SEASONAL VARIATIONS IN WHOLESALE AND RETAIL TRADE

Many of the Federal Reserve Board's indexes of production and trade are presented in the FEDERAL RESERVE BULLETIN in two forms, as "adjusted for seasonal variations" and "without seasonal adjustment." [1] The "unadjusted" indexes reflect the net composite effect upon industry and trade of seasonal variations, changes in general business conditions, long-time growth, and temporary accidental changes such as those occasioned by strikes. In the "adjusted" index the influence of regular seasonal variations is eliminated. The present article deals in some detail with the simple mathematical processes by which adjustments have been effected for eliminating the particular effects of seasonal influences upon the volume of wholesale and retail sales. In any such account descriptive of mathematical processes it is difficult to avoid a somewhat fictitious implication of perfect regularity of incidence and variation in seasonal changes and a further implication of complete adequacy of data for measuring these effects. No such implications are here intended. The adjusted index for sales is presented as being only an approximation in which the margin of error is too small to invalidate the index as a measure of nonseasonal fluctuations and trends in the volume of trade.

Seasonal variations may be described as those fluctuations in the volume of industry—whether agriculture, manufacture, trade, or transportation—which recur regularly at annual intervals, with a periodicity determined by climatic or other seasonal influences or by social conventions. The custom of purchasing new spring wardrobes at Easter time, for instance, regularly occasions during the weeks immediately preceding greater activity in the manufacture and sale of clothing year after year. In the months of February and March the factory output of fabrics, of shoes, and of millinery increases and sales of wholesale clothing firms also are greater. Somewhat later—in March and April, according to the date of Easter—sales of department and apparel stores, mail-order houses, and 5-and-10-cent stores increase in volume. Summer brings some recession in almost all lines of business, followed by an expansion of production and trade in the autumn, and by a great increase of retail sales in December, particularly at Christmas time.

A wide seasonal swing exists when the business of the year is concentrated within a few months and other months are very dull in contrast. Lines of industry differ materially in the magnitude of their characteristic seasonal fluctuation. Production and wholesale sales of men's and women's clothing, for example, are commonly described as "highly seasonal," while wholesale sales of such products as meats, groceries, drugs, and hardware are found to be more evenly distributed throughout the year.

Recognition of these seasonal variations has impelled those who interpret the current state of business activity by the use of figures for actual sales, or of index numbers based upon those figures, to take into account the customary seasonal change. But such interpretations made without reference to some mathematical measure of the share of the year's business usually done in the given month are at best of uncertain and unverifiable value. In interpreting the unadjusted index number of 184 for department-store sales in December, 1926, to take a specific instance, it is necessary to know not simply that sales in December are usually above the average for the year, but that sales in this month usually exceed the average by approximately a given percentage. An index number from which the regular seasonal peaks have been eliminated reveals the direction and measures the extent of nonseasonal monthly changes and of long-time trends. In constructing the Federal Reserve Board's new indexes of wholesale and retail trade such a mathematicl measurement in the form of a percentage is substituted for an informal allowance made for months considered "slack" or "busy," and is used as a near approximation to a typical quota of business done in each month in the year. These monthly quotas are used as divisors of current volume index numbers for appropriate months, and the resulting index numbers are "adjusted for seasonal variations."

Original data.—The original data from which current volume index numbers and their seasonal-adjustment quotas were prepared appear in the FEDERAL RESERVE BULLETIN for December, 1927, February, 1928, and April, 1928. For the purpose of deriving mathematical measures of seasonal variations these data are in two respects somewhat deficient: (1) The period for which they are available is relatively short, and (2) the dollar values upon which they are based are subject to wide price fluctuations. For lines of wholesale distribution

[1] Descriptions of these index numbers are to be found in the following issues of the FEDERAL RESERVE BULLETIN: Industrial production, February, 1927, pp. 100-103, and March, 1927, pp. 170-177; building contracts, freight-car loadings, and revised index of automobile production, August, 1927, pp. 562-563; wholesale distribution, December, 1927, pp. 817-828; department-store sales and stocks, February, 1928, pp. 114-124; revised indexes of chain-store and mail-order house sales, this issue.

and retail trade data were generally available for about nine years, from 1919 to June, 1927. Sales in three of the nine lines represented by the index of wholesale distribution—meats, furniture, and drugs—had been reported to the Federal reserve banks for a somewhat shorter period—about six or seven years. Computations from the dollar volume of sales at wholesale were complicated by the rise in wholesale prices throughout 1919 and the spring of 1920 and their fall from May of 1920 to 1921. Because of the highly accidental character of changes from month to month during this period, data for these early years were given little weight in determining seasonal adjustment factors.

