Syllabus for MATH 6201: Statistical Techniques in Finance

Basic Probability and Statistical Models: Conditional Probability, Independence, Bayes Theorem, Central Limit Theorem; Binomial, Uniform, Normal, Log-normal, Exponential, Double Exponential, t, F, Chi-square, Gamma, Beta Distributions; Skewness and Kurtosis; Correlation; Maximum likelihood estimation.

Financial Return: Net Return, Gross Return, Log-return, Random Walk model, IID Return, Log-normal model, Geometric Random Walk

Time Series: Stationarity and Nonstationarity, AR(1), AR(p), LS Estimation, MA(q), ARMA(p,q), ARIMA(p,d,q) models, ACF; Model selection: AIC, BIC

Portfolio Theory: Expected Return and Risk, mean-variance theory, Sharpe ratio, Tangency portfolio with two risky assets, Risk Efficient portfolio, Minimum variance portfolio

Regression: Linear regression, estimation of the parameters, Multiple Linear Regression, ANOVA, R^2, adjusted R^2, F-test, Best linear predictor, model selection, Collinearity and Variance Inflation factor, Nonlinear regression, residual analysis: Test for normality (normal probability plot), nonconstant variance (scatter plot smoother), Weighted least Squares.

CAPM: Capital Market Line, Security Market Line, Beta, Security Characteristic Line, Reducing Risk, Estimation of Beta and Testing the CAPM

GARCH Models: ARCH(1), ARCH(q), GARCH(p,q), GARCH-M, ARIMA (p_A, d, q_A)/ GARCH(p_G, q_G) models; ACF; Conditional least squares estimation.