ECONOMIC AND BUSINESS STATISTICS

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THE SEASONAL FACTOR IN INDIAN TRADE, INDUSTRY AND FINANCE

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Causes of Seasonal Swings

Etymologically, the word *season* means "time of sowing" or "seed-time", which points to the intimate influence of the season on agriculture. In a country like India in which the national income and its distribution are so closely bound up with agriculture, the influence of the season on economic life must be profound. The building industry is another industry, which is considerably affected by seasons. But it is not of such a great importance in India that its seasonal fluctuation will give rise to a corresponding fluctuation in the economic activity of the country as a whole, as in some other parts of the world. In some spheres not connected with economics, the seasonal factor is however pronounced, e.g. prevalence of malaria, diarrhœa, cholera, plague etc. Thus, seasonal factors are of importance not only in statistics handled by economists but also in those handled by sociologists, biologists doctors, public health workers etc. In the present paper, however, we shall confine ourselves only to economic data.

Commencement and Retreat of the Monsoon

The most important seasonal factor in India so far as agriculture is concerned is the monsoon. Its onset in different parts of India is quite irregular as shown in Appendix I. Thus on the Malabar coast, the monsoon set in as early as May 10 in 1918 and as late as June 13 in 1915. In Bombay the corresponding dates were May 24 in 1918, and June 25 in 1905. In Bengal they were the 2nd week of May in 1928 and the end of 2nd week of June in 1920 and 1934. These dates were derived from meteorological considerations but they may be checked up with the help of the statistics of rainfall, by first computing, say, a five-day moving average and thus finding out the time when rainfall definitely begins to increase. We may define the middle of that period as the time of onset of the monsoon. Similarly the time of retreat may be found by the same process, when rainfall definitely wanes. Such dates will also be found to vary from year to year. The distribution of rain-fall is equally irregular. This will be apparent from a study of the chart relating to monsoon rainfall published in the *Estimates of Area and Yield of Principal Crops in India.*

Other Irregularities

The Christmas falls on the same date year after year. Not so the Easter, nor the *Pujah*. The *Id* calculated according to the lunar month falls in different months in different years. The consequent disturbance to economic activity must therefore be naturally irregular. Books are closed on different dates, following the calendar year, financial year, Bengali year, Sambat year and so on. For this reason also the swings cannot be strictly recurrent.

Difficulties of Indian Seasonals

Thus in India we are faced with the curious situation that although seasonal factors are certainly of profound effect on economic life, their behaviour is irregular. It is because of this reason probably that no systematic attempt has been made so far to study seasonal fluctuations. But we should remember that in the absence of any accurate notion about seasonal factors, our conclusions derived from month-to-month changes must necessarily be faulty. For, we are not in a position to say to what extent the observed change is inherent in the monthly figures themselves, and to what extent that change is significant, calling for special scrutiny and examination. Thus there is always a risk of confusing a purely seasonal improvement with a genuine upward phase of the trade cycle. It is for this reason that a systematic computation of seasonal factors of different economic series is of great importance.

Previous Workers

The pioneer workers in this field were Messrs. Braju Mohan Chatterji and Gopal Chandra Ray, who computed seasonal factors for (a) note circulation in India, (b) percentage of gold reserve to note circulation (c) price of 3½% Government of India rupee paper and (d) Calcutta Index No. of wholesale prices in the *Indian Economist* (dated July 29, 1935, August 12, 1935, September 23, 1935, and June 15, 1936, respectively). They were concerned mainly with a study of cycles, and did not naturally consider the appropriateness of their technique of computation of the seasonal factors in detail. The next worker was Prof. S. R. Bose who calculated the seasonal indices for the various components of his "Index of Business Activity" in the *Indian Journal of Economics*, (Vol. 18, 1937-38). Some of the series studied by him were very short, only of 3-4 years' duration. He therefore did not think it worth while to devote much attention to the principles underlying the method actually followed by him in preference to the other methods available, for the results were necessarily very rough. The next worker was Mr. J. Guha Thakurta whose "Index of Business Activity" first appeared in *Capital* (dated March 17, 1938). But the method adopted by him has not been explained in full.

Stability in Seasonals

Various methods of computing seasonal factors have been tried out in other countries. It will be useful to give a brief account of these methods and to discuss how far they are applicable to Indian data. By definition, seasonal factors, unlike other factors in time series such as cyclic and irregular items, have a periodicity of one year exactly. We may also postulate that there is a substantial conformity with a seasonal pattern year after year, for it is this which we are out to discover.*

Elimination of Disturbing Factors

If these two assumptions are valid, the obvious course is to have a twelve-monthly moving average, which will obliterate, or at any rate considerably damp down, the seasonal factors. The question now is, what further irregularities are likely to creep in during this process. In the first place, if the trend is not linear, the moving average cannot give the trend exactly, the concavity or convexity of a non-linear trend being necessarily reduced. In the second place, cycles have generally a periodicity greater than one year and therefore

*This assumption is not agreed to by the protagonists of varying seasonals, whose case will be examined in a later section of this paper.

some of the cyclic influences must persist in the twelve-monthly moving average. In the third place, the irregular items may not mutually cancel themselves. In the fourth place, the process of moving average inevitably involves two technical difficulties (*a*) omission of five or six* items at the beginning and at the end of series; (*b*) distortion a few months ahead of and subsequent to a sharp rise or decline. So far as the second technical difficulty is concerned, the only solution seems to be to break up the series into different components at points of such patent discontinuity and compute seasonal factors for each of such component periods separately. This is also necessary if the assumption about substantial conformity with a standard seasonal pattern is valid. As regards the first technical difficulty, one solution is to use a free hand curve, as practised by the Federal Reserve Board**. With regard to the three difficulties involved in choosing one year as the period of moving average it is evident that this process must damp down the cyclic and irregular items to a considerable extent. The deviations measured from the moving average must therefore throw the seasonal factors into high relief.

Deviations from the Twelve-Monthly Moving Average

The question now arises whether the arithmetic difference or the proportionate difference between the actual observation and the corresponding moving average value is to be taken. In other words, which is the better hypothesis, A(Actual) = T(Trend) + S(Seasonal + C(Cycle) + I(Irregular) or $A = T \times C \times S \times I$? The logical course in the case or an ordinary time series would point to the latter, which is borne. out also by practical experience. Thus the actual computation of the seasonal index is carried on in the following way. For each month, the actual data are expressed as percentages of the corresponding moving average values. Thus we get a set of percentages for January, another set for February and so on. Each figure in any one set is affected in full by the seasonal factor for that month and in part by (*a*) curvilinear trend (if any); (*b*) cyclic factors; and (*c*) irregular elements. The second and the third would vanish if averaging is done for a fairly long series of years. But in that case there is a risk that the seasonal pattern itself may have been somewhat altered in the mean time. For, as explained above, we ought to break up the given series into a number of sub-series in such a manner that there are no irregularities or abnormalities to affect the seasonal fluctuations during such component periods. Thus we have to balance the advantages due to the length of a series against the risks of alternations in the seasonal pattern and then choose the proper period for determining the seasonal factors. In any case, the difficulty with regard to curvilinear trend remains. This can however be minimised by a simple expedient in many cases. If instead of working with the data just as they are, we work with their respective logarithms, then equal proportional increases and not equal absolute increases will be treated as identical with the result that a fairly complex relationship can be linearly represented without serious error.

Testing of These Deviations

The problem now is to examine the several percentage deviations (or logarithmic differences) for any one month, say January. The routine procedure is to plot them on a ratio chart for the series of years and then see whether they exhibit any definite trend or not.

*According as whether or not a second moving average of two items each is computed in order to "centre" it, as it is called.

**See *Federal Reserve Bulletin*, December, 1930.

If the moving average method has been successful, there should be no trend, provided of course our assumption about a fixed seasonal pattern is valid. But if there appears to be a trend and that of a similar character for all the twelve months,—then obviously the trend has not been fully eliminated. But this rarely happens if the series has been properly broken up into components. In any case, this procedure is necessary in order to satisfy ourselves that we have been able to get at the seasonal fluctuations.