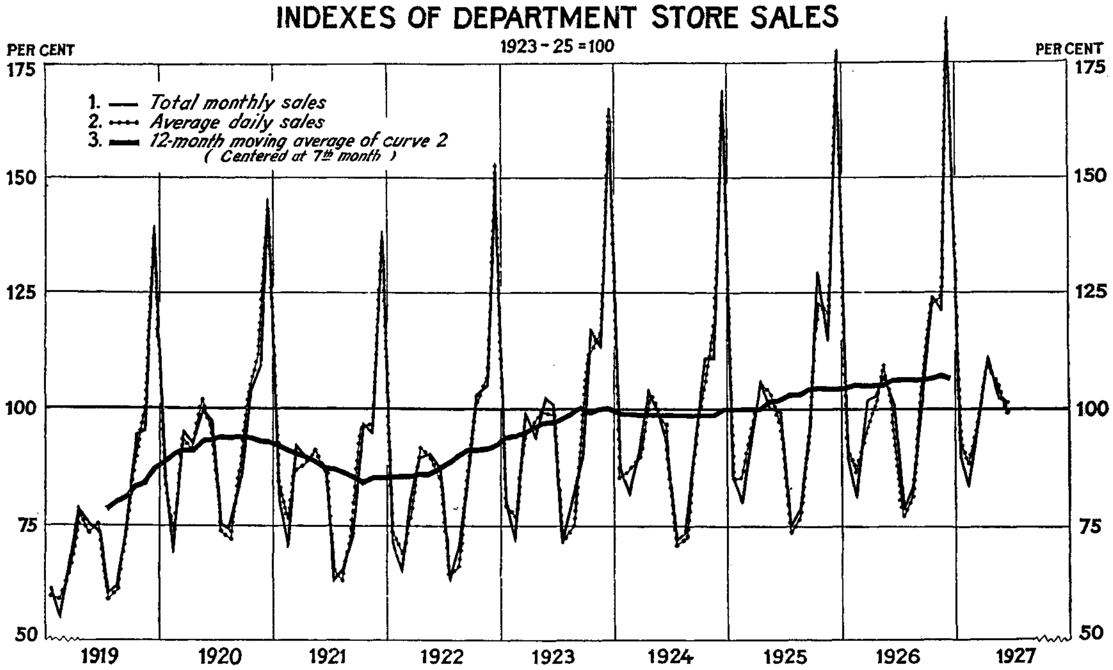
Method of deriving adjustment factors.—Various statistical devices are employed in deriving measures of seasonal variations, each device furnishing a mere *approximation*, which must be revised occasionally to take account of gradual changes, evidently in progress in many lines of trade, which affect their seasonal variations.

The device adopted by the Federal Reserve Board for use in computing its revised indexes is the ratio to moving average.[2] Details of its application to index numbers of wholesale distribution, department-store sales and stocks, chain-store and mail-order house sales are described below and illustrated by the computations for department-store sales for the United States.

"Average daily" and "monthly total" figures.—A distinctive feature of the new "adjusted" indexes of department and chain store and mail-order-house sales is that they are based on average daily sales, instead of total sales during the calendar month, and are, therefore, not influenced by differences in the number of days in the month or by the occurrence of Sundays or holidays. An unadjusted index of monthly sales reflects a lower volume of business for February than is justified by the actual state of trade, largely because February is two or three days shorter than the other months.

