**MA\*730 Financial Mathematics**

Introduction to Mathematical Finance: Stocks, bonds and financial markets, Options and forward contracts, Pricing by no-arbitrage consideration, One-period binomial model, The Fundamental Theorems of Asset Pricing. The Binomial Asset Pricing Model: Pricing by replication in a multi-period model, Basic probability, Martingales and European derivative securities, The risk-neutral probability measure, Derivative securities with random payment times, Computational issues. The Black-Scholes Formula: Scaling time and model parameters, Using the Central Limit Theorem to obtain a limit, The role of volatility. Brownian motion: Limit Theorem to obtain a limit. The role of volatility. Brownian motion: Limit of scaled random walks, Definition of Brownian motion, Quadratic variation of Brownian motion, The problem of integration with respect to Brownian motion. Stochastic calculus: Ito’s integral. Ito’s formula, Geometric Brownian motion. The Black-Scholes Formula Revisites:

Evolution of a call option price, Evolution of replication portfolio, Matching evolutions to price the call. Optimal Consumption and Investment in the Binomial Model: Risk aversion, some decision theory and utility functions, Dynamic programming. Optimal Consumption and Investment in the Brownian Motion Model: The Merton problem, The optimal-control formulation and the Hamilton-Jacobi-Bellman (HJB) equation, Constant relative risk aversion (CRRA) utilities and proportional investment strategies, Further Topics in Optimal Consumption and Investment. The martingale method, Complete and incomplete markets.

**References:**

1. Ales Cerny (2009). “Mathematical Techniques in Finance: Tools for Incomplete Markets”. Princeton University Press.
2. S. R. Pliska (2002). “Introduction to Mathematical Finance: Discrete Time Models”. Blackwell Publishers INc
3. M. Capinski and T. Zastawniak, Mathematics for Finance: An Introduction to Financial Engineering, Springer, 2005
4. J. C. Hull, Options, Futures and Other Derivatives, 7th Edition, Pearson Education, 2009
5. S. Shreve, Stochastic Calculus for Finance, Vol. 1 and Vol. 2, Springer, 2004.