properties of the notion of conditional probability and expectation, and which concludes with a discussion of the convergence properties of conditional expectations. The results obtained are then used to derive the convergence properties of the entropy function, the Shannon-McMillan-Brieman theorem on convergence almost everywhere of the averaged logarithm of a conditional probability, and the equipartition property of ergodic shifts. A final section of the fourth chapter presents some interesting results of Eggleston and the author, relating the entropy of certain shift transformations to the Hausdorff measure of Cantor-like perfect sets on the real axis.

In the fifth and final chapter, the general theory is applied to the concrete problems of coding and information transmission, out of which the theory originally developed. A noiseless channel is modelled as a measurable transformation in a clear and convincing way; the proof that the entropy of a source is a lower bound for the capacity of a channel capable of transmitting the source without loss of information follows almost immediately. The converse result, i.e., the existence of a channel of capacity equal to the source entropy capable of transmitting the source, is reduced to a hypothesis concerning standard shifts. The results are then extended to noisy channels. Finally, the abstract existence-of-a-channel result is reformulated in concrete terms as a statement about the existence of block codes for the transmission of data from a given source, which is, of course, the form in which the result is of greatest interest to the practicing communications engineer.

The exposition is consistently crisp, succinct, unpretentious, and maximally clear. Professor Billingsley's work may be recommended not only to mathematicians wishing to become familiar with the interesting advances in ergodic theory on which he reports, and to communications scientists desiring insight into the theoretical foundations of information-rate theory, but also to potential authors, who will see in it an inspiring example of what the short survey monograph can be.

D. S.

74[P, X].—RAYMOND W. SOUTHWORTH & SAMUEL L. DELEEUW, *Digital Computation and Numerical Methods*, McGraw-Hill Book Co., Inc., New York, 1965, xiv + 508 pp., 23 cm. Price $11.75.

According to the preface, "The aims of this course are (1) to introduce the student to numerical methods, as applied to the analysis and solution of engineering problems and (2) to develop enough facility in the programming of computers to allow him to solve problems on a digital computer." With this purpose in view the authors have divided the book into two main sections: a programming section comprising about a third of the book and a numerical analysis section comprising the remaining two thirds. Most chapters end with illustrative examples taken from various fields of engineering in addition to a large selection of problems for the student.

The section of the book devoted to programming covers flow charting and FORTRAN (FORTRAN IV) programming. The book also contains a chapter on machine language programming which appears to be too terse to eliminate the students' "black box" view of the computer. The chapter could have been deleted without damage to the book as a whole.

The scope of the numerical analysis section may be indicated by simply listing

the chapter headings: Rounding and Truncation Errors, Roots of Equations, Simultaneous Linear Equations, Interpolation, Numerical Differentiation and Integration, Taylor's Series, Numerical Solution of Ordinary Differential Equations, and Empirical Formulas and Approximation. In general, the technique the authors have adopted is to describe a numerical analysis procedure and then to follow this procedure with a flow chart of a possible algorithm. The actual mathematics is seldom justified except in the most intuitive way.

On the whole, the book seems to be well written and much of the included material would be of value to the beginning engineering students.

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75[W].—CHARLES CHRISTENSON, *Strategic Aspects of Competitive Bidding for Corporate Securities*, Division of Research, Harvard Business School, Boston, Mass., 1965, x + 116 pp., 26 cm. Price $6.00.

A syndicate preparing a bid to underwrite a bond issue must usually specify three quantities in order to prepare a responsive, and responsible, bid. The quantities are the offering price which will be charged the public, the coupon rate which the issuer must pay during the life of the bond, and the proceeds to the issuer which will be paid by the syndicate for the securities.

This monograph provides a complete analysis of the interplay of forces between the syndicate and its competitors as well as of the factors which affect the relationship of members of the syndicate to each other and to the public.

The scope and setting of the problem is described in detail with the help of a case study. The exposition is sufficient to set the stage for any neophyte to the bond market if he has any degree of mathematical sophistication.

The pricing problem is considered in a chapter devoted to this decision process, but greatest attention is paid to the bidding problem, consisting of setting the coupon rate and the proceeds. The bidding problem is approached via game theory in one chapter, assuming perfect rationality among competitors who seek to adopt a strategy to maximize their return. In a Bayes approach, to which another chapter is devoted, statistical decision theory is employed to make a choice under uncertainty. Considerable new and novel material is to be found in these sections of the book.

Another interesting and, to the financial world, novel finding is one that suggests it may be more profitable to the syndicate to hold the bonds in inventory for a while instead of seeking an immediate total disposal.

It would be interesting to apply some of the author's precepts to a recent British underwriting in which the bid on some Imperial Chemical Industries bonds was so high—and hence disadvantageous to ICI—that the public subscription ran to many times the available number of securities.

As one of the "Studies in Managerial Economics," the book is attractively printed with a complete bibliography, but without an index. Misprints noted were few: "Player 1" should be "Player 0" on the sixth line from the bottom of p. 58; the equation reference in the text in the middle of p. 73 should be to "(6-1)" rather than