A survey made by the Federal Reserve Board to determine the days on which department stores are ordinarily closed indicated that Sundays and the six national holidays—January 1, May 30, July 4, Labor Day, Thanksgiving Day, and December 25—should be deducted from the total number of days in the month. The observance of other holidays was not sufficiently uniform throughout the United States to make it practicable to take them into account. The adjustment effected

CHART I



[2] See FEDERAL RESERVE BULLETIN for December, 1922, p. 1416, and March, 1927, p. 172, for descriptions of the use of this device in computing indexes of industrial production.

by dividing monthly total sales by the number of business days is shown by a comparison of the indexes of monthly sales and average daily sales. (Chart I, curves 1 and 2.)

In the indexes of wholesale distribution no adjustment was made for number of selling days, since variation in the number of business days in different months has a less pronounced effect on the volume of sales than in the case of retail trade. Seasonal adjustments for wholesale trade are therefore computed directly from the unadjusted index, as are also, for obvious reasons, adjustments for department-store stocks, for which end-of-month figures only are reported.

The ratio to moving average.—(1) In estimating the proportion of yearly sales which is customarily made in each month, the simplest method is to obtain an average of sales in each month in the years from 1919 to 1927 and to compute the percentage which each average formed of the average for the 12. Inaccuracy would result from such a procedure because, for example, the upward trend in department-store sales subsequent to 1922 (see Chart I) would result in a higher average for each of the late months of the year—December, for instance—than would be warranted by the true seasonal movement. It has therefore been necessary to construct a curve roughly describing this year-to-year growth and other important nonseasonal factors, such as the effect of short-time fluctuations in the industry, in order to obtain a more correct average measure for each month. The device used is a 12-month moving average placed opposite the seventh month of its set of 12. The method of computation is shown in Table 1. The index figures of average daily sales of department stores for the 12 months of 1926, for example, were added and averaged and the average placed opposite July; the next average, for the 12 months from February, 1926, through January, 1927, was placed opposite August of 1926, and thus the average moved on throughout the series. Accurate values for the six months at either end of the series were, of necessity, lacking, but approximate figures were estimated.

Table 1.—Method of Seasonal Adjustment of Department-Store Sales

Year and month	1 Index of average daily sales (1923–25=100)[1]	2 12-month moving total centered at seventh month	3 12-month moving average centered at seventh month	4 Ratio of index of average daily sales to moving average [(1÷3)100]
1926				
January	91.0	1,251.0	104.3	87.2
February	86.7	1,254.0	104.5	82.9
March	96.2	1,258.8	104.9	91.7
April	101.6	1,265.6	105.5	96.3
May	109.4	1,264.9	105.4	103.8
June	99.3	1,267.6	105.6	94.0
July	76.9	1,273.3	106.1	72.5
August	81.4	1,273.5	106.1	76.7
September	103.6	1,275.0	106.3	97.5
October	121.8	1,273.4	106.1	114.8
November	124.1	1,281.2	106.8	116.2
December	181.3	1,276.5	106.4	170.4

[1] The figures for July through December, 1925, and January through June, 1927, which were necessary to compute the moving totals and averages are as follows: 1925—July, 73.9; August, 76.6; September, 96.8; October, 122.5; November, 121.4; and December, 175.6. 1927—January, 91.2; February, 88.2; March, 94.6; April, 109.4; May, 104.7; and June, 99.8.

The resulting curve (Chart I, curve 3) is a relatively smooth one, which reflects the more important nonseasonal fluctuations in department-store sales—the depression of 1921 and the first half of 1922 and the gradual rise which took place in the succeeding four years.

(2) The influence of the nonseasonal fluctuations measured in this manner was then eliminated by dividing each monthly figure in the index of average daily sales by the moving average placed opposite it (and multiplying by 100 to remove decimals). (See Table 1, column 4.) The ratios derived by this procedure reflect all the seasonal fluctuations, but none of the nonseasonal elements measured by the moving average. These ratios are arranged by months, chronologically, in Table 2.

