Book Reviews

Books for review are to be sent to the Book Review Editor Jan Wretman, Statistical Research Unit, Statistic Sweden. S–115 81 Stockholm, Sweden.

Hedges, L.V. and Olkin, I., Statistical Methods for Meta-Analysis. Academic Press, Orlando, FL, 1985, ISBN 0–12–336380–2, xxiii + 369 pp.

Light, R.J. and Pillemer, D.B., Summing Up: The Science of Reviewing Research. Harvard University Press, Cambridge, MA, 1984, ISBN 0–674–85430–6, xiii + 191 pp.

Rosenthal, R., Meta-Analytic Procedures for Social Research. Applied Social Research Methods Series, Vol. 6. Sage Publications, Beverly Hills, CA, 1984, ISBN 0–8039–2033–4 (hardback), ISBN 0–8039–2034–2 (paperback), 148 pp., £17.75 (hardback), £8.95 (paperback).

Differentiation and Integration: Combining the Results from Different Studies. A Review of Three Books on Meta-Analysis.[1]

In a 1954 article for the Handbook of Social Psychology, Frederick Mosteller and Robert Bush described different approaches for combining results from the statistical literature for a social-science audience and triggered the interest of many people. This interest ultimately, directly or indirectly, has led to the three books under review here, each of which deals with statistical analysis of the results of analyses of separate studies, now known as meta-analysis. Mosteller, of course, has with various coauthors done a series of exemplary meta-analyses in diverse social and medical areas which illustrate the qualitative as well as the quantitative aspects of the enterprise, e.g. see Gilbert, Light, and Mosteller (1975) and Gilbert, McPeek, and Mosteller (1977).

These ideas of meta-analysis or integrative research, combining the results of multiple studies, may at first sound remote to the readers of this journal. But, the view that official statistics agencies should only be producing

general-purpose data for analysis by others is simply outdated. Statisticians in government agencies are asked regularly to make inferences about policy issues based on analysis of administrative or sample survey data. Moreover, as resources for data collection and analysis become scarce there will be greater pressure on statisticians to carry out secondary analyses of data by pulling together data from multiple sources and multiple surveys that may address the policy issues from different perspectives. For example, there is increasing interest in the integration of results for related questions from different survey instruments. The ideas on meta-analysis in the three books under review are directly relevant to such secondary analyses.

These books stress different aspects of meta-analysis and, although they overlap somewhat, a reader interested in the full range of issues in research synthesis will want to read all of them. Other recent books on the topic (Glass, McGraw, and Smith (1981); Hunter, Schmidt, and Jackson (1982); Cooper (1984)) may be somewhat less useful for the readers of this journal.

Light and Pillemer's book provides an excellent, semi-technical introduction to methodological issues in research synthesis. It contains a multitude of fascinating examples on topics that range from the rehabilitation of criminal offenders, to the measurement of masses in particle physics, to the effectiveness of government-sponsored employment and training programs. The authors stress simple statistical techniques and focus on how to think about quantitative problems across different kinds of studies. Although there are less than a dozen formulae sprinkled throughout the book, the technically trained reader still benefits from the authors' advice.

Four general themes underlie Light and Pillemer's presentation:

1. Any reviewing strategy comes from the questions that clarify the purpose of the review.
2. Disagreements among findings are valuable and should be exploited.
3. Both numerical and qualitative information play key roles in a good synthesis.
4. Statistical precision cannot replace conceptual clarity.

Chapters 2 through 4 pursue these themes with illustrations. Chapter 5, entitled "What We Have Learned," contains brief discussions of what the authors believe to be exemplary meta-analysis reviews, and the final chapter contains a checklist of ten questions for evaluating such reviews.

A major problem with the kind of meta-analysis review described by Light and Pillemer is that they rely heavily on summary information from other studies. The quality of individual studies is often not apparent from a superficial reading. For example, the authors appear to applaud the study of Murray and Cox (1979) on the importance of one component of rehabilitation programs for juvenile delinquents, but the study's basic conclusions fail to stand up under careful scrutiny (e.g., see Huang (1984)). Moreover, Light and Pillemer tend to simplify technical discussions to the degree that they sometimes muddle the interpretation (e.g., in their discussion of significance levels and p-values on pp. 54–55). Nevertheless, these are minor complaints about an otherwise excellent introductory book.

