Operations Research at Yale: A Personal Account

by Eric V. Denardo

INFORMS asked me to write a history of operations research at Yale. The account that appears here is based on my personal experience and recollection. It consists of discussions of our faculty, of our Ph. D. program, of our contributions to professional and undergraduate education, and of our experience as an organization.

Yale's operations research group began as part of the Department of Industrial Administration in the faculty of Arts and Sciences (FAS). In the mid-sixties, our department's name was changed to Administrative Sciences (Ad. Sci.). This department was folded into Yale's School of Organization and Management (SOM) in 1976. In the fall of 1988, several of us were cast out of SOM. In the spring of 1989, we were formed as the Department of Operations Research within FAS, and our department was demolished shortly thereafter.

Faculty

I begin with a sample of our faculty. This sample is representative, but it omits important members of our group.

Early in the 1960's Robert B. Fetter joined our group as a junior faculty member. Early in his career at Yale, Bob lunched with a wealthy alumnus who expressed his enthusiasm for operations research, broadly defined, and offered an endowment of $15,000,000 to help develop the field at Yale. The President of Yale insisted that the money be donated for one of the humanities, and the alumnus withdrew his offer.

Bob Fetter is best known for the contributions that he and John D. Thompson made to peer review and subsequently to medical reimbursement. They observed that a peer review panel at Yale/New Haven Hospital dealt with instances of medical practice that were unusual but not inappropriate. This led them to invent and develop Diagnostic Related Groups (DRGs). A DRG describes the norm for the treatment of a medical procedure, such as a routine appendectomy. DRGs allowed Bob and John to present to the peer review panel instances of medical practice that differed sharply from the norm. This vastly improved the panel's

effectiveness. Bob later expanded work on DRGs to provide the basis for cost-based medical reimbursement, e.g., by Medicare.

In 1963, Martin Shubik joined our group as a full professor. Martin's research exhibited extraordinary span and power. In its issue dated Sept. 1, 2018, the *NY Times* celebrated Martin's accomplishments with a lengthy testimonial and a photograph. In addition to his own work, Martin launched and enhanced the careers of a great many students in areas as diverse as management gaming, financial analysis, national defense, game theory, and arts management. He was for decades a mainstay of our Ph. D. program.

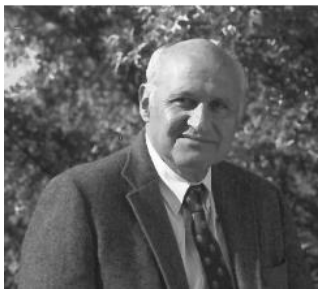
Prior to 1967, Nils Hakanson and Ellis Johnson joined our group. Nils made fundamental contributions to accounting and finance. Ellis did beautiful and exceedingly useful work on networks and integer programming. Both left by 1969.

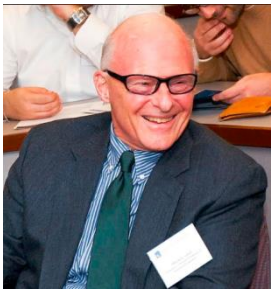
In 1967, Matthew Sobel, Don Topkis, and Harvey Wagner joined our group. Don did path-breaking analyses of problems whose optimal solutions can be shown to be monotone in a parameter. He stayed for two years. Harvey Wagner and Matt Sobel remained for a time.

Harvey's text brought into focus the work of scores of operations researchers and made the field accessible to a wide audience. While at Yale, Harvey continued his exploration of inventory systems, and he oversaw a number of Ph. D. theses. He left to become a Dean at the University of North Carolina.

Matt Sobel made lovely contributions to inventory control, to production management, and to applications. He and Dan Heyman coauthored a pair of comprehensive and highly acclaimed books on applied probability. Matt earned tenure at Yale, but left soon thereafter. Over the course of his career, Matt has mentored about two dozen Ph. D. students.

Martin Shubik and Matt Sobel





Ward Whitt joined our group in 1969. Ward made several important contributions to probability and its applications. His work includes extremely useful approximations of queues with high utilization. Ward left Yale before 1976.

Uriel G. Rothblum joined our group in the mid 70's. His Ph. D. thesis had included superb and much-cited work on nonnegative matrices. While at Yale, Uri made deep contributions to several fields, Markov decision models among them. After being denied tenure at Yale, Uri continued a very fruitful career at The Technion. He may have been the most versatile scholar in the mathematics of operations research. He interrupted his research activities to be a very successful administrator. He was also my favorite coauthor.

Ludo Van der Heyden graduated from our Ph. D. program. His research span was broad. It included important work on fixed-point approximation. Ludo earned tenure at Yale. He left in 1989.

Arthur J. Swersey joined our group early in the history of SOM. Art did good applied work, and he was instrumental in the development of very successful SOM courses in quantitative reasoning and in operations management. He earned tenure at SOM and was much-loved by its students. They endowed a classroom in his honor.

Kurt Anstreicher joined our group in 1982. He is very well known for fundamental work on interior-point methods. He is also the best teacher I have ever encountered. He left Yale in 1991 after being denied tenure.

