

Required Core Courses

JRN 565: Communicating Your Science: This course is for graduate students in science, biomedical, engineering, and health disciplines who want to communicate effectively and responsively with multiple audiences, from peers and professors to potential employers, policymakers and the lay public. Students will focus on speaking about science clearly and vividly in ways that can engage varied audiences, especially those outside their own field. The class will include instruction and practice in connecting and finding common ground with an audience, defining goals, identifying main points, speaking without jargon, explaining meaning and context, using storytelling techniques, and using multimedia elements. The class will include improvisational theater exercises that help speakers pay close and dynamic attention to others, reading nonverbal cues, and responding freely without self-consciousness. As a culminating activity, students will develop and deliver an engaging short oral presentation on a scientific topic. For permission to enroll, please contact: aldacenter@stonybrook.edu and cc: jennifer.mccauley@stonybrook.edu. *3 credits, Letter graded (A, A-, B+, etc.)*

OR

JRN 511: Scientific Communication to Decision Makers, 1 credit, required for all STRIDE students. Learning how to effectively communicate science to decision makers is increasingly important for scientists and health professions. This interactive course provides you with the skills, practice and knowledge you need to clearly and vividly communicate complex science to decisions makers (e.g., Congress, local officials, community groups, etc.) in a variety of forums and settings. (Discontinued)

JRN 513: Science of Science Communication

The U.S. National Academies has paid increased attention to the “science of science communication,” an interdisciplinary area of social science and humanities research and scholarship that spans a range of disciplines, including communication, psychology, decision science, mass communication, risk communication, health communication, political science, sociology, and science and technology studies, history, and others. This course is designed as an introductory survey course for graduate students in science, biomedical, engineering, and health disciplines to this interdisciplinary field. The key goal is to provide context on science communication research that can inform students’ science communication practices. Specifically targeted to students who are not communication researchers, this essential overview will help students understand the importance of linking theory with practice when they communicate about their own research. The course is designed to complement applied science communication coursework offered by the Alan Alda Center for Communicating Science® in the School of Journalism. Online course. Offered spring, 1 credit, Letter graded (A, A-, B+, etc.)

JRN 501: Communicating Science: Distilling Your Message Current and future scientists and health professionals will learn to communicate clearly and engagingly with different kinds of audiences, at different levels of complexity, using different forms. We'll examine the basics of clear, two-way communication, including knowing and being responsive to your audience, overcoming "the curse of knowledge," having a point, avoiding jargon, using storytelling techniques, being personal, asking questions, and introducing complexity in stages. Students will start by crafting a short, controversial statement about their work and why it matters. We'll expand that to a longer statement, convert it into a brief piece of writing, such as a letter to the editor or a blog post, practice answering questions about it from the public and from the media, plan a public presentation, and learn to apply these skills in the classroom. Skills learned in this course can help scientists and health professionals communicate more effectively with students, potential employers or funders, public officials, family and friends, the press, and colleagues in other disciplines. JRN501, JRN502, and JRN503 are 1-credit modules, each lasting four or five weeks. Students may take all three consecutively in one semester or may take only one or two. Offered Fall, Spring, and Summer, 1 credit, Letter graded (A, A-, B+, etc.)

JRN 503: Communicating Science: Improvisation for Scientists. This innovative course uses improvisational theater techniques to help students speak more spontaneously and connect more directly and responsively with their audience and with each other. After warm-up exercises, emphasizing physical freedom and verbal spontaneity, students take part in two- and three-person exercises and situational improvisations that focus on paying attention to your listeners, and altering your approach to meet their needs. At the beginning and end of this course, students will deliver a short oral statement about their research or a scientific topic that interests them, so they can measure their progress. This course is not about acting; it's about helping current and future scientists and health professionals connect with their audiences. Science graduate students who had several sessions of improvisation training in a pilot session reported communicating better as teachers, researchers, students, and family members. A glimpse of the process can be seen in a short video on the web page of Stony Brook's Center for Communicating Science: www.stonybrook.edu/journalism/science. JRN501 and JRN503 are 1-credit modules, each lasting four or five weeks. Students may take both consecutively in one semester or may take only one or two. Fall, Spring, and Summer, 1 credit, S/U grading

*If you have already taken any of the required JRN 501, 503, or 511/513, please complete the 3 credits with the individual classes. If you have *not* yet taken any of the 1-credit JRN courses, please register for the 3-credit course, JRN 565.

CSE 564: Visualization. Visualization plays an increasingly important role in the understanding of the massive data that are nowadays being collected in almost any domain – science, medicine, business, commerce, finance, social networks, and many more. As such, visualization is often deeply integrated into the analytics tools developed for data science. This course will discuss both foundations and applications of this emerging paradigm known as visual analytics. It will begin with the basics – visual perception, cognition, human-computer interaction, the sense-making process, data mining, computer graphics, and information visualization. It will then move to discuss how these elementary constituents are coupled into an effective visual analytics pipeline that allows humans to interactively reason with data and gain insight. Students will have the opportunity to hone their skills by a set of projects and then more deeply explore a topic of their choice by ways of a final programming project. We will use the public-domain statistics library R for data analytics and the popular javascript library D3.js for interactive information visualization directly in the web browser. In addition, students will also gain practical experience with a state of the art volume renderer for the visualization of medical data.

Prerequisite: All STRIDE students must take one statistics course from the statistics list below before taking CSE 564

MAR 534: Scientific Decision Support, 1 credit, required for all STRIDE students (NEW COURSE) In this innovative course, professional government/industry scientists, decision makers and journalists will present and lead discussions on the science, societal and other challenges associated with decision support in their field. This format will permit exploring a wide range of topics including career paths and work environments. Presentations will be remote via standard network tools, thereby eliminating travel costs and greatly lowering the barrier to participation and hence enabling a very wide ranging seminar program. We already anticipate seminars from scientists at NOAA, NASA, NIH, DOE, Global Electric, IBM and CDC laboratories, and from officials of multiple local, state and federal agencies, and from journalists associated with multiple formats. The sessions will be recorded and made available for nationwide access.

Core Statistics course

NOTE: Students pick one from the list, and course must be taken prior to taking CSE 564

AMS 570: Introduction to Mathematical Statistics Probability and distributions; multivariate distributions; distributions of functions of random