Having read Light and Pillemer's introduction to research synthesis, an invigorated reader should be prepared to actually go out and do a meta-analysis. Rosenthal's brief book could then serve as a methodological and analytical guide. Following an introductory discussion of cumulation and small effects in the social sciences, Rosenthal turns in Chapter 2 to the two principal quantitive methods used in comparing and combining the results of a series of studies, effect size and statistical significance. He points out that many common test statistics directly confound a measure of effect magnitude with the sample size. He also has some advice on the problem of multiple or correlated results from the same study.

The heart of the book is the extended examination, in Chapters 4 and 5, of formal methods for combining research results, expressed both in the form of estimates of effect magnitude and in the form of p-values. These are how-to-do-it chapters with worked-out examples and numerical details. The later chapter contains a description of the "file-drawer problem," which is the result of journals "filled with the 5% of the studies that show type I errors, while the file drawers

back at the lab are filled with the 95% of the studies that show nonsignificant (e.g., $p>.05$) results." Rosenthal's ingenious solution to this problem is a procedure for computing the number of unpublished null results that must be in the file drawers before an overall probability of a type I error, computed as part of a meta-analysis of published studies, can be brought up to a desired level of significance, e.g., $p=.05$. Iyengar and Greenhouse (1987) have recently demonstrated that Rosenthal's procedure tends to overestimate the number of papers in the file drawers. Rosenthal illustrates his solution with an example of 345 studies on the effects of interpersonal self-fulfilling prophecies and he estimates that the file-drawers would need to contain 65 123 papers with null results before the overall results of the 345 studies could be ascribed to sampling bias. Iyengar and Greenhouse show that a more reasonable estimate would be 3 002 papers, still a substantial number!

Chapter 6 gives some detailed applications of the methods from the earlier chapters, and then Rosenthal ends the book with a brief chapter outlining several criticisms of the meta-analysis approach. While the Rosenthal book contains some technical errors (like the one on the file-drawer problems mentioned above) and while it places too much emphasis, for my taste, on combining significant levels across studies, the reader will find it a careful and well-written book that teaches some basic techniques that are of use in practice.

Having come this far, the statistically-trained readers may now express concern or questions regarding the formal properties of the basic methods used by meta-analysts. This is where the book by Hedges and Olkin shines. It is a formal statistics book, a full understanding of which goes well beyond the one-year sequence at a noncalculus level referred to in the preface. It discusses, in a clear and convincing fashion, the strengths and inadequacies of various procedures used in meta-analyses, occasionally saving technical details for a final section at the end of the chapter.

After a brief introduction, Hedges and Olkin describe and list in Chapter 2 four data-sets used to illustrate procedures throughout the book. The topics are cogni-

tive gender differences, sex differences in conformity, the effectiveness of open education programs, and the relationship between teacher indirectiveness and student achievement. In Chapter 3, they review tests of significance for combining p-values, focussing on the criteria of admissibility and asymptotic efficiency. Chapter 4 deals with vote-counting methods (based on the outcomes of tests of significance in a series of replicated studies) and notes the inadequacy of this approach.

Chapters 5 through 10 consider methods for the estimation of effect sizes, beginning with the case of a single study, progressing to pooled estimation from a series of experiments, and then to various ANOVA-like and multivariate models for effect sizes. This latter material on models for effect sizes is, in effect, unique to this book and brings the full arsenal of statistical methodology to bear on meta-analysis problems. For the researcher who is serious about sensible analyses in a synthesis context, a careful reading of Chapters 7 through 10 is a must.

The next four chapters deal with more specialized problems, ranging from combining estimates of correlations, to the diagnostic procedures, to aspects of clustering and incomplete data (it is here where they address Rosenthal's file-drawer problem). The book concludes with a chapter reviewing meta-analysis in the physical and biological sciences, thus supplementing the focus on social science examples in the earlier chapters.

