

MATH 6201- Statistical Finance

MS Math Finance Course

Course description

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Quick Review of Probability and Statistical Models: Axioms of Probability, Conditional Probability, Independence, Bayes Theorem, Probability Distributions: Binomial, Uniform, Normal, Log-normal, Exponential, Double Exponential, t, F, Chi-square, Skewness and Kurtosis, heavy tailed distributions including Pareto distribution, LLN, CLT, Correlation, Multivariate Normal Distribution, Best linear Predictor, Maximum likelihood estimation, confidence interval for the mean, Hypothesis testing, P-value, Two sample t-test, likelihood ratio test.

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

Time Series: Stationarity and Nonstationarity, AR (1), AR (p), LS Estimation, MA (q), ARMA, ARIMA models. 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, t-value, p-value, ANOVA, R^2 , adjusted R^2 , and F-test, Best linear predictor, model selection, Collinearity and Variance Inflation factor, Cook's D, 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

Options Pricing: Call Options, Put Options, Arbitrage, Binomial Model, Pricing Call by Binomial Model, Two step binomial, Multi step binomial Tree, Martingale, Risk

neutral measure, Weak Convergence of Random Walk to Brownian Motion, Geometric Brownian Motion, Black-Scholes Model, Black-Scholes Options Pricing Formula, Put-Call Parity, Hedging, Greeks, Interpretation of Greeks, Delta and Gamma Hedging

Fixed Income Securities: Zero Coupon Bond, Yield to Maturity, Term Structure, Forward Rate, Estimation of Forward Rate, Short Rate Models: Vasicek Model, Cox-Ingersoll-Ross Model, Interest rate derivatives.

GARCH Models: ARCH (1), ARCH (q), GARCH (p,q), I-GARCH, E-GARCH, Options Pricing Under GARCH, Continuous time GARCH.

Value at Risk: VaR, Nonparametric Estimation of VaR including Quantile Estimation, Confidence Interval for VaR, VaR for a Portfolio of Assets, VaR and Risk Management, Little bit on Coherent Risk

Behavioral Finance: Defense and Challenges to Efficient Market Hypothesis

If time permits:

Bootstrap and Relation to Efficient Portfolio, Nonparametric Regression and Splines (linear, quadratic and pth degree splines).

Basic Text: Statistics and Finance by David Ruppert References: Analysis of Financial Time Series, Tsay (2005) Stable Paretian Models in Finance, Rachev and Mittnik (2000) Quantitative Risk Management: McNeil, Frey and Embrechts (2005)

Softwares: SAS and MATLAB