Edward Kaplan's first major accomplishment after joining our group dealt with a needle exchange experiment in New Haven. He analyzed its results and concluded that needle exchange would decrease the rate of spread of the HIV virus by about one third. This conclusion was confirmed by the National Academy of Sciences. It led many states to legalize needle exchange. In this instance and in many others, Ed has displayed a unique talent for innovative and insightful models of operational issues.

Art Swersey and Ed Kaplan

These faculty members are illustrative. Others of comparable quality joined our group. In concert, they attest to our ability to identify and attract young scholars who would become world famous. These people would be a credit to the decision sciences at any of the world's finest universities.

Doctoral education

Over the course of its history, our Ph. D. program in operations research had a high success rate, a short time to degree, diverse output, and excellent placement. Mentioned here are a few of the many scholars that we produced.

Michael Todd (now emeritus from Cornell) did brilliant work on optimization. Paul Bracken (now a professor at Yale) made fundamental contributions to defense analysis and other areas. Chris Tang (now a university distinguished professor at UCLA) is esteemed for his work on supply systems. Anat Admati (now at Stanford) is famous for her work in finance and banking. David Paltiel (now at Yale) is expert at medical decision making.

Throughout our history, our Ph. D. students were admired and welcomed by the faculty in cognate departments. When Ad. Sci. was folded into SOM, we broadened our program to serve the needs of faculty in related disciplines. In 1988, our program was transferred to FAS. It was closed shortly thereafter.

Professional education

During our time at SOM, its professional curriculum had nine core courses. Our faculty developed and taught these three – quant, operations, and data. All three were challenging, useful, integrative, and very well received. This curriculum was severely altered in 1988.

Our group also contributed substantially to the management of SOM. One role we played was in the development of its admissions process. By 1983, SOM had a superb director of admissions, an admissions process that involved faculty and students, and an excellent track record. We lost a few applicants to Harvard, a few to Stanford, and virtually none to other schools. This too was disrupted in 1988.

Undergraduate education

While we were housed in SOM, undergraduate education could not be a top priority. It went reasonably well, nonetheless. Funds from FAS helped support our courses, and visiting faculty helped to teach them.

In the spring of 1989, operations research became a department, undergraduate education became a focal point, and interest in the applied mathematics major doubled immediately. The students who concentrated in operations research found excellent and far-ranging topics for their senior projects. But the faculty positions that had been allocated to us were promptly eliminated.

Our participation in the applied math major lingered for a time. This was largely due to the participation of Adjunct Professor Jerome Bracken. He taught a very successful course in military operations research. It attracted humanists and applied math majors in equal numbers. Jerry helped many students to find professional employment opportunities in or near Washington DC. Half of the funds needed to support Jerry's course were provided by the Dean of Yale College. The other half was cobbled together each year.

A milestone

The fall of 1988, the President of Yale named a new Dean of SOM. The President also announced that none of the untenured faculty in organizational behavior would be reappointed and that many of the operations research faculty would be shifted from SOM to FAS.

Janny Leung, Jon Lee, Kurt Anstreicher and Offer Kella

This violated Yale's norm of basing decisions on informed consultation. Prior to the President's announcements, there had been no discussion with any faculty member in organizational behavior, none with any faculty member in operations research, and none with the director of SOM's management program. There had been no prior discussion with the Dean of Yale College, who was responsible for undergraduate education. And there had been no prior discussion with the Dean of the Graduate School, who was responsible for doctoral education.

When the President informed me of his decisions, I expressed my regret that he had not consulted with me, and I expressed my opinion that he had, to a very considerable extent, separated the students of SOM from their education. I asked that operations research be set up as an independent unit within FAS and that there be no reduction in scale. I also asked that each of our untenured faculty members be guaranteed an opportunity to be evaluated for his or her next promotion. I might have insisted that we be granted a half decade to rebuild and stabilize our faculty, but I did not foresee the necessity of doing so.

The President's decisions were destabilizing. Bob Fetter retired earlier than he had intended, and Ludo Van der Heyden accepted a position at INSEAD at Fontainebleau. Kurt Anstreicher needed to be coaxed to rescind his resignation, and each untenured faculty member was wary.

Neither I nor any other member of our group had advocated shifting us to FAS, and no plans had been made to fund our slots in FAS. SOM's incoming Dean was informed by his administrator that restricted endowment of approximately $10,000,000 must shift with me to FAS. The President assured me that it would, but that did not occur.

In addition, failure to consult with the Deans of Yale College and of the Graduate School had made it impossible to establish a smooth transition to FAS. We were slated for demolition at the first opportunity.

The end was deeply saddening. Had we been allowed to establish ourselves within FAS, undergraduate interest in operations research would have swelled, and Yale would have become more competitive with Stanford, Princeton, Columbia, and other universities in the market for technically gifted undergraduates.

A personal note

There were good times as well as sad times. Administrative duties had its high notes. Jaroslav Pelikan was a towering figure, and dealing with him was a joy that I cherish still. Henry Broude kept Yale's best interests foremost, and I remember him fondly. And there are others. Research was exciting. One highlight was the opportunity to collaborate with Uri Rothblum. Teaching was great fun, be it at the undergraduate, professional or doctoral level. In the aggregate, I consider myself to have been exceedingly lucky. I was paid to do things I thoroughly enjoyed.

Uri Rothblum, Chris Tang, and myself