Tripos Course (3 Year) in Mathematics & Statistics

All examinations must be taken at an approved University of London examination or certified proctoring centre. Some modules have an element of continuous assessment with marked quizzes, homework assignments, or reflection prompts. The relevant lecturer will discuss the marking scheme at the beginning of the term.

ST104a

Statistics 1 introduces students to the fundamental language and logic of probability and data analysis. The course begins with descriptive statistics, covering methods for summarising and visualising data using numerical measures, tables, and graphical representations. Students then learn the axioms of probability, permutations and combinations, and the behaviour of discrete and continuous random variables. Expectation, variance, and covariance are developed systematically, building intuition for stochastic behaviour. Classical distributions including binomial, Poisson, and normal distributions are explored in both theoretical and applied contexts. The module also introduces the Law of Large Numbers and the Central Limit Theorem at an introductory level, highlighting their importance in statistical inference. Throughout, students practise solving structured quantitative problems, interpreting real-world datasets, and understanding how probability models uncertainty in scientific and business environments.

Likely topics covered:

- • Descriptive statistics
- • Sampling
- • Probability axioms
- • Combinatorics
- • Random variables
- • Expectations
- • Variance
- • Binomial distribution
- • Poisson distribution
- • Normal distribution
- • Law of large numbers
- • Central limit theorem (intro)

ST104b

Statistics 2 expands the foundations developed in Statistics 1, transitioning from descriptive methods to formal statistical inference. Students study point estimation, including properties such as unbiasedness, consistency, and efficiency. Confidence intervals are developed through repeated-sampling interpretations, and hypothesis testing is introduced with emphasis on significance levels, Type I and Type II errors, and p-values. Classical methods including t-tests, chi-square tests, and simple regression analysis are covered in both analytical and applied detail. Students learn to interpret correlation coefficients, residual plots, and diagnostics used for model validation. Emphasis is placed on understanding the logic of inference—how conclusions are drawn about populations from samples. By the end of the module, students gain practical competence in drawing evidence-based conclusions from data using standard statistical techniques.

Likely topics covered:

- • Point estimation
- • Unbiasedness
- • Consistency
- • Confidence intervals
- • Hypothesis testing
- • t-distribution
- • Chi-square tests
- • Simple regression
- • Correlation
- • Residual diagnostics
- • Inference for proportions

ST2195

Programming for Data Science provides students with a practical foundation in computational thinking, software tools, and coding practices essential for modern data science. The module emphasises programming in Python and R, teaching variables, control structures, modular design, and debugging. Students learn data wrangling using packages such as pandas and dplyr, and practise data visualisation with matplotlib, seaborn, and ggplot2. The module covers SQL and database fundamentals, enabling students to query and manage structured datasets. Students are introduced to machine learning workflows, including model training, evaluation, and cross-validation using libraries such as scikit-learn. Git-based version control reinforces collaborative programming and reproducibility. By the end of the module, students can design small-scale analytical systems, write maintainable code, and integrate multiple programming tools commonly used in data science work.

Likely topics covered:

- • Python fundamentals

- • R fundamentals
- • Control flow
- • Functions and modularity
- • Data wrangling with pandas
- • Data visualisation
- • SQL querying
- • APIs and web data
- • Database design
- • Version control (Git)
- • Machine learning libraries
- • Model evaluation
- • Scripting and automation

ST2187

This applied analytics module teaches students how to construct, evaluate, and interpret quantitative models used in business decision-making. The course covers multiple regression, logistic regression, and forecasting models, showing how these techniques are implemented and validated. Time-series analysis includes decomposition, seasonality, and exponential smoothing. Students explore simulation-based methods, optimisation frameworks, and decision analysis tools that support managerial planning. A key component is predictive modelling: students learn the end-to-end workflow from data preprocessing to model selection and evaluation. Emphasis is placed on the interpretation of statistical evidence in real business contexts, avoiding overfitting, and assessing model reliability. Practical assignments develop the ability to translate data into actionable insights.