"Positional" or "Modified" Average

It should however be remembered that no statistical ingenuity can make an average representative, if there is no well-marked central tendency. It should also be remembered that these percentage deviations show not only seasonal fluctuations but also other types of changes in the series in varying degrees. It follows therefore that some "end" items do not, strictly speaking, belong to the series. The median is naturally suggested. But if the number of years is not sufficiently long, the procedure of "positional" or "modified" averages has to be adopted. Thus we should throw the set of figures for each month in the form of an array and then decide on the central group which shows the greatest concentration. It is true that this involves a subjective element, but this may be obviated if we decide on a rule, about neglecting all items the deviations of which from the mean exceed, say, 1·5 times the standard deviation. This also is not free from difficulties. For instance, it may very well be that for January two items on each side have to be left out, whereas for February three items at one end and two on the other have to be ignored. In other words, the averages for different months may be based on differing number of central items. This is *prima facie* undesirable, but if we remember that all factors of heterogeneity were not entirely eliminated by the previous process of moving average, we cannot avoid such modified means based on a varying number of items. After the twelve averages for the twelve months are derived in this way, they are further adjusted in order that their total may be 1200.

Other Methods for Deriving the Trend

It has been suggested above that we should use a twelve-montly moving average properly centered,—ordinary in the case of a linear trend and logarithmic in the case of a curvilinear trend. Some statisticians use more complex moving averages giving greater weight to central than to end items. Some use mathematical trends derived from *a priori* considerations. Others again use a free hand curve for smoothing. These are all subjective methods, and do not in most cases furnish any better basis than the method of moving average.

The "Link Relative" Method

One method of deriving seasonals does not involve the determination of the trend in the first instance, viz. the method of link relatives. In this method the figure for each month is expressed as a percentage of that for the previous month. It is these "link relatives", which are utilised in deriving seasonals. This has certain obvious advantages. In the first place, there is only one link relative less than the original data, whereas in the case of deviations from the centered twelve-monthly moving average, six items are not available at each end. This is an important consideration especially in a short series. In the second place, it has been argued that month-to-month variations should give us a better idea with regard to the seasonal factors than deviations from the moving average. For so far as trend and cycle are concerned, the division of one month's figure by the next month's figure will moderate their influence to a considerable extent, throwing the seasonal element into high relief. The random items occur irregularly and their influence will be eliminated during the process of averaging of the series of figures for each individual month. The average in this case also has to be a "positional" or "modified" one. Similarly a final adjustment is called for. For it is found that when these link relatives are forged into a chain, that is to say when these 12 average link-relatives for January to December are multiplied together, their continued product is not unity. An adjustment has therefore to be made in order to achieve this, otherwise a trend element is surreptitiously introduced.

Objects of Finding out Seasonals

There are roughly two objects in deriving seasonals in economic data. In the first place we may wish to make the figures for several months comparable, so as to be in a position to estimate to what extent the observed increase or decrease for any one month is to be regarded as normal for that particular month of the year and to what extent that change is to be regarded as significant. In other words, our purpose is to find a convenient measure of the seasonal swing. In the second place, we may not require any such measure. Our object may be simply to eliminate the seasonal swings and handle only such adjusted data and not the original data.

Defects of Link Relative Method

If the above view is correct, it follows that we should regard seasonal factors as departures from normal values in either case. It is here that the greatest weakness of the link relative method lies. For the basis in this case is month-to-month variation and not the deviation from a moving average. In the second place, the argument that the proportional ratio between the figures for consecutive months gives us a good measure of seasonal swing is open to question. Mr. Allyn Young examined this point when he considered chain index numbers in relation to fixed base index numbers and preferred the latter*. In the third place, the calculation is laborious. In fourth place, it is found in many cases that this method yields results substantially similar to the other methods previously discussed. But these disadvantages have to be set off against the advantages previously mentioned. To sum up, this method is generally utilised when (*a*) the series is short, or (*b*) the figures for several months are subject to abnormal influences. An instance in point is Unemployment Statistics considered in *London and Cambridge Special Memorandum* No. 36, for they were subject to many "non-seasonal" influences such as trade disputes, legislative changes, and could not be manipulated by the moving average method.

Changing Seasonals

To revert to the objective of deriving seasonals once more, the two purposes require further examination. What do we mean by "normal" seasonal swing? Is it "normal" for that particular month for all years or is it "normal" for that particular month for that particular year? The discerning reader will notice that we are now entering upon the debatable ground of changing seasonals. That seasonal factors do change is admitted on all hands. It is equally true that such change need not necessarily be sudden. Thus there may be changes in India's foreign trade seasonals due to the separation of Burma or due to the increasing importance of groundnut in the export trade. The first change is abrupt

*Rietz, H. L. : *Hand book of Mathematical Statistics* (1924) p. 184

but the second is gradual. Thus in the latter case the division of a series into a number of components will not be successful. Etymologically as well as historically, there is an intimate connection between a "statesman" and a "statistician",—particularly an economic statistician. It is no wonder therefore that an economic statistician tries to follow the policy of divide and rule. But in politics as well as in statistics, this policy is not uniformly successful, especially for long periods.

CHANGE IN PATTERN

Seasonals may change only in their amplitudes or in their pattern itself. In the latter case, by definition, the change must necessarily be gradual. A commonsense procedure has been suggested in the *Special Memorandum* previously referred to. Thus we are asked to find out the seasonal factors, say, for the first eleven years and apply those factors to the data for the central or the sixth year. Next, we are to find the seasonal factors for the next eleven years, i.e. from the second to the twelfth year, and apply the results to the seventh year's data and so on. If our hypothesis about the gradual nature of the change is valid, we may project the eleven-yearly moving averages backwards and forwards and then find seasonals for the first five and last five years also.

CHANGE IN AMPLITUDE

In the short period, there may be no change in pattern. There may be change only in the respective amplitudes. The seasonal swings in a year of bountiful harvest are generally more pronounced than in a year of deficient rainfall. But the general character will not thereby be affected unless there has been irregularity in the onset and retreat of the monsoon or any other similar disturbing cause. The method suggested by Mr. Simon Kuznets in his *Seasonal Variations in Industry and Trade* (1933) is to compare the seasonals for January to December derived for a group of years with the corresponding monthly percentage deviations from the moving average, year by year, and find out the respective correlation coefficients. If such coefficients for the several years are high, there is a reasonable chance that the seasonal pattern has been successfully analysed*. On the other hand, in this view of the matter, we tacitly assume that the amplitudes for the several years are not the same. They must therefore be suitably adjusted.

LOGICAL DIFFICULTY

There is one serious difficulty, whose nature will be apparent from the following example. Suppose the seasonal factor for December is 80 and that for January 110. Suppose also that the correction factor for amplitude for the first year is 80 and that for the next is 130. Thus the adjusted seasonal factors for two consecutive months, December and January, are $80\times80\div100$ or 64 and $110\times130\div110$ or 143. If these measures are applied to the actual data for December and January, a serious discontinuity is at once introduced. This question has not escaped the attention of economic statisticians such as WALD and ZAYCOFF, as detailed in *Econometrica* Vol. 5, No. 3, July, 1937, by HORST MENDERHAUSEN, whose comments on the several methods are given below:

*The years for which the relative correlation coefficients are low are "abnormal years". It is generally seen that the figures for those years have to be left out in computing the "positional" or "modified" average.

"........it seems that the methods .... represent no real progress in the field of eliminating changing seasonal movements (p. 253). ZAYCOFF's working hypotheses seem somewhat more realistic than those of WALD, but the procedure remains mechanical, and causal factors are only mentioned by the way, so that the real meaning of the seasonal and causal component finally separated is rather obscure (p. 254)........".

Method Followed

From the above discussion the following broad conclusions may be drawn for application to Indian data :—

(1) for stable seasonals, the logarthmic moving average is the most appropriate method :

(2) unless the series is sufficiently long, gradually changing seasonals should not be computed ;

(3) the link relative method should be applied only in the last resort, when there are a large number of discontinuities in the series ;

(4) different amplitude ratios for different years should be computed only when there are logical reasons to do so.

Procedure for Computation of Stable Seasonals

In the *Special Memorandum* previously cited, the procedure for computation of logarthmic seasonals is made clear by an actual example. A simple algebraic proof of the method is given in Appendix 2. It will be seen that the method consists in finding out the arithmetic average of the deviations for a number of years from the twelve-monthly logarithmic moving average, and is therefore valid, (*a*) if the logarithmic trend is substantially linear and (*b*) the seasonals do not change during the period chosen for study.

