a result then, it will be a guide to farmers about to produce those commodities and have a choice of possible ones they might produce. When compared with the general price index, the relative positions are readily shown. They are thus a distinct aid in determining farm management and production policies and serve also as instruments for forecasting price trends and again for comparison of specific commodities in other states. In simple form, the price relative may be expressed as $\frac{\Sigma P_1}{\Sigma P_0}$.

The general index number for farm prices is a composite number, usually an average of the several relatives of the prices of the individual farm products received by the producer. It is a convenient statistical measure of the relative position of agriculture and

other industries and also of the relative farm situation in other states or countries. It is not as sensitive as the price relatives for measuring or reflecting variation, but nevertheless is an effective instrument for measuring and forecasting trends. It also serves us as a base for purchasing power indices and for economic readjustment.

An income index is much more intangible and indefinite to define and construct. In the first place it may be either one of two alternatives--gross or net income. Given reliable and adequate price series, together with production or marketing statistics and gross income, indices may then be readily computed. They are usually of the form $\frac{\Sigma P_1 q_1}{\Sigma P_0 q_0}$ or some modification of it. It is an especially desirable and important form since by it the relative importance of the sources of income to Oregon farmers may be ascertained, i.e., what commodities yield the chief source of income? A small crop may bring a larger income than a big crop it has been learned. An income index is a better means of weighting commodities than mere production or sales since it accurately allows for the smaller quantity and higher price. We would do well to extend our efforts to include production and marketings as well as prices in order to con-

struct this and subsidiary indices.

Few states, as we noted above, compute production indices. They are directly dependent upon production statistics. However, valuable correlations with price data for use in income, purchasing power and for price analysis work, may be had from their development.

The purchasing power index is perhaps one of the most difficult of to construct. This is not due to such difficult mathematical calculations, but this very thing under discussion--the purpose or use.

Purchasing Power indices are derivative indices. They may represent the purchasing power of a farmer or of his farm products.

1. The difference between a 'farmers' purchasing power index and farm products purchasing power index is that a farmers' index requires (1) index of changes in the net incomes of farmers and (2) an index of the retail prices of consumer's goods purchased by farmers and their families. Neither of these are available except in parts and short periods. Fluctuations in net income differ widely from those in the exchange value of farm products owing:

(a) To changes in the farmers' profit margin

(b) To changes in his volume of production

Such an index would therefore not reflect accurately changes in the real incomes of farmers. (It is the ratio of farm product prices at the farm to the retail prices of consumers' goods weighted according to purchases made by the average family on the farm). Table IX shows the difference between these two indices of purchasing power as indicated by index numbers.

TABLE IX

Relative Purchasing Power of the Farmer's Dollar and the Farmer's Product

Year	Farmer's Dollar	Farmer's Product
1910	98	101
1911	105	99
1912	100	99
1913	96	95
1914	103	105
1915	99	99
1916	72	85
1917	55	97
1918	53	107
1919	50	105
1920	41	85
1921	60	69
1922	60	74
1923	58	79
1924	62	83
1925	60	89

It would be still more accurate if it was compared with those producer and consumer articles purchased by the farmers according to their importance in the farm budget. But the data for this are not available either.

So most purchasing power indices are constructed from the wholesale prices of farm products and the wholesale prices of general commodities. This gives the ratio of farm product prices at wholesale to general commodity wholesale prices. It is in this sense and form that the phrase 'purchasing power of farm products' has been widely used in recent years. Such an index is really only a rough indication of the quantity of products the farmer is able to buy in exchange for his own products. It has what ought to be called a 'double bias' upward from a farmer's standpoint, for the wholesale price is constantly above the farm price, due to market costs and in turn and for the same causes is always less than retail prices, which farmers actually are concerned with, so is again biased upward. There is no question about the statistics for wholesale prices of commodities being much more reliable, adequate, and available. It is much easier to use such statistics, for these reasons, in constructing a purchasing power index and also such an index is really worth while because the data is quite comparable and shows the exchange value of goods in the same market. It is desirable, however, that it be clearly understood that such an index may be far from revealing the farmer's actual case. In lieu

of this deficiency, it would be wise also to construct a farm products price (at the farm) index of purchasing power using retail prices where available and where not available, the wholesale price index of all non-agricultural commodities. While there would still be an upward bias (one which tends to show the farm products purchasing power really better than it is) it would not be a double bias as with wholesale prices alone. The Crops and Markets publication each month shows a relative purchasing power index of farm products, it being the ratio to the non-agricultural products index.

Such an index is especially desirable, and timely too, since most Oregon products have been suffering in recent years from tremendous price disparities as related to other commodities. Problems of freight rate adjustments, credit relationships, tariff levels, and land values, make a purchasing power index of products and our price relationship to the pre-war period and to prices of other commodities, very necessary. And it is even more significant in a newer and growing state like Oregon than it would be in an older and more stabilized district.

Input indices are also very important because of the extent of their uses and possibilities. This would

be especially true here in Oregon, where we have many specialized industries such as seeds, for example, which can be and are an important product. Wage indices are valuable to farm management policies. Then, also, indices of the cost of farm machinery and of feeds and even of building material have significant uses. These indicate the extent to which data must be gathered and which it may be in such a project as the writer outlined above. New Jersey suggests in their letter that we add indices of taxes also, as a desirable form. It represents such an important part of a farmer's expenditure and land values.

2. What commodities?

Having thus reviewed the specific purposes of the indices and also noting the choice and extent of quotations of agricultural crops and livestock products necessary, let us proceed to that phase of determining the size of the sample--the number of commodities and quotations used.

There are two important principles which should be considered in choosing the commodities.[1] (1) The samples used must be large enough to be representative and

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[1] Journal of Farm Economics, July, 1926, page 357.

must be secured continuously and regularly in approximately the same way. (2) The products chosen should reflect as accurately as possible the changes in the farmers' income aside from changes in total quantity.

The first consideration it would be well to make is what commodities now have any price series or data. Those included for Oregon in the farm price statistical bulletin #17, pp. 124-132, are: wheat, corn, oats, barley, apples, grapes (incomplete), cabbage, onions, potatoes, tomatoes (incomplete) turnips, beans (dry), hay--loose, alfalfa, clover and timothy, beef cattle, veal calves, milk cows, milk, butter, hogs, sheep, lambs, wool, horses, chickens, turkeys (incomplete) and eggs.

As this list is such a varied and heterogeneous one, the writer thinks it would be well to classify and group them in some such manner as the United States Department of Agriculture does. Here, we may use our two principles for criteria of selection; namely, first representation and second, the amount or percent of income or value. The only available data on value are those estimates of the statistician for Oregon crop and livestock production and value for recent years. Copies of such for years 1925-1927 are given in appendix (c).

Though this topic is not specifically concerned with the problem of weighting or of their relative importance, the selection of the appropriate and representative commodities must really be made upon that basis. What we desire and need, as has been noted above, is to have enough commodities and a variety of them so that the seasonal variations of all branches of agriculture will exert their proportional influence.

Though many states discard fruits and vegetables from their index number, a state index for Oregon would be materially impaired by such an omission. There are some seasons when fruits represent a very large amount of the total income.

The U. S. Department of Agriculture ratio of the estimated aggregate value of 22 crops by states (which corresponds to those for which we have published prices and are listed above) is 75% of all crop value for Oregon. This in itself indicates the inadequacy and unrepresentativeness of the present price series for a state index. The percent omitted is one-third of that given so that if chance favored that one-third some season and its probability is a large constant factor, the index number could easily be distorted and become unreliable. They have discarded practically all fruit.

Though these statistics of value for Oregon are only estimates, by using the three years' series and considering broadly their relative ratios, not specific values, we can readily note there are certain products which tend to represent the total acreage, production and estimated value.

Additional crops which should be added to the list as already published in order to make it more accurate and inclusive of farm income are pears, prunes, (fresh and dried, cherries, berries, (including loganberries, strawberries, raspberries, and blackberries), truck crops, hops and seeds. This makes a list which comprises about 95% - 99% of the estimated value of Oregon crops. Prices are now being gathered on all of these, but past series would have to be supplied from some research project as suggested. These crops comprise about 98% of the total acreage.

The question may arise, 'is it necessary to have as large a percent in order to be accurate?' Mitchell says, "Large index numbers are more trustworthy than small ones, not only insofar as they include more groups of relative prices, but also insofar as they contain more samples from each group." Jerome[1] says, "At best, the prices used are a sample and we have seen that the

[1]Jerome, Statistical Methods, page 194.

probability of the accuracy of the sample increases with the size of the sample." Fisher states that, "seldom are index numbers of much value unless they contain more than 20 commodities."[1]

One of the most important needs of a state index number, we have noted, is that it be more sensitive and applicable than a general purpose or United States index number. If it really is sensitive to changes, each group must be represented. Following are the suggested groups and commodities the writer has determined upon in considering the above points:

Field crops 8 (winter and spring) wheat, oats, barley, corn (tame and wild) hay, hops, seeds, potatoes.

