STATISTICS (STAT)

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STAT 103 Fundamentals of Statistics (3 Credit Hours)
This course provides an introduction to statistical reasoning and techniques in descriptive and inferential statistics and their applications in economics, education, genetics, medicine, physics, political science, and psychology. Not open to students who have completed ISOM 241.
Knowledge Area: Quantitative Knowledge
Course equivalencies: ISSCM/H/241/STAT103/ACST101/03
Outcomes:
Students will obtain a background in the fundamentals of descriptive and inferential statistics along with an understanding of their uses and misuses; This course satisfies the quantitative literacy requirement of the core curriculum

STAT 203 Introduction to Probability & Statistics (3 Credit Hours)
Pre-requisites: MATH 132 or MATH 162 or MATH 162A; MATH 162 may also be taken concurrently as a co-requisite
This course is a Calculus-based rigorous introduction to basic topics in probability (distributions, expectations, variance, central limit theorem and the law of large numbers) and statistics (estimation, hypothesis testing, regression, design of experiments) needed in engineering and science applications.
Outcomes:
Students will obtain required knowledge in probability and statistics useful in every area of engineering and science; They will learn how to assess data and outcomes of experiments

STAT 303 SAS Programming & Applied Statistics (3 Credit Hours)
Pre-requisites: STAT 103 or 203 or 335
This course provides an introduction to SAS programming in the context of practical problems taken from applied statistics.
Outcomes:
Students obtain extensive experience with data-set manipulations, SAS procedures, and their application in contexts such as t-tests, simple and multiple regression, ANOVA, and regression

STAT 304 Introduction to Probability (3 Credit Hours)
Pre-requisites: MATH 263 or MATH 263A
This course provides a calculus based introduction to probability theory, including topics such as combinatorial analysis, conditional probability, and a variety of statistical distributions.
Course equivalencies: X-MATH304/STAT304
Outcomes:
Students obtain the theoretical background in probability needed for further study in probability and statistics

STAT 305 Introduction to Mathematical Statistics (3 Credit Hours)
This course is a continuation of STAT 304 and applies the techniques of calculus and probability to the study of advanced topics in statistics.
Course equivalencies: X-MATH305/STAT305
Outcomes:
Students obtain the theoretical background in statistics needed for graduate level work in probability and statistics

STAT 306 Intro to Stochastic Processes (3 Credit Hours)
Pre-requisites: (STAT 203 or STAT 335) and (MATH 212 or MATH 266)
This course discusses topics such as finite-state Markov processes and Markov chains, classification of states, long-run behavior, continuous time processes, birth and death processes, random walks, and Brownian motion.
Course equivalencies: X-MATH306/STAT306
Outcomes:
Students will obtain a background in stochastic processes that will allow them to apply them in areas like genetics, population growth, inventory, cash management, and gambling theory

STAT 307 Statistical Design & Analysis of Experiments (3 Credit Hours)
Pre-requisites: (STAT 203 or STAT 335 with a C- or better) and STAT 308 with a C- or better
This course discusses comparative experiments, analysis of variance and covariance, fixed and random effects models, and a variety of experimental design models including cross-over and split plot designs; contemporary statistical software will be used extensively.
Outcomes:
Students will obtain the background in statistical design and analysis of experiments needed to apply them in their own areas of interest

STAT 308 Applied Regression Analysis (3 Credit Hours)
Pre-requisites: STAT 203 or 335
This course discusses simple and multiple linear regression methods, multiple comparison estimation procedures, residual analysis, and other methods for studying the aptness of a proposed regression model; contemporary statistical software will be used extensively.
Outcomes:
Students will obtain an extensive background in the applications of regression analysis and computer coding of regression models

STAT 310 Categorical Data Analysis (3 Credit Hours)
Pre-requisites: (STAT 203 or STAT 335) and (STAT 303 or STAT 308)
An introduction to modern-day extensions of simple linear regression and ANOVA to the chi-square test including logistic regression and log-linear modelling techniques based on generalized linear models. Methods for matched-pair, small datasets, ordinal and multi-category data also discussed. This course focuses on applications using real-life data sets, and uses popular software packages.
Outcomes:
Students will obtain an extensive background in the applications of categorical data analysis methods

