

Mathematics for Business Decisions

HOW REAL ARE THE PROJECTS?

What do we mean when we say that *Mathematics for Business Decisions* has "*major, real world*" projects? Consider the following. The mathematics behind two of our four projects, one each in *Part 1* and *Part 2*, won Nobel prizes in economics during the last 10 years.

- * John C. Harsanyi, John F Nash and Reinhard Selten were awarded the 1994 Nobel Prize in Economics for work containing what is now called the Nash equilibrium. In *Project 2* of *Mathematics for Business Decisions Part 2*, students develop a Nash equilibrium bidding strategy in first-price, sealed-bid auctions.
- * Robert C. Merton and Myron S. Scholes were awarded the 1997 Nobel Prize in Economics for work containing what is now called the Black Scholes formula for determining the value of a European stock option. In *Project 2* of *Mathematics for Business Decisions Part 1*, students use historical data on stock prices to measure volatility and compute the value of a European call option.

The mathematics in these achievements is still challenging, requiring a background of considerable mathematical sophistication. How does *Mathematics for Business Decisions* make the underlying concepts accessible to freshman business students? The answer is in one word. Computers. Our projects set up the structure of a decision problem, and then present the mathematical tools that students need in order to teach a computer how to simulate auctions or option values. In the instructional setting, simulation by Monte Carlo methods and bootstrapping can replace a great deal of mathematical complexity, while still yielding meaningful business answers. Of course, we emphasize that simulation cannot replace traditional mathematical rigor in the work of mathematicians and economists.

This research to instructional flow has also produced a reverse flow from undergraduate instruction to research. Simulation has led to the discovery, and subsequent full mathematical proofs, of new research level results in auction theory. This has been done by Richard B. Thompson and A. Larry Wright at the University of Arizona. Students in *Part 2* of *Mathematics for Business Decisions* give reports using Nobel prize structure and terminology to find a Nash equilibrium, whose existence was unknown until the year 2001.

This use of simulation to bring complex mathematical concepts into the work of lower division undergraduates benefits both students and mathematics. Students see that mathematics can provide powerful support for business decisions. In their later business careers, this will motivate them to consult with mathematicians and employ effective quantitative methods.

Mathematics provides many important tools for economics and other business fields. However, our discipline does not profit from this work when students (who later become part of the general public) are unaware of its existence. Presenting trivial mathematical applications only makes matters worse, since they are clearly recognizable as being of little importance. This actually diminishes our subject in the eyes of students. Using computers to bring the underlying structure of significant mathematics to undergraduates allows them to appreciate the role that our subject can play in their academic work and later lives. The recognition of its importance by many students each year will certainly strengthen the position of mathematics in our society.