Fruit crops 7 apples, pears, prunes, cherries, berries and nuts.

Vegetables (includes celery, cauliflower, onions, broccoli and cabbage)

Livestock, sale 5-hogs, beef, veal, sheep, horses

Livestock products 7 wool, butterfat, milk, cheese, turkeys, chickens, and eggs.

Now arises two corollary problems: The first is the addition or subtraction from the list. Making the list as large and as representative as it is, it is very improbable that it would ever be necessary to change

[1]Fisher, Making of Index Numbers, page 340.

it, not in the near future at least. No doubt the relative importance of many of them will change often, but new revisions of the weighting system will take care of that. The writer firmly believes it is far better to revise and extend existing data so that the suggested commodities above may be used from the first construction of the index rather than to revise the whole index number to include them as each commodity price series is revised or compiled. The accuracy is threatened thereby and the extra computations and work of altering the index would largely make up for the initial revision and expense. The government is in a different position. With the whole United States to consider, they frequently have to add some or discontinue some. They accomplish it by relating the aggregate of one month or year to the aggregate of the preceding month or year having the same commodities and multiplying the resulting index by the index of the preceding month or year.

The other problem concerns the question of quotations for these given commodities. If more than one quotation is obtained for these given commodities, shall the quotations be used separately or shall they be averaged? In fact, as Jerome says, page 183, in many

instances the prices which enter into the computation of an index number are themselves averages of several quotations. This applies mainly to the reports received from the individual counties which range in number from 2 to 15 or 20 for a specific commodity. Jerome offers this further suggestion which the writer believes we should use: "Because of their simplicity and amenability to combinations, simple arithmetic means should be used for the averaging of original quotations."[1]

3. Weighting.

W. C. Mitchel says, "It is customary to distinguish sharply between 'simple' and 'weighed' index numbers. When an effort is made to ascertain the relative importance of the various commodities included and to apply some plan by which each commodity shall exercise an influence upon the final results proportionate to its relative importance, the index number is said to be weighted."[2]

Rather than a lengthy discussion on the theory of weighting, let us first consider some in use by the U. S. Department of Agriculture and of various states. The former's weights used are quantities selected to

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[1]Jerome, Statistical Methods, page 195.

[2]Bulletin #284, page 59.

represent average annual marketings by farmers for the period 1918-1923. The use of weights relating to 1918-1923 instead of to the base period permits comparison between this index and the index of wholesale prices of all commodities of the Bureau of Labor Statistics.

Any index number we know implies two dates and the quantity or value by which we are to weight the ratios of those two dates will be very apt to be different at those respective times. Constant weighting (the same weight for the same item over a period of time) while merely a makeshift and never theoretically correct as Fisher says (page 45) is in a large measure, however, freed from any bias by the use of a five-year average. An arbitrary weight or ratio is sometimes adopted.

In the state indices, however, the writer finds few that weight by marketings alone. As in Oregon individual sales and sales methods are so varied that no agency can give with much accuracy the total marketings at the present time. Freight billings for states alone are often quite inaccurate. For interstate trade, as the United States uses, they may be determined better but with stop in-transit privileges, as with fruit, etc., a car may be shipped from two different points. Then poorer grades which aren't shipped are marketed locally

or privately and would not be included. Borderline counties of the state may ship from points not even within the state. This is particularly true in Eastern Oregon, i.e., Malheur County, and also some in southern Oregon. However, they afford the best statistics we have on marketings of fruits, wheat and livestock. But then many commodities are not shipped. Hay and forage crops are sold locally or fed. Neither the price nor crop reporters at the present time nor in the past have reported on marketings so marketings for crops are not a satisfactory method for us yet.

The marketing method for weights has this decided advantage over production in that it avoids the duplication that often arises in livestock sales. As the latter consume a large portion of what is produced, mere production weights do not take account of it while reported sales or marketings would lessen the receipts for hay and grains by the approximate amount fed to livestock and the income attributed to them would thus not be duplicated.

The 'total value criterion' must have reliable production statistics, together with the price series. As Fisher pointed out, 'total value as a criterion' is somewhat analogous to the 'factor reversal test'--samples

are so chosen that their price index times their quantity index shall give the true value index for the whole field represented by those samples.

There are two phases of weighting to be done in Oregon. The first is the weighting of the prices. As we noted above there are a large number of quotations in each county. A simple arithmetic mean of them will be computed. But now each county differs in its influence and proportion of the total amount in the state. The Department of Agriculture has been using a district system of weighting based on production and our state statistician's office is using a county weighting system. Each county is ascribed its percent of the state total. This is somewhat arbitrary and it seems the best form for such weights. There is no question that the price of apples, i.e., of Hood River, should have more influence on the state average price than the price of apples in Umatilla or Lake County. In Table II in the appendix, we have the copy of the present basis for weighting used by the state statistician's office.

Then again there arises this question,--Continuing with apples as an example, should every price reported on apples be averaged equally? There is indeed a wide variation in price as between varieties and also between

sales and grades. Where there is a distinct line of demarcation as exists between varieties and grades, it would seem advisable to gather statistics on such features as well, and thus approximately weight such a price within the commodity. The same is true with berries and cherries which include some four or five kinds. The hay prices should also be weighted accordingly as the ratio between clover, alfalfa, grain, etc. And so with the various other commodities. Each variation in the reported prices will be accounted for. Thus each commodity price will be in itself practically a small index number and will accurately represent all its component parts according to their respective influence. It is no more effort to gather statistics on a phase or two of one commodity if the big effort of getting them for the commodity as a whole is made. In fact, it is easier for the reporter to answer a schedule when specific questions are asked. This will make our results more accurate and provide us with a representative system of weighting.

Then when we come to the last phase of weighting, which is by the commodities within the group and the importance of the groups themselves, we will have already weighted the prices within the commodities and their

representation in the state by the county relative ratio of the state total. This is due to the fact that weighting process will not need to be near as specific and accurate as otherwise. The relative weights of the various commodities within each group may be accurately enough determined by their percent of the estimated value as the writer has computed above. This can be compared with the percent of acreage as a check and the degree of correlation is almost readily apparent. The groups are fairly well divided, enough so that such relative weights as 4, 2, 2, and 2 respectively would weight them sufficiently for the total.

Professor Mitchell infers, from a study of standard index numbers that except in abnormal years weighting seldom makes a difference of 10%. But this he suggests is a much larger margin of error than is allowable in a good index number.[1]

"Weighting need not be precise, round numbers or even rough estimates will often serve the purpose about as well as precise figures", says Fisher. So that the writer believes for a relative type of index, we can determine weights successfully, but it behooves us to gather more statistics on kinds and qualities as well as of sales and marketings.

[1]Handbook of Mathematical Statistics, page 190.

Base Period:

One of the most fundamental problems in index number construction is the point of reference or base period. When the relative form is used the base is one of the first things to consider; in the aggregate form it comes last. But if an index number is used for comparison of anything in time or in place there must be an ascribed and designated base or point of reference.

In the analysis of this step there are some 5 - 6 points or phases to consider. The first is the 'length of the time period forming the base'. This is subject to the following criteria:

(a) The nature of the industry and the fluctuations in it.

(b) Availability of data, its accuracy and representativeness.

(c) Form of index--aggregative or relative.

The agricultural industry in this respect was discussed by Dr. Stein in his paper before the American Statistical Association last December. He said, "A broad base period seems to be necessary for agricultural products. There are great fluctuations in short periods but prices tend to remain in a fairly stable relationship to each other over a longer period. Fluctuations are due to

annual variations in crop yields and marketings of live-stock products. A five-year base, however, is long enough to include hog and poultry production cycles, etc."

Next the availability of data, their accuracy and representativeness, is a strong factor in choosing a base. We know off hand we couldn't go back of 1908 even if we desired to. And from our discussion of existing price series any accurate base period before this year (1928) seems at present impossible.

This brings us to a second consideration; namely, the best period to which these criteria apply. The time period is commonly dichotomized into that of Pre-war and Post-war. It has already been considered advisable to avoid the war influence on prices for the base period. It was largely the great price discrepancies and exchange disparities between agriculture and non-agriculture that has so stimulated the use of index numbers during the past decade. To establish and maintain a parity of exchange of commodities and income, one must consider each month or year with those at a time when conditions were normal and parity existed.

Such a period may be tested in general by the purchasing power index. The years 1909-1914 have seemed to be the most normal period from such a standpoint that we

have ever had. The purchasing power of agriculture had been constantly increasing for 75 years and had just started to balance and sometimes tip the scales a little just before the war. So now we still desire to know if that equilibrium will be regained and how soon. Hence, most indices use it as their point of reference. The U. S. Dept. of Agriculture uses the five-year pre-war period, August 1909 - July, 1914, and plan to until a like period is again reached. The period ending July, 1914, is free of war influences. Nearly all states have adopted the same practice, especially if they have adequate data for that period. A period longer than five years has not seemed advisable because prices prior to 1909 are less reliable and the war influences upon prices were soon felt after 1914.