Period Covered

In the *Accounts Relating to the Inland (Rail and River-borne) Trade of India* monthly data are available for inland trade figures relating to a number of commodities from 1933-34 onwards. They are all compiled on a uniform plan. The effect of the Depression had been nearly over by the end of 1932. The shadow of the European war was not definitely cast before the early months of 1939. Thus the period from April 1933 to March 1939 may be regarded as one of substantial stability. It is true that there was a mild boom about 1937 but this was followed by a recession. Thus the phases of the cycle were nearly completed and there is no *a priori* reason to suppose that there was any abrupt change either in the amplitude or in the pattern of the seasonal factor. The only difficulty is that we get data for only six years and we may not be quite certain that the random and cyclic elements have been entirely eliminated by the process of averaging when it extends to such a short period. It is for this reason that the results obtained were carefully examined in the light of the data themselves in each case. It was found that the seasonal factor finally computed was in substantial conformity with the pattern for each year, thus making it clear that the standard seasonal factor had in fact been determined.

STABLE SEASONALS FOR INLAND TRADE DATA

The following commodities were studied and the relative fixed seasonal factors were found out as detailed in Appendix III :—

(1) Cotton Piece Goods : Foreign, in bales
(2) Cotton Piece Goods : Indian, in bales
(3) Grain, Pulse and Flour : Rice, in the husk
(4) Grain, Pulse and Flour : Wheat
(5) Jute, raw : loose
(6) Jute raw : *pucca* bales*
(7) Oil Seeds : Groundnuts
(8) Oil Seeds : Linseed
(9) Salt
(10) Sugar
(11) Sugar : *Gur*, *Rab*, molasses, *Jaggery etc.*
(12) Tea

FINANCIAL DATA

So far as financial series were concerned, some of the most important had been studied by Messrs. Braja Mohan Chatterji and Gopal Chandra Ray, as stated in an earlier section of this paper. They utilised the link relative method, which should, as explained above, be used when the series is so discontinuous that the other methods are found to fail. The trends assumed by them were simple straight lines and not logarithmic straight lines. Their closing dates were December, 1934 in every case. For these and other reasons, it was thought advisable to study their first series, viz., notes in circulation once again on the same plan as for inland trade data, the results being shown in Appendix III(13). For facility of comparison the results previously obtained by Messrs. Chatterji and Ray are also quoted. The series studied is the same in either case, viz. currency notes in circulation in India and Burma. The only difficulty is that since April, 1935, the average of Friday figures is shown excluding the notes held with the Banking Department of the Reserve Bank of India. Thus the figures subsequent to April, 1935 are not comparable with those for the earlier period. This has no doubt affected the trend, but has not, it is believed seriously influenced the seasonal factor.

*Most of the raw jute bought and sold in the inland trade of India is in the form of *kutcha* or half-pressed bales, and not of *pucca* or full-pressed bales of 400 lbs net each. A reference was therefore made to the Director General of Commercial Intelligence and Statistics who in his letter No. 7065-Q dated the 2nd June, 1941, addressed to the Hony. Secretary, Indian Statistical Institute kindly replied as follows: "Certain reporting authorities actually record figures of *kutcha* bales or half-pressed jute under jute, raw: *pucca* bales, instead of under jute, raw: loose, in the returns furnished to this Department. Necessary instructions have already been issued to the registering authorities concerned to avoid such misclassification in future. I am thankful to you for bringing this matter to my notice."

SUMMARY OF RESULTS

The results arrived at in Appendix III are shown in a summary form in Table No. below :—

TABLE I. SUMMARY OF STABLE SEASONALS FROM 1933-34 TO 1938-39

Serial No. in App. III	Series	Peak		Trough		
		Months	Corresponding Seasonal Factors	Months	Corresponding Seasonal Factors	Range of Seasonal Factors
(1)	(2)	(3)	(4)	(5)	(6)	(7)=(4)-(6)
1	Cotton piece goods : *foreign in bales*	Oct	140·02	Feb.	84·88	55·14
		April	120·39	June	78·76	41·63
2	Cotton piece goods : Indian in bales	Oct.	133·01	Feb.	92·21	41·40
		April	105·25	June	76·46	28·79
3	Grain, pulse and flour : rice in the husk	March	133·13	July	60·20	73·93
		Aug.	135·27	Nov.	69·96	65·31
4	Grain, pulse and flour : wheat	May	201·02	Feb.	60·35	141·57
5	Jute, raw, loose	Nov.	235·02	July	27·45	207·57
6	Jute, raw, *pucca* bales	Oct.	190·14	July	40·59	149·65
7	Oil seeds : groundnuts	Jan.	319·55	Sept.	41·44	278·11
8	Oilseeds : linseed	May	223·35	Nov.	31·94	191·41
9	Salt	May	138·81	Aug.	63·06	75·75
10	Sugar	March	140·61	July	79·75	60·86
		Sept.	91·02	Nov	71·95	19·07
11	Sugar : *Gur Rab*, molasses, *Jaggery* etc.	Jan	193·88	Aug.	38·63	155·25
12	Tea	Oct.	170·31	March	27·66	142·65
13	Notes in Circulation	March	103·62	Aug.	95·46	8·16

If we leave out notes in circulation and confine ourselves to inland trade data only it will appear from the above table that the three greatest ranges of seasonal fluctuation are recorded respectively by groundnuts (No. 7), loose jute (No. 6) and linseed (No. 8); that the three lowest respectively by Indian Cotton piece goods (No. 2), foreign cotton piece goods (No. 1) and sugar (No. 10), thus revealing the great difference in agricultural and manufacturing industries. It is curious that the seasonal range for rice in the husk is not very high, being nearly equal to that for salt, for which there is naturally more orderly marketing. The reason for this paradox probably lies in the fact that paddy is generally stored by cultivators immediately after harvest, partly to be cleaned week by week for consumption at home, and partly for sale from month to month at a fairly steady rate in order to meet the cash expenses of the cultivators such as payment of debt and interest charges and purchases of necessaries like salt, kerosene oil etc. The rice mills in their turn also buy at a steady rate to meet the uniform consumption needs. They do not think it necessary to hold any considerable stock as the jute mills. The special factors operating in the case of the different series are noted below.

COTTON PIECE GOODS: FOREIGN AND INDIAN IN BALES

It will be seen from Appendix III (1) and (2) that the seasonal index begins to rise markedly from September onwards, reaching a maximum about October, a definite decline setting in by January. A second peak period is noticeable about March/April, this latter increase being worked off by June. The causes of these two peaks are however not the same. The former is due to the customary Pujah sales, whereas the latter is due to the closing of the financial year and to any possible change in the rate of duty which may be prescribed in the budget with effect from the beginning of the financial year.

GRAIN, PULSE AND FLOUR: RICE IN THE HUSK

The relative seasonal factors are to be found in Appendix III(3). Trade becomes brisk immediately after the harvest of the winter rice from January onwards. A second spurt is recorded in August/September due to the Autumn rice coming into the market.

GRAIN, PULSE AND FLOUR: WHEAT

It is well known that wheat is a *rabi* crop which is harvested during March to May. Accordingly the seasonal factor records a peak in May, as shown in Appendix III (4).

JUTE, RAW: LOOSE AND PUCCA BALES

Jute is harvested in August/September and the seasonal peak is attained in October November. Even the earliest crop is not available before August. Thus July records the least trade.

OILSEEDS: GROUNDNUTS

This crop is harvested about November and naturally the trade records the seasonal rise from December onwards. Unlike rice and wheat, it is a "money" crop, which accounts for the very considerable seasonal range.

OILSEEDS: LINSEED

Linseed is also a *rabi* crop and the seasonal pattern is therefore substantially similar to that for wheat. Only as it is a non-food crop, its seasonal fluctuation is somewhat more pronounced.

SALT

Of the total trade in this commodity, about one-sixth is in foreign and five-sixths in indigenous salt. A small proportion of the home production is derived from mines, chiefly from the Salt Range of the Punjab. The remainder is obtained either from direct evaporation of sea-water or from sub-soil and lake brine. It is therefore clear that although salt is a manufactured commodity, its production and trade must be influenced by the season. The peak month is May, the hottest month of the year before the setting in of the south-west monsoon. The small drop in February is probably due to the winter monsoon giving rain to the Coromandel coast, which is one of the most important areas of production.

SUGAR : MANUFACTURED

It is well known that the Indian sugar season extends from November to October, but the manufacturing season comes to a close by May. This is clearly borne out by the seasonal factors given in Appendix III (10).