Hedges and Olkin's book is for the statistical analyst who wishes to go beyond the basic analyses in research synthesis and explore the technical basis for the methods in use. It is not a guide to what is probably the hardest part of the meta-analyses task how to go about locating relevant studies, assessing their quality, and relating the quality to the analyses. The other two books are of some help in this regard, although they too stop short of explaining how to assess quality and how to work with that assessment.

One final statistical comment seems worth attention. The meta-analysis literature appears to have settled on a rather arbitrary definition of effect size, one whose interpretation is awkward at best. Hedges and Olkin do address the issue of interpretation briefly

in their introduction and then again in Chapter 5. Their discussion is helpful, relating the effect size back to a normal theory model. But I find the lack of a good discussion of the choice and interpretation of effect sizes a major flaw in the literature, one not completely rectified by the Hedges and Olkin presentation.

Overall, this trio of books on meta-analysis – the stastistical approach to research synthesis – is an important addition to the applied statistics literature and should serve to initiate the reader of the Journal of Official Statistics to a fascinating and important area of research work.

References

Cooper, H. (1984): The Interpretive Research Review: A Systematic Approach. Sage Publications, Beverly Hills, CA.

Gilbert, J.P., Light, R.J., and Mosteller, F. (1975): Assessing Social Innovations: An Empirical Base for Policy. In C.A. Bennett and A.A. Lumsdaine (Eds.), Evaluation and Experiment: Some Critical Issues in Assessing Social Programs. New York: Academic, pp. 39–193.

Gilbert, J.P., McPeek, B., and Mosteller, F. (1977): Progress in Surgery and Anesthesia: Benefits and Risks of Innovation Therapy. In J. Bunker, B. Barnes, and F. Mosteller (Eds.), Costs, Risks and Benefits of Surgery. Oxford University Press, New York.

Glass, G.V., McGaw, B., and Smith, M.L. (1981): Meta-Analysis in Social Research. Sage Publications, Beverly Hills, CA.

Huang, S. (1984): Modeling the Supression Effect of Correctional Programs in Juvenile Delinquency. Unpublished PhD dissertation, Department of Statistics, Carnegie-Mellon University.

Hunter, J.E., Schmidt, F.L., and Jackson, G.B. (1982): Meta-analysis: Cumulating Research Findings Across Studies. Sage Publications, Beverly Hills, CA.

Iyengar, S. and Greenhouse, J.B. (1987): Selection Models and the File-drawer Problem. Unpublished manuscript, Department of Statistics, Carnegie-Mellon University.

Mosteller, F. and Bush, R.R. (1954): Selected Quantitative Techniques. In G. Lindzey (Ed.), Handbook of Social Psychology:

Vol. 1. Theory and Method. Addison-Wesley, Cambridge, MA.

Murray, C.A. and Cox, L.A., Jr. (1979): Beyond Probation: Juvenile Corrections and the Chronic Delinquent. Sage Publications, Beverly Hills, CA.

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Srivastava, M.S. and Carter, E.M., An Introduction to Applied Multivariate Statistics. North-Holland Publishing Company, New York, 1983, ISBN 0–444–00621–4, x + 394 pp., $ 40.50.

This book, as the title suggests, is an introduction to applications of multivariate methods. The presentation is intended for first or second year graduate students in applied statistics. Nevertheless, it could also be valuable for researchers in the natural and social sciences, since it includes an abundance of examples from these fields. The reader is expected to have a good knowledge of elementary univariate theory and some knowledge of matrix notation and manipulations.

The book gives a comprehensive presentation of topics in multivariate analysis including some newer material. One of the book's strong points is that it discusses and provides examples of how to use the SAS and BMDP computer packages for multivariate problems. Some examples of APL programs are given in an appendix. There is a lack of theoretical derivations which, from my point of view, makes the book less appropriate as a graduate-level textbook in mathematical statistics.