For Oregon the pre-war period is the most desirable in order to make comparisons with normal conditions. However, in our study of the price series and the question of their accuracy, we know it would not be wise to use that period until some check or revision is made. If the base is inaccurate, then every relative is subject to inaccuracy with a constantly increasing bias or skewness, especially over a long period. Even with a normal base there develops a probable error oftentimes,

as W. C. Mitchell points out[1] "The measurement of price fluctuations becomes difficult in proportion to the length of time during which the variations to be measured have continued. In other words, the farther apart are the dates for which prices are compared, the wider is the margin of error to which index numbers are subject, the greater the discrepancies likely to appear between index numbers made by different investigators, the wider the divergencies between the average and the individual variations, from which they are computed, so the larger the body of data required to give confidence in the representative value of the results."

These apparent handicaps of a fixed pre-war base suggests two other alternatives:

(1) A progressive or chain base, giving a link relative, or

(2) A fixed base but of more recent date.

As most users of index numbers prefer to make comparisons with recent dates the case for 'chain-indices' is very strong. They show the average rise or fall of prices as of the preceding year. It boasts of three distinct advantages as Jerome suggests

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[1]Bulletin #284, page 22.

(1) It makes the dropping of obsolescent and the adding of new commodities very easy.

(2) Also the change or revision of weights or relative importance is likewise facilitated.

(3) It tends to be more accurate for the chain or annual variations are concentrated about their central norm or tendency while the variations from what prices used to be are widely dispersed. Then again a fixed base usually tends to have an upward bias--commodities that have a consistent long-time trend (e.g., cattle) gradually climb far above or fall below the average of relative prices. So the high relative prices come to exercise more influence on the average than the others. This would be more true of the aggregate form than with the relative.

However, there are several serious defects to a chain index:

(1) It is so laborious to compute--for it changes every year.

(2) It is not comparable over a period of years--which is really what we need and desire in an agricultural index.

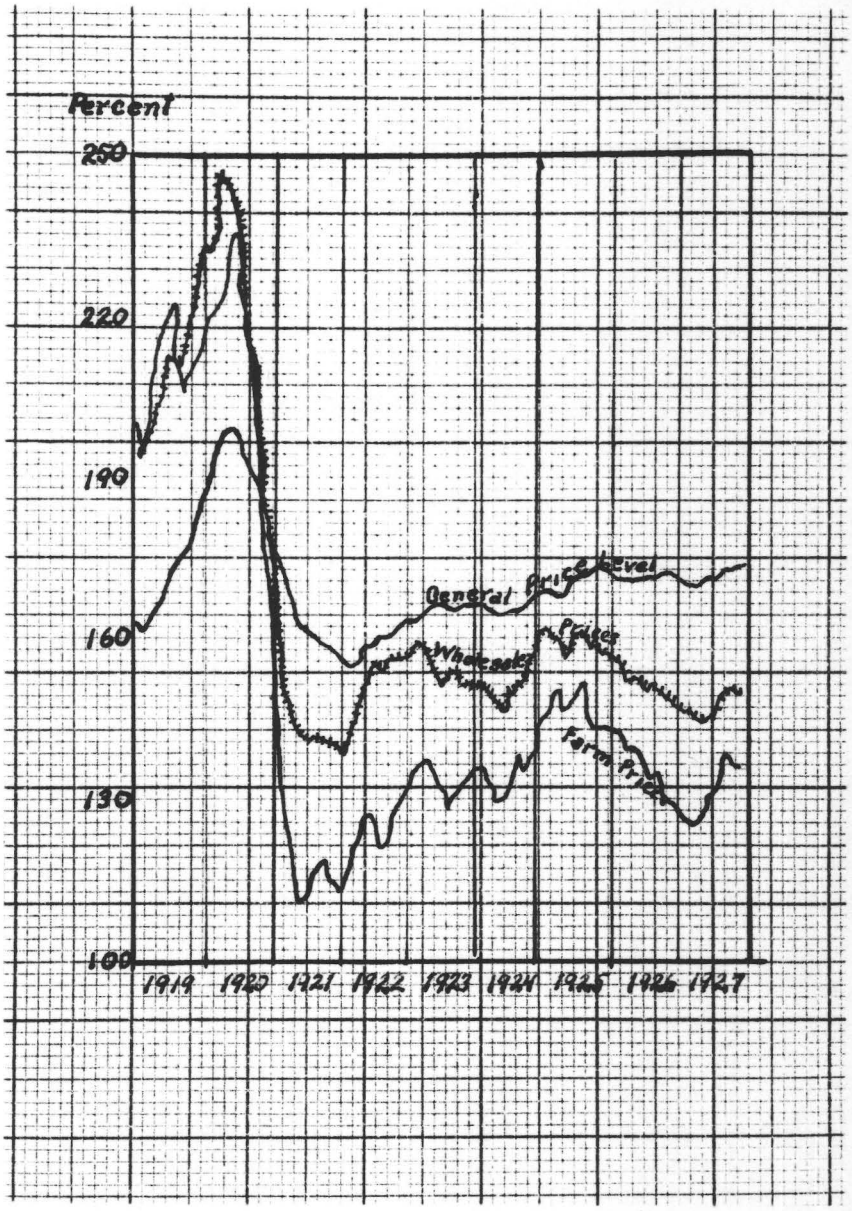
(3) Then again it is hardly suited to agriculture which needs a broad base.

So it hardly seems necessary to consider its bid for use any further.

Is it possible then to find a fixed post-war base that would give us a more reliable price series and yet at the same time represent a normal period? Graph III shows the U. S. Agricultural Index as compared with the non-agricultural. The wide disparity even now is at once apparent.

A CHART SHOWING THE COMPARISON OF THE WHOLESALE, THE FARM AND THE GENERAL PRICE LEVEL INDICES SINCE THE WORLD WAR.

* Taken from "Review of Economic Statistics, February 1928, p. 46.


Percent
250
220
190
160
130
100
1919
1920
1921
1922
1923
1924
1925
1926
1927
General price level
Wholesale prices
Farm prices

Further, let us consider the relative purchasing power index of farm products as compared with the index of non-agricultural products--during the post-war period. (This is given in each issue of Crops and Markets).

TABLE X

Giving the Index Number of the Relative Purchasing Power of Agricultural Products With Non-Agricultural for Years 1919 - 1926

Year	Index Number
1919	105
1920	85
1921	69
1922	74
1923	79
1924	83
1925	89
1926	85

Selecting then the five-year period, 1922 - 1926 as the most recent with comparable statistics and possible for a post-war base, we would have the average of relative purchasing power for the United States as 82% of agricultural to non-agricultural products. This is in terms of commodity purchasing power and is the most favorable form of the agricultural situation when seeking normality. The relative purchasing power of a farmer's income was still only about 60% as we noted above.

Granting the advantage it is readily apparent that though the last year has practically reached a parity with non-agricultural prices as compared with pre-war times, the five-year average period which is desirable is still nearly 20% below normal. A three-year average would be about 15% below also. This is the United States average, of course. The only state comparisons possible are those made by Cornell University in their Farm Economic bulletins. As was pointed out in their comparison with Iowa's revised index there was some discrepancy and with other states, especially Oregon, there might be made differences annually, but if we take a five-year period as 1922-1926, the average should be fairly accurate and would also be comparable with the U. S. figure.

TABLE XI.

Five-Year Average (1922-1926) of Index Number by States as Published by Cornell University

State	U.S.	N.Y.	Oregon	Texas	Georgia	Penn.	Iowa	S.D.
Aver.	139	141	128	149	170	143	127	130

Now if the United States average of 139 represents only 82% of normal (in purchasing power test) then similarly states with a smaller five-year average than the United States would tend to have less purchasing

power. Oregon, we noted was among the lowest in every respect. Here is Cornell's computed indices for Oregon:

TABLE XII

Years	Index Number	Years	Index Number
1910	107	1918	191
1911	97	1919	198
1912	96	1920	195
1913	98	1921	119
1914	102	1922	119
1915	106	1923	119
1916	114	1924	121
1917	168	1925	147
		1926	136

Though this ratio method of comparison is perhaps not as desirable as if it were direct, yet in the absence of any such available statistics, it reveals the tendency so markedly we may safely infer that this possible post-war period is not satisfactory. In our study of reports also, we noted little improvement in the reliability or adequacy of them until after 1926.

As the only alternative for a pre-war-normal period, the writer offers this suggestion--the period August 1926 - July, 1931. The agricultural year for crops and price series more appropriately starts in the summer than at the beginning of the year, so in order to follow the seasonal production and marketings some such division seems advisable. Also it allows that much of a year's advance toward normal again. The year 1928-1929, which

would be the mid-point of this base is being declared quite normal and no doubt the following period of 1-2 years will reach above the average enough to balance the deficiency of 1926-1927. At any rate the new base in order to be most comparable should be adopted as the same as that of the Bureau of Agricultural Economics when they shift theirs.

