measurements of each larval instar were used, they were not displayed because of the grouping of developmental stages. The curve segments are the appropriate integrals of $\hat{X}(z,t)$ in z. As each measurement becomes available, $\hat{X}(z,t)$ is updated producing the usual discontinuities. Biologically, after adult influx eggs are produced, larva development begins in the Spring, eventually resulting in young adult weevils. Concurrently, the parasite cycle goes through two generations, beginning with pupating cocoons in April. These cocoons become adults and parasitize weevil larva, which eventually produces a second adult parasite generation.

The fact that third and fourth parasitized instar larva are estimated particularly low with respect to measurements indicates that severe modeling errors cannot be compensated for by filtering formulations alone. It should be noted that this simulation costs no more than a deterministic simulation, which is particularly important to entomologists, who are constantly adjusting model parameters and rerunning simulations in response to new submodel information.

VI. Conclusion

This work was concerned with obtaining relatively simple algorithms for estimating insect density in a field using counts taken at various instants. Entomologists are beginning to consider the use of models in the management of individual alfalfa fields [1]. When this occurs, the filtering techniques considered herein will have their strongest justification. Moreover, using the parametric approach, entomologists can easily modify their crudest models to incorporate the information provided by insect counts taken during the entire season.

It is difficult to precisely formulate stochastic models in terms of explicitly representable uncertainties. Although modeling errors contribute to this problem, an additional contribution is made by a wide variety of unobserved environmental variations which differ in characteristics from field to field. Thus it would be reasonable to expect that such difficulties are inherent in the stochastic model formulations. To compensate, artificial uncertainties must be introduced. The question of how much artificial uncertainty to use remains to be a matter of judgment. Despite these difficulties, it has been shown that a simplified filter can be constructed to enhance insect population models.

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Book Reviews

Dynamic Programming and Stochastic Control—D. P. Bertsekas (New York: Academic, 1976, 397 pp.). *Reviewed by Chelsea C. White, III, Department of Applied Mathematics and Computer Science, University of Virginia, Charlottesville, VA 22903.*

This first-year graduate level text represents a well-written and substantial contribution to the teaching of the theory and application of stochastic control. Its primary contribution is an elegant, but not mathematically demanding, framework for the simultaneous study of several classes of stochastic control problems important to operations researchers, control engineers, statisticians, and economists. It contains examples from a wide variety of problem areas which illustrate theoretical developments and their applications and present a broad view of the theory's applicability (e.g., the operations research student perusing this text would become acquainted with the linear-quadratic-Gaussian control problem). The author has stressed several basic principles (feedback, adaptivity, sufficient statistics, contraction mappings) which are fundamental to the treatment of uncertainty in the context of control. The role of causality in the development of the optimality equations is sufficiently, although implicitly, discussed (a thorough discussion can be found in [1]). Other invaluable topics are also presented, such as state estimation, suboptimality, state space augmentation, and computational aspects. Several systems topics such as controllability, observability, and stability are addressed. Performance indices other than the usual expectation of a sum of random variables are considered, taking into consideration risk sensitive utility functions (more extensive discussions of applications of dynamic programming to other performance indices can be found in [2], [3]).

The text is divided into two parts. Part I is concerned with finite horizon problems, whereas Part II deals with several infinite horizon cases. The problem formulation throughout is based on a stochastic difference equation description of the state dynamics which is standard in modern control theory. Operations researchers should have little trouble adjusting to this slightly different (and for the finite state case, equivalent) description of system state evolution. Part I emphasizes conceptual aspects of sequential decisionmaking under uncertainty and requires as a mathematical background introductory probability theory and undergraduate mathematics. The mathematical rigor of Part II is appropriately more substantial but easily should be within the reach of the reasonably prepared student.

Part I is composed of four chapters which respectively discuss dynamic programming, applications, problems with imperfect state information, and computational aspects and suboptimal control. The applications chapter presents the linear-quadratic-Gaussian problem (popular in modern control theory), an inventory control problem (an operations research problem), a portfolio analysis problem (an investment problem), and an optimal stopping problem (motivated by a land investment example). The finite-state material discussed for the partial information case is new in textbook form. The subsections concerned with the notion of adaptivity and various suboptimal controllers (also new in textbook form) combine several interesting and valuable concepts and techniques which are probably unfamiliar to many not directly involved with stochastic control research.

Part II is composed of three chapters, each one primarily concerned with one of the following performance indices: discounted cost, undiscounted cost, and average cost. The usual computational methods—successive approximation, policy iteration, and linear programming—are presented. The important contraction mapping approach is utilized in the discounted (uniformly bounded) cost case, and interesting new monotone mapping results recently developed by the author are presented which do not require the often restrictive boundedness assumption (further results can be found in [4]). The undiscounted cost chapter evolves from the material (presented in Section 6.4) on unbounded cost. The average cost chapter lucidly presents relatively standard material on the topic.

