REGULATIONS FOR THE DEGREE OF
MASTER OF STATISTICS
(MStat)
For students admitted in 2014-2015 and thereafter

(See also General Regulations)

Any publication based on work approved for a higher degree should contain a reference to the effect that the work was submitted to the University of Hong Kong for the award of the degree.

Admission requirements

MS 1. To be eligible for admission to the courses leading to the degree of Master of Statistics a candidate

(a) shall comply with the General Regulations;
(b) shall hold
  (i) a Bachelor's degree with honours of this University, or
  (ii) another qualification of equivalent standard from this University or another University or comparable institution acceptable for this purpose; and
(c) shall pass a qualifying examination if so required.

Length of curriculum

MS 2. (a) The curriculum of the programme shall extend over not less than two academic years for part-time study and over not less than one academic year for full-time study. Candidates shall not be permitted to complete the curriculum in more than three academic years for part-time study, and two academic years for full-time study, except with the approval of the Faculty Board.

(b) A candidate with appropriate qualification and professional experiences may, on production of appropriate certification of having satisfactorily completed any of the two compulsory courses as specified in the syllabuses, be exempted from those courses and be replaced by other elective courses in the curriculum when he/she is admitted to this programme, subject to the approval of the Head of Department.

Award of degree

MS 3. To be eligible for the award of the degree of Master of Statistics, a candidate shall

(a) comply with the General Regulations; and
(b) successfully complete the curriculum in accordance with the regulations set out below.

Completion of curriculum

MS 4. To successfully complete the curriculum, a candidate shall follow courses of instruction and shall satisfy the examiners in the prescribed courses and in any prescribed form of examination in accordance with the regulations set out below.

Examinations

MS 5. (a) In any course where so prescribed in the syllabus, coursework or a project report may constitute part or whole of the examination for the course.

(b) Except where otherwise stated, the assessment weight assigned to coursework will be 25% of the total marks.

MS 6. If during any academic year a candidate has failed at his/her first attempt in a course or courses, but is not required to discontinue his/her studies by Regulation MS 8, the candidate may be permitted to present himself/herself

(a) for re-examination in the failed course or courses before the next academic year, resulting in no more than a pass grade under this provision; or
(b) for repeating the curriculum and re-examination in the failed course or courses in the next academic year; or
(c) for enrolment and examination in substitute courses of equal number of credits of the failed course or courses, noting that under this provision a course that is designated as compulsory cannot be substituted.

MS 7. Failure to undertake the examination of a paper as scheduled shall normally result in automatic failure in that paper. A candidate who, because of illness, is unable to be present for one or more papers in any written examination may apply for permission to present himself/herself at a special examination for the paper(s) in question before the next academic year begins. Any such application shall be made on the form prescribed within two weeks of the day of the examination of the paper in question. A special examination authorized under these circumstances shall not be subject to Regulation MS 6(a).

MS 8. A candidate who

(a) during any academic year has failed in half or more than half the number of credits of all the courses to be examined in that academic year, or
(b) has failed at a repeated attempt in any course

may be required to discontinue his/her studies.

Examination results

MS 9. At the conclusion of all the examinations, a pass list of candidates who have successfully completed all the degree requirements shall be published. A candidate who has shown exceptional merit at the whole examination may be awarded a mark of distinction, and this mark shall be recorded in the candidate's degree diploma.

SYLLABUSES FOR THE DEGREE OF MASTER OF STATISTICS

The Department of Statistics and Actuarial Science offers a postgraduate programme leading to the degree of Master of Statistics, with two study modes: the one year full-time mode and the two years part-time mode. The programme is designed to provide graduates with training in the principles and practice of statistics. Candidates should have knowledge of matrices and calculus. Candidates applying for full-time mode of study should also have knowledge of introductory statistics and linear modelling.

The programme offers great flexibilities for students who wish to take a general approach or a specialized theme in Risk Management or Data Analytics. A student may choose to have his/her theme printed on the transcript if he/she has satisfied one of the theme requirements.