Likely topics covered:

- • Simple and multiple regression
- • Logistic regression
- • Forecasting models
- • Time-series decomposition
- • Exponential smoothing
- • Simulation methods
- • Optimisation models
- • Decision analysis
- • Predictive modelling workflow
- • Cross-validation
- • Performance metrics
- • Business-case evaluation

ST2133

Advanced Statistics: Distribution Theory develops the mathematical foundation underlying modern probability and statistical inference. Students study classical discrete and continuous distributions in detail, including Poisson, geometric, exponential, gamma, beta, normal, and multivariate distributions. The module explores joint, marginal, and conditional distributions, transformations of variables, and Jacobian techniques. Fundamental tools such as moment-generating functions, characteristic functions, order statistics, and sampling distributions are introduced. Convergence concepts—including convergence in distribution and the Central Limit Theorem—are treated with greater rigour than in earlier modules. Emphasis is placed on derivations, proofs, and formal reasoning. This module provides the theoretical backbone needed for advanced statistical inference and econometrics.

Likely topics covered:

- • Discrete distributions
- • Continuous distributions
- • MGFs and CFs
- • Joint distributions
- • Transformations
- • Sampling distributions
- • Order statistics
- • Convergence concepts
- • Large sample approximations
- • Multivariate distributions

ST2134

This module provides a rigorous introduction to the principles of statistical inference. Students explore point estimation in depth, including sufficiency, completeness, and likelihood-based estimation. Maximum likelihood methods are developed thoroughly, with applications to common parametric families. Confidence interval construction is analysed through both exact and asymptotic methods. Hypothesis testing frameworks include likelihood ratio tests, Wald tests, and score tests, with emphasis on their theoretical properties. Students also learn the fundamentals of Bayesian inference, prior selection, posterior analysis, and Bayesian decision-making. Asymptotic theory underlies much of the module, ensuring that students understand the large-sample behaviour of estimators and test statistics. By the end, students are equipped with the conceptual tools required for higher-level econometrics and applied modelling.

Likely topics covered:

- • Point estimation
- • Sufficiency
- • Likelihood methods

- • Maximum likelihood estimation
- • Confidence intervals
- • Hypothesis tests
- • Likelihood ratio tests
- • Bayesian concepts
- • Decision theory (intro)
- • Asymptotic inference

IS1060

This module provides a foundational introduction to information systems and their role in supporting business operations and decision-making. Students study essential system components—hardware, software, databases, networks—and explore how these elements integrate into coherent organisational technologies. The module covers the system development life cycle (SDLC), process modelling, UML diagrams, and the principles of information management. Students examine enterprise systems, cybersecurity fundamentals, data governance, and digital ethics. Increasing emphasis is placed on understanding how information systems shape organisational behaviour and strategy. By the end, students can analyse process flows, evaluate system requirements, and understand the foundations of digital infrastructures used in modern enterprises.

Likely topics covered:

- • Information systems types
- • System development lifecycle
- • Business processes
- • UML modelling
- • Database structures
- • Enterprise systems
- • Network architectures
- • Cybersecurity basics
- • Data governance
- • Human–computer interaction

IS2184

Information Systems Management examines the strategic, organisational, and operational issues involved in managing digital technologies. Students learn frameworks for aligning IT resources with business objectives, analysing IT project risks, and assessing return on investment. Topics include enterprise architecture, IT service management (ITSM), cybersecurity governance, regulatory compliance, and digital transformation. The module also addresses human factors, organisational change, and leadership in technology-rich environments. Students evaluate real-world case studies illustrating successful and failed IT initiatives. By the end, students understand how to manage information resources effectively within complex organisations.