SUGAR *Rab*: *Gur*, , MOLASSES, *Juggery* ETC.

Here the seasonal factor begins to rise from December onwards, which is quite in keeping with the conventional season, viz. from January to December. The considerable seasonal swing is the result of lack of orderly marketing.

TEA

The production of tea in Northern India begins from May, the auction sales in Calcutta starting from June. There is no such definite plucking or manufacturing season for tea in Southern India but its output is comparatively small and therefore does not affect the seasonal pattern. This is borne out by the seasonal indices detailed in Appendix III (12).

ARRIVAL OF RAW JUTE INTO CALCUTTA

We have so long been considering stable seasonals. But this method cannot be applied in the case of the data for the arrival of raw jute into Calcutta, a long series for which is available in the *Annual Reports* of the Indian Jute Mills Association. In the first place, the financial year April to March used in connection with inland trade and financial data discussed so far is clearly inappropriate in this case ; the agricultural year July to June should obviously be used. In the second place, the period from 1919-29 onwards was affected in turn by a number of factors, e.g. (*a*) change in world demand ; (*b*) unstable exchange rate ; (*c*) economic depression ; (*d*) restriction in cultivation ; (*e*) regulation of the output of jute manufactures ; (*f*) measures for increasing the power of the cultivator to hold the crop, and so on. As a matter of fact, we get somewhat discordant results even for recent years, when some of these disturbing factors were not at work. For instance, in the *Report on the Marketing and Transport of Jute in India* 1940, p. 155, the peak month for the arrival of jute in Calcutta is shown to be October, and the busy season as extending from September to December. The method adopted there is to compare the arrivals during the several months as percentages of the total arrivals during the agricultural years (July to June) from 1934-35 to 1938-39. This procedure makes allowance for the trend, for all the monthly figures from July to June during any agricultural year are expressed as percentages of the same annual figure. But no adjustment is made for cyclic and irregular factor. Besides, there is an inherent assumption that the figures for any season remain steady from July to June and then move *per saltum* during the next season. In any case, if we consider the inland trade data for raw jute both loose and in the form of *pucca* bales, we arrive at the fixed seasonals from 1933-34 to 1938-39 as given in Appendix III (5) and (6). It will be seen that the peak month for loose jute is November and that for jute in *pucca* bales is October. If, however, we turn our attention to earlier years, the results become still more confusing. It was therefore found necessary to break the whole series up into two components, the first period of fairly high prices from 1919-20 to 1925-26 and the second of generally low prices from 1926-27 to 1936-37. So far as the first period is concerned, the seasonal index was found to be fairly steady throughout, as shown in Appendix IV (1). This was however found not to be the case during the second period, the data and the seasonals for which are given in Appendix IV (2). A further examination was therefore necessary. It was found that the correlation coefficient between the standard seasonals obtained for the entire period and the monthly deviations from the moving average year by year (column 14), Appendix IV, Part II, was pretty high, ranging from 72, in 1931-32, the year of the depeest depression, to 1.00 in 1928-29, the year just before the outbreak of the economic crisis. The ordinary tests of significance are no doubt invalid in a case like the present one, for the items in question are not random in accordance with the theory of probability. But it is nevertheless true that the high correlation coefficients obtained point to substantial conformity with the standard seasonal pattern. It follows therefore, that the change in seasonals, which must be presumed from the above factors was not in the pattern, but in the amplitude of the seasonal factor. Thus this was a fit case for computing variable amplitude ratios; Kuznet's method of variable seasonals is clearly applicable here. As the method is not very well known, it is explained symbolically in Appendix V. The results obtained are given in page 63 in Table No. 2 below.

Variable Seasonals for Raw Jute Arrival

It will be seen that during the second period of generally low prices viz. from 1926-27 to 1936-37 the seasonals were on an average more subdued than in the first period of usually high prices viz. for 1919-20 to 1926-26, the corresponding ranges between peak and trough being 145.8 and 198.64 respectively. Even if we consider separately the variable seasonals for individual years, we find that the range between the peak and trough was always below 108.64 except during 1926-27, when it was 207.04. At the same time there is considerable variation in the ranges during different years, the lowest range being recorded in 1932-33.

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APPENDIX I

Dates of Commencement of Monsoon in Bengal

1917	1st. Week of June	1929	5th June
1918	27th May	1930	1st. June
1919	6th June	1931	21st June
1920	End of 2nd week of June	1932	8th June
1921	26th May	1933	22nd May
1922	Last week of May	1934	End of 2nd week of June
1923	2nd week of June	1935	1st week of June
1924	2nd week of June	1936	27th May
1925	Last week of May	1937	25th May
1926	Last week of May	1938	Last week of May
1927	1st week of June	1939	Temporary advance 5th June ; final onset middle of second week of June
1928	2nd week of May	1940	4th June.

TABLE 2.—SEASONAL FACTOR FOR ARRIVAL OF RAW JUTE INTO CALCUTTA

Year	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Peak Month	Trough Month	Range
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
1919-20 to 1925-26	42·36	113·06	193·41	230·76	178·23	124·42	87·31	01·21	56·00	43·13	37·09	32·12	Oct.	June	198·64
1926-27 to 1936-37	46·5	93·6	155·7	192·3	168·9	118·2	106·5	81·4	72·7	58·4	59·7	56·1	"	July	145·8
1926-27	24·03	90·91	179·09	231·07	183·04	125·84	109·23	73·59	61·23	40·03	42·77	37·06	"	"	207·04
1927-28	47·03	03·06	155·14	191·38	158·31	118·02	106·44	81·59	72·07	58·82	60·91	56·54	"	"	144·35
1928-29	29·38	91·55	173·52	221·84	177·75	124·02	108·58	75·45	63·96	45·09	46·80	42·05	"	"	192·46
1929-30	40·61	92·00	161·83	202·45	165·38	120·20	107·22	70·35	69·70	53·82	55·27	51·27	"	"	161·84
1930-31	47·03	03·66	155·14	191·38	158·31	118·02	106·44	81·41	72·07	58·82	60·91	56·54	"	"	144·35
1931-32	43·82	93·28	158·49	196·92	161·85	110·11	106·83	80·47	71·33	56·32	57·08	53·00	"	"	153·10
1932-33	60·94	95·33	140·66	167·38	143·00	113·29	104·75	86·42	80·97	69·03	70·58	67·95	"	"	106·44
1933-34	50·78	94·11	151·24	184·92	154·19	116·74	105·98	82·89	74·88	61·73	62·92	59·61	"	"	134·14
1934-35	53·00	94·50	147·00	179·38	150·65	115·65	105·59	84·00	76·52	64·22	65·34	62·25	"	"	125·48
1935-36	58·80	95·07	143·89	171·07	145·35	114·01	105·01	85·68	78·98	67·07	68·97	66·20	"	"	112·27
1936-37	37·40	92·57	165·17	207·99	168·91	121·29	107·61	73·24	63·06	51·33	52·85	48·64	"	"	170·59

APPENDIX I

Date of Commencement of Moonson in Malabar Coast and Bombay

Year	Malabar Coast		Bombay	
	May	June	May	June
(1)	(2)	(3)	(4)	(5)
1888	—	1	—	5
1889	30	—	—	5¾**
1890	27	—	—	1
1891	—	2	—	20
1892	22	—	—	5
1893	22½	—	27	—
1894	—	3½	—	6
1895	—	11	—	11
1896	—	4	—	2†
1897	—	4	—	6
1898	—	2	—	8
1899	24½	3rd Permanent	—	9
1900	—	8½*	—	23
1901	—	3½	—	6
1902	—	4½	—	10
1903	—	9½	—	12
1904	31	—	—	7
1905	—	7	—	25
1906	—	3	—	11½
1907	31	—	—	15
1908	—	9	—	12
1909	—	1	—	3(8)
1910	—	1	—	4
1911	—	4	—	5
1912	—	6	—	15
1913	29(?)	2(?)	—	8
1914	—	3	—	13
1915	—	13	—	17
1916	20	—	—	1
1917	29	—	—	4
1918	10	—	24	—
1919	27	—	—	6
1920	—	2	—	7
1921	—	1½	—	9
1922	30½	—	—	1
1923	—	10½	—	12
1924	31	1	—	12
1925	28	—	28	—
1926	—	4	—	10
1927	27-28	—	—	14
1928	—	2	—	9
1929	29 or 31	—	—	2
1930	—	8	—	11
1931	—	4	—	13

* *i.e.* the appearance of the monsoon was spread from May 31st to June 1.

