handled via simulators (especially at colleges) and with the flexibility that simulators offer, that probably would have been a better approach to take.

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Faces of Science, by V. V. Nalimov, ISI Press, 1981, xv + 297 pp., $22.50.

This is a charming collection of essays on the philosophy of science, written by a distinguished Soviet statistician who brings to the topic an unusual breadth of expression in theoretical and applied science.

As a young scientist, Nalimov worked in high-vacuum physics and in metallurgy. He came to statistics through its applications to practical scientific work, and he has been a leader in introducing Western work on experimental design to Soviet science. He is known in the West for his book on statistics in chemistry (*The Application of Mathematical Statistics to Chemical Analysis*, Pergamon, 1963) and for his papers on experimental design in *Technometrics* and *Metron*. Now in his early 70's, Nalimov is Chief of the Laboratory of Mathematical Experiment at Moscow State University.

Faces of Science is the second of three books by Nalimov that have been published by the ISI Press. The first, *In the Labyrinths of Language: A Mathematician's Journey* (1981), explored various mathematical approaches to language, including a Bayesian analysis of semantics. The third, *Realms of the Unconscious: The Enchanted Frontier* (1982), extended this analysis to a deeper study of psychology.

Nalimov gives serious attention to the philosophers of science prominent in the English-speaking world: Popper, Kuhn, Lakatos, and so forth. But whereas English-speaking philosophy of science has tended to concentrate on the most successful and elegant scientific theories and on abstract logical and statistical issues, Nalimov's perspective takes in the messier realities of contemporary science. He points out to Popper that only some science is open to direct experimental falsification, and he points out to Kuhn that contradictory paradigms can flourish simultaneously.

One of the most interesting themes of the book is Nalimov's development of the idea that mathematics is the language of science. Applied mathematics, he suggests, is the use of mathematics as a language, and pure mathematics is the study of the grammar of this language. Probability and mathematical statistics, in particular, provide a language and hence a way of thinking about the world. Statistical analysis, he suggests, is the art of using this language to describe the real world. To do this is not to pretend that the real world exactly fits the grammar of the language. Probabilists who deride most statistical work because it goes beyond situations of true randomness are missing this point.

Another interesting theme is the comparison of science to the biosphere: both are self-organizing systems that can, to some extent, create resources for their own further growth. The creation of new disciplines in science is marked by a specialization of language that prevents easy communication with other disciplines, just as the creation of new species in the biosphere is marked by a specialization of genetic codes that prevents easy cross-breeding. Science, Nalimov suggests, has not yet found a mechanism, like natural selection in the biosphere, to eliminate its barren branches.

Nalimov has much to say about the organization of science, particularly in the Soviet Union. Soviet science is quite concentrated: 50% of the creative scientists are located in Moscow and another 13% in Leningrad. The disadvantages faced by scientists in other centers are indicated by the fact that more than 9,000 different scientific journals are received by libraries in Moscow, about 5,700 in Leningrad and only 3,600 in the third most active center, Novosibirsk. One also learns that the reallocation of personnel from the physical to the biological sciences that has taken place in the West since 1960 has not taken place in the Soviet Union.

Nalimov decries the lack of a statistics tradition in the Soviet Union; there statistics remains "either an appendage to economics or a branch of pure mathematics," so students in mathematical statistics and probability theory acquire a "contempt for experimental research and the corresponding mode of thinking." There are no applied statistics journals in the Soviet Union, and only 20 copies of *Technometrics* are received there.

Like many collections of essays, this book can be faulted for its repetitions. Occasionally the English translation seems less than perfect. But on the whole, the book is entertaining and valuable.

Glenn Shafer
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Applied Time Series Analysis II, edited by David F. Findley, Academic Press, 1981, 798 pp., $49.50.

This volume contains 21 papers that are revised versions of talks given at the Second Applied Time Series Symposium in Tulsa in March 1980 under the sponsorship of the University of Tulsa and the Tulsa Section of the Institute for Electronic and Electrical Engineers. The authors are from universities, government, and industry. They include an astronomer, an economist, several electrical engineers, geophysicists, mathematicians, seismologists, and statisticians.

To assist the nonspecialist reader, an extensive introduction has been provided, which summarizes each of the papers—often with a perspective different from that of the authors and with a "neutral" terminology. A key-word index can be found at the end of this collection.

A few of the papers are survey papers. Others present some advances in time series analysis and signal processing. The first 10 papers deal mainly with signal processing and the last 11 with statistical modeling and deconvolution.

Of special interest to statisticians are papers by Justice, Ulrych and Walker, Gray and Woodward, Parzen, and Martin. Justice summarizes the advances made in recent years in extending methods of time series analysis to "spatial" series—that is, those whose time parameter is multidimensional. Ulrych and Walker use a simulated example to study the effectiveness of a variety of two-dimensional spectrum estimators. Gray and Woodward's emphasis is on model identification for nonstationary series. Parzen looks at time series modeling as a sequential procedure. Trends and periodicities with long memory are to be eliminated to produce residuals with short memory, such as an autoregressive process, and finally, these are to be estimated and subtracted to produce residuals with no memory—that is, white noise. Martin's paper looks into the problem of outlier resistant procedure in time series analysis.

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TABLE OF CONTENTS