Likely topics covered:

- • Strategic IT alignment
- • Project management
- • Risk assessment
- • Systems governance
- • Enterprise architecture
- • ICT investment analysis
- • IT service management
- • Change management
- • Digital transformation
- • Regulation and compliance

IS2182

Innovating Digital Systems and Services explores the design and implementation of user-centred digital solutions in modern organisations. Students learn innovation frameworks, needs assessment techniques, and the principles of service design. Agile methodologies, prototyping, and iterative development are emphasised. The module examines digital platforms, cloud-based services, and emerging technologies such as AI and IoT. Students analyse scalability, usability, and system integration challenges. Hands-on design exercises build skills in conceptual modelling and evaluation. The module prepares students to contribute to innovation processes within technology-driven organisations.

Likely topics covered:

- • Innovation frameworks
- • User needs assessment
- • Digital platforms
- • Service design
- • Prototyping
- • Agile development
- • Human-centred design
- • UX evaluation
- • Scalability considerations
- • Emerging technologies (AI, IoT)

IS1181

Digital Infrastructures for Business examines the underlying technical architectures that enable modern organisations to function. Students explore cloud computing, virtualisation, networking, distributed systems, enterprise platforms, and data pipelines. The course emphasises how these infrastructures support business processes, scalability, cybersecurity, and resilience. Students learn how digital infrastructures integrate into organisational strategy, enabling automation, analytics, and digital transformation initiatives.

Likely topics covered:

- • Cloud computing
- • Virtualisation
- • Networking fundamentals
- • Distributed systems
- • APIs
- • Data centres
- • Enterprise IT systems
- • Cybersecurity
- • Data pipelines
- • Digital architecture

IS3159

This capstone research module trains students in the design, execution, and communication of scholarly work in information systems. Students learn qualitative and quantitative research methods, including interviews, surveys, experiments, and case studies. Emphasis is placed on research ethics, methodology selection, data analysis, and critical evaluation of academic literature. Students propose, conduct, and write up an original research project that demonstrates mastery of conceptual frameworks and empirical analysis. The final report reflects a professional standard suitable for academic or industry research settings.

Likely topics covered:

- • Research design
- • Qualitative methods
- • Quantitative methods
- • Survey construction
- • Interview techniques
- • Data collection
- • Ethics in research
- • Statistical analysis
- • Modelling
- • Literature review
- • Report writing
- • Presentation of findings

ST3188

Statistical Methods for Market Research develops specialised skills for analysing consumer behaviour and market data. Students study survey design, sampling strategies, and questionnaire construction. Analytical methods include factor analysis, cluster analysis, conjoint analysis, multidimensional scaling, ANOVA, and various regression techniques. Practical emphasis is placed on interpreting results for business decision-making, designing marketing studies, and segmenting consumer populations. By the end, students can

structure market research projects and apply multivariate statistical techniques to real-world problems.

Likely topics covered:

- • Survey design
- • Sampling techniques
- • Questionnaire construction
- • Factor analysis
- • Cluster analysis
- • Conjoint analysis
- • Regression models
- • ANOVA
- • Multivariate analysis
- • Marketing metrics
- • Consumer segmentation

ST3189

Machine Learning introduces predictive modelling, pattern recognition, and data-driven decision systems. Students explore supervised and unsupervised learning methods, including linear and logistic regression, decision trees, random forests, boosting, clustering, and dimensionality reduction techniques. Neural networks and deep learning concepts are introduced at an accessible level. Emphasis is placed on overfitting, regularisation, model selection, cross-validation, and evaluation metrics. Students implement models in Python using scikit-learn and analyse real datasets. By the end, they gain practical and theoretical competence in modern machine learning.

Likely topics covered:

- • Supervised learning
- • Unsupervised learning
- • Linear models
- • Tree-based models
- • Ensemble learning
- • Neural networks (intro)
- • Regularisation
- • Overfitting and bias–variance tradeoff
- • Model evaluation
- • Cross-validation
- • Feature engineering
- • Clustering
- • Dimensionality reduction