Chapter 1 contains elementary matrix algebra including examples using SAS Proc Matrix. In Chapter 2 the multivariate normal distribution and the Wishart distribution are introduced. The multivariate normal distribution is introduced in a pedagogical way. Starting from p independent standard normal random variables the authors define the general p-dimensional normal distribution

by using a linear transformation in a manner analogous to the univariate case. This method is well suited to generate random numbers from a *p*-dimensional normal distribution.

The next five chapters contain multivariate generalizations of univariate procedures for *t*-tests, analysis of variance, and multiple regression. The likelihood ratio approach has been used for tests of significance. Confidence intervals have been derived using both Bonferoni's inequalities and Roy's union-intersection principle. The end of Chapter 3 deals with some special topics such as testing for joint normality using graphical methods, transformations, and missing data.

Chapters 8 through 11 treat the strictly multivariate procedures starting with discriminant analysis in Chapter 8. This chapter includes methods of selecting as few variables as possible and also the use of canonical variates for discrimination. In Chapter 9 different measures of association are discussed. The main features of principal component analysis and factor analysis including the use of principal components in testing for multivariate normality are given in Chapters 10 and 11.

The last chapter deals with the problem of testing the assumptions made about the covariance matrices in the previous chapters.

Each chapter concludes with a section on computer procedures and numerical problems containing real data selected from different areas. Tables of percent points of the distributions used in the book are given in Appendix 1.

Since many teachers, including myself, have used Morrison (1976) as a text in a course for graduate students in applied statistics, it can be appropriate to draw some comparisons. The level of the books is the same. Morrison's book gives a better justification for and explanation of the techniques. Srivastava and Carter's book covers a wider range of techniques and gives a more up-to-date discussion of certain topics. Most important, the inclusion of the use of computer packages and sample outputs from these packages is a welcome addition in times when the use of computers to solve multivariate problems is almost inevitable. It is, however, unfortunate that there are so many typographical errors.

On the whole, the book's pluses outweigh its minuses. I would recommend the book for both applied statistics classes and as a handbook for practitioners.

Reference:

Morrison, D.F. (1976): Multivariate Statistical Methods. McGraw-Hill, New York.

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Manly, B.F.J., Multivariate Statistical Methods: A Primer. Chapman and Hall, London, 1986, ISBN 0–412–28610–6 (hardback), ISBN 0–412–28620–3 (paperback), x + 159 pp., £ 15.00 (hardback), £ 6.95 (paperback).

To write a book on multivariate statistics and explain the most common methods in use for an audience with a limited knowledge of mathematics is a challenge with considerable pedagogical difficulties. To do this in only 159 short pages seems almost impossible. A book of this size can only give a cursory view of the methods and try to convey some of the main ideas. At best it can function as an appetizer and stimulate further reading.

The prerequisite for the book is stated as "a working knowledge of elementary statistics." Matrix algebra, which is necessary for compact notation, is briefly covered at the beginning in less than nine pages. To me it is doubtful that a reader without much mathematical background will learn enough from nine pages to understand the usefulness of matrix algebra, since the author (quite rightly I would say in a book like this one) makes very little use of matrix manipulations.

The book covers most of the methods used in what we consider the main areas of multivariate statistics: Principal components, factor analysis, discriminant analysis, cluster analysis, canonical correlation and multidi-

mensional scaling. The only topic left out of what is generally covered in textbooks on multivariate statistics seems to be multivariate analysis of variance.

However, the cursory treatment of each part of the field leaves out some aspects that are vital to the methods. The chapter on factor analysis gives the impression that it is more or less the same thing as principal components followed by a mysterious stage called rotation. The model-based aspect of factor analysis is hardly touched upon. Some methods and terms are mentioned with the warning "not for beginners." This must be more confusing than enlightening. The abundance of methods in cluster analysis is merely hinted at, and the problem of choosing the number of clusters seems to be a decision of judgement without any criteria. On the other hand the author's explanation by example of canonical correlation surpasses that in any other standard textbook.