This suggested base is really for future use and mentioned only to show the present trend of affairs and what to consider. In the meantime all price series should be revised and checked and series of relatives and indices computed for our economic and analysis work. Base year periods may be readily shifted especially when a geometric mean has been used. So, we could easily shift to the later period any time but we need an existing index to indicate the best period for the base. Perhaps the months or even a year or so would have to be changed. Or again some unforeseen economic or political disturbance might disrupt their normal tendency.

As we desire that our state index be computed monthly, we have another step to consider. Should the base price for each month be the average of the sixty months of the base period or of just the five corresponding months of the base? The latter is more desirable

in order to truly represent the seasonal variations in the marketings or value of each commodity. Donald Cowan, in his bulletin of Missouri Farm Prices and Purchasing Power, 1926, page 9, says in discussing the defects and criticism of their state index number which did not allow for it, "The price of each farm product has a normal seasonal variation. As compared with an all-commodity index number like that of the U. S. Bureau of Labor, the number of commodities in the Missouri farm price index is small and seasonal variations are not liable to offset each other sufficiently to produce accurate results. In fact, the seasonal variations of a majority of farm products are in the same direction and tend to set up seasonal occilations in the index number."

Another base consideration is that for weights used. Most states and also the U. S. Department of Agriculture have shifted their base for weights from the base period itself to a more recent time. The latter uses 1918-1923, as noted above, largely to make it more comparable with the other Federal index numbers. The majority of states use the 1919 census figures. Our present county weights are based on the 1924 census statistics. One year is hardly enough for weights though. The period 1919-1924 would have the advantage of two Federal censuses and

should be as representative of production and marketings as any. The war demand and influence for wheat and other cereals is thus avoided. As our annual sample census work is carried on a little further and becomes somewhat standardized in form and results they would undoubtedly furnish the most adequate source of base statistics.

In all of the discussions on bases or points of reference, the time factor has alone been considered. True, most of our comparisons are necessarily from one period to another, i.e., seeing how history will repeat itself. A base may equally well apply to places and relatives or index numbers computed for them. The writer knows their use would be somewhat limited and this thought is really an 'ad addendum'. However, they have some interesting possibilities especially for county and district comparisons in Oregon and with those in other states. Our price series now are very good and we might compute relatives on these for individual commodities, as between places. Comparable series could be currently issued from now on.

5. Formula:

Lastly, we come to the selection of the type of aggregate or average through which the movement of the

group is to be expressed and the manner in which the combinations of the index will be published. The study of formula occupies the central theme of Fisher's whole book, "The making of Index Numbers".

Corra M. Walsh, in his "Problem of Estimation", notes in an interesting and pertinent manner the important controversy that gave rise to this very study of formula type. The controversy was over a horse worth about 100 crowns. However, one man said it was worth 1000 crown, another said, only 10. Which is the less erroneous? "Thus the problem of estimation is a question of means, and its solution involves the finding of the kind of mean suitable for equalizing errors above and below the true quantity.

The question of formula was one of the primary objects of the writer's questionnaire. In order that state indices might be as comparable as possible and yet register individual state variations, a similar formula is desirable.

There are three general types of index formula, corresponding to the different ways of expressing the magnitude of group change which we could use. And they in turn may assume almost innumerable forms so it is almost impossible to analyze the merits and defects of

each, especially until we have made our price series complete and reliable.

These main types are:

(1) Average of relatives

(2) Ratios of averages

(3) Ratios of aggregates[1]

As we are interested in index numbers and hence relative series only forms (1) and (3) can be used. Anyway, it takes both (2) and (3) to make the relative for (3).[2]

In (1) the changes undergone by each separate variable in the group may be expressed by a series of relatives and the averages of such relatives taken to express the changes of the group. While in (3) the aggregative method, the individual variables in the group may be combined so as to form an aggregate, then a series of such aggregates expressed by relatives--any desired year or period being used as a base.

Following is an illustration of each method as applied to a common series of data:

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[1] Handbook of Mathematical Statistics, page 181.
[2] Ibid, page 182.

Article	Amount	Price Year A	Price Year B	Relative A as base	Aggregate A	Aggregate B
Wheat	bu.	$2.00	$1.00	50	$2.00	$1.00
Apples	box	3.00	3.00	100	3.00	3.00
Hay	ton	5.00	10.00	200	5.00	10.00
					10.00	14.00

The geometric mean of the three price relatives for the year B on the base A is 100; the relative decline in the price of wheat is exactly offset by the relative advance in the hay. The ratio of aggregates, on the other hand, is 14/10 or 140 for the year B on the base of 100 for the year A. In this form we note the much larger absolute increase in the price of a ton of hay completely overshadows the smaller absolute decrease in the price of a bushel of wheat. As Mitchel says, "Clearly this simple method of measuring changes in the price level by casting sums of actual prices is not trustworthy."[1] For a relatively slight fall in the quotation for hay would affect the total thus computed, much more than on a relatively enormous increase in the price of wheat. Day says, "A ratio of aggregate allows absolute differences to take full effect on the index number. This is especially desirable in an index like the 'cost of living' where we regard the price changes from the point of view of a

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[1]Mitchell, #284, page 31.

person purchasing a consignment of goods in the two years."[1]

In discussing the aggregate type we may well begin with a brief description of those types most generally used in farm price indices.

L. H. Bean and O. C. Stine, of the U. S. Department of Agricultural Economics outlined such types some four years ago in an article "Four Types of Index Numbers of Farm Prices", in the Journal of the American Statistical Association, March, 1924, page 30. Albert Black and Dorothea Kittredge, recently discussed and reviewed these types so tersely and yet so explicitly in their article, "State indices of Prices of Farm Products, Journal of Farm Economics, July, 1928, that the writer will give their statement.

The four types were expressed as follows:

Type A $\frac{\Sigma P_1 Q_a}{\Sigma P_0 Q_a}$

Type B $\frac{\Sigma P_1 Q_a}{\Sigma P_{cm} Q_a}$

Type C $\frac{\Sigma P_1 Q_{cm}}{\Sigma P_0 Q_{cm}}$

Type D $\frac{\Sigma P_1 Q_{cm}}{\Sigma P_{cm} Q_{cm}}$

[1] Day, Statistical Analysis, page 349.

The terminology used in these formulas was:

P_1 - Price given month

P_o - Average base price (e.g., average of 60 monthly averages)

P_{cm} - Average price for corresponding months in base period

Q_a - Quantity per annum

Q_{cm} - Average quantity for corresponding months in base periods

"In Type A the monthly price of each commodity is weighted by an annual quantity of the commodity sold in some year, although not necessarily in the base year for prices. Thus, this type of index measures the fluctuations in value of a fixed imaginary cargo consisting of specified quantities. It fails to represent accurately the farmers' 'national wagonload', which varies both in quantity and contents from month to month." It is the type of formula now used by the Bureau of Agricultural Economics in constructing their index of farm prices.

"An index of Type B differs from Type A in that base prices for corresponding months (P_{cm}) are used instead of the average of monthly prices over the entire base period (P_o). This eliminates from an index of Type B whatever seasonal variation in prices are obtained during

the base period. The weighting is the same as Type A and it therefore shares the same limitations due to fixed annual weights." It corresponds to the formula used by New York except that their weights are as of 1919.

"Type C is constructed by using an average of monthly prices over the entire base period, as in Type A, but it is 'weighted by monthly sales instead of sales per annum'. This index is, therefore, a measure of fluctuations in the value not of an 'imaginary' annual wagonload, but of a load 'normal' for each month. The quantities actually marketed in a given month will not, however, agree with normal monthly weights. This is especially true in agriculture where marketings vary from year to year with early and late seasons, price fluctuations, crop failures, or abundant crops. When situations of this kind appear, this type fails to measure accurately the real situation.

"Type D differs from Type C in that base prices for corresponding months are used instead of the average of monthly prices over the entire base period, thus eliminating seasonal fluctuations. Since the weighting is the same as Type C, it suffers the same limitations as Type C whenever actual and monthly marketings differ

from so-called 'normal' marketings". Missouri constructs an index number of this type.

Their advantages and limitations have been noted in the discussion. They seem to increase in application to specific situations with each type so that formula D most nearly embodies those characteristics for a sensitive and representative state index number. We see its general limitation, however, of establishing accurate or appropriate monthly marketing weights due to weather conditions largely.

Again, though Professor Young in his analysis of index numbers, says, "Weights must be selected with reference first to the type of formula used".[1] The writer has purposely reversed this order. It is true that if the aggregate form is used, then appropriate quantity weights must be selected. However, the writer preferred to investigate the available data and the extent of it first since it is the material used in the formula and if part of it did not exist or was unsatisfactory, then perhaps we could resort to another type. And so it has seemed to be: We noted above that we have scarcely any statistics on marketings and especially not current as the prices are gathered. There would thus be an

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[1] Handbook of Mathematical Statistics, Page 180.

unavoidable delay in constructing a monthly index of either the C or D type which would be the only advisable ones to use. Though most of the states are using the aggregative method, they use the type A, which shows itself really unsuited for a representative state index which is subject to almost spasmodic seasonal variations due to the diversity of commodities and specialties.