STRUCTURE AND EVALUATION

Each student must complete at least 54 credits of courses. Courses with 6 credits are offered in the first and second semesters while courses with 3 credits are offered in the summer semester. If a student selects an MStat course whose contents are similar to a course (or courses) which he/she has taken in his/her previous study, the Department may not approve the selection in question.

Curriculum for full-time study

The period of study extending over one year full-time commencing September. Among the 54 credits of courses, students should take STAT6014 Advanced statistical modelling and one of the two compulsory courses, STAT6008 Statistical inference OR STAT6009 Research methods in statistics.

<table>
<tr><td colspan="2">Two compulsory courses (12 credits)
STAT6008 Statistical inference OR STAT6009 Research methods in statistics
STAT6014 Advanced statistical modelling</td></tr>
<tr><td>Risk Management theme

plus at least 24 credits from
STAT6006 Stochastic calculus with financial applications (6 credits)
STAT6013 Financial data analysis (6 credits)
STAT6015 Advanced quantitative risk management and finance (6 credits)
STAT8003 Time series forecasting (6 credits)
STAT8007 Statistical methods in economics and finance (6 credits)
STAT8014 Risk management and Basel accords (6 credits)
STAT8015 Actuarial statistics (6 credits)
STAT8017 Data mining techniques (6 credits)
STAT8301 Big data analytics (3 credits)
STAT8303 Quantitative strategies and algorithmic trading (3 credits)

The remaining 18 credits of courses can be selected from other MStat courses</td><td>Data Analytics theme

plus at least 24 credits courses from
STAT6011 Computational statistics (6 credits)
STAT6016 Spatial data analysis (6 credits)
STAT7005 Multivariate methods (6 credits)
STAT7007 Categorical data analysis (6 credits)
STAT8003 Time series forecasting (6 credits)
STAT8016 Biostatistics (6 credits)
STAT8017 Data mining techniques (6 credits)
STAT8019 Marketing analytics (6 credits)
STAT8301 Big data analytics (3 credits)
STAT8302 Structural equation modelling (3 credits)

The remaining 18 credits of courses can be selected from other MStat courses</td></tr>
</table>

Whenever feasible, candidates may choose not to follow any theme and may take 42 credits of elective courses in any order.

Curriculum for part-time study

The period of study extends over two years part-time commencing September. Among the 54 credits of courses, students should take the two compulsory courses STAT7003 and STAT7004. Only under exceptional academic circumstances can the compulsory course STAT7003 or STAT7004 be replaced by an elective course.

<table>
<tr><td colspan="2">Two compulsory courses (12 credits)
STAT7003 Foundations of statistics
STAT7004 Linear modelling</td></tr>
<tr><td>Risk Management theme

plus at least 24 credits from
STAT6006 Stochastic calculus with financial applications (6 credits)
STAT6013 Financial data analysis (6 credits)
STAT6015 Advanced quantitative risk management and finance (6 credits)
STAT8003 Time series forecasting (6 credits)
STAT8007 Statistical methods in economics and finance (6 credits)
STAT8014 Risk management and Basel accords (6 credits)
STAT8015 Actuarial statistics (6 credits)
STAT8017 Data mining techniques (6 credits)
STAT8301 Big data analytics (3 credits)
STAT8303 Quantitative strategies and algorithmic trading (3 credits)

The remaining 18 credits of courses can be selected from other MStat courses</td><td>Data Analytics theme

plus at least 24 credits from
STAT6011 Computational statistics (6 credits)
STAT6014 Advanced statistical modelling (6 credits)
STAT6016 Spatial data analysis (6 credits)
STAT7005 Multivariate methods (6 credits)
STAT7007 Categorical data analysis (6 credits)
STAT8003 Time series forecasting (6 credits)
STAT8016 Biostatistics (6 credits)
STAT8017 Data mining techniques (6 credits)
STAT8019 Marketing analytics (6 credits)
STAT8301 Big data analytics (3 credits)
STAT8302 Structural equation modelling (3 credits)

The remaining 18 credits of courses can be selected from other MStat courses</td></tr>
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Whenever feasible, candidates may choose not to follow any theme and may take 42 credits of elective courses in any order.