When it comes to the practical application of the methods, the author recommends both the use of standard packages and the writing of BASIC programs using published algorithms. Considering both the intended audience and the many packages for micros available today, the latter way of performance seems to be a waste of time. For an applied scientist it must be more rewarding to rely on packages and devote more time to penetrating the methods.

The book contains some nice sets of multivariate data from different fields. (It is noteworthy that Fisher's Iris data are *not* included in the book!) Another good feature is the short section on recommendation for further reading at the end of each chapter.

As a textbook this book is probably too cursory even for an introductory course in multivariate statistics. Nor are there any exercises or problems for students to work. But the book will certainly increase the audience's interest in multivariate analysis and make them wish to learn more about the subject.

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Jöreskog, K.G. and Wold, H. (Eds.), Systems under Indirect Observation: Causality, Structure, Prediction, Parts I and II. Contributions to Economic Analysis, Vol. 139, North-Holland Publishing Company, Amsterdam, 1982, ISBN 0–444–86301–X (set), xx + 292 pp. (Part I), xii + 343 pp. (Part II), $ 127.75.

The two volumes under review contain the edited proceedings of the Conference on Systems under Indirect Observation organized by the editors. The conference brought together a variety of social scientists and others interested in models involving variables that are only indirectly observable. Such variables have been termed "latent" and have been understood to represent concepts such as "intelligence," "ability," and "social class status." The chief characteristic of latent variables are that they are neither well defined nor well measured, but that they can be "indicated" by a set of well defined and well measured indicators, such as test scores, performance at school, income and education of parents, etc.

The division of the conference papers into two parts, the first edited by Jöreskog and the second by Wold, reflects the two editors' different approaches to estimation of models with latent variables. The papers in Part I focus mainly on the maximum likelihood (ML) approach developed by Jöreskog, and those in Part II on the partial least squares (PLS) approach developed by Wold. The opening remarks for the conference are written by Harald Cramér, who recalls his early association with Herman Wold and – referring to the work of Wold and Jöreskog at the University of Uppsala – emphasizes the fact that "one and the same research center is the birthplace of two leading lines of approach for the same general problem areas" (p. xi). Cramér also asserts that "the two approaches to the investigation of path models with latent variables are complementary rather than competitive" (p. x).

The first three chapters in Part I deal with models for *categorical* latent variables. In Chapter 1 Mooijaart, following earlier work on latent structure analysis by Lazarsfeld,

formulates a "latent class model," discusses its estimation by ordinary and generalized least squares methods, and provides an illustrative application dealing with attitudes towards abortion. Except for some mild data mining, the statistical procedure is well executed. The bulk of Chapter 2 by Duncan, Sloan, and Brody consists of the presentation of empirical examples involving attitudes towards free speech, abortion, role of sex, nuclear energy, etc. The unifying theme is the examination of a "response-consistency effect" which the authors never properly define. The chapter is rather long (46 pages) and fairly esoteric. Chapter 3, written by Muthén, deals with models in which a continuous latent variable is measured only dichotomously.

Chapter 4 by Jöreskog is a key chapter of Part I. It contains a description and explanation of the LISREL approach to causal model building in the social sciences. The list of models covered by the LISREL umbrella (*linear structural relations*) goes considerably beyond the path models which were the only ones mentioned by Cramér in the introduction. The emphasis of Jöreskog's chapter appears to be the use of LISREL in the analysis of longitudinal data. The chapter is well written except for the author's inexplicable reference to models as "techniques." In Chapter 5 Bentler grapples with the definition, levels, and types of latent variables. Although some of the definitions may be questionable, the author does provide some useful insights in comparing the psychometric and econometric traditions. In Chapter 6 Graff and Schmidt discuss decomposition effects in the context of the LISREL model, which involve the determination of the reduced form coefficients called "impact multipliers."

Chapter 7 contains the results of a Monte Carlo study by Boomsma to find the small sample properties of the MLE's of a factor analysis model. The study is well thought out and professionally carried out. Another Monte Carlo experiment – conducted by de Pijper and Saris and concerned with the scale restrictions used in models with latent variables – is described in Chapter 8. In Chapter 9 Sörbom discusses estimation of group differences using estimated means of latent variables. Chapter 10 by Alwin and Jackson is empirical and deals with measures of parental values. Chapter 11 by Lyttkens consists of a comprehensive and thorough survey of the instrumental variables estimation method, which is a digression from the theme of the conference.