The so-called relative form of index number was early resorted to in order to get away from the undue influence of absolute prices of commodities not expressed in the same units. But it, too, has brought many problems and hence alternatives, though mainly of a theoretical nature. Its very essence and entity lies in the form of average used. Though many mathematical discussions and illustrations might be given to show the relative merits of each of the five forms possible, the writer will give only the conclusion of such study. Though both the geometric mean (the nth root of the products of 'n' price relatives) and the median satisfy the base reversal test, which if not satisfied, will result in a biased index number,[1] the geometric mean is really the preferable of the two for a state index. This is because when the

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[1]Handbook of Mathematical Statistics, page 182.

number of items to be averaged is small, as is necessarily the case in limited state indices, which only include agricultural commodities, medians are erratic in their behavior and also they are not as perfectly reversible as the geometric means are. Geometric means are self-consistent. They can be shifted from one base period to another without producing inconsistent results. Also indices computed by geometric means are readily comparable (regardless of base). As we noted above, frequent shifting of base periods is advisable and as was suggested we might be shifting our base period in a few years. The writer strongly recommends the geometric form of average. Its technical use and unfamiliarity will be discussed later. Then as one of our initial efforts in index work will be the construction and use of price relatives when we desire the index it can be computed from these "by combining them and taking their geometric mean. Their weighting must be given by value or income and though present value statistics are only estimates, such weighting need only to be relatively and not as exact as is needed for actual prices and marketings. Relative monthly weights may be determined from corresponding months of the base period and if the weather or season is abnormal and current monthly weights would radically dif-

fer, their relative or approximate percent could largely be determined from current prices and other reports. "Price" as John D. Black of Harvard, states it, "is really an indicator of the way the market is being fed".

The index number of prices of Iowa farm products is of this weighted geometric type. It involves the price relatives of 10 commodities, which show the relation of the current monthly price to the price of the five-year period 1910-1914. Their formula is expressed as

$$\Sigma P_x Q_x \sqrt{\left(\frac{P_1}{P_0}\right)^{P_x Q_x} \times \left(\frac{P_1'}{Q_0'}\right)^{P_x' Q_x'} \times \left(\frac{P_1''}{Q_0''}\right)^{P_x'' Q_x''}}$$

When P_1 - given monthly price

P_0 - price in base period

$P_x Q_x$ - weighting for each commodity expressed as a percentage of the gross income 1920-1924.

This is a rather formidable and difficult appearing formula and furthermore ours would be at first thought three times as long since it would take 27 commodities in Oregon to represent as high a percent of farm income and value as it does in Iowa. However, if we divide them into four groups, only the geometric mean of these four group indices need be taken. A word might well be said here as to the actual computation of such a formula.

Instead of adding the relatives just as they come and then dividing the sum by their number as is done in an arithmetic average, the computer must convert the relative prices of each group (four) into their logarithms, then find their arithmetic mean and finally look up the natural numbers corresponding to the quotients thus obtained. For the geometric mean is the antilogarithm of the arithmetic mean of the logarithms of the numbers.[1] In addition each relative must be multiplied by its relative weight before the logarithm is sought.

Immediately someone will comment that such an index number would be unsatisfactory because its technicalities and unfamiliarity make it impossible for the people of the state or at large to follow. But is not "such a test wholly irrelevant" as Clayton stated[2] when testing the validity or expediency of employing a scientific technique in the search for truth. "However, desirable it may be", he continues, "it simply is not true that the discovery of truth is advanced by the use of methods which in themselves are capable of popular appreciation and appeal. Nor is such an appeal essential to the purpose of research. Most persons who drive an automobile

[1]Handbook of Mathematical Statistics, page 25.

[2]Index Number of Farm Prices, Journal of Farm Economics, July, 1926, page 353.

never made one. It is one thing to build an automobile. To teach a driver to shift the gears is quite another. It is not a difficult matter for a farmer to see whether an index number is traveling up hill or down. And some supplementary instruction may well give him a better foundation for his judgment as to when and where to put his foot on the gas feed and when and where to take it off--especially perhaps to take it off." Give him the best and most accurate indices possible, even though he may not know how to construct them. He does not want to make them and besides he hasn't the time, nor is he in the position to do so.

The writer is well aware of the fact that the best or ideal formula or type of formula as Fisher and others have advocated is a weighted geometric mean of an aggregate rather than a relative, though for number 5253, which is equally as accurate, is a weighted geometric relative. But Fisher's ideal formula has the requirement that is very seldom met; namely, that corresponding data on price and volume are available. When such are on hand a further consideration may then be given to the aggregate method which surmounts most all of these technical difficulties attending the construction of index numbers we have

been reviewing and yet when given appropriate weights and the aggregates reduced to ratios or relatives, they can be made to agree and coincide with relatives themselves. However, as we gather statistics on value and income for the state which we would do for an income index anyway, the writer believes it would be possible to do what Fisher has done in taking the geometric mean of product of two aggregates, crossed weighted, we take the geometric mean of the product of our price index of relatives and of our index of incomes, thus giving cross weights.

Albert Black and Dorothea Kittredge have suggested a new formula in their article, page 321 of the current July number of Farm Economics which is the most recent on state index numbers. It aims to satisfy those two desired improvements in state index numbers which the writer has held desirable and necessary; namely, (1) a system of weighting which will represent actual conditions rather than some concept of "normal" which may not be normal at all for a certain year--the limitation to formulas of the C & D types discussed above, though they are far better than any others in this respect. (2) Establishing a relationship between the price index number and the index of income. A high price does not

necessarily and in fact seldom does mean greater income. A study of a demand curve will show the characteristic diminishing quantity at the higher price. So if the price index and an income index be combined a much more exact resultant would be given. If ever the prices of commodities and the quantity sold at that price are gathered which, though somewhat detailed and laborious, is necessary to the computation of an index of income it may be readily combined or crossed, as Fisher says, with the price index and expressed as they have

$$\sqrt{\frac{\Sigma[P_1 Q_{cm(o)}]}{\Sigma[P_{cm(o)} Q_{cm(o)}]} \times \frac{\Sigma[P_1 Q_{cm(1)}]}{\Sigma[P_{cm(o)} Q_{cm(1)}]}}$$

Where P_1 - given monthly price

$P_{cm(o)}$ - average price for corresponding month of base period

$Q_{cm(o)}$ - average amount sold for corresponding month of base period.

$Q_{cm(1)}$ - amount sold in given month.

This formula is very similar to Fisher's #353 of the aggregate and is analogous for the aggregate method to my suggestion for relatives. Though as Bowley says,[1] and as Fisher admits, this aggregate formula has no special claim to accuracy over the geometric mean of

[1]Bowley, Elements, page 207.

relative. Its only advantages are (1) intelligibility and a simplicity of construction.

Let us for a moment just consider the accuracy of index numbers. How mathematically correct are they able to measure variations in prices? Though errors may be introduced from any one or from all four sources of circumstances, including (1) choice of formula (2) number of commodities included, (3) the assortment or weighting of them and (4) from the original data itself, it is even possible to construct an index number that will be mathematically accurate to within 1/8 of 1% or less. One part in 800 or as Fisher says, less than a hands breadth in measuring the height of Washington Monument. With such possible accuracy does it not behoove us to see that we satisfy those circumstances upon which accuracy depends and above all have reliable and adequate data.

CONCLUSION

Now in conclusion, let us briefly consider and emphasize the main inductions and empirical results of this discussion. We have seen and felt the great maladjustment of the agricultural industry and others, especially during this post-war period, and we have desired to measure it by some accurate method. Index numbers can do that. They are also of great value and use as a measurement of the relative position of the agricultural industry itself and of the several enterprises within the industry. Or as a measurement of the relative farm situation in various states or in countries; then as an instrument for measuring and forecasting price trends and so are an aid in determining farm management and organization policies. The field of price analysis and of price forecasting is becoming one of the most potential fields of economic and statistical research. There lie the secrets of control and scientific judgment.

We noted the need of state indices as well as national ones since the latter are often too general and not applicable to specific state conditions. Even a state index is perhaps somewhat too general to apply to its many geographical areas. South Dakota is planning

on making three regional indices for their state and are now gathering statistics incident to its construction; e.g., one for the corn belt section; one for the wheat belt and one for the range section.

A questionnaire was sent to the agricultural college in each state as a means and an aid in making a survey of current state indices and their extent and use. Also for comparable and helpful suggestions from those who have and use them.

The most fundamental step in constructing an index is to have reliable and adequate data and quotations to work with. So a study of the state of Oregon was made, and a specific analysis of price series revealed a great scarcity and dearth of reliable statistics. As true a fate as came to the man who built his house upon the sand, so to us would come the same grief and failure if we built upon our present price statistics. What can we do about it? We can check and revise our series. Farmers and dealers' records, court files, newspapers, etc. throughout the state contain a wealth of statistics, not only of farm prices, but retail prices, cost, etc., which could all be gathered at the same time. This is part of our program on making a state index and can best be carried

on in the form of a project. Perhaps cooperation of the U. S. Department of Agriculture could be secured to reduce the cost.

