

Class Code: MM307		Class Title: Stochastics and Financial Econometrics	
Type: UG	Level: 3	Credits: 20	Semester: 2
Class Coordinator: Dr J Pan		Tel: 2853	Email: jiazhu.pan@strath.ac.uk
Teaching Staff: Dr J Pan/Professor X Mao			
Pre-requisites: MM304 or equivalent.			
Students: Compulsory: MS Optional: M, MT, MSA, MSE, MSMS, MSF			
Overlaps:			

CLASS DELIVERY (HOURS)

LECTURES	TUTORIALS	LABORATORIES	ASSIGNMENTS	SELF STUDY	TOTAL
48	12	12	24	104	200

CLASS ASSESSMENT

3 hour degree examination in May with August resit.

GENERAL AIMS

- To introduce the basic concepts of random phenomena evolving in time, from two complementary points of view: probabilistic modelling and data-driven analysis.
- To present underlying ideas of simple stochastic processes, time series models, and the associated probability theory and statistical techniques.
- To present applications of the methods to financial and economic systems, including modelling, data analysis, and forecasting.

LEARNING OUTCOMES

- On completion of this class, the student should be able to
- understand and apply appropriate methods from probability theory;
 - analyse simple stochastic models (Markov chains, Poisson and renewal processes, queueing systems);
 - understand basic concepts of time series (stationarity, trend, seasonality, and autocorrelation);
 - identify and interpret various time series models, and choose appropriate methods for analysing a given time series.
 - apply methods of analysis and forecasting to financial and economic systems in the presence of volatility.

SYLLABUS

Markov chains: Markov models in finance, Markov property, n-step transition probabilities, classification of states, stationary distribution, 1st-step analysis, simple random walk.

Poisson processes: Poisson processes as insurance claim number processes, independent and stationary increments, inter-arrival and waiting time distributions, thinning, superposition.

Renewal processes: Risk models, renewal sequence, renewal process, arrival times, inter-arrival times, renewal function and equation, renewal theorem, some basic premium principles.

Queueing theory: Poisson arrivals, exponential service times, single or multiple servers, probability distribution of queue size, stationary distribution, M/M/1 queue, M/M/1 queue with balking, M/M/∞ queue, M/M/s queue.

Characteristics of financial time series: Asset returns, time plots, review of statistical distributions, distributions of returns, likelihood function of returns, empirical properties of returns.

Fundamental concepts: Variance and covariance, correlation and autocorrelation function, stationarity, deterministic versus stochastic trends, seasonality, regression methods, residual analysis.

Linear time series: White noise, sample autocorrelation function, Box-Jenkins approach, autoregressive models (properties, partial autocorrelation, identification, estimation), moving average models (properties, identification, estimation), ARMA models, ARIMA models.

Volatility models: Characteristics of financial volatilities, conditional heteroscedasticity, structure of volatility model, ARCH models (properties, estimation and tests), application to analysis of financial data, value-at-risk.

Forecasting: Minimum mean-square error forecasting, forecasting using AR, MA and ARMA models, deterministic trends and ARIMA forecasting, forecasting evaluation.

RECOMMENDED TEXT/READING

Ross, S.M. *"Introduction to Probability Models"* (Academic Press, 10th Ed.). ISBN: 0123756863.

Pinsky, M.A., & Karlin, S. *"An Introduction to Stochastic Models"* (4th edition, Academic Press, 2011). ISBN: 9780123814166.

Cryer, J.D. & Chan, K.S. *"Time Series Analysis with Applications in R"* (Springer, 2nd Ed.). ISBN: 9780387759586.

Tsay, R.S. *"Analysis of Financial Time Series"* (Wiley). ISBN: 9780471690740.

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