STAT 311 Applied Survival Analysis (3 Credit Hours)
Pre-requisites: STAT 308 (Applied Regression Analysis)
This course focuses on methods for analyzing time-to-event data. The course will explore non-parametric methods for analyzing time-to-event data like Life tables, the Kaplan-Meier method, the Nelson-Aalen method and the log-rank test. This course will also explore semi-parametric models such as the Cox proportional hazards regression models and parametric models including exponential, Weibull and log-logistic regression model.
Outcomes:
Derive survival and hazard functions from an underlying distribution, calculate survival probabilities and hazard rates, compare survival probabilities and hazard ratios between two or more cohorts

STAT 321 Computational Aspects of Modeling and Simulation (3 Credit Hours)
Pre-requisites: STAT 308
This course uses SAS and R languages to address statistical modelling and to conduct statistical simulations to assess linear, generalized linear, nonlinear and complex models and experimental designs.
Course equivalencies: X-STAT356/COMP321/STAT321
Outcomes:
Students will gain practical experience and knowledge in real-world statistical situations for which underlying theory is cumbersome or intractable

STAT 335 Introduction to Biostatistics (3 Credit Hours)
Pre-requisites: BIOL 102 and (MATH 132 or MATH 162 or MATH 162A (MATH 162 may be taken as a pre- or co-requisite))
For Bioinformatics Majors only: BIOL 101 and (MATH 132 or MATH 162 or MATH 162A (MATH 162 may be taken as a pre- or co-requisite)). This course provides an introduction to descriptive and inferential statistics in the biological sciences. Topics include data visualization, probability, discrete and continuous probability distributions, confidence intervals, t-tests, tests of proportions, chi-square tests, correlation, linear regression and ANOVA. Contemporary computer software will be used to apply the methods.
Interdisciplinary Option: Bioinformatics, Forensic Science
Course equivalencies: X-BIOL335/STAT335
Outcomes:
Students will be able to visualize data appropriately, to properly design a statistical experiment, to apply the correct statistical methods and properly analyze the results

STAT 336 Advanced Biostatistics (3 Credit Hours)
Pre-requisites: STAT 203 or STAT 335
This course overviews applied statistical methods useful in biomedical modelling chosen from: experimental design, categorical data analysis including logistic regression, nonlinear regression, bioassay and synergy modelling, multivariate methods, survival statistics, and longitudinal data analysis techniques. Modern statistical software methods will be extensively used and illustrated.
Course equivalencies: X-STAT336/BIOL336
Outcomes:
Students are expected to obtain expertise in applying this course's advanced biostatistical methods application areas including knowing how best to implement these methods, interpret results, and use statistical software output

STAT 337 Quantitative Methods in Bioinformatics (3 Credit Hours)
Pre-requisites: STAT 203 or 335
This course develops the mathematical and statistical methods necessary to analyze and interpret genomic and proteomic data, including signal analysis, sequence alignment methods, data-base search methods useful in bioinformatics and data mining.
Interdisciplinary Option: Bioinformatics
Course equivalencies: XSTAT337/BIOL337/BIOI337
Outcomes:
Students will obtain the quantitative skills used in BLAST, including inference, stochastic processes and hidden Markov models, random walks, microarray analysis and biological sequence analysis

STAT 338 Predictive Analytics (3 Credit Hours)
Pre-requisites: STAT 308
Students will study methods for predicting future events and properly classifying data using both supervised and unsupervised statistical learning techniques.
Outcomes:
Learn methods for predicting and classifying; Model Selection; Evaluate the effectiveness and accuracy of a model/prediction

STAT 344 Longitudinal Data Analysis and Mixed Modelling (3 Credit Hours)
Pre-requisites: (STAT 203 or STAT 335 with a C- or better) and STAT 308 with a C- or better or permission of the instructor
Repeated measures and longitudinal data are ubiquitous in studies, research and applications. This course explores methods for repeated measures, longitudinal (time-series), and nested/hierarchical data in a detailed manner. These methods take account of correlations between measurements by allowing each individual in a study to serve as their own control.
Outcomes:
Students are expected to master the analysis and interpretation of repeated measures, longitudinal, mixed, and nested/hierarchical data; This includes effectively using R, SAS or other software for these data analyses

STAT 351 Nonparametric Statistical Methods (3 Credit Hours)
Pre-requisites: STAT 203 or STAT 335 with C- or better
This course will cover the basic principles of nonparametric methods in statistics including: one, two and K sample location methods; tests of randomness; tests of goodness of fit; nonlinear correlation; histogram; density estimation; nonparametric regression. Students should learn how to apply the nonparametric techniques in real datasets, interpret the results and draw conclusions.