There are four short appendices (mathematical review, on optimization theory, on probability theory, on finite state Markov chains) which represent the level and extent of prerequisite material for the text. The list of references is excellent and of substantial value to the research community. The home problems have been thoughtfully developed and represent a particularly nice theoretical and applications-oriented complement to the text. Although not required for the remainder of the text, Chapter 1 serves as an introduction to several general notions associated with decision-making under uncertainty.

In summary, the book is an excellent addition to the stochastic control textbook literature. It represents a more appealing format for relating the stochastic control problem formulations of a variety of disciplines and is much broader in perspective than any of the recent well-known stochastic control texts.

Although the author has endeavored to present fundamental concepts under general structural assumptions, many of the special cases considered in the examples provoke additional, structure-dependent results, e.g., the existence of an optimal control linear in the conditional expected state for the LQG problem, the existence of optimal strategies composed of monotone policies for the standard countable-state replacement and inventory control problems. The author references Witsenhausen's 1971 *IEEE Proceedings* paper, which discussed at length structural properties of optimal controls for standard and nonstandard LQG problems; an additional hallmark article regarding general structural attributes for optimal policies under which the aforementioned monotonicity results can be considered is [5].

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Redesigning the Future, A Systems Approach to Societal Problems—Russell L. Ackoff (New York: Wiley-Interscience, 1974). *Reviewed by John N. Warfield, Department of Electrical Engineering, University of Virginia, Charlottesville, VA 22901.*

This book presents an organizing perspective on society and some of its problems.

In the first part, titled "In General," it is argued that we are in the "Systems Age," and this age is producing a "Postindustrial Revolution." One of the principal requirements in such an age is to develop organizing approaches to societal problems. Such approaches benefit from "expansionism," a way of thinking that places much emphasis on interactions in society.

Three major types of problems are identified in the first part. These are self-control, humanization, and environmentalization. Generally speaking, these relate to gaining the capacity to cope with interacting problems, and to organizing our systems in such a way that the purposes of the parts are served while the purposes of the systems are also served.

Several modes of thinking about societal problems are compared. These are "reactive," "inactive," "preactive," and "interactive." The author clearly favors the interactive mode, and develops and illustrates the other three modes to help contrast them with the preferred mode.

The second part, "In Particular," discusses possible innovative approaches to the resolution of various kinds of societal problems or messes, including education, the generation gap, race, crime, health, solid waste and litter, transportation and the city, and development of underdeveloped countries.

The style tends to be literary and tentative, or idealistic, rather than analytical. The author stresses the need to establish ideals and to work toward these. Cases are occasionally used to add sharpness and a sense of purpose to the more general discussions.

The book is distinctly weakened by the liberal use of such generalities as "educators make little or no effort to relate the bits and pieces of information they dispense," "the young know that their parents do not mean much of what they say, but their parents do not know this," "modern medical practice is not as far from that of the primitive medicine man as physicians would like us to believe," "hospitals ... are more concerned with serving doctors and other staff members than they are with patients," "the quality of candidates for public office is frequently so low as to deprive the electorate of responsible and effective representation and meaningful choice."

The author is well-known for contributions to the concept of "purposeful system." The author surely must be a purposeful system, seeking to bring about major changes in the way people think, and to stimulate innovative approaches to systemic change. Wholesale indictments of large groups of people seems to conflict with this purpose. The people who would have to be instrumental in bringing about the kinds of change the author advocates would seem to include the groups that the author is ready to indict *en masse.*

The author must intend that we "do as he says, not as he does." His convincing argument for treating students and workers as individuals rather than as "black boxes whose output would hopefully exactly match what was put into them" contrasts rather sharply with his own treatment of educators, parents, physicians, candidates, and others who do not have the advantage of being students or workers.

The advocates of systems approaches are at their best when they are applying such approaches and helping others learn how to do so. They are close to their worst when they preach from soap boxes or beer barrels.

Societal Systems: Planning Policy, Complexity—John N. Warfield (New York: Wiley-Interscience, 1976, xxvii + 490 pp.). *Reviewed by Raymond Fitz, University of Dayton, Dayton, OH 45469.*

Over approximately the last 15 years, John Warfield has been addressing questions on the systemic and systematic approaches to dealing with modern societal problems. The book, *Societal Systems*, represents a compilation and integration of Warfield's efforts. Warfield's book will be a foundational book in the field of solving complex societal problems. In the future there will be books on the topic of societal complexity which will be better when evaluated from the limited perspective of "pedagogy" or "social science research." Yet it is safe to say that each of these contributions will be influenced by Warfield's contribution to the problem of societal complexity.

Specifically, Warfield has explored the methodological questions of how frameworks of appreciation, that is, frameworks of understanding and valuing, can be developed for complex societal situations and how these frameworks of appreciation can be developed collectively. Warfield points