of the acid, while the alcohol moiety plays a part in the ease of breakdown of the complex.

The benzoates have considerable affinity for lipase, probably because of the conjugation of the 'carbonyl' group with the phenyl nucleus, but this conjugation must be lost on hydrolysis. The enzyme is apparently incapable of facilitating this process, with the result that the benzoates are not more easily hydrolysed when in combination with the enzyme than they are in the free state³. It seems that the enzyme is best suited to overcome unfavourable influences on hydrolysis due to inductive effects.

If this hypothesis is correct, other hydrogen-bonding substances will combine with the enzyme. This may be the mechanism of the inhibition exerted by fluoride ions⁴. Similarly, combination with water is possible.

This reaction may explain the apparently slight affinity for lipase shown by substrates (for example, triacetin, tripropionin and 'Tween 20') in homogeneous solution, although when an oil-water interface is present the affinity is very much greater⁵. The surface-active properties of lipase tend to bring it to such an interface⁶, where the concentration of water is small compared with the concentration of substrate. The linear relationship between the concentration of triacetin and the rate of hydrolysis⁷ may perhaps be due to competitive inhibition by water.

This hypothesis attributes to the enzyme the function of inducing, by means of hydrogen bonding, electronic shifts at appropriate points in the substrate, thereby speeding up the reactions which these compounds normally but with difficulty undergo. Surface-action effects, which are very important in catalysis by lipase, probably enhance the efficiency and specificity of this process.

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Errors in the Estimation of Serial Correlations

SINCE the introduction of the serial correlation coefficient by Yule¹ the method of correlogram analysis has been extensively used. As a rule, the correlogram analysis has been preceded by a smoothing process for the removal of trend (either by curve fitting or moving averages), and the serial correlations are estimated from the residuals. Although it is quite generally realized that parameters so estimated are

liable to bias, the form and full extent of this bias have not been extensively investigated.

These biases may have serious effects on the practical analysis of time series. The removal of any fitted constants will affect the correlogram, and tests of goodness of fit will be vitiated. In particular, the moving average method of trend elimination may give rise to a correlogram entirely different from that of the parent process.

The bias arises from two sources. In the first place, the serial correlation coefficient is the ratio of the serial covariance to the variance of the series. When these quantities are estimated from the data they are themselves subject to sampling error, and so the expectation of their ratio is not in general equal to the parent serial correlation. This bias always reduces the absolute value of the serial correlation, and disappears only when the parent serial correlation is zero. Secondly, the fitting of constants to the series introduces further bias. For example, when the mean is estimated from the data, a negative bias is introduced into the estimated serial covariance, reducing the value of the serial correlation.

When the mean only is fitted from the data, the serial correlation may be estimated as:

$$r_k = \frac{\frac{1}{n-k} \left\{ \sum_{i=1}^{n-k} x_i x_{i+k} - \frac{1}{n-k} \left(\sum_{i=1}^{n-k} x_i \right) \left(\sum_{i=1}^{n-k} x_{i+k} \right) \right\}}{\frac{1}{n} \left\{ \sum_{i=1}^n x_i^2 - \frac{1}{n} \left(\sum_{i=1}^n x_i \right)^2 \right\}}$$

Using this definition, the biases in the serial correlations may be found in special cases. For example, for the moving average $x_t = \varepsilon_{t-1} + \varepsilon_t$,

$$E(r_1) = \frac{1}{2} - \frac{3}{2n} + O\left(\frac{1}{n^2}\right),$$

so that the bias, to order $1/n$, is $-3/2n$. For the Markoff process $x_t = \rho x_{t-1} + \varepsilon_t$,

$$E(r_1) = \rho - \frac{1+3\rho}{n} + O\left(\frac{1}{n^2}\right).$$

These biases are larger than has generally been supposed. For example, for a Markoff process with parameter 0.8, the expectation of r_1 in a series of twenty terms when the mean is estimated is 0.630. The only previous work on this subject is by Sastry². He calculated the bias due to fitting the mean, but neglected the first source of bias mentioned above, and in consequence the biases he gives are much too small. For example, using a slightly different definition of r_1 , he gives the expectation of r_1 in series of twenty terms from a Markoff process with parameter 0.8 as 0.690, under-estimating the bias by 35 per cent.

Extensive calculations have been carried out on artificially constructed stochastic series confirming these results. Work is at present in process on the effect of various methods of trend removal, and detailed accounts will be published elsewhere.

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