Polynomial Forecasting Utilizing
Exponential Smoothing on Successive
Coefficient Determinations. (May 1969)

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Economic forecasting techniques are being successfully applied to problems of inventory and production control. Literature on this subject is generally divided into two classifications: the first being a qualitative approach dealing with business cycles or long-term economic growth, and the second dealing with methods of obtaining short-term forecasts of product demand. Among the techniques for the latter group are the exponential smoothing models developed by R. G. Brown. These methods provide reasonably accurate and reliable forecasts. In addition, they require a minimum of computations and are suitable for use with digital computers.

Two new models are developed here that use the algorithm of single exponential smoothing to weigh the coefficients of a polynomial such that, for each new data point, a new equation is obtained. These models retain all the advantages of exponential

smoothing while providing a new approach for predicting future occurrences.

Since there are many situations which can be adequately forecasted using linear trends, a model is presented that makes use of the equation for a straight line. The coefficients of this equation are successively smoothed in a sequential manner throughout the time series. The result is a model in which the most recent information is exponentially weighted based on a smoothing constant.

Historical data can often be approximated by the equation of a quadratic curve. A model is therefore presented which successively smoothes the coefficients of a parabola. This model makes use of single exponential smoothing on each of the three coefficients of the quadratic equation. The resulting equation involves all the data in the time series in a varying degree depending on the forecasters choice of the smoothing constant.

The models developed here are shown to have both an unbiased estimator and a bounded variance. The significance of these calculations is discussed in relation to the forecasting objective.

Three programs have been written for a digital computer in order to facilitate the implementation of the models. The results are presented along with an analysis of their content.

The models developed here, referred to as coefficient smoothing, are extended to equations of higher order polynomials, multivariable equations, and complex equations in product form. Algorithms are presented, along with a computational procedure, which will solve these equations. Advantages of these models are discussed in relation to other forecasting techniques presently used.