STAT6006 Stochastic calculus with financial applications (6 credits)

This course is an advanced course on the option pricing theory. The course covers Black-Scholes equation and stochastic calculus, and interest models. Contents include: Brownian motion; introduction to stochastic calculus; arithmetic and geometric Brownian motion; Ito formula; Sharpe ratio and risk premium; Black-Scholes equation; risk-neutral stock-price process and option pricing; option's elasticity and volatility; Vasicek, Cox-Ingersoll-Ross, and Black-Derman-Toy models; delta-hedging for bonds and the Sharpe-ratio equality constraint; Black's model; options on zero-coupon bonds; interest-rate caps and caplets.
Assessment: One 3-hour written examination; 25% coursework and 75% examination

STAT6008 Statistical inference (6 credits)

This course covers the advanced theory of point estimation, interval estimation and hypothesis testing. Using a mathematically-oriented approach, the course provides a solid and rigorous treatment of inferential problems, statistical methodologies and the underlying concepts and theory. It is suitable in particular for students intending to further their studies or to develop a career in statistical research. Contents include: (1) Paradigms of inference: frequentist, Bayesian, Fisherian; (2) Decision theory: loss function; risk; decision rule; admissibility; minimaxity; unbiasedness; Bayes' rule; (3) Estimation theory: exponential families; likelihood; sufficiency; minimal sufficiency; ancillarity; completeness; UMVU estimators; information inequality; large-sample theory of maximum likelihood estimation; (4) Hypothesis testing: uniformly most powerful test; monotone likelihood ratio; unbiasedness; UMP unbiased test; maximal invariants; most powerful invariant test; large-sample theory of likelihood ratio.
Assessment: One 2-hour written examination; 25% coursework and 75% examination

STAT6009 Research methods in statistics (6 credits)

This course introduces some statistical concepts and methods which potential graduate students will find useful in preparing for work on a research degree in statistics. Focus is on applications of state-of-the-art statistical techniques and their underlying theory. Contents may be selected from: (1) Basic asymptotic methods: modes of convergence; stochastic orders; laws of large numbers; central limit theorems; delta method; Edgeworth expansions; saddlepoint approximations; (2) Parametric and nonparametric likelihood methods: high-order approximations; profile likelihood and its variants; signed likelihood ratio statistics; empirical likelihood; (3) Nonparametric statistical inference: sign and rank tests; Kolmogorov-Smirnov test; nonparametric regression; density estimation; kernel methods; (4) Computationally-intensive methods: cross-validation; bootstrap; permutation methods; (5) Robust methods: measures of robustness; M-estimator; L-estimator; R-estimator; estimating functions; (6) Sequential analysis: sequential probability ratio test; sequential estimation; (7) Model selection using information criteria; (8) Other topics as determined by the instructor.
Assessment: One 2-hour written examination; 25% coursework and 75% examination

STAT6010 Advanced probability (6 credits)

This course provides an introduction to measure theory and probability. The course will focus on some basic concepts in theoretical probability which are important for students to do research in actuarial science, probability and statistics. Contents include: sigma-algebra, measurable space, measure and probability, measure space and probability space, measurable functions, random variables, integration theory, characteristic functions, convergence of random variables, Hilbert spaces, conditional expectations, martingales.
Assessment: One 2-hour written examination; 50% coursework and 50% examination

STAT6011 Computational statistics (6 credits)

This course aims to give postgraduate students in statistics a background in modern computationally-intensive methods in statistics. It emphasizes the role of computation as a fundamental tool of discovery in data analysis, of statistical inference, and for development of statistical theory and methods. Contents include: Generation of random variables including the inversion method, the grid method, the sampling/importance resampling method, the stochastic representation method, and the conditional sampling method; Optimization techniques including Newton's method, expectation-maximization (EM) algorithm and its variants, and minorization-maximization (MM) algorithms; Integration including Laplace approximations, Riemannian simulation, the importance sampling method and variance reduction techniques; Markov chain Monte Carlo methods including data augmentation algorithm, Gibbs sampler, and the exact inverse Bayes formulae sampling; Bootstrap methods.
Assessment: One 2-hour written examination; 50% coursework and 50% examination

