Adaptive Control Systems, by E. MISHKIN and L. BRAUN, 1961; 533 pp. (London: *McGraw-Hill Publishing Co. Ltd.*, 128s.)

A book in which each chapter is written by one or two authors out of a team might be expected to be difficult to review. Here we have eleven authors producing seventeen chapters, and I do find difficulty. It is not so much that there is a marked variation in style, or gaps or overlaps in the contents of the different chapters, but that there does not seem to be a really consistent main theme right through the book. The title would indicate that there is a main theme, but it is somewhat disconcerting to find that the major section entitled "Adaptive Control Systems" does not begin until page 293.

There is an introductory chapter by Prof. Truxal on the concept of adaptive control, followed by sections on linear systems (four chapters) and non-linear systems (three chapters). After the four chapters on adaptive control systems comes the final section of five chapters covering selected topics in systems engineering.

Truxal put forward a definition of an adaptive control system at a symposium (Proceedings of the Self Adaptive Flight Control Systems Symposium, WADC Rept. 59–49, ASTIA Document AD209389, March 1959) some three years ago, when there was considerable discussion and little agreement on this matter. In this book he sticks to his maxim that an adaptive system is any physical system which has been designed with an adaptive viewpoint, and this to some extent might explain the structure of the book (all the authors are from his Electrical Engineering Department at the Polytechnic Institute of Brooklyn). Much of it could well be described as the theory of control systems written from an adaptive point of view, particularly the first section. Even from this standpoint, however, there are about 300 pages out of a total of 527 which cannot be ascribed as significantly applicable to the design of an adaptive system rather than any other type of control system.

The parts that directly relate to adaptive systems begin with two chapters by Truxal. He analyses possible methods for identifying the process dynamics, since most adaptive systems include some means for doing this automatically; also he examines some particularly difficult design problems in order to bring out the essential reasons why conventional techniques do not provide satisfactory solutions, and why an adaptive point of view might lead to success.

The "proper" adaptive control section of the book contains one chapter on automatic methods of process identification, another on particular systems that have been developed for aircraft control (so far one of the principal fields of activity in adaptive control), and a third chapter describing half a dozen computer-controlled systems. The final chapter in this section is headed "Some Unusual But Nonadaptive Systems," and outlines the Flügge-Lotz and Taylor, the Minneapolis-Honeywell, and the Dodco control systems.

In Britain the book is expensive, and many will hesitate to buy when they realize that it is not what it seems. On the other hand, I imagine that just as many will welcome a volume which collects together in reasonable detail a wealth of information, which was hitherto scattered within many different books and journals. Non-adaptive topics discussed include sampled data systems, describing function analysis, Nyquist and root locus procedures with non-linear systems, optimum response and final value systems, phase plane analysis, the Wiener theory of non-linear systems, application of Laguerre, Hermite, Chebyshev and other orthonormal polynomials, digital computers and techniques, theory of games, linear and dynamic programming, and queueing theory.

H. R. HOPKIN.

Correspondence

To the Editor,
The Computer Journal.

Dear Sir,

I would like to comment briefly, from the viewpoint of the computer rather than the statistician, on the article by Lucy Joan Slater dealing with Regression Analysis that appeared in the January issue of this *Journal*.

Firstly, the author's statement (p. 288, col. 1, line 32) "$X = x_{ij}$ is the $M \times N$ matrix of initial observations" is not correct. To be consistent with the preceding equations, X must be an M by $(N + 1)$ matrix, the elements of the first column having the value unity, and the remaining N columns comprising the matrix of initial observations. It will be seen from this that the first diagonal element of the matrix X^TX is M, not the N which appears in the expanded matrix form of the generalized normal equations some few lines before in the text.

Secondly, and more importantly, I cannot accept the author's explanation in the section headed "Some Points of Difficulty" (p. 289, col. 2) of the reason for the inaccuracy in the calculation of s^2. If we define any function by an explicit formula, then we can, if we retain a sufficient number of digits throughout the calculation, compute the function to any desired accuracy, and the statisticians' request for double-length working was not, in my view, unreasonable. The arguments put forward by the author to explain why no improvement took place when this was tried indicate that she has fallen into the error of thinking that non-leading digits are not "significant." This is true if they have been polluted by rounding error (they then become meaningless), but it is not necessarily so if they result from errors in observed measurements. In this case they indicate a lack of precision in the measurements themselves, and if we wish to evaluate this imprecision, as we do when we compute s^2, they then become (computationally) highly significant. Since s^2 is essentially a measure of imprecision of one sort or another, and the leading digits exhibit no imprecision, i.e. the measurements are sufficiently accurate for these digits to be absolutely reliable, then it is scarcely surprising that, during the calculation of s^2, they cancel out. The fact that s^2 is, by definition, a function only of the experimentally unreliable non-leading digits of a set of measurements does not absolve the computing laboratory from the duty of calculating it accurately, and not introducing, by suspect numerical processes, excessive rounding error.

I suggest that the reason for the inaccurate values of s^2 being obtained is that the matrix X^TX is somewhat ill-conditioned, and that an inaccurate value of the vector b was thus obtained. With the particular method of computing s^2 used by the author (which involves the subtraction of two large nearly equal numbers, in itself a dubious