Table 2.—Seasonal Adjustment Factors—Department-Stores Sales

Years	Ratios of index of average daily sales to moving average, monthly[1]											
	January	February	March	April	May	June	July	August	September	October	November	December
1919							76.1	76.4	**94.2**	106.9	120.4	158.0
1920	93.2	**82.1**	102.9	**99.2**	110.3	101.8	78.3	77.0	92.8	109.4	119.2	154.9
1921	90.3	**83.6**	**96.9**	98.3	**102.3**	**97.9**	74.7	73.1	87.6	113.3	114.3	160.8
1922	**86.6**	81.4	90.2	106.5	**103.1**	**97.8**	**72.9**	**74.1**	**95.3**	**111.5**	**117.0**	166.2
1923	84.1	81.6	98.6	**100.5**	**103.4**	101.8	**73.7**	**75.9**	95.5	**111.6**	116.1	**165.6**
1924	**85.5**	87.6	90.0	**103.5**	100.0	**97.7**	71.9	73.3	96.6	106.1	119.2	**165.8**
1925	84.8	85.5	**93.4**	104.4	100.9	95.4	71.8	74.0	93.4	118.0	**117.3**	168.7
1926	**87.2**	**82.9**	**91.7**	96.3	103.8	94.0	72.5	76.7	97.5	114.8	116.2	170.4
Total 2 or 3 middle items	259.3	248.6	282.0	303.2	308.8	293.4	146.6	150.0	189.5	223.1	234.3	331.4
Average 2 or 3 middle items	86.4	82.9	94.0	101.1	102.9	97.8	73.3	75.0	94.8	111.6	117.2	165.7
Final seasonal adjustment factors	86	83	93	101	102	97	74	76	95	111	117	165

[1] Middle ratios are in bold-face type.

(3) The ratios were next arranged in monthly groups in order of size, without regard to chronology. The clustering of the ratios within a narrow range of values in each monthly group (Chart II) indicates that sales in each month approximate the same proportion, year after year, of the annual total.

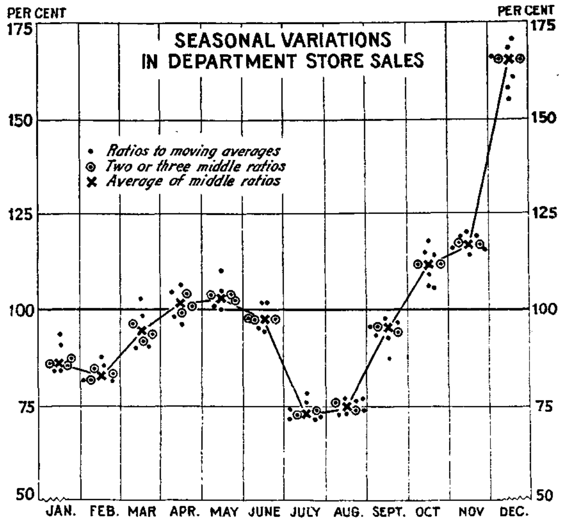
(4) An average figure was obtained for each month by computing averages of the two or three middle items of these arrays. (See Table 2.) The number of items composing the average varied according to whether ratios were available for an odd or an even number of years. This average is believed to be a more accurate one for obtaining a typical figure than either a median, which in so small an array of items is likely to be erratic, or a simple arithmetic average, in which large items have an undue influence. In the month of May, for example, a ratio of 110.3 in 1920, when retail prices were at their peak, and a low ratio of 100 during the period of business recession in 1924 were not included in the average. The middle items in each series are shown in bold-face type in Table 2 and indicated on Chart II by dots surrounded by circles. The averages are shown on the chart by cross marks (x).

(5) The 12 average ratios were then rounded off to whole numbers and adjusted to total 1,200 in order that each monthly measure might express the proportionate volume of sales in that month to 100 as the average for the year. (See Table 2.) This adjustment to 1,200 was based in part on the evident tendency of a particular month to increase or decrease in relation to the other months in recent years, or, in other words, to some extent the known change in seasons was taken into account.

(6) After the averages of the middle items for each of the 12 months had been adjusted to total 1,200, the resultant figures were inspected to determine whether they measured the typical seasonal movement or gave evidence of accidental variations of a nonseasonal character. To test their accuracy a provisional index adjusted for seasonal variations by dividing each monthly relative by the appropriate provisional seasonal factor was constructed. Occasionally the "adjusted" figures so derived showed an increase or decrease between certain consecutive months in nearly every year, indicating a fixed error. When this occurred the seasonal factor in question was raised or lowered by one or two points to correct the error, which usually arose from accidents in selection of the two or three middle items in the original small array.