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STAT6013 Financial data analysis (6 credits)

This course aims at introducing statistical methodologies in analyzing financial data. Financial applications and statistical methodologies are intertwined in all lectures. Contents include: recent advances in modern portfolio theory, market microstructure and high frequency data analysis.
Assessment: One 2-hour written examination; 40% coursework and 60% examination

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STAT6014 Advanced statistical modelling (6 credits)

This course introduces modern methods for constructing and evaluating statistical models and their implementation using popular computing software, such as SAS or R. It will cover both the underlying principles of each modelling approach and the statistical properties of the model estimation procedures. Topics from: (i) Generalized linear models; (ii) Random effects and mixed models; (iii) Nonparametric and semi-parametric methods: kernel and local polymial regression; selection of smoothing parameters; (iv) Additive models; semi-parametric mixed models; generalized additive models; (v) General issues of model selection: AIC, BIC and Cross-validation.
Assessment: One 2-hour written examination; 50% coursework and 50% examination

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STAT6015 Advanced quantitative risk management and finance (6 credits)

This course covers statistical methods and models of importance to risk management and finance and links finance theory to market practice via statistical modelling and decision making. Emphases will be put on empirical analyses to address the discrepancy between finance theory and market data. Contents include: Basic Monte Carlo and Quasi-Monte Carlo Methods; Variance Reduction Techniques; Simulating the value of options and the value-at-risk for risk management; Review of univariate volatility models; multivariate volatility models; Value-at-risk and expected shortfall; estimation, back-testing and stress testing; Copula; Extreme value theory for risk management.
Assessment: One 2-hour written examination; 25% coursework and 75% examination

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STAT6016 Spatial data analysis (6 credits)

This course covers statistical concepts and tools involved in modelling data which are correlated in space. Applications can be found in many fields including epidemiology and public health, environmental sciences and ecology, economics and others. Covered topics include: (1) *Outline* of three types of spatial data: point-level (geostatistical), areal (lattice), and spatial point process. (2) *Model-based geostatistics*: covariance functions and the variogram; spatial trends and directional effects; intrinsic models; estimation by curve fitting or by maximum likelihood; spatial prediction by least squares, by simple and ordinary kriging, by trans-Gaussian kriging. (3) *Areal data models*: introduction to Markov random fields; conditional, intrinsic, and simultaneous autoregressive (CAR, IAR, and SAR) models. (4) *Hierarchical modeling* for univariate spatial response data, including Bayesian kriging and lattice modeling. (5) *Introduction* to simple spatial point processes and spatio-temporal models. Real data analysis examples will be provided with dedicated R packages such as geoR.
Assessment: One 2-hour written examination; 50% coursework and 50% examination

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STAT7003 Foundations of statistics (6 credits)

Motivated by real problems involving uncertainty and variability, this course introduces the basic concepts and principles of statistical inference and decision-making. Ideas developed will include probability modelling, statistical distributions; parametric classes; the likelihood principle; maximum likelihood estimation; likelihood ratio tests; hypotheses testing. (Only under exceptional academic circumstances can this compulsory course be replaced by an elective course.)
Assessment: One 3-hour written examination; 25% coursework and 75% examination

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STAT7004 Linear modelling (6 credits)

Much of the analysis of variability is concerned with locating the sources of the variability, and many current statistical techniques investigate these sources through the use of 'linear' models. This course presents a unified theory of such statistical problems including regression; variance and covariance analyses; design of experiments; and their practical implementation with statistical packages. (Only under exceptional academic circumstances can this compulsory course be replaced by an elective course.)
Assessment: One 3-hour written examination; 25% coursework and 75% examination

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STAT7005 Multivariate methods (6 credits)

In many disciplines the basic data on an experimental unit consist of a vector of possibly correlated measurements. Examples include the chemical composition of a rock; the results of clinical observations and tests on a patient; the household expenditures on different commodities. Through the challenge of problems in a number of fields of application, this course considers appropriate statistical models for explaining the patterns of variability of such multivariate data. Topics include: multiple, partial and canonical correlation; multivariate regression; tests on means for one-sample and two-sample problems; profile analysis; test for covariances structure; multivariate ANOVA; principal components analysis; factor analysis; discriminant analysis and classification.
Assessment: One 3-hour written examination; 40% coursework and 60% examination

