In the last three decades, derivatives have become increasingly important in the world of finance. Futures and options are now traded actively on many exchanges and OTC around the world. Yet most of our undergraduate finance courses, which mostly study underlying assets and institutions, simply do not have enough time for an in-depth discussion of derivatives. This class presents both a practical and theoretical approach to derivatives markets.

The course starts with basic definitions and properties of put and call options, and forward and futures contracts. Payoff diagrams are used to illustrate these basic notions. Determinants of derivatives values are discussed. The basic no-arbitrage pricing relationships between different types of derivatives are established.

Then the course proceeds to the basic probability and calculus review. Reviewing required mathematical tools at a relatively early stage enables students of different levels of technical preparation to succeed in the class. Once students acquire the required mathematical tools, the course quickly moves to proving the Black-Scholes formula and its properties ("Greeks"). We originally prove the formula for European put and call options written on nondividend-paying assets in a very simple, discrete time, two-period setting. The distinctions between European and American put and call options in terms early exercise and therefore applicability of the Black-Scholes formula are discussed in depth. The derivation ultimately culminates in obtaining the Black-Scholes formula for dividend-paying assets in continuous time. The relationships between the expectation and standard deviation of the rate of return of the derivative and the expectation and standard deviation of the
rate of return of its underlying instrument are established. Proving the results rather than simply stating them ensures not only a deeper understanding, but also that the students will correctly apply derived formulas.

Once on a sound technical ground, the course moves to practical applications (pricing, hedging) and calculations. The practical part of the course starts with Excel Spreadsheet software that calculates the Black-Scholes prices of put and call options and "Greeks" for different combinations of underlying asset price, risk-free rate, sigma, time to expiration, and strike price. I use it for live demonstrations in class and students are required to download this software to perform calculations on their own. As a practical application of this software we price long-term put options written on long-term retirement portfolios invested in stocks, thus answering the question of how risky and expensive it would be to insure a long-term individual Social Security account invested in stocks against the risk that the portfolio’s value would collapse.

We then take a look at various index and equity options traded on CBOE, and futures and futures options traded on CME. For example, we use Matlab Financial Toolbox and actual market prices of futures and futures options contacts written on the S&P/Case-Shiller Home Price Indexes traded on the CME to obtain the implied market volatility to estimate the variances of these indexes. Then we use this estimate to calculate the Black-Scholes prices of pools of single family mortgages in default in Freddie Mac and Fannie Mae portfolios for 5 different geographical regions and various mark-to-market LTVs.

So, this is a very comprehensive course, where a strong theoretical component is combined with computational experiments and an in-depth practical look at actual derivatives markets. According to the recent data, roughly 30% of our Haas undergraduates go into the financial services industry. There is no doubt that this course will make them more competitive in this ever more demanding market place.

**Required Text:** John C. Cox and Mark Rubinstein, Options Markets, Prentice Hall, 1985