** *i.e.* the appearance of the monsoon was nearer to June 6 than to June 5.

† Reappeared on the 14th.

APPENDIX II

Logarithmic Seasonal Index

Year	Months											
	Jan. I	Feb. II	Mar. III	April IV	May V	June VI	July VII	Aug. VIII	Sep. IX	Oct. X	Nov. XI	Dec. XII
1	$\underline{A_{I,1}}$	$\underline{A_{II,1}}$	$\underline{A_{III,1}}$	$\underline{A_{IV,1}}$	$\underline{A_{V,1}}$	$\underline{A_{VI,1}}$	$A_{VII,1}$	$A_{VIII,1}$	$A_{IX,1}$	$A_{X,1}$	$A_{XI,1}$	$A_{XII,1}$
2	$A_{I,2}$	$A_{II,2}$	$A_{III,2}$	$A_{IV,2}$	$A_{V,2}$	$A_{VI,2}$	$A_{VII,2}$	$A_{VIII,2}$	$A_{IX,2}$	$A_{X,2}$	$A_{XI,2}$	$A_{XII,2}$
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
r	$A_{I,r}$	$A_{II,r}$	$A_{III,r}$	$A_{IV,r}$	$A_{V,r}$	$A_{VI,r}$	$A_{VII,r}$	$A_{VIII,r}$	$A_{IX,r}$	$A_{X,r}$	$A_{XI,r}$	$A_{XII,r}$
:	:	:	:	:	:	:	:	..	:	..	..	..
n	$A_{I,n}$	$A_{II,n}$	$A_{III,n}$	$A_{IV,n}$	$A_{V,n}$	$A_{VI,n}$	$\underline{A_{VII,n}}$	$\underline{A_{VIII,n}}$	$\underline{A_{IX,n}}$	$\underline{A_{X,n}}$	$\underline{A_{XI,n}}$	$\underline{A_{XII,n}}$
Total	S_I	S_{II}	S_{III}	S_{IV}	S_V	S_{VI}	S_{VII}	S_{VIII}	S_{IX}	S_X	S_{XI}	S_{XII}

Let $A_{I,m}$ be log. of figure for January of the m^{th} year, characteristic being omitted.

$A_{II,m}$ be log. of figure for February of the m^{th} year and so on.

The whole scheme is completed as shown above. The first six and the last six items are underlined. Omitting these items, $S_I \ldots . S_{XII}$ are obtained by adding $(n-1)$ figures for January, February, March etc. to December.

Let $S_I+S_{II}+S_{III}+ \ldots . +S_{XII}=Z$

The trend value for $(I, 2)=\frac{1}{2}[\frac{1}{12}(A_{VII,1}+A_{VIII,1}+\ldots A_{VI,2})+\frac{1}{12}[A_{VIII,1}+A_{IX,1}+\ldots A_{VII,2})]$

$$=\frac{1}{12}[\frac{1}{2}[2(A_{VII,1}+A_{VIII,1}+\ldots .+A_{VI,2})+(A_{VII,2}-A_{VII,1})]$$

$$=\frac{1}{12}[\frac{1}{2}(A_{VII,2}-A_{VII,1})+(A_{VII,1}+A_{VIII,1}+\ldots .A_{VI,2})]$$

Thus the deviation of $A_{I,2}$ from the trend value

$$=A_{I,2}-\frac{1}{12}[\frac{1}{2}(A_{VII,2}-A_{VII,1})+(A_{VII,1}+A_{VIII,1}+\ldots .+A_{VI,2})]$$

Similarly the deviation of $A_{I,3}$ from the trend value

$$=A_{I,3}-\frac{1}{12}[\frac{1}{2}(A_{VII,3}-A_{VII,2})+(A_{VII,2}+A_{VIII,2}+\ldots .A_{VI,3})]$$

Similarly the deviation of $A_{I,r}$ from the trend value

$$=A_{I,r}-\frac{1}{12}[\frac{1}{2}(A_{VII,r}-A_{VII,r-1})+(A_{VII,r-1}+A_{VIII,r-1}+\ldots .A_{VI,r})]$$

Similarly the deviation of $A_{I,n}$ from the trend value

$$=A_{I,n}-\frac{1}{12}[\frac{1}{2}(A_{VII,n}-A_{VII,n-1})+(A_{VII,n-1}+A_{VIII,n-1}+A_{VI,n})]$$

∴ The sum of the deviations of $(A_{I,2} \ldots\ldots A_{I,n})$ from their respective trend values

$$=S_I-\tfrac{1}{12}[\tfrac{1}{2}(A_{VII,n}-A_{VII,1})+Z]$$

Again the trend value of $(II, 2)=\tfrac{1}{2}[\tfrac{1}{12}(A_{VIII,1}+A_{IX,1}+\ldots\ldots+A_{VII,2})$
$+\tfrac{1}{12}(A_{IX,1}+A_{X,1}+\ldots\ldots+A_{VIII,2})$

∴ The sum of the deviations of $(A_{II,2}\ldots\ldots A_{II,n})$

$$=S_{II}-\tfrac{1}{12}\{\tfrac{1}{2}(A_{VIII,n}-A_{VIII,1})+Z+(A_{VII,n}-A_{VII,1})\}$$

Similarly the sum of the deviations of $(A_{III,2}\ldots\ldots A_{III,n})$

$$=S_{III}-\tfrac{1}{12}\{\tfrac{1}{2}(A_{IX,n}-A_{IX,1})+Z+(A_{VII,n}-A_{VII,1})+(A_{VIII,n}-A_{VIII,1})\}$$

Similarly the sum of the deviations of $(A_{IV,2}\ldots\ldots A_{IV,n})$

$$=S_{IV}-\tfrac{1}{12}\{\tfrac{1}{2}(A_{X,n}-A_{X,1})+Z+(A_{VII,n}-A_{VII,1})+(A_{VIII,n}-A_{VIII,1})+(A_{IX,n}-A_{IX,1})\}$$

$$=S_{IV}-\tfrac{1}{12}\{\tfrac{1}{2}(A_{X,n}-A_{X,1})+Z+(A_{VII,n}+A_{VIII,n}+A_{IX,n})-(A_{VII,1}+A_{VIII,1}+A_{IX,1})\}$$

Similarly the sum of the deviations of $(A_{V,2}\ldots\ldots A_{V,n})$

$$=S_V-\tfrac{1}{12}\{\tfrac{1}{2}(A_{XI,n}-A_{XI,1})+Z+(A_{VII,n}+\ldots\ldots+A_{X,n})-(A_{VII,1}+\ldots\ldots+A_{X,1})\}$$

Similarly the sum of the deviations of $(A_{VI,2}\ldots\ldots A_{VI,n})$

$$=S_{VI}-\tfrac{1}{12}\{\tfrac{1}{2}(A_{XII,n}-A_{XII,1})+Z+(A_{VII,n}+\ldots\ldots A_{XI,n})-(A_{VII,1}+\ldots\ldots A_{XI,1})\}$$

Similarly the sum of the deviations of $(A_{VII,1}\ldots\ldots A_{VII,n-1})$

$$=S_{VII}-\tfrac{1}{12}\{\tfrac{1}{2}(A_{I,n}-A_{I,1})+Z+(A_{I,1}+\ldots\ldots A_{VI,1})-(A_{I,n}+\ldots\ldots A_{VI,n})\}$$

Similarly the sum of the deviations of $(A_{VIII,1}\ldots\ldots A_{VIII,n-1})$

$$=S_{VIII}-\tfrac{1}{12}\{\tfrac{1}{2}(A_{II,n}-A_{II,1})+Z+(A_{II,1}+\ldots\ldots A_{VI,1})-(A_{II,n}+\ldots\ldots A_{VI,n})\}$$

Similarly the sum of the deviations of $(A_{IX,1}\ldots\ldots A_{IX,n-1})$

$$=S_{IX}-\tfrac{1}{12}\{\tfrac{1}{2}(A_{III,n}-A_{III,1})+Z+(A_{III,1}+\ldots\ldots A_{VI,1})-(A_{III,n}+\ldots\ldots A_{VI,n})\}$$

