

Introduction to the 2010 Edition

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In this classic book Richard Bellman introduces the reader to the mathematical theory of his subject, dynamic programming. His goal is to show how multistage decision processes, occurring in various kinds of situations of concern to military, business, and industrial planners and to economists, are amenable to mathematical analysis. Written during the infancy of high-speed, large-capacity digital computers, it is understandable that he takes as his goal the mathematical deduction of the structure of optimal decision policies for such problems.

He brilliantly accomplishes this for a surprising variety of situations involving both deterministic and stochastic processes, continuous as well as discrete-stage evolution, and finite as well as infinite problem duration.

Even while demonstrating his impressive mathematical ingenuity, Bellman informs the reader in his preface that research is already underway on the computational solution of problems for which general solution structures are unattainable. He clearly believes that dynamic-programming problems can be mathematically intractable yet, when approached with formulational ingenuity, yield results of practical value. I was privileged to join him in this effort.

We illustrated and attempted to popularize this computational application of dynamic programming using largely military and industrial planning problems of the kind faced by members of our operations-research community. Despite our best efforts, however, surveys of applied practitioners in our area regularly, and painfully for us, showed dynamic programming to be used much less than our planning competitor, linear programming. In the real world of operational planning, the number of state-variable values needed to describe any particular situation that might be encountered during a sequential planning process had frequently turned out to be too large for computational treatment. Dynamic programming seemed to have fallen victim to what Bellman has called the “curse of dimensionality.”

One might well wonder, why reprint this introductory volume if dynamic