The final chapter in Part I, written by Jöreskog and Wold, is meant to present some historical and comparative aspects of "the ML and PLS techniques for modeling with latent variables" (p. 263). This potentially important chapter is rather brief (8 pages) and concise, but on the whole more confusing than illuminating. Most fundamentally, the authors never clarify whether the ML and PLS "techniques for modeling" (p. 263) are two different methods of estimation or two estimation methods designed for two different models. In fact, the conceptual distinction between a model (i.e., a substantive phenomenon) and a method of estimation (i.e., a description of a numerical procedure and its motivation) is hopelessly blurred. Further, the chapter appears to be dealing only with path models, even though Jöreskog in Chapter 4 clearly states that his ML-LISREL approach applies to simultaneous equation models as well.

Part II consists of papers dealing with various aspects of the PLS approach. The long (54 pages) opening chapter by Wold contains a discussion of "soft modeling," i.e., modeling when prior knowledge is scarce. It represents a serious attempt to explain the formulation of soft models and their estimation by PLS. Unfortunately, the description of the PLS method is purely cookbookish, telling the reader *how* to proceed without explaining *why*. Since the procedure is sometimes counter-intuitive (e.g., in the specification of the model, indicators are given as functions of the latent variables, whereas in the estimation procedure the roles are reversed), the lack of motivation becomes a serious handicap. The reader is never told what is being minimized and why.

In the second chapter of Part II, Bookstein tries to shed some light on soft modeling by explaining its meaning geometrically, and he manages to provide some mind-boggling figures. In Chapter 3, Noonan and Wold address the issue of indeterminacy in models with three or more latent variables, and they illustrate their proposed approach using a

relatively large macromodel of schooling. Chapter 4, by Areskoug, deals with asymptotic properties of PLS estimators (in path models with two latent variables) and with a comparison of LISREL and PLS estimators by means of a Monte Carlo experiment. The material is clearly presented and well explained. In this reviewer's opinion, this is the best chapter in the whole book. In Chapter 5 Hui and Wold present the results of a simulation experiment whose purpose was to examine the consistency of PLS estimates.

The seven chapters that follow, Chapters 6–12, contain applications of the PLS approach to research problems in political science (two chapters), chemistry (two chapters), economic development, education, and agricultural economics. Chapter 13 by Dupáčová and Wold is again methodological and deals with the problem of identification, concentrating on the ML-LISREL approach but making references to the PLS approach as well. The chapter contains a curious statement that "the problem of identifiability does not occur in the PLS estimation procedure" (p. 294). This statement is difficult to reconcile with the claim of consistency of the PLS estimates made in Chapter 5, and with the well-known fact that identification is a *necessary condition* for consistency.

The final chapter – Chapter 14 – contains a summary of the panel discussion at the close of the conference, written by Bookstein. Some of the discussion was devoted to attempts to define elusive concepts and the implied nature of scientific inquiry. At the end, however, common sense prevailed with the affirmation that "for useful interpretation of data one needs an explicit model of LV's tied to a reasonable sample of indicators. One must take the structure of the model seriously..." (p. 320) and "the ultimate purpose of any model, which is generalization, requires new samples. Eventually then, one must cease adding parameters to any model, even if the fit is thereby improved..." (p. 320). The participants also agreed that "prediction and structure are tightly intertwined" (p. 321) and that "structure helps the researcher choose predictors" (p. 321).

The papers in this book clearly indicate that there is a reasonably widespread interest in models with latent variables among re-

searchers in various disciplines. The research efforts, both theoretical and applied, are professionally executed and in some respects very impressive. It is interesting to note, though, that while econometrics is frequently mentioned throughout the book, there is only one paper in this collection that falls in the field of econometrics, and this paper is largely irrelevant to the subject of the conference. A perusal of econometric literature shows a similar lack of interest in the models discussed in the book at hand. It would be interesting to speculate about the reasons for this state of affairs.