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STAT7006 Survey research methods (6 credits)

Inferring the characteristics of a population from those observed in a selection or sample from that population is a situation often forced on us for economic, ethical or technological reasons. Against the background of practical situations, this course considers the basic principles, practice and design of sampling techniques to produce objective answers free from bias. Emphasis will be on current and local problems.
Assessment: One 3-hour written examination; 25% coursework and 75% examination

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STAT7007 Categorical data analysis (6 credits)

Many social and medical studies, especially those involving questionnaires, contain large amounts of categorical data. Examples of categorical data include presence or absence of disease (yes / no), mode of transportation (bus, taxi, railway), attitude toward an issue (strongly disagree, disagree, agree, strongly agree). This course focuses on analyzing categorical response data with emphasis on hands-on training of analyzing real data using statistical software such as SAS. Consulting experience may be presented in the form of case studies. Topics include: classical treatments of 2 and 3-way contingency tables, measures of association and nonparametric methods; generalized linear models, logistic regression for binary, multinomial and ordinal data, loglinear models, Poisson regression; Modelling repeated measurements; generalized estimating equations.
Assessment: One 3-hour written examination; 50% coursework and 50% examination

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STAT8000 Workshop on spreadsheet modeling and database management (0 credits)

This course aims to enhance students' IT knowledge and skills which are not covered in the current curriculum but are essential for career development of statistical and risk analysts. The course contains a series of computer hands-on workshops on Excel VBA programming, MS-Access and SQL and C++ basics.
Assessment: 100% coursework

STAT8002 Project (6 credits)

A project in any branch of statistics or probability will be chosen, through consultation between students and lecturers. A substantial written report is required. This must be submitted by April 30 of the academic year. (A detailed proposal will be required, which should not be overlapped with the other courses. Availability of this course is subject to approval.)
Assessment: 75% written report and 25% oral presentation

STAT8003 Time series forecasting (6 credits)

A time series consists of a set of observations on a random variable taken over time. Such series arise naturally in climatology, economics, finance, environmental research and many other disciplines. In additional to statistical modelling, the course deals with the prediction of future behaviour of these time series. This course distinguishes different types of time series, investigates various representations for them and studies the relative merits of different forecasting procedures.
Assessment: One 3-hour written examination; 40% coursework and 60% examination

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STAT8007 Statistical methods in economics and finance (6 credits)

This course provides a comprehensive introduction to state-of-the-art statistical techniques in economics and finance, with emphasis on their applications to time series and panel data sets in economics and finance. Topics include: regression with autocorrelated errors, modelling returns and volatility; instrumental variables and two stage least squares; panel time series models; unit root tests, co-integration, error correction models.
Assessment: One 3-hour written examination; 25% coursework and 75% examination

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STAT8014 Risk management and Basel accords (6 credits)

Being an important financial centre, Hong Kong has always been on the alert for risk in the banking and financial industry. We have weathered many attacks and crises over the past decades. Following the deep and long lasting global financial crisis started in 2007/08, this risk has been the primary focus of most people. This course will provide, and it is paramount for people in or related to the industry be fully aware of the relevant risk management, including the nature, the culture, the framework, the cycle, the measurement (with focus on market, credit and operational risks) and the mitigation techniques, along with the knowledge of the Basel Accords and practical critical issues.
Assessment: One 3-hour written examination; 40% coursework and 60% examination

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STAT8015 Actuarial statistics (6 credits)

The main focus of this module will be on financial mathematics of compound interest with an introduction to life contingencies and statistical theory of risk. Topics include simple and compound interest, annuities certain, yield rates, survival models and life tables, population studies, life annuities, assurances and premiums, reserves, joint life and last survivor statuses, multiple decrement tables, expenses, individual and collective risk theory.
Assessment: One 3-hour written examination; 25% coursework and 75% examination

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STAT8016 Biostatistics (6 credits)