Similarly the sum of the deviations of $(A_{X,1}\ldots\ldots A_{X,n-1})$

$$=S_X-\tfrac{1}{12}\{\tfrac{1}{2}(A_{IV,n}-A_{IV,1})+Z+(A_{IV,1}+\ldots\ldots A_{IV,n-1})-(A_{IV,n}+\ldots\ldots A_{VI,n})\}$$

Similarly the sum of the deviations of $(A_{XI,1}\ldots\ldots A_{XI,n-1})$

$$=S_{XI}-\tfrac{1}{12}\{\tfrac{1}{2}(A_{V,n}-A_{V,1})+Z+(A_{V,1}+A_{VI,1})-(A_{V,n}+A_{VI,n})\}$$

Similarly the sum of the deviations of $(A_{XII,1}\ldots\ldots A_{XII,n-1})$

$$=S_{XII}-\tfrac{1}{12}\{\tfrac{1}{2}(A_{VI,n}-A_{VI,1})+Z+(A_{VI,1}-A_{VI,n})\}$$

$$=S_{XII}-\tfrac{1}{12}\{\tfrac{1}{2}(A_{VI,1}-A_{VI,n})+Z\}$$

APPENDIX III

(a) STABLE SEASONAL FACTORS FOR INLAND TRADE DATA

1. COTTON PIECE-GOODS FOREIGN, IN BALES (IN THOUSAND MAUNDS)

Year	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1933-34	101·50	116·90	101·10	70·99	88·12	111·90	83·56	70·95	75·14	52·72	57·53	64·49
1934-35	68·08	80·85	51·81	49·08	50·29	54·67	93·24	69·78	64·36	64·84	60·57	66·53
1935-36	86·50	85·91	50·66	58·33	54·36	75·39	101·80	74·45	63·18	67·19	68·67	77·47
1936-37	82·17	59·12	47·33	45·30	40·97	51·95	74·58	80·25	49·18	44·35	33·66	34·52
1937-38	51·30	39·05	33·32	41·44	31·04	47·32	68·86	57·10	35·76	34·10	31·30	39·86
1938-39	51·68	44·95	36·24	36·51	43·96	47·88	61·83	56·11	41·27	42·11	34·07	42·12
Seasonal factor for the period	*120·39*	*107·57*	*78·76*	*81·08*	*80·50*	*102·22*	*100·02*	*119·01*	*96·25*	*89·48*	*84·88*	*96·84*

2. COTTON PIECE GOODS—INDIAN, IN BALES (IN THOUSAND MAUNDS)

Year	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1933-34	560·60	642·20	587·00	542·60	552·10	703·20	703·30	752·50	717·30	695·40	604·51	682·20
1934-35	669·60	806·30	500·70	525·50	568·90	725·20	944·40	851·30	846·60	764·90	611·20	583·50
1935-36	759·80	706·70	524·70	558·70	556·80	850·30	992·70	789·40	679·80	685·30	694·40	684·60
1936-37	765·20	659·10	553·70	560·30	519·10	780·60	1104·00	963·00	892·90	873·20	696·30	772·70
1937-38	910·00	794·30	658·30	680·70	605·40	1038·00	1140·00	907·80	792·10	800·99	725·59	795·10
1938-39	853·92	832·13	502·30	589·68	674·06	1048·88	1024·58	974·19	788·44	886·29	810·27	783·80
Seasonal factor for the period	*105·25*	*102·35*	*76·46*	*76·81*	*78·28*	*115·59*	*133·61*	*116·72*	*105·32*	*102·91*	*92·21*	*93·96*

3. GRAIN, PULSE AND FLOUR—RICE IN THE HUSK (IN THOUSAND MAUNDS)

Year	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1933-34	560·70	534·60	330·20	240·40	240·50	347·60	414·50	309·80	437·90	503·20	667·10	667·20
1934-35	508·10	576·50	403·40	305·90	262·70	363·70	555·50	507·00	643·80	908·80	900·20	802·00
1935-36	831·50	825·30	770·60	822·30	727·30	087·00	663·10	713·00	780·00	1148·00	846·00	1078·00
1936-37	943·30	944·10	733·60	450·80	350·80	322·80	406·80	300·00	379·90	614·10	679·70	982·40
1937-38	712·60	545·60	419·80	250·40	222·90	365·00	370·90	317·40	359·50	500·81	078·13	755·73
1938-39	643·57	585·27	581·71	327·80	391·42	498·02	531·55	375·14	719·85	740·34	777·52	1214·00
Seasonal factors for the period	*110·06*	*101·77*	*85·51*	*60·20*	*1 5·27*	*112·31*	*75·43*	*69·56*	*78·72*	*11.·81*	*118·77*	*133·13*

4. GRAIN, PULSE AND FLOUR—WHEAT (IN THOUSAND MAUNDS)

Year	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1933-34	1726·00	3308·00	2596·00	1798·00	843·70	922·00	1015·00	1484·00	1487·00	1471·00	1447·00	1603·00
1934-35	1455·00	3270·00	3708·00	2677·00	1987·00	1180·00	1060·00	1035·00	1259·00	1502·00	1105·00	1039·00
1935-36	1444·00	3703·00	3702·00	2001·00	1018·00	1334·00	1827·00	1075·00	1152·00	1511·00	1326·00	1409·00
1936-37	2040·00	3657·00	3052·00	2503·00	2779·00	2263·00	3004·00	1731·00	2690·00	1592·00	677·40	1853·00
1937-38	2806·00	6562·00	5637·00	3811·00	1550·00	1497·00	1420·00	1970·00	1823·00	2071·39	1787·60	1760·52
1938-39	1857·64	5609·35	5553·73	4231·04	1751·67	1532·76	1413·51	1248·17	1464·25	1172·16	900·20	1155·00
Seasonal facotrs for the period	*84·61*	*201·9*	*193·63*	*134·85*	*87·73*	*70·91*	*74·90*	*67·52*	*73·29*	*76·39*	*60·35*	*69·53*

5. JUTE, RAW—LOOSE (IN THOUSAND MAUNDS)

Year	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1933-34	138·00	61·41	19·51	16·85	61·14	70·35	180·70	200·00	114·00	94·43	56·56	43·93
1934-35	52·45	33·35	30·23	49·17	60·43	127·10	218·60	252·00	170·30	70·80	48·39	38·40
1935-36	34·14	38·54	38·20	21·61	19·87	159·00	226·00	230·40	128·10	79·67	39·66	69·78
1936-37	48·04	46·23	26·70	15·62	127·60	158·20	201·50	205·50	148·70	109·30	60·26	109·00
1937-38	105·60	32·28	8·56	13·59	65·73	112·10	222·00	188·60	134·00	103·19	96·91	95·86
1938-39	58·52	44·95	48·07	52·49	68·28	89·69	176·51	170·24	141·16	129·49	116·58	40·13
Seasonal factor for the period.	*58·92*	*40·89*	*27·99*	*27·45*	*66·45*	*131·61*	*227·10*	*235·02*	*150·83*	*97·31*	*66·38*	*69·71*

6. JUTE, RAW—PUCCA BALES (IN THOUSAND MAUNDS)

Year	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1933-34	1440·00	2583·00	1090·00	1080·00	2262·00	4558·00	5376·00	3805·09	2242·00	2026·00	1382·00	1318·00
1934-35	1495·00	751·80	1145·00	761·20	2273·00	3059·00	3105·09	2630·00	2103·00	3175·00	2059·00	1351·00
1935-36	1715·00	2261·00	2266·00	883·00	1603·00	3387·00	4357·00	3258·00	2338·00	2838·00	1198·00	1844·00
1936-37	1416·00	1558·00	1578·00	970·10	3190·00	5269·00	5757·00	4777·00	3858·00	3856·00	2504·00	2136·00
1937-38	2208·00	1499·00	670·10	791·60	2714·00	3918·00	5216·00	4025·00	2473·00	2306·11	2160·18	2721·37
1938-39	1621·79	1155·55	1700·86	1777·63	3130·13	3705·73	5011·68	3303·08	2039·09	3092·30	2218·01	1507·00
Seasonal factor for the period	*68·95*	*55·79*	*56·09*	*40·59*	*102·75*	*155·99*	*190·14*	*153·66*	*107·91*	*120·39*	*73·82*	*73·89*