STAT 370 Data Science Consulting (3 Credit Hours)
Pre-requisites: STAT 308
Students will work on a research project with a client acting as a consultant on the statistical and computational aspects of the project. Students are required to meet with a client, develop a strategy for addressing their problem, and present their results to the client (and their classmates).
This course satisfies the Engaged Learning requirement.
Outcomes:
1) Apply methods learned in classes to a address a real world problem; 2) Oral and Written presentation skills; 3) Collaboration skills

STAT 388 Topics (1-3 Credit Hours)
Pre-requisites: STAT 203 or STAT 335
This course covers advanced topics in statistics, such as multivariate analysis, sampling theory, non-parametric methods, decision theory, and Bayesian analysis.
Outcomes:
Students will obtain an understanding of an advanced topic in their major

STAT 390 Undergraduate Seminar (1 Credit Hour)
Pre-requisites: Senior Standing, including completion of MATH 304/ STAT 304
The seminar will cultivate students' presentation skills through participation in and critical discussion of brief lectures on familiar and unfamiliar topics; preparation and presentation of two brief lectures by the student (one on a familiar topic from the curriculum, one on a higher level material not customarily from the curriculum); and preparation of an extended abstract summarizing the advanced material presented.
Outcomes:
Students will gain the ability to present material in Statistics, and their applications to a general audience

STAT 391 Internship in Actuarial Science (1-3 Credit Hours)
Pre-requisites: STAT 304 and 396; approval of the internship director
This course offers an opportunity to obtain experience in actuarial science in a professional environment; placement requires approval of the internship coordinator and acceptance by an employer.
This course satisfies the Engaged Learning requirement.
Outcomes:
Students will obtain first hand experience doing actuarial work in a real world environment

STAT 396 Actuarial Seminar I (1 Credit Hour)
Pre-requisites: MATH 263
The seminar provides a comprehensive review of the probability topics that most commonly appear on the Actuarial Exam P. Topics covered include: axiomatic probability, combinatorial probability, conditional probability and Bayes' Theorem, independence, random variables and their various distributions, joint distributions, marginal distributions, conditional distributions of tow of more random variables.
Outcomes:
The purpose of the seminar is to prepare students for the Actuarial Exam P; The students will also learn test-taking strategies and will have the opportunity to take practice tests

STAT 397 Actuarial Seminar II (1 Credit Hour)
Pre-requisites: MATH 263
The seminar is a continuation of STAT 396. It provides a comprehensive review of topics in probability and risk management directed toward students preparing for the Actuarial Exam P. Additional topics may include order statistics, moment-generating functions, the Central Limit Theorem and risk analysis.
Outcomes:
The purpose of the seminar is to prepare students for the Actuarial Exam P; The students will also learn test-taking strategies and will have the opportunity to take practice tests

STAT 398 Independent Study (1-6 Credit Hours)
This course allows students to engage in independent study on selected topics in statistics under the supervision of a faculty member.
Outcomes:
Students will obtain an understanding of an advanced topic in their major

STAT 399H Honors Tutorial (1-3 Credit Hours)
This course allows students in the honors program to engage in independent study of selected topics in statistics for honors credit under the supervision of a faculty member.
Course equivalencies: STAT399H / STAT399
Outcomes:
Students will obtain an understanding of an advanced topic in their major

STAT 401 Introduction to Applied Statistics Using R (1 Credit Hour)
Pre-requisites: Limited to Graduate Students Only
This course covers the basics of applied statistics including descriptive statistics and visualization (including graphing), univariate methods, inference, hypothesis testing and confidence intervals, two-sample and paired analyses, simple and multiple linear regression, ANOVA and logistic regression. The course introduces and uses the R freeware package.
Outcomes:
Upon completion of this course, it is expected that students will skillfully and accurately perform real-time data analysis using R and R/Studio

STAT 403 SAS Program & Applied Statistics (3 Credit Hours)
While simultaneously reviewing basic statistical methods (t tests, regression, ANOVA, interaction, etc.), this course introduces statistical modelling using the SAS program, involving the DATA step and various SAS procedures. Working on hands-on projects using real datasets, students present their final project results.