Then we considered the various steps and problems in constructing an index number. Specific purpose and use of the index is very important since it largely determines what goes into the index and the nature of it. We see it would be very desirable to develop some four or five state indices; namely, (1) Indices of prices of farm commodities, consisting of both price relatives and a general index number. These are especially valuable for measuring the relative position of the enterprises within the industry and for determining trends and price forecasting which may aid in farm management policies. (2) An index of farm income is very helpful--especially for measuring agriculture itself with other industries. (3) Then comes an index of purchasing power. One by commodities rather than for farmers' themselves is suggested because of the scarcity of statistics on farmers' costs of living, etc. (4) Input goods indices, such as wages, machinery, seeds, fertilizer, feeds, etc. are of specific value and use. (5) Also an index of production, though not constructed, many states should be considered and statistics gathered for future work at least.

Twenty-seven commodities, represented by four groups were suggested as necessary and desirable to secure adequate representation of Oregon agriculture, both in respect to value and acreage. These twenty-seven commodities would represent approximately 92 - 95% of the farm income. They are:

1. Field Crops,--wheat, oats, barley, corn, potatoes, hops, seeds, hay.

2. Fruits and vegetables,--apples, pears, prunes, cherries, berries, nuts, other vegetables.

3. Livestock,--hogs, beef, veal, sheep, horses.

4. Livestock products,--wool, butterfat, milk, cheese, butter, chickens, eggs.

As each of these commodities and our groups are not of equal importance in farm agricultural income, weights were considered. Since no production weights are available for livestock and as we have no reliable marketing figures, it seems best to use relatives of value. They, too, are but estimates but since each are determined in the same manner, a mere approximation of their relative importance can be made; e.g., relatives weights for the five groups can be given as: Field Crops (4) Fruit Crops (2) Livestock (2) Livestock Products (2).

The base year or point of reference we found could not reliably be taken as pre-war--years 1910 - 14, as most states do. It is desirable to have the pre-war base in order to secure comparisons with normal exchange and parity of purchasing power between industries, since our basic data for them seems inadequate and unreliable at present. The post-war period was found to be unsuited for a base period. Though agricultural prices have been quoted consistently above the pre-war time the ratio was much lower than the non-agricultural. The present year seems to be more nearly normal again when agriculture is considered with other lines, so we are perhaps entering another good base period.

The question of a formula was largely settled for us after discussing the other problems and especially of the extent and kind of data. An average of relatives is the best for our data at present. A formula like that of Iowa would fulfill the purpose very well--a geometric mean of the relatives weighted by fixed monthly ratios of the average annual income for a base year. To overcome any discrepancy or bias introduced by seasonal or monthly changes due to weather conditions or otherwise, the writer suggested the adoption of Fisher's idea in his ideal formula of taking the geometric mean of the

product of two indices, (cross weighting) the one based on quantities in the base-weight period, the other the quantities of the given year. Since we would not be using the aggregate at present, at least our formula could necessarily be weighted by income so we would compute an income index. A very similar or perhaps better alternative for the future was stated in the Minnesota formula, which uses type D aggregate suggested by Stine and Bean and an income index. They announce a very high correlation between their's (termed type F and type D).

The state indices should be issued monthly. As statistics enable the construction of county indices, they may well be made seasonal (quarterly) if adequate representation is to be had.

"What of the future of Oregon Agriculture? Should we attempt to understand and in a measure govern the influences that will operate to shape its destiny? Or should we assume that this is beyond our comprehension and within a realm where the elements of human intelligence is to play no part?" It was the optimism of the first alternative that stimulated this effort. A program is needed. The above discussion on state indices numbers has intended to suggest such a program for

Oregon agriculture, whereby "we attempt to understand and in a measure govern the influences that will operate to shape its destiny."

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APPENDIX

Exhibit I.

VALUE OF OREGON COMMODITIES

1925

Field Crops	Value	To Nearest %.
All Wheat- - - - - - -	$25,704,000.00	15
Oats,- - - - - - - -	4,779,210.00	3
Barley,- - - - - - -	2,236,720.00	2
Rye, - - - - - - - -	154,000.00	
Corn, grain, - - - -	729,205.00	
Corn, silage, etc. -	1,560,900.00	1
Hay, tame, - - - - -	21,866,000.00	13
Hay, wild, - - - - -	2,256,000.00	2
Potatoes,- - - - - -	6,600,000.00	4
Hops,- - - - - - - -	3,588,000.00	2
Clover seed, - - - -	120,000.00	
Flax, fiber, - - - -	240,000.00	
Miscellaneous seed -	250,000.00	
Miscellaneous forage	400,000.00	
Total field,- -	$70,484,035.00	42

Fruit Crops		
Apples,- - - - - - -	$6,750,000.00	4
Pears, - - - - - - -	2,400,000.00	2
Prunes, sold fresh -	420,000.00	
Prunes, dried, - - -	1,360,000.00	1
Peaches, - - - - - -	405,000.00	
Cherries,- - - - - -	1,250,000.00	1
Loganberries,- - - -	360,000.00	
Strawberries,- - - -	840,000.00	
Black & Raspberries-	720,000.00	
Cranberries, - - - -	67,500.00	
Grapes,- - - - - - -	93,000.00	
Misc. Fruits,- - - -	250,000.00	
Nuts,- - - - - - - -	300,000.00	
Nursery stock, - - -	1,500,000.00	1
Total fruit, - -	$16,715,500.00	9

VALUE OF OREGON COMMODITIES

1925 - Continued

Truck Crops	Value	To Nearest %.
Cabbage, - - - - - - - - -	92,000.00	
Cauliflower- - - - - - -	448,000.00	
Celery,- - - - - - - - -	185,250.00	
Lettuce, - - - - - - - - -	58,500.00	
Onions,- - - - - - - - -	369,000.00	
Farm & City Gardens, - -	2,500,000.00	2
Total truck,- - - - -	$3,652,750.00	2
Livestock		
Dairy Production (Preliminary Estimate) - -	$25,000,000.00	13
Wool & Mohair, - - - - -	5,500,000.00	3
Poultry & Eggs,- - - - -	10,000,000.00	6
Livestock Sales- - - - -	43,000,000.00	25
Total Livestock, - -	$83,000,000.00	47
GRAND TOTAL, - - -	$173,852,285.00	

Exhibit I - continued.

VALUE OF OREGON COMMODITIES

1926

Field Crops	Value	To Nearest %.
Winter Wheat,- - - - - - - -	$ 19,986,000.00	13
Spring Wheat,- - - - - - -	2,834,400.00	2
Oats,- - - - - - - - - - -	4,408,000.00	3
Barley,- - - - - - - - - -	1,480,550.00	1
Rye, - - - - - - - - - - -	124,800.00	
Corn, grain, - - - - - - -	825,000.00	1
Corn, silage, etc. - - - -	1,650,000.00	1
Hay, tame, - - - - - - - -	18,521,000.00	12
Hay, wild, - - - - - - - -	1,890,000.00	1
Potatoes,- - - - - - - - -	4,673,450.00	3
Hops,- - - - - - - - - - -	3,737,500.00	3
Clover seed, - - - - - - -	382,500.00	
Flax, fiber, - - - - - - -	113,400.00	
Flax, seed,- - - - - - - -	22,000.00	
Peppermint,- - - - - - - -	300,000.00	
Misc. seed,- - - - - - - -	404,000.00	
Misc. forage,- - - - - - -	400,000.00	
Total Field, - - - - - -	$ 61,758,600.00	40

Fruit Crops	Value	To Nearest %.
Apples, - - - - -- - - - -	$ 5,625,000.00	4
Pears, - - - - - - - - - -	1,785,000.00	1
Prunes, sold fresh,- - - -	344,000.00	
Prunes, dried, - - - - - -	3,230,000.00	2
Peaches, - - - - - - - - -	450,000.00	
Cherries,- - - - - - - - -	2,304,000.00	2
Loganberries,- - - - - - -	1,232,650.00	1
Strawberries,- - - - - - -	1,051,200.00	1
Raspberries, - - - - - - -	629,450.00	
Blackberries(mostly wild)	662,500.00	
Misc. Fruits,- - - - - - -	400,000.00	
Nuts, - - - - - - - - - -	500,000.00	
Nursery stock, - - - - - - - -	1,250,000.00	1
Total Fruit	$19,463,800.00	12

Exhibit I - continued.

VALUE OF OREGON COMMODITIES

1926

Truck Crops	Value	To Nearest %.
Cabbage,- - - - - - - - -	$164,900.00	
Cauliflower (& broc.) -	825,000.00	1
Celery, - - - - - - - - -	201,600.00	
Lettuce,- - - - - - - - -	75,600.00	
Onions, - - - - - - - - -	333,600.00	
Farm & City Gardens - -	2,000,000.00	1
Total Truck	$3,600,700.00	2

Livestock	Value	To Nearest %.
Dairy Production, - - -	$24,522,222.00	16
Wool & Mohair,- - - - -	6,153,000.00	4
Poultry & Eggs, - - - -	10,000,000.00	7
Livestock Sales,- - - -	30,581,560.00	19
Total Livestock,- -	$71,256,782.00	46
GRAND TOTAL,- - - -	$156,079,882.00	100

Exhibit I - continued.