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Boyer, M. and Kihlstrom, R.E. (Eds.), Bayesian Models in Economic Theory. Studies in Bayesian Econometrics, Vol. 5, North-Holland Publishing Company, Amsterdam, 1984, ISBN 0–444–86502–0, viii+317 pp., $ 63.50.

A much debated and seemingly eternal question is how much of a society's resources should be allocated to the production of information. For a central statistical bureau, the problem of developing a program of relevant official statistics is: What statistics does the society need? Many solutions to this problem use some form of benefit-cost analysis, i.e., the choice between alternative statistical programs is assumed to be based on an evaluation of the anticipated benefits and costs. This raises the question of assessing the value of information. Even if, unrealistically enough, we know the decision processes where the statistical information is to be used, there remains the problem of determining the benefit of the information. Although economists have always recognized the importance of the economic agents' attitudes towards uncertainty and lack of information,

it is only during recent decades that there has been substantial progress in the economics of information.

The modelling of the role of information in different kinds of decision processes is the main theme in almost all of the papers in this monograph. For a statistician these are also the most interesting. It should be stressed that even if this volume is included in the series "Studies in Bayesian Econometrics" the approach is purely theoretical with no discussion of, e.g., the possibilities of testing the relevance of the models and estimating their parameters. The only clear connection to statistical methodology is the frequent use of models and techniques from Bayesian decision theory. The book gives a review of the progress made during the last few decades in the research on the theoretical foundations of the economics of information based on the Bayesian paradigm. Special attention is paid to the deriving of formal models that allow for evaluation of the effects of different degrees of information and uncertainty on different kinds of economic phenomena.

The common structure of most of the problems is as follows. A decision-maker has to make a decision. The quality of this decision depends on an unknown state-of-nature, i.e., the value of a parameter which is not completely known. He has, however, the possibility to observe the value of a certain stochastic variable which is assumed to be correlated with the parameter. After observing the variable, the decision-maker is assumed to change his prior belief about the parameter. Obviously the value of getting this additional information, i.e., the expected increase in the return of the decision must be balanced against the costs of its acquisition.

For example, the monograph discusses the problem of the consumer who has to choose between products of varying and unknown quality or of the producer screening job applicants in order to find the best candidate. Included are also chapters about, e.g., some portfolio problems and the effects of fair vs. misleading advertisement. An interesting result in many of the studies is that there might be cases where the value of even cost-less information is zero or negative. This nonconcavity in the value of information is

discussed in articles by Radner and Stiglitz and by Kihlstrom, and is touched upon in many other of the chapters as well. In an interesting and comprehensive study on screening procedures by Stiglitz, it is shown that under certain conditions more information about the working abilities of people in a given society may result in a Pareto inferior equilibrium. A perhaps more obvious result is that an increase in the decision-makers' risk-aversion tends to lead to a decrease in their demand for information. This is shown in an article on risk-aversion and information-demand by Freixas and Kihlstrom.

Besides the chapters dealing explicitly with the evaluation of the value of information, the monograph also includes six studies on modelling of problems characterized by of asymmetric information. Questions discussed are, e.g., delegation problems, "the free rider," and problems connected with the choice of a regulatory policy by a state authority. A study about the optimal investment in information in bidding situations is also included. One can find well-known names among the authors, e.g., Baron, Holmström, and Stiglitz.

It seems to be typical for most advanced works in mathematical economics that they make difficult reading. This monograph is no exception, even if most of the articles are self-contained and well-structured. Many also include illustrative examples. I found it a little bit surprising that for many of the chapters, the latest references are from the 1970s. This indicates a great time lag between the finishing of the manuscripts and the publication of the book.

The monograph can be recommended for anyone interested in the theoretical foundations of the economics of information. It seems probable that for most potential readers the value of the information they can get from the book exceeds the cost of acquiring and reading it, at least if they are not already experts in the field and if they can borrow the book from a library.

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