STAT 404 Probability & Statistics I (3 Credit Hours)
As the first part in a two-semester sequence, this course introduces basic principles of probability including combinatorial methods, probability and cumulative density and mass functions, moment generating functions and applications, expected values and variance and other moments, and order statistics. This course emphasizes related theorems and proofs.
Course equivalencies: X-MATH404/STAT404

STAT 405 Probability & Statistics II (3 Credit Hours)
As the second part in a two-semester sequence, this course thoroughly explores the central limit theorem and its variants and uses, estimation, hypothesis testing, sufficiency, efficiency, uniformly most powerful methods, information, and asymptotic methods. Time permitting, Bayesian topics may also be explored and discussed.
Course equivalencies: X-MATH405/STAT405

STAT 406 Stochastic Processes (3 Credit Hours)
This course addresses topics such as finite-state Markov processes and Markov chains, classification of states, long-run behavior, continuous time processes, birth and death processes, random walks, and Brownian motion.
Course equivalencies: X-MATH406/STAT406

STAT 407 Statistical Design (3 Credit Hours)
This course provides students with a thorough introduction to statistical experimental design and to the statistical methods used to analyze the resulting data. The concepts of comparative experiments, ANOVA and mean separation procedures will be reviewed; blocking (complete and incomplete) will be discussed, as will be factorial designs, fractional factorial designs, and confounding. The course will focus on biometric applications such as clinical trials, HIV studies, and environmental and agricultural research, but industrial and other examples will occasionally be provided to show the breadth of application of experimental design ideas.

STAT 408 Applied Regression Analysis (3 Credit Hours)
This course provides students with a thorough introduction to applied regression methodology. The concept of simple linear regression will be reviewed and discussed using matrices, and multiple linear regression, transformations, diagnostics, polynomial regression, indicator variables, model building and multicolinearity will be discussed, as will be nonlinear and generalized linear regression. The course will focus on applications such as those from biometry and biostatistics (clinical trials, HIV studies, etc.), sports, engineering, agriculture and environmental science.

STAT 410 Categorical Data Analysis (3 Credit Hours)
This course provides an introduction to modern-day extensions of simple linear regression and ANOVA to the chi-square test including logistic regression and log-linear modeling techniques based on generalized linear models. Specialized methods for ordinal data, small samples, multi-category data, and matched pairs will also be discussed. The focus throughout this course will be on applications and real-life data sets.

STAT 411 Applied Survival Analysis (3 Credit Hours)
Modern statistical methods are covered to analyze data that is right, left and/or interval-censored. Nonparametric approaches such as the Kaplan-Meier estimation technique, log-rank test and proportional-hazards model are considered as are parametric methods such as those based on the Exponential and Weibull distribution. Accelerated failure time models and nonlinear models are also discussed.

STAT 421 Math Modeling & Simulation (3 Credit Hours)
This course uses SAS, R and high-level languages to perform statistical modelling by conducting statistical simulations to assess linear, generalized linear, nonlinear and complex models and experimental designs. Students will gain practical experience and knowledge in real-world statistical situations for which underlying theory is cumbersome or otherwise intractable.
Course equivalencies: X-COMP421/MATH421/STAT421

STAT 426 Advanced Statistical Inference (3 Credit Hours)
This course presents the role of likelihood methods in a whole range of statistical problems. The course reviews theoretical developments such as efficiency, completeness, and the Cramer-Rao lower bound, and shows how the likelihood approach is used to surpass these methods and to analyze regression problems, to deal with nuisance parameters by using marginal likelihood methods, and to deal with complex data structures such as censored and spatial data.