Statistical methodologies and applications in fields of medicine, clinical research, epidemiology, biology and biomedical research are considered. The types of statistical problems encountered will be motivated by experimental data sets. Important topics include design and analysis of randomized clinical trials, group sequential designs and crossover trials; survival studies; diagnosis; statistical analysis of the medical process.
Assessment: One 3-hour written examination; 25% coursework and 75% examination

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STAT8017 Data mining techniques (6 credits)

With the rapid developments in computer and data storage technologies, the fundamental paradigms of classical data analysis are mature for change. Data mining techniques aim at helping people to work smarter by revealing underlying structure and relationships in large amounts of data. This course takes a practical approach to introduce the new generation of statistical data mining techniques and show how to use them to make better decisions. Topics include data preparation, association rules, trees and rules for classification and regression, cluster analysis, classical statistical models and non-linear models such as neural networks.
Assessment: 100% coursework

STAT8019 Marketing analytics (6 credits)

This course aims to introduce various statistical models and methodology used in marketing research. Special emphasis will be put on marketing analytics and statistical techniques for marketing decision making including market segmentation, market response models, consumer preference analysis and conjoint analysis. Contents include market response models, statistical methods for segmentation, targeting and positioning, statistical methods for new product design.
Assessment: One 3-hour written examination; 40% coursework and 60% examination

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STAT8088 Practicum (6 credits)

This course is designed for full-time students of Master of Statistics Programme. It provides students with first-hand experience in the applications of academic knowledge in a real-life work environment. To be eligible, students should be undertaking a statistics-related or risk-management-related practicum with no less than 160 hours in at least 20 working days spent in a paid or unpaid position.

Assessment: Upon completion of the practicum, each student is required to submit a written report and to give an oral presentation on his/her practicum experience. Supervisors will assess the students based on their performance during the practicum period. Assessment of this course is on a Pass or Fail basis with 3 criteria: (1) supervisor's evaluation, (2) written report, (3) oral presentation. Please note that fail in fulfilling any of the 3 criteria satisfactorily would lead to a "Fail" grade in the course.

STAT8301 Big data analytics (3 credits)

The recent explosion of social media and the computerization of every aspect of life resulted in the creation of volumes of mostly unstructured data (big data): web logs, e-mails, Tweets, and others. This course aims to provide students with knowledge and skills of some advanced analytics and statistical modeling for solving big data problems. Topics may be selected from the following areas: data visualization, web analytics, text analytics, sentiment analytics, link analysis, social network analysis, recommendation systems, and parallel computing for big data analytics.
Pre-requisites: Pass in STAT8017 Data mining techniques or equivalent
Assessment: One 1.5-hour written examination; 50% coursework and 50% examination

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STAT8302 Structural equation modeling (3 credits)

Structural Equation Modeling (SEM) is a general statistical modeling technique to establish relationships among variables. A key feature of SEM is that observed variables are understood to represent a small number of "latent constructs" that cannot be directly measured, only inferred from the observed measured variables. This course covers the theories of structural equation models and their applications. Topics may include path models, confirmatory factor analysis, structural equation models with latent variables, Sub-models including multiple group analysis, MIMIC model, second order factor analysis, two-wave model, and simplex model, model fitness, model identification, and Comparison with competing models.
Pre-requisites: Pass in STAT7005 Multivariate methods or equivalent
Assessment: One 1.5-hour written examination; 25% coursework and 75% examination

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STAT8303 Quantitative strategies and algorithmic trading (3 credits)

Quantitative trading consists of investment techniques which make use of statistical models and computer algorithms to identify trading opportunities. This course aims to introduce relevant methods and models that may lead to promising quantitative trading strategies. Topics may include the efficient market hypothesis, mean-reverting vs momentum strategies, back-testing and performance evaluation, money and risk management, statistical arbitrage and pairs trading, high frequency trading, VWAP and optimal trading strategies. Students are required to work on a class project to gain hands-on trading experience.
Pre-requisites: Pass in STAT6013 Financial data analysis or equivalent
Assessment: One 1-hour written examination; 60% coursework and 40% examination