VALUE OF OREGON COMMODITIES

1927

Field Crops	Value	To Nearest %.
Winter Wheat,- - - - - - - -	$26,208,000.00	15
Spring Wheat,- - - - - - -	3,788,000.00	3
Oats,- - - -- -- - - - - -	5,586,000.00	3
Barley,- - - - - - - - - -	2,452,000.00	2
Rye, - - - - - - - - - - -	152,000.00	
Corn, grain, - - - - - - -	991,800.00	
Corn, silage, etc.,- - - -	1,830,400.00	1
Hay, tame, - - - - - - - -	22,938,000.00	13
Hay, wild, - - - - - - - -	2,205,000.00	1
Potatoes,- - - - - - - - -	4,680,000.00	3
Hops,- - - - - - - - - - -	3,975,000.00	2
Clover seed,- - - - - - - -	731,000.00	
Flax, fiber, - - - - - - -	144,000.00	
Flax, seed,- - - - - - - -	22,000.00	
Peppermint,- - - - - - - -	250,000.00	
Misc. seed,- - - - - - - -	851,000.00	
Misc. forage,- - - - - - -	400,000.00	
Total Field, - - - -	$77,204,200.00	43

Fruit Crops	Value	To Nearest %.
Apples,- - - - - - - - - -	$ 4,950,000.00	4
Pears, - - - - - - - - - -	2,660,000.00	2
Prunes, sold fresh,- - - -	320,000.00	
Prunes, dried, - - - - - -	1,440,000.00	1
Peaches, - - - - - - - - -	256,000.00	
Cherries,- - - - - - - - -	1,800,000.00	1
Loganberries,- - - - - - -	875,000.00	1
Raspberries, - - - - - - -	393,750.00	
Strawberries,- - - - - - -	1,920,000.00	1
Blackberries,(mostly wild)	350,000.00	
Cranberries, - - - - - - -	81,000.00	
Misc. Fruits,- - - - - - -	300,000.00	
Nuts,- - - - - - - - - - -	400,000.00	
Nursery Stock, - - - - - -	2,500,000.00	2
Total Fruit,- - - - -	$18,245,750.00	12

Exhibit I - continued.

VALUE OF OREGON COMMODITIES

1927

Truck Crops	Value	To Nearest %.
Cabbage,- - - - - - - - -$	170,000.00	
Cauliflower (& broc.) - -	504,000.00	
Celery, - - - - - - - - -	221,400.00	
Lettuce,- - - - - - - - -	18,750.00	
Onions, - - - - - - - - -	216,750.00	
Farm & City Gardens & Misc.	2,500,000.00	2
Total Truck,- - - - -	$3,630,900.00	2

Livestock	Value	To Nearest %.
Dairy Production, - - - -	$25,750,000.00	15
Wool & Mohair,- - - - - -	6,289,000.00	4
Poultry & Eggs, - - - - -	10,500,000.00	6
Livestock Sales,- - - - -	30,000,000.00	18
Total Livestock, - -	$72,539,000.00	43
GRAND TOTAL, - - - -	$171,619,850.00	100

Exhibit II.

District No.	COUNTIES	Corn	Wheat (all)	Oats	Barley	Rye	Potatoes	Apples	Hay (all)	Alfalfa hay	Clover	Grain	Wild hay	Dairy cattle (milk same)	Beef cattle(all)	Hogs	Sheep (wool same)	Horses	Mules	Goats (Mohair same)	Chickens (Eggs same)
1	Clackamas	8	3	10	1	2	10	2	3	-	16	4	-	7	3	8	1	3	1	5	11
	Clatsop	-	-	-	-	-	1	-	1	-	-	-	1	2	1	1	-	-	-	-	2
	Columbia	1	-	1	-	-	3	1	1	-	1	1	2	3	1	1	-	1	-	-	2
	Marion	16	5	17	2	8	10	2	4	-	15	4	1	7	3	9	1	4	1	6	9
	Multnomah	3	-	1	1	-	10	1	1	-	2	1	1	4	1	2	-	1	-	-	3
	Polk	5	3	7	2	-	2	1	2	-	6	4	1	4	2	3	1	2	-	10	3
	Tillamook	-	-	-	-	-	-	-	1	-	-	-	1	6	2	1	-	1	-	-	1
	Wash.	8	3	13	1	1	9	2	4	1	13	3	1	7	3	3	-	3	1	1	8
	Yamhill	7	3	9	2	3	2	2	3	-	11	5	-	5	2	5	1	3	1	9	5
		48	17	58	9	14	47	11	20	1	64	22	8	45	18	33	4	18	4	31	44
2	Gilliam	-	5	-	2	1	-	-	1	1	-	3	-	-	1	1	3	3	8	-	1
	Hood River	-	-		-	-	2	50	1	1	1	-	-	1	-	1	-	1	-	-	1
	Morrow	-	5		3	1	-	-	3	4	-	6	-	1	1	1	9	4	12	-	1
	Sherman	-	10		2	-	-	-	1	-	-	4	-	-	1	2	1	4	3	-	1
	Umatilla	2	30	½	24	2	4	8	8	13	-	8	1	4	4	4	8	7	29	-	4
	Wasco	1	6	½	4	1	1	4	2	2	-	4	-	1	2	4	5	4	3	-	2
		3	56	1	35	5	7	63	16	21	1	25	1	7	9	13	26	23	55	-	10
3	Union	1	6	3	9	8	2	4	3	7	-	2	5	2	3	5	1	4	2	-	2
	Wallowa	1	3	2	9	5	1	-	3	4	1	4	1	2	3	9	4	4	3	-	1
		2	9	5	18	13	3	4	6	11	1	6	6	4	6	14	5	8	5	-	3
4	Benton	3	2	4	2	2	2	2	2	-	4	3	1	3	1	1	1	1	-	6	3
	Lane	7	2	8	4	5	6	3	4	-	5	8	1	6	4	5	2	3	2	13	9
	Lincoln	-	-	-	-	-	1	1	1	-	1	1	-	2	1	1	-	1	-	7	1
	Linn	10	4	15	9	12	3	1	5	-	14	6	1	7	4	7	3	4	1	9	8
		20	8	27	15	19	12	7	12	0	24	18	3	18	10	14	6	9	3	35	21
5	Crook	-	1	½	1	3	1	-	2	4	-	2	3	1	3	1	2	2	1	-	1
	Deschutes	-	1	-	-	2	3	-	2	6	-	1	-	2	1	1	1	1	-	-	1
	Grant	½	-	½	1	3	-	-	3	2	-	3	4	1	5	1	4	4	3	-	1
	Jefferson	-	2	-	-	1	-	-	1	1	-	3	-	-	1	-	2	2	2	-	1
	Wheeler	½	-	-	1	5	-	-	1	2	0	2	2	-	2	1	5	2	1	-	1
		1	4	1	3	14	4	0	9	15	1	11	9	4	12	4	14	11	7	-	5
6	Baker	1	2	2	4	3	2	1	8	16	1	1	10	4	8	4	4	5	4	-	2

Exhibit II - continued.

District No.		Corn	Wheat (all)	Oats	Barley	Rye	Potatoes	Apples	Hay (all)	Alfalfa hay	Clover	Grain	Wild hay	Dairy cattle (milk same)	Beef cattle (all)	Hogs	Sheep (wool same)	Horses	Mules	Goats (Mohair same)	Chickens (Eggs same)
7	Coos	2	-	-	1	-	3	1	2	-	1	1	-	5	3	2	-	1	-	-	1
	Curry	-	-	-	-	-	-	-	1	-	1	1	-	1	1	1	1	-	-	2	-
	Douglas	7	1	2	1	1	1	4	2	4	1	5	1	3	2	3	5	2	1	25	4
	Jackson	6	1	1	4	-	1	6	5	7	1	3	1	3	5	4	1	2	2	6	4
	Josephine	2		1	1	1	1	1	1	2	1	1	-	1	1	1	-	1	-	1	1
		17	2	4	7	2	6	12	11	13	5	11	2	13	12	11	7	6	3	34	10
8	Klamath	-	1	1	2	22	7	-	5	7	-	3	10	1	4	2	3	3	2	-	1
	Lake	-	-	-	-	1	-	-	3	2	1	1	17	1	5	1	6	3	5	-	1
		-	1	1	2	23	7	0	8	9	1	4	27	2	9	3	9	6	7	-	2
9	Harney	-	-	-	1	3	-	-	3	4	1	1	24	1	9	1	8	7	5	-	1
	Malheur	8	1	1	6	4	12	2	7	10	2	1	10	2	7	3	17	7	7	-	2
		8	1	1	7	7	12	2	10	14	3	2	34	3	16	4	25	14	12	-	3

Exhibit III.