7. Oil Seeds—Ground Nuts (in thousand maunds)

Year	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1933-34	1189·00	2230·00	1060·00	1272·00	604·70	897·00	613·60	1303·00	1670·00	1749·00	1927·00	1915·00
1934-35	1661·00	2596·00	1111·00	1142·00	1273·00	793·00	743·70	490·70	934·80	1196·00	627·60	226·50
1935-36	544·30	805·40	634·10	235·10	466·90	583·50	590·00	929·10	1640·00	2058·00	907·70	100·30
1936-37	1108·00	604·30	631·70	934·60	712·00	353·30	1020·00	1871·00	3574·00	3579·00	1130·00	1040·00
1937-38	867·20	219·20	170·40	208·50	232·00	211·30	331·70	1110·00	2283·00	2473·65	1894·43	2083·38
1938-39	1330·43	1727·09	1311·22	1610·98	714·44	702·96	968·76	2323·85	3948·98	3053·26	2307·36	2150·00
Seasonal factor for the period	*91·21*	*71·45*	*55·31*	*55·53*	*50·21*	*41·11*	*54·80*	*93·21*	*163·17*	*319·55*	*105·43*	*92·36*

8. Oilseeds—Linseed (in thousand maunds)

Year	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1933-34	1032·00	1600·00	1038·00	1705·00	843·70	1028·00	338·20	426·80	404·00	278·60	412·20	822·30
1934-35	980·00	1577·00	1037·00	312·70	601·40	570·80	234·50	109·50	220·00	262·30	257·80	430·20
1935-36	801·50	931·00	541·40	232·40	292·30	717·10	920·70	317·70	510·10	780·30	647·00	1048·00
1936-37	1309·00	1201·00	528·50	885·70	924·00	583·10	100·00	131·30	105·10	179·00	157·70	700·30
1937-38	975·00	1120·00	710·80	980·40	507·80	630·20	442·20	153·70	109·50	356·44	570·92	1114·28
1938-39	1028·09	1872·04	705·21	567·29	353·43	1050·83	157·81	121·02	354·40	340·13	590·65	1297·00
Seasonal factor for the period	*137·41*	*223·35*	*120·53*	*81·81*	*56·11*	*129·06*	*51·74*	*31·91*	*44·14*	*53·27*	*60·23*	*130·35*

9 SALT—(IN THOUSAND MAUNDS)

Year	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1933-34	3289·00	3041·00	2839·00	1490·00	1495·00	1798·00	2145·00	2411·00	2258·00	2168·00	3559·00	2714·00
1934-35	3141·00	3180·00	2374·00	1733·00	1462·00	2180·00	1925·00	2290·00	2404·00	2568·00	2700·00	2081·00
1935-36	2118·00	3990·00	2624·00	1885·00	1544·00	1829·00	2829·00	2411·00	2212·00	2487·00	1672·00	2698·00
1936-37	3591·00	3372·00	2787·00	2089·00	1658·00	1765·00	2311·00	2317·00	2928·00	2520·00	2110·00	2554·00
1937-38	3330·00	3370·00	2730·00	2066·00	1573·00	2019·00	2271·00	2480·00	2010·00	2837·00	1957·00	2988·48
1938-39	3303·24	3141·57	2360·41	2248·89	1481·62	2455·38	2460·10	2705·37	2998·74	2501·59	2243·08	2231·00
Seasonal factor for the period	*25·44*	*135·51*	*105·38*	*81·40*	*63·06*	*83·66*	*91·84*	*99·12*	*102·87*	*102·61*	*95·84*	*106·93*

10. SUGAR—(IN THOUSAND MAUNDS)

Year	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1933-34	1523·00	1432·00	1130·00	927·10	988·90	1114·00	1088·00	1079·00	1364·00	1487·00	2328·00	2679·00
1934-35	1428·00	1202·00	928·00	768·40	1034·00	1170·00	1139·00	873·30	1772·00	2254·00	1843·00	1870·00
1935-36	1080·00	1465·00	1304·00	955·30	910·50	1258·00	1201·00	875·20	1643·00	2362·00	1933·00	2418·00
1936-37	2023·00	1739·00	1515·00	1422·00	1690·00	1033·00	1754·00	1668·00	1964·00	2931·00	3758·00	2887·00
1937-38	2610·00	2110·00	1913·00	1656·00	1560·00	1688·00	1834·00	1710·00	1521·00	2043·54	20·8107	2415·27
1938-39	2383·20	2700·07	2352·04	1775·04	1801·13	2633·26	1972·56	1204·03	1443·57	1898·52	2511·55	1546·00
Seasonal factor for the period.	*113·10*	*102·81*	*86·45*	*70·75*	*78·06*	*91·02*	*83·67*	*71·95*	*98·22*	*128·12*	*135·24*	*110·61*

11. Sugar—*Gur*, *Rab*, molasses, *jaggery* etc. (in thousand maunds)

Year	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	March
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1933-34	1200·00	785·20	509·60	354·00	407·80	397·20	412·90	845·70	1612·00	1876·00	2100·00	1483·00
1934-35	985·50	728·40	473·50	396·70	439·30	316·80	405·40	996·80	1505·00	2081·00	1768·00	1752·00
1935-36	1270·00	754·70	511·20	424·40	387·00	363·10	422·00	805·90	1652·02	2301·00	2227·00	2109·00
1936-37	1299·00	877·40	783·00	768·30	691·80	505·00	558·10	938·00	1610·00	2805·00	2138·00	2426·00
1937-38	1851·00	1321·00	909·80	738·00	730·90	604·00	664·00	1067·00	2095·00	2085·78	2077·85	2120·00
1938-39	1202·14	1127·32	811·82	818·57	739·70	546·15	616·57	1131·21	1894·73	1825·46	1354·54	1458·00
Seasonal factor for the period	*111·98*	*79·71*	*58·13*	*50·92*	*49·22*	*38·63*	*43·83*	*77·16*	*149·74*	*193·88*	*178·89*	*168·36*

12. Tea—(in thousand maunds)

Year	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1933-34	75·10	157·40	303·30	429·80	501·90	535·00	535·30	478·40	344·10	232·20	148·10	97·57
1934-35	90·12	150·70	301·10	432·00	593·30	549·90	565·60	494·70	354·00	218·90	122·90	85·79
1935-36	92·87	161·70	303·60	460·20	538·80	534·90	500·80	474·80	335·70	210·00	129·90	93·48
1936-37	110·20	178·30	376·70	530·60	674·30	680·90	691·00	540·40	339·00	214·80	119·80	91·47
1937-38	132·40	158·40	348·70	553·70	653·40	701·80	708·50	629·80	431·10	207·30	123·30	127·36
1938-39	138·31	212·58	458·03	591·80	752·05	754·87	688·90	611·80	401·15	248·62	137·15	131·50
Seasonal factor for the period	*31·18*	*47·22*	*96·32*	*140·45*	*169·76*	*169·21*	*170·1*	*118·63*	*102·01*	*61·07*	*36·13*	*27·66*

(b) Stable Seasonal Factors for Financial Data

13. Notes in Circulation (in crores of Rupees).

Year	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1933-34	177·00	176·00	177·00	179·00	180·00	180·00	180·00	180·00	178·00	178·00	177·00	177·00
1934-35	177·00	179·00	181·00	184·00	185·00	185·00	186·00	186·00	184·00	184·00	183·00	186·00
1935-36	168·00	167·00	165·00	159·00	157·00	157·00	161·00	161·00	167·00	169·00	169·00	170·00
1936-37	172·00	169·00	166·00	163·00	163·00	165·00	170·00	175·00	184·00	193·00	196·00	195·00
1937-38	195·00	193·00	190·00	184·00	180·00	181·00	183·00	183·00	184·00	185·00	187·00	189·00
1938-39	186·00	184·00	179·00	175·00	173·00	175·00	178·00	179·00	184·00	190·00	193·00	192·00
Seasonal factor for the period	*101·63*	*100·65*	*99·02*	*96·60*	*95·46*	*96·89*	*99·15*	*99·61*	*101·16*	*102·78*	*103·43*	*103·62*
Do for 1924 to 1934 by Link Relative Method	*98·11*	*97·53*	*98·16*	*100·27*	*100·98*	*101·71*	*101·72*	*100·84*	*100·26*	*99·95*	*100·37*	*100·10*

Appendix IV Part I

Arrival of Raw Jute into Calcutta (1919-20 to 1925-26) (in ten thousand maunds)