(7) After a satisfactory set of seasonal adjustment factors had been derived, an index finally adjusted for seasonal variations was obtained by dividing each monthly relative in the index of average daily sales (Table 1, column 1) by the ratio figures representing seasonal variation for the given month. Thus the relative of average daily sales of department stores for January, 1927, 91.2, was divided by

CHART II[1]



[1] Figures are given in Table 2.

86, the seasonal adjustment factor for January (and multiplied by 100 to remove decimals), to obtain an adjusted relative of 106 per cent, and so on for each month of the year.

For most lines of trade this method gave fair measures of seasonal variations, and adjusted the indexes satisfactorily.[3] It was necessary to modify this basic formula in the case of department stores and 5-and-10-cent chain stores and mail-order houses because of Easter fluctuations, and in the case of wholesale sales of men's and women's clothing because of changes in seasonal fluctuations.

Adjustment for Easter fluctuations in retail sales.—After the adjustments just described were made, sharp peaks in March and April remained in the provisionally adjusted curve of department-store sales, these peaks representing the seasonal increase in sales because of Easter purchases. The fact that Easter, which is second only to Christmas in increasing

[3] Seasonal adjustment factors for the various indexes are given in the articles referred to in footnote 1.

the volume of retail trade, may occur as early as March 22 or as late as April 25 makes adjustment by means of a single set of 12 adjustment factors unsatisfactory. When Easter comes in March, retail sales are much greater in that month than they would otherwise be, and if it comes later than the middle of April, April sales are large and those of March proportionately small.

For the sake of accurate comparisons of sales in the spring months, a sliding scale of adjustment factors, varying with the date of Easter, was devised for removing the seasonal influence of Easter from the sales figures. Five different sets of these seasonal factors were derived for the months of March and April and used with constant seasonal adjustment factors for the other 10 months given in Table 2, so that the total was always 1,200. The Easter adjustment factors for department-store sales for the United States are shown in the following table. The figures in parentheses indicate the sliding scale of differences between the adjustment factors used for March and April when Easter falls in the respective periods shown and the average adjustment factors for those two months—i. e., those which are used when Easter comes in the middle period, April 5 to April 8.

TABLE 3.—EASTER SEASONAL ADJUSTMENT FACTORS FOR DEPARTMENT-STORE SALES

Date of Easter	Adjustment factors	
	March	April
Before Mar. 31	96 (average+3)	98 (average−3).
Apr. 1–Apr. 4	95 (average+2)	99 (average−2).
Apr. 5–Apr. 8 (average)	93 (average)	101 (average).
Apr. 9–Apr. 14	91 (average−2)	103 (average+2).
After Apr. 15	90 (average−3)	104 (average+3).

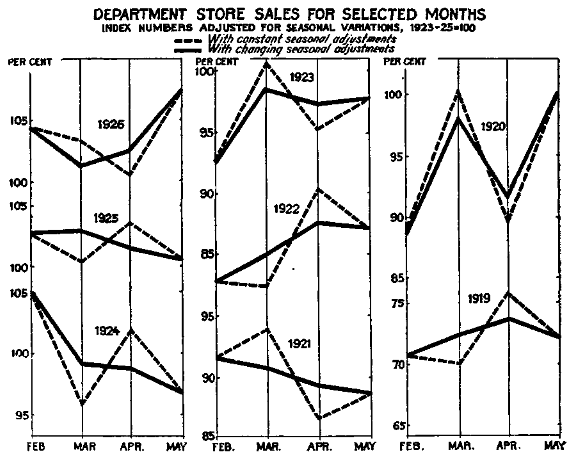
This scale of adjustment factors was derived in the following manner:

(1) One set of 12 monthly seasonal adjustment factors was obtained by the ratio to moving average method described above. The preliminary adjusted curve resulting from the application of these 12 adjustment factors to the index of average daily sales contained, as has been noted, a March or April peak in every year, directly attributable to Easter sales and varying in intensity according to the date of Easter. This is shown on Chart III by the broken-line curves representing the index adjusted by means of constant seasonal factors.

(2) The provisionally adjusted curve was then studied and the differences between the relatives for March and April in each year were calculated and arranged in order according to the date of Easter. For example, in 1924, when Easter was on April 20, the preliminary adjusted relative of department-store sales for March was approximately 96 and for April 102, a difference of 8 points.