STAT 436 Topics in Biostatistics (3 Credit Hours)
This course covers experimental design (including interaction, analysis of covariance, and crossover designs) and the analysis of designed studies, simple and multiple linear regression, generalized linear and nonlinear regression, bioassay, relative potency and drug synergy, multivariate analysis (including MANOVA and multivariate regression), repeated measures (designs and analysis), and survival analysis (Cox proportional odds, log-rank tests, Kaplan-Meier estimation) of censored data. The emphasis of the course will be on applications instead of statistical theory, and students will be required to analyze real-life datasets using popular statistical packages.

STAT 437 Quantitative Bioinformatics (3 Credit Hours)
This course explores recently developed mathematical, probabilistic and statistical methods currently used in the fields of bioinformatics and DNA microarray and protein array data analysis. These include stochastic processes, (hidden and traditional) Markov chains, tree- and clustering techniques (including principal components analysis and biplots), discriminant analysis, experimental design strategies and ANOVA methods. Our focus in this course is on the application of these techniques and on meaningful interpretation of results.

STAT 438 Introduction to Predictive Analytics (3 Credit Hours)
Pre-requisites: Graduate students only
This course focuses on finding patterns, associations, and relationships in data. In examining real-world datasets, this course highlights, develops and applies methods in simple and multiple linear and logistic regression, classification and discriminant analysis, resampling methods, model selection, additive models and splines, tree-based methods, support vector machines, and unsupervised learning techniques such as clustering and PCA.
Outcomes:
Upon completion of this course, it is expected that students will master applied methods in predictive analytics (using R and/or Python) with applications to real data-sets

STAT 444 Longitudinal Data Analysis and Mixed Modeling (3 Credit Hours)
Pre-requisites: Graduate Students only
This course focuses on repeated measures, longitudinal, hierarchical and mixed modeling data analysis with an eye to applications, model identification, software implementation, and interpretation of computer results.
Outcomes:
Upon completion of this course, it is expected that students will master applied mixed-modelling methods (using R and/or SAS) with applications to real data-sets

STAT 451 Applied Nonparametric Methods (3 Credit Hours)
Pre-requisites: Graduate Students only
Many basic statistical techniques are based upon normal or binomial distributional assumptions which may not be appropriate in practice. This course introduces and illustrates rank-based methods, permutation tests, bootstrap methods, and curve smoothing useful to analyze data when normal and/or binomial assumptions are not valid.
Outcomes:
Upon completion of this course, it is expected that students will master applied nonparametric statistical methods (using R and/or SAS) with applications to real data-sets

STAT 465 Actuarial Theory I (0 Credit Hours)
This course provides an introduction to the models and methods used in actuarial mathematics and risk theory. Students are expected to gain a broad understanding of frequency and severity modelling, pricing, and accumulated risk. This course includes a blend of theory and applications.
Course equivalencies: X-MATH465/STAT465

STAT 466 Actuarial Theory II (0 Credit Hours)
With an introductory background in the field provided in STAT 465, this course thoroughly explores modelling and estimation techniques in actuarial mathematics and risk theory.
Course equivalencies: X-STAT466/MATH466

STAT 468 Risk Theory (0 Credit Hours)
With a focus on insurance, pensions and investments, this course provides an overview of the theory of risk, emphasizing the statistical challenges and assumptions inherent in models and methods.
Course equivalencies: X-STAT468/MATH468

STAT 488 Topics in Statistics (1-3 Credit Hours)
This topics course provides the means for new courses on current or 'hot' topics to be offered to students, with the topics being crafted to the given topic at hand. As such, the course may be taken repeatedly.

STAT 495 Statistical Consulting Capstone (2 Credit Hours)
Pre-requisites: Graduate Students only
Students enrolled in this course will be introduced to statistical consulting techniques useful for work with researchers and decision-makers in university, medical, financial and industrial settings; students will engage in actual hands-on statistical consulting with administrators, researchers, or students at one of Loyola's lakeside campuses or remotely.
Outcomes:
Upon completion of this course, it is expected that students will master the soft-skills of statistical consulting, communication, active listening, and real-time data analysis

STAT 498 Independent Study Statistics (1-6 Credit Hours)
Working with a statistics faculty member on a one-on-one or small group format, this course affords students the opportunity to thorough explore a statistical topic at greater depth. Generally, it involves a good deal of outside reading and/or programming, and weekly meetings with the professor.