Are 314 Schedules Enough for the State of Oregon

Commodity	No. of reports	Aver. price arith. mean	Standard deviation of reports	Coefficient of variability	Probable error of av. price	Relative P.E.	4 times Relative P.E.
				%	¢per bu.	%	%
Wheat	179	1.32	13¢per bu.	9.9	.67	.5	2.4
Potatoes	200	1.22	40.6	33	.02	1.6	6.4
Clover seed, red	42	.25½	4½	17.7	.47	.18	.72
Apples	26	1.60	57	32	.83	.52	2.8
Wool	102	.40	6.3	15.6	.41	.1	.4
Eggs	230	.22	2.7	12.3	.14	.07	.28
Butterfat	180	42.5	3	7	.17	.04	.16
Hogs	144	9.50	1.32	14	.81	.66	2.64

The probabilities are 99 out of 100 that the average of a much larger sample collected in the same way and at the same time, would not vary from this average by more than four times the relative probable error. The last column gives the result of four times the probable error. The present number of schedules seems to be practically sufficient, especially for seeds, wool, eggs, and butterfat.

Questionnaire

1. Agricultural index numbers now computed for your state: check (x)
   a. Indices of prices of farm commodities:
      1. Individual (price relatives) (_____) Number computed: (_____)
      2. All (general index numbers) (_____)
   b. Do you compute an index of gross farm income?____ Net farm income?____
   c. Do you compute indices of agricultural production?_____
   d. Have you computed a state index of farm purchasing power?_____
   e. Do you compute indices of the cost of farm imput goods such as: wages, machinery, fertilizer, seed, etc.?_____
   f. Other?_____
      _____

2. Which of the above do you contemplate developing, if not already computed? (Check by letter) a (1, 2,) b, c, d, e,

3. Indicate by number in order of importance the purposes for which such index numbers are of value.
   a. A convenient statistical measure of the relative position of agriculture and other industries?_____
   b. A measurement of the relative position of the agricultural industry itself and of the several enterprises within the industry?_____
   c. As a measurement of the relative farm situation in your state and in other states or countries?_____
   d. As an instrument for measuring and forecasting price trends?_____
   e. As an aid in determining farm management and organization policies?_____
   f. Other?_____

4. Form and construction of your index number, as to:
   a. Source and character of data
      1. Government data and reports? ( ) Any other supplements and for what products?_____
      2. What is the average number of reports per month that are collected and used?_____
      3. Do you take an annual state census?_____What is its approximate cost per farm?_____
      4. Did you ever revise the data for your state?_____
         Do you ever plan to do so?_____
   b. How many commodities are represented in your index?_____
      1. What per cent of total value of farm commodities or of farm income do they represent?_____
      2. How are they weighted:- value ( ): production ( ): marketings ( ) Others?_____
      3. Do you combine the crop and livestock series?_____How?_____
   c. What base period do you favor, Pre-war or Post-war?_____Years?_____
      1. Do you have a month or year base for monthly index numbers?
      2. What base do you use for commodity weightings?_____
   d. Do you use the aggregate or relative form of index?
      Give formula or example.

5. What difficulties or objections have you found?_____
   a. Basic data inadequate or unreliable?_____
   b. Cost of constructing and maintaining them?_____
   c. Others?_____
      _____
      _____

6. Remarks or suggestions.

[C. E. 1–69]
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UNITED STATES DEPARTMENT OF AGRICULTURE
AND
OREGON STATE AGRICULTURAL COLLEGE
IN COOPERATION
316 OREGON BUILDING
PORTLAND, OREGON

Bureau of Agricultural Economics
Division of Crop and Livestock Estimates

Extension Service
Division of Agricultural Economics

DEAR SIR: The Oregon Federal Cooperative Crop Reporting Service cooperating with the Extension Service of the Oregon State Agricultural College would appreciate having **your estimate** of the average prices **paid to producers** in your locality about the 15th of this month, for such farm products as you are familiar with. As only one quotation is desired for each product, it should be representative of all sales, occurring on or about the 15th of the month or for the week preceding the 15th. Please return not later than the 16th of this month in the accompanying envelope, **which requires no postage.** In return, a digest of current economic information will be mailed to you. Thanking you for your assistance in this work, I am,

Respectfully,

F. L. KENT,
Agricultural Statistician.

Report prices ONLY for such farm products as are produced in your locality and marketed during this month.

IMPORTANT.—THIS SCHEDULE SHOULD BE MAILED BY THE 15TH OF THIS MONTH

*Name*_____ *County*_____ *Date*_____

*Post Office*_____ *R. D. No.*_____ *State*_____

Do NOT report prices of farm products shipped INTO your market.
Please quote prices in the unit of measure stated for each product.
Quotations should be, as near as can be given, the average prices **paid to producers;** that is, such a price, as, if multiplied by the total quantity bought from the producer, would give the total value of all such purchases made on or about the 15th of this month. Do **not** give the range of prices. **Give the average prices.**

RETURN SCHEDULE EVEN THOUGH YOU CAN REPORT FOR ONLY ONE OR TWO COMMODITIES

PRICES PAID TO PRODUCERS

RETURN SCHEDULE EVEN THOUGH YOU CAN REPORT FOR ONLY ONE OR TWO COMMODITIES

CROPS

(1) Corn, per **bu.** of 70 pounds if in ear, or 56 pounds if shelled	(2) Wheat, per **bushel** of 60 pounds	(3) Oats, per **bu.** of 32 lbs.	(4) Barley, per **bu.** of 48 lbs.	(5) Rye, per **bu.** of 56 lbs.	(6) Flaxseed, per **bu.** of 56 lbs.	(7) Potatoes, per **100 lbs.**	(8) Beans (dry edible), per **100 lbs.**	(9) Hops, per **pound**	(10) Apples, per **bushel**	(11) Boxed apples, per **box**	(12) Dried prunes, per **lb.**
$ Cts.	$ Cts.	$ Cts.	$ Cts.	$ Cts.	$ Cts.	$ Cts.	$ Cts.	Cents	$ Cts.	$ Cts.	Cents

HAY CROPS

(13) Hay, all (loose), per **ton** of 2,000 lbs.	(14) Hay, all (baled), per **ton** of 2,000 lbs.	(15) Alfalfa hay (loose), per **ton** of 2,000 lbs.	(16) Clover hay (loose), per **ton** of 2,000 lbs.	(17) Vetch hay (loose), per **ton** of 2,000 lbs.	(18) Grain hay, per **ton** of 2,000 lbs.	(19) Prairie wild or grass hay (loose), per **ton** of 2,000 lbs.
$ Cts.	$ Cts.	$ Cts.	$ Cts.	$ Cts.	$ Cts.	$ Cts.

SEEDS

(20) Clover seed, per **100 lbs.**	(21) Alfalfa seed, per **100 lbs.**	(22) Vetch seed, per **100 lbs.**	(23) Grass seed, per **100 lbs.**
$ Cts.	$ Cts.	$ Cts.	$ Cts.
Red_____	Common_____	Common_____	Rye grass_____
Alsike_____		Hairy_____	Bent grass_____
White_____		Hungarian_____	Tall oat_____
Sweet_____	Grimm_____	Purple_____	Timothy_____

[C. E. 1–69]
"O"

IMPORTANT.—THIS SCHEDULE SHOULD BE MAILED BY THE 15TH OF THIS MONTH

RETURN SCHEDULE EVEN THOUGH YOU CAN REPORT FOR ONLY ONE OR TWO COMMODITIES

Report prices ONLY for such farm products as are produced in your locality and marketed during this month.

PRICES PAID TO PRODUCERS

LIVESTOCK

(24) Hogs (live weight), per **100 lbs.**	Beef cattle (live weight)		(27) Veal calves (live weight), per **100 lbs.**	(28) Sheep (live weight), per **100 lbs.**	Lambs (live weight)		(31) Milk cows, per **head**	(32) Beef cows, per **head**	(33) Goats, per **head**	(34) Horses, per **head**	(35) Mules, per **head**	(36) Chickens (live weight), per **lb.**	(37) Turkeys, per **pound**
	(25) Feeder steers, per **100 lbs.**	(26) Fat steers, per **100 lbs.**			(29) Feeder lambs, per **100 lbs.**	(30) Fat lambs, per **100 lbs.**							
$ Cts.	$ Cts.	$ Cts.	$ Cts.	$ Cts.	$ Cts.	$ Cts.	$	$	$ Cts.	$	$	Cents	Cents Live ---------- or Dressed ----------

LIVESTOCK PRODUCTS

(38) Butter, per **pound**	(39) Butterfat, per **pound**	(40) Milk (whole), retail, per **quart**	(41) Milk (whole), wholesale, per **100 lbs.** (11.4 gals.), **to dealers, factories, etc.**	(42) Eggs, per **dozen**	(43) Wool (unwashed), per **lb.**	(44) Mohair, per **pound**
Cents	Cents	Cents	$ Cts.	Cents	Cents	Cents

U. S. GOVERNMENT PRINTING OFFICE : 1925