(3) From a study of these differences, the amount by which the average adjustment factors (see paragraph (6) above) must be raised or lowered to smooth the provisionally adjusted curve was determined. Within the period under review, for example, Easter has occurred after the 15th of April in four years—1919, 1922, 1924, and 1927. To adjust this group

CHART III



of March and April relatives it was necessary to lower the average March adjustment factor (93) to 90 and raise the average April factor (101) by the same amount to 104. In a similar experimental fashion adjustment factors for the other periods shown in Table 3 were derived.

The length of the periods chosen and changes in the sliding scale are not uniform, since they have been determined with reference to the actual distribution of sales between the two months as affected by the incidence of Easter in different years. For example, if Easter falls in March, all of the Easter trading will presumably be in that month; hence all dates in March are grouped in one period; if in the first four days of April, most of the Easter sales will be in March, and therefore April 1 to April 4 was considered as one period; if between April 5 and April 8, selected as the average period, there are sufficient days in April before

Easter to permit some Easter trading in that month. If Easter is later than April 8, a considerably larger portion of the sales is made in April, but the variation of the date by a few days causes a much smaller relative variation in sales than earlier in the month; therefore, the period is made longer, extending to April 14. If Easter comes at any time after April 14, the exact date has practically no significance in respect to the distribution of sales between March and April. Therefore, one set of factors was applied to this period.

(4) Finally, the relatives of average daily sales for March and April were divided by appropriate adjustment factors to obtain the adjusted index.

The dates of Easter for the years 1919–1930 and the scale of differences to be applied to the average adjustment factors (those used for the period April 5–April 8 and shown for March and April in Table 2) in order to adjust for Easter variations are shown in Table 4, and the newly adjusted indexes are shown by the heavy lines on Chart III.

TABLE 4

Year	Date of Easter	Difference from average adjustment factor	
		March	April
1919	Apr. 20	−3	+3
1920	Apr. 4	+2	−2
1921	Mar. 27	+3	−3
1922	Apr. 16	−3	+3
1923	Apr. 1	+2	−2
1924	Apr. 20	−3	+3
1925	Apr. 12	−2	+2
1926	Apr. 4	+2	−2
1927	Apr. 17	−3	+3
1928	Apr. 8	Average.	Average.
1929	Mar. 31	+3	−3
1930	Apr. 20	−3	+3

This sliding scale of adjustment factors is reasonably effective in the elimination of Easter variations in the indexes of department-store sales and 5-and-10-cent-chain store and mail-order-house sales for the years 1919–1927, but a wider scale of differences from the average is necessary in the case of sales of shoes and other wearing apparel by chain stores, owing to the fact that Easter purchases are of greater importance in shops whose specialty is clothing.[4]

Changing seasonal variations in wholesale sales of men's and women's clothing.—In most lines of production and trade there is evidence that the seasos nare shifting, and the distribution of business among the 12 months of the year is changing. As the Christmas trade has grown, for example, the proportion of annual department-store sales made in December has increased year after year. (See Table 2.) In this instance, as in most lines of wholesale and retail trade, the changes have been of such small magnitude from 1919 to 1927 that one fairly typical set of 12 seasonal factors could be derived. In wholesale sales in the clothing trade, however, the changes were so marked during the period that it was necessary to derive changing seasonal adjustment factors, by an adaptation of the ratio to moving average method.

The first two steps in the procedure described above—computation of a 12-month moving average and of ratios of the original index to the corresponding moving average were identical. These ratios were than tabulated and charted in chronological order, in monthly groups, in the manner shown in Table 2. Instead of obtaining one typical figure for each month for all years, a complete set of 12 factors was derived for each year in the following manner:

(*a*) A three-year-period moving average of the ratios was computed and tabulated opposite the central year.

(*b*) The curves obtained by the use of this moving average were then smoothed, free-hand, and projected for the first and last years of each monthly group, and the resulting figures were read off the chart. Each yearly group was adjusted to total 1,200 in the manner described above. Thus the set of 12 adjustment factors was obtained for each year.[5] These computations are extended annually in order to obtain seasonal factors for the current year.