Year	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1919-20	227	439	550	522	450	376	356	291	301	261	262	335
1920-21	265	379	531	622	564	376	281	169	166	162	159	107
1921-22	177	297	470	616	422	242	247	201	203	218	253	228
1922-23	149	271	540	579	417	300	162	135	88	62	65	90
1923-24	106	403	674	786	670	512	377	240	212	150	98	66
1924-25	82	454	767	863	649	468	343	188	191	110	60	30
1925-26	125	401	851	1059	703	460	220	140	108	70	72	48
Seasonal factor for the period	*42·36*	*113·96*	*183·41*	*23·76*	*178·23*	*121·42*	*87·31*	*61·21*	*56·00*	*43·13*	*37·09*	*32·12*

Appendix IV

Arrival of Raw Jute into Calcutta (1926-27 to 1936-37) in ten thousands maunds

Year	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Correlation Coefficient between the seasonal factors for the entire period and the adjusted monthly deviations from the trend year by year.	Amplitude ratio = gradient of the linear equation between the seasonal factors and the monthly deviations
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1926-27	179	376	720	885	854	738	691	476	416	307	227	175	·93	1·42
1927-28	183	454	666	745	740	640	499	384	281	287	296	248	·95	·99
1928-29	172	473	817	932	606	554	369	367	246	182	198	157	·90	1·32
1929-30	182	543	764	820	569	484	418	307	275	221	220	185	·98	1·11
1930-31	157	438	702	775	639	470	319	331	306	265	257	253	·98	·99
1931-32	152	216	373	557	530	283	238	172	221	115	133	150	·72	1·05
1932-33	138	303	403	588	515	380	333	203	313	219	335	323	·84	·73
1933-34	186	276	543	691	571	369	432	200	260	250	194	214	·95	·92
1934-35	203	370	616	673	500	433	547	335	233	226	254	204	·96	·80
1935-36	224	237	389	645	551	387	357	249	255	213	213	214	·85	·77
1936-37	171	350	661	871	707	535	501	351	332	294	253	119	·96	1·17
Seasonal factor for the period	*46·5*	*93·6*	*155·7*	*193·3*	*158·9*	*118·2*	*106·5*	*81·4*	*72·7*	*58·4*	*59·7*	*56·1*		

* See appendix V for the meaning of these terms.

APPENDIX V

Method of Computation of Variable Seasonals

Let $y_{I,1}, y_{II,1}, y_{III,1} \dots y_{XII,1}$ respectively be the deviations for the first to the twelfth month from the corresponding trend values during the first year; let $y_{I,2}, y_{II,2}, y_{III,2} \dots y_{XII,2}$ be those during the second year; and so on.

Let $y'_{I,1}, y'_{II,1}, y'_{III,1} \dots y_{XII,1}$ etc. be the corresponding 'adjusted' values such that

$$y'_{I,1}=\frac{y_{I,1}\times 1200}{(y_{I,1}+y_{II,1}+\dots y_{XII,1})},\quad y'_{II,1}=\frac{y_{II,1}\times 1200}{(y_{I,1}+y_{II,1}+\dots y_{XII,1})}$$

and so on.

$$\therefore\ y'_{I,1}+y'_{II,1}+\dots y'_{XII,1}=1200$$

Let $\eta_{I,1}=100-y'_{I,1}$; $\eta_{II,1}=100-y'_{II,1}$; $\eta_{III,1}=100-y'_{III,1}$ and so on

$$\therefore\ \eta_{I,1}+\eta_{II,1}+\dots \eta_{XII,1}=0;$$

Similarly for the r^{th} year $\eta_{I,r}+\eta_{II,r}+\dots \eta_{XII,r}=0$

Month	Deviation of seasonal factors from 100	Corresponding values obtained for deviation from trend values	Products Col. (2) × Col. (3)	Squares (Col. 2)^2	Deviation of Variable Seasonal from 100 $p_r/\sigma^2\times$ Col. (2)	Variable Seasonal factors 100−Col. (6)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
First	ξ_I	$\eta_{I,r}$	$\xi_I\times\eta_{I,r}$	ξ^2_I	$p_r/\sigma^2\times\xi_I$	$100-p_r/\sigma^2\ \xi_I$
Second	ξ_{II}	$\eta_{II,r}$	$\xi_{II}\times\eta_{II,r}$	ξ^2_{II}	$p_r/\sigma^2\times\xi_{II}$	$100-p_r/\sigma^2\ \xi_{II}$
Third	ξ_{III}	$\eta_{III,r}$	$\xi_{III}\times\eta_{III,r}$	ξ^2_{III}	$p_r/\sigma^2\times\xi_{III}$	$100-p_r/\sigma^2\ \xi_{III}$
Fourth	ξ_{IV}	$\eta_{IV,r}$	$\xi_{IV}\times\eta_{IV,r}$	ξ^2_{IV}	$p_r/\sigma^2\times\xi_{IV}$	$100-p_r/\sigma^2\ \xi_{IV}$
Fifth	ξ_V	$\eta_{V,r}$	$\xi_V\times\eta_{V,r}$	ξ^2_V	$p_r/\sigma^2\times\xi_V$	$100-p_r/\sigma^2\ \xi_V$
Sixth	ξ_{VI}	$\eta_{VI,r}$	$\xi_{VI}\times\eta_{VI,r}$	ξ^2_{VI}	$p_r/\sigma^2\times\xi_{VI}$	$100-p_r/\sigma^2\ \xi_{VI}$
Seventh	ξ_{VII}	$\eta_{VII,r}$	$\xi_{VII}\times\eta_{VII,r}$	ξ^2_{VII}	$p_r/\sigma^2\times\xi_{VII}$	$100-p_r/\sigma^2\ \xi_{VII}$
Eighth	ξ_{VIII}	$\eta_{VIII,r}$	$\xi_{VIII}\times\eta_{VIII,r}$	ξ^2_{VIII}	$p_r/\sigma^2\times\xi_{VIII}$	$100-p_r/\sigma^2\ \xi_{VIII}$
Ninth	ξ_{IX}	$\eta_{IX,r}$	$\xi_{IX}\times\eta_{XI,r}$	ξ^2_{IX}	$p_r/\sigma^2\times\xi_{IX}$	$100-p_r/\sigma^2\ \xi_{IX}$
Tenth	ξ_X	$\eta_{X,r}$	$\xi_X\times\eta_{X,r}$	ξ^2_X	$p_r/\sigma^2\times\xi_X$	$100-p_r/\sigma^2\ \xi_X$
Eleventh	ξ_{XI}	$\eta_{XI,r}$	$\xi_{XI}\times\eta_{XI,r}$	ξ^2_{XI}	$p_r/\sigma^2\times\xi_{XI}$	$100-p_r/\sigma^2\ \xi_{XI}$
Twelvth	ξ_{XII}	$\eta_{XII,r}$	$\xi_{XII}\times\eta_{XII,r}$	ξ^2_{XII}	$p_r/\sigma^2\times\xi_{XII}$	$100-p_r/\sigma^2\ \xi_{XII}$
Total	0	0	p_r	σ^2	0	1200

Where $x_{I}, x_{II}, x_{III} \ldots . x_{XII}$ are the seasonal factors for the first to the twelfth month for the period of study, so that $x_{I}+x_{II}+\ldots . x_{XII}=1200$. Let $\xi_{I}=100-x_{I}$, $\xi_{II}=100-x_{II}$ and so on. $\therefore \xi_{I}+\xi_{II}+\ldots \xi_{XII}=0$.

Let σ be the standard deviation of $\xi_{I}, \xi_{II} \ldots . \xi_{XII}$; thus $\xi^2_{I}+\xi^2_{II}+\ldots . \xi^2_{XII}=\sigma^2$

Let $\xi_{I} \times \eta_{I, r}+\xi_{II} \times \eta_{II, r}+\ldots . \xi_{XII} \times \eta_{XII, r}=p_r$; then the deviations of the variable seasonal factors from 100 are given by $\frac{p_r}{\sigma^2} \times \xi_{I}, \frac{p_r}{\sigma^2} \times \xi_{II}, \ldots . \frac{p_r}{\sigma^2} \times \xi_{XII}$

For the rth year, the procedure for calculation of the correlation coefficient, (column (14), appendix IV part 2), of the amplitude ratio (column (15), appendix IV, part 2) and of variable Seasonals (table no. 2 in the text) is shown below in the preceding page.

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