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Volume Author/Editor: Julius Shiskin

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Chapter Author: Julius Shiskin

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ing the estimated annual total over the months according to the pattern shown by the seasonal factors. The seasonal factors will be of further value in making shorter-term forecasts, that is, forecasts of month-to-month changes. The original estimates based upon the distribution of the annual forecast can be revised each month by applying the normal seasonal change to the most recent month's experience. Measures of the average magnitude of the irregular fluctuations and the pattern of their variations would provide valuable supplementary information. Knowledge of the average month-to-month movements of both the seasonal and the irregular factors can be used to reduce overordering, overproduction, and overstocking.

## II. TYPES OF ECONOMIC FLUCTUATIONS

For many years economists and statisticians have found it useful to consider each economic time series as a composite of cyclical, trend, seasonal, and irregular factors. The cycle consists of short-run cumulative and reversible movements characterized by alternating periods of expansion and contraction and lasting three to four years, on the average, from trough to trough, though the range may extend from two to ten years. The trend makes up the still longer-run movements of the series and ordinarily has little effect upon month-to-month movements of economic series; for convenience in short-term forecasting it is often combined with the cyclical factor.<sup>1</sup> The seasonal factor consists of intra-year movements and follows a more or less regular pattern. For example, each year farm income rises steadily from early spring to fall and then drops sharply again to early spring. Most economic series contain significant seasonal fluctuations, but some contain virtually none (stock prices, for

example). The irregular fluctuations are those that remain after the other types are accounted for. They are occasioned by a wide variety of factors: exceptional events, such as unusual weather, strikes, unexpected political developments, or the failure of a large business concern, and statistical errors, such as sampling errors, response errors, and errors caused by defective seasonal adjustments.

Irregular, seasonal, and cyclical movements all vary a great deal in magnitude from one series to another. The irregular are very large, for example, in the liabilities of business failures but are very small in grocery sales. Similarly, the seasonal factor is quite large in the construction and retail industries but small in many lines of manufacturing. The cyclical amplitude is considerably larger in new-orders series than it is in employment series. The relations among these types of fluctuations for different eco-

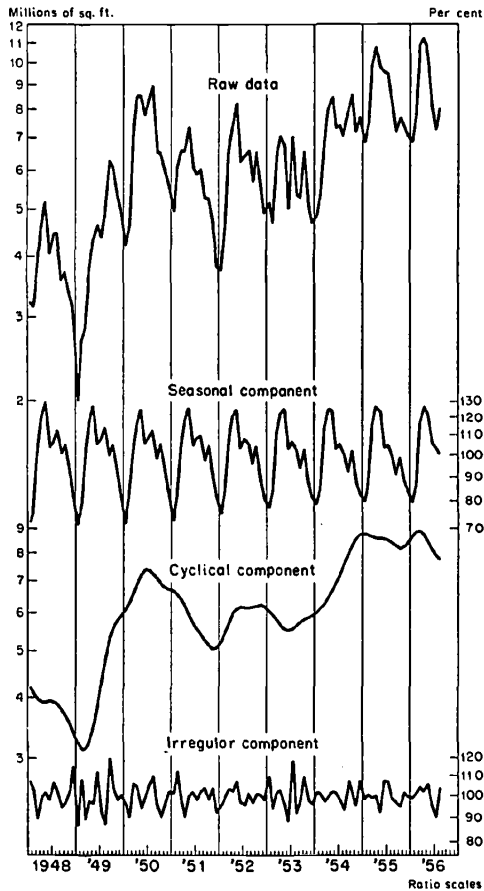
<sup>1</sup> This practice is usually followed in this paper. The reader should try to bear this in mind, because sometimes the trend is important, even over short periods—for example, in series showing airline traffic since 1947. The curves used to delineate the cyclical component also show shorter movements that are not generally recognized as cyclical—for example, the rise from July to October, 1932, and the decline from the spring to the fall of 1951. Furthermore, the term "cyclical" is used in other sciences, and especially in mathematics, to mean something different—a curve with a recurrent cycle that has a symmetrical pattern, a standard amplitude, and a fixed period. For these reasons, the use of the word "cyclical" to identify our curves leaves something to be desired; another word, possibly "systematic" or "oscillatory," might be preferable if we were starting afresh. But the use of the term "cyclical" to describe alternating periods of business expansion and contraction, with uneven patterns, varying amplitudes, and irregular durations, is so widespread among economists that it would probably be impossible to substitute another term now.

The method of time-series decomposition described here follows the general plan formulated by earlier analysts of economic time series, particularly Warren M. Persons (see his articles, "Indices of Business Conditions" and "An Index of General Business Conditions," *Review of Economics and Statistics*, January and April, 1919).

conomic series are discussed more fully later.

Chart I shows the original observations and the seasonal, cyclical, and irregular components, residential building contracts, 1948-56.

**CHART I**  
THE RAW DATA AND THE SEASONAL, CYCLICAL, AND IRREGULAR COMPONENTS, RESIDENTIAL BUILDING CONTRACTS, 1948-56



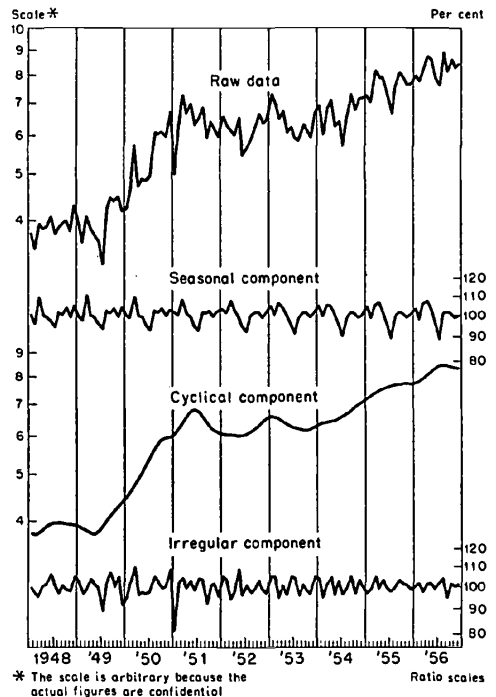
regular factors for a series on total residential building contracts. Chart II shows similar figures for the sales of a major chemical company. In both cases the period covered is 1948-56.

**III. ILLUSTRATIVE SERIES—SOME ECONOMIC INDICATORS**

Almost any economic series could be used to illustrate the technique of con-

verting the original observations into more useful data, but we have selected some well-known economic indicators, partly because they are of interest for their own sake and partly because they make it easy to show how the final products facilitate economic analysis.

**CHART II**  
THE RAW DATA AND THE SEASONAL, CYCLICAL, AND IRREGULAR COMPONENTS, SALES OF A MAJOR CHEMICAL COMPANY, 1948-56



The Federal Reserve index of industrial production and the Bureau of Labor Statistics estimates of non-agricultural employment are shown in Chart III. These series, being of broad industrial scope, represent well the business-cycle movements in the economy. The period selected for this illustration is 1936-39, because the cyclical movements during this period were relatively clear. They were smaller than those of the 1929-35 period but larger than any since the end of World War II. The first curves