(*c*) Adjusted indexes of sales of men's and women's clothing were computed by dividing each unadjusted relative of monthly sales by the seasonal adjustment factor for that particular month.[6]

The resulting adjusted indexes of men's and women's clothing appeared to be much more satisfactory than any obtained by other methods. The fact that the period used was so short and that the years of violent price changes (1919–1921) were necessarily given little weight may somewhat invalidate the results, which are accordingly subject to revision as more data accumulate. There can

[4] These seasonal adjustment factors are available at the Division of Research and Statistics and may be obtained upon request.

[5] See FEDERAL RESERVE BULLETIN, December, 1927, p. 828.

[6] Adjustments for changing seasonal variations have been made for several series in the index of industrial production. A detailed description of the method used, together with illustrations, may be obtained from the Division of Research and Statistics.

be little doubt, however, that seasonal variations have changed for the firms reporting sales of men's and women's clothing and that the business of these firms is more unevenly distributed throughout the year now than formerly. Sales in the late winter and early spring buying season, as well as that in late summer and early fall, have been increased, and the early summer months, when trade is usually dull, have had an ever smaller proportion of yearly sales. Owing to the fact that these clothing firms are all located in the New York Federal reserve district, generalizations for the clothing trade as a whole can not be drawn from them.

CHANGES IN MEMBERSHIP IN THE FEDERAL RESERVE SYSTEM

Between October 10 and December 31, 1927, there was a further decline of 53 in the number of member banks in active operation in the Federal reserve system, as indicated by the number of banks submitting the required reports of condition on the two dates. The decline in membership represented decreases of 39 in the number of national banks and of 14 in the number of member State banks, and was the result largely of mergers between member banks, suspensions, and insolvencies, and the absorption of member banks by existing nonmember banks. Changes in membership during the last quarter of the year are summarized in the following table:

CHANGES IN MEMBERSHIP IN THE FEDERAL RESERVE SYSTEM, OCTOBER 11, 1927, TO DECEMBER 31, 1927

Class of change	Number of banks
Active member banks, Oct. 11, 1927	9,087
Banks joining the system	26
Banks withdrawing from the system	[1] 35
Net decrease from banks joining and withdrawing	9
Decrease in membership through mergers between member banks, suspensions, and voluntary liquidations	44
Net decrease for the period	53
Active member banks, Dec. 31, 1927	9,034

[1] Includes 21 withdrawals which were incidental to the absorption of member banks by existing nonmember banks.

On December 31, 1927, there were 7,759 member national banks and 1,275 member State banks in active operation, making a total of 9,034 member banks in the system. This represents a decline during the year of 147 in the number of member national banks and of 79 in the number of member State banks. That the total decline of 226 in the number of member banks in operation was the result chiefly of mergers between member banks and of suspensions is shown in the following table:

CHANGES IN MEMBERSHIP IN THE FEDERAL RESERVE SYSTEM, JANUARY 1, 1927, TO DECEMBER 31, 1927

Class of change	Number of banks
Active member banks, Jan. 1, 1927	9,260
Banks joining the system	154
Banks withdrawing from the system	[1] 101
Net increase from banks joining and withdrawing	53
Decrease in membership through mergers between member banks, suspensions, and voluntary liquidations	279
Net decrease for the year	226
Active member banks, Dec. 31, 1927	9,034

[1] Includes 55 withdrawals which were incidental to the absorption of member banks by existing nonmember banks.

During the year 154 banks joined the system and 101 banks withdrew, with the net result that there was a net voluntary accession of 53 member banks to membership in the system. Of the banks that joined, 83 were newly organized national banks (including one bank organized to succeed a member bank that had previously suspended) and 61 were State banks that entered the system, 32 becoming national banks and 29 being admitted with the status of State institutions. Ten banks, which had previously suspended, resumed operations again. Of the member banks that withdrew from the system, 24 were State banks that withdrew after advance notice to the Federal Reserve Board, two were banks that were dropped from membership in the system at the expiration of their State charters, 20 were banks succeeded by nonmember banks organized for the purpose, 55 were absorbed by existing nonmember banks; the latter, losses to membership through the