NASA TECH BRIEF

Simple Data-Smoothing and Noise-Suppression Technique

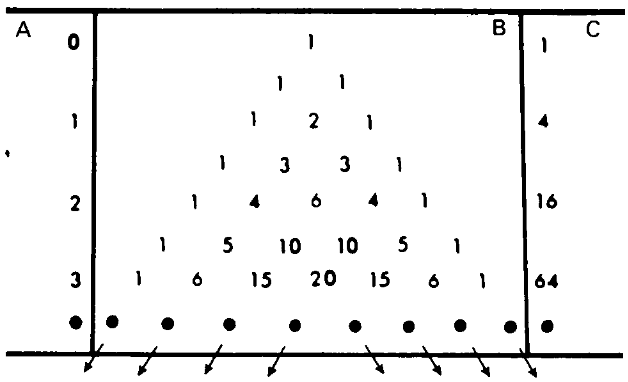

Figure 1. Aperture Number (A), Pascal (B), and Σ-Coefficients (C)

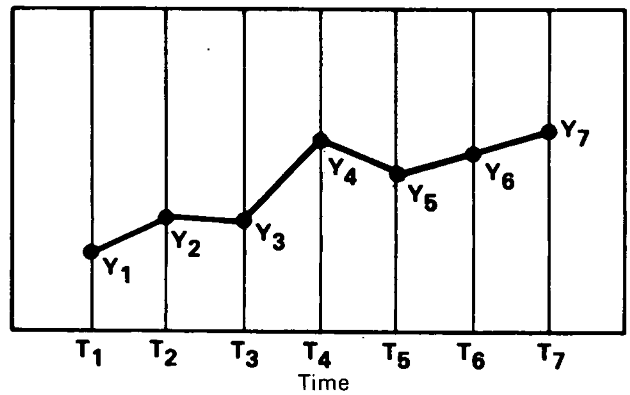

Figure 2. Example of No. 3 Aperture

An algorithm, based on the Borel method of summing divergent sequences, can be used for smoothing noisy data where knowledge of frequency content is not required.

A Pascal triangle (Fig. 1) is formed from data points, equally spaced in time, where the ordinate values y_1, y_2, y_3, correspond to times t_1, t_2, t_3. Any (trial) aperture number is chosen and applied to the prescribed data. (The degree of smoothing increases with an increase in the aperture number.) The specific weighting of the data points in the neighborhood of a point to be smoothed is determined by the Pascal-triangle row corresponding to the chosen aperture. The point to be smoothed must then be normalized by the coefficient of the chosen aperture before plotting. Figure 2 shows the application of aperture No. 3 to smoothing the data point y_4. The smoothed value $\bar{y}_4$ is given by

$$\bar{y}_4 = 1/64(y_1+6y_2+15y_3+20y_4+15y_5+6y_6+y_7)$$

Using the Pascal-triangle technique is like using a telescope to "view" the data points. The Pascal aperture number is like the field stop in a telescope that determines the angular field of view—in this case, the number of data points covered. The "telescope" may be moved in time from point to point for smoothing an entire set of data. If the data within the field of view lie on a straight line, the smoothed value, such as $\bar{y}_4$, will be identical with the original value regardless of the aperture number. Further smoothing results if the entire process is reiterated on the smoothed data.

The technique's effectiveness is demonstrated by a series of graphs.

Note:

Requests for further information may be directed to:

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(continued overleaf)

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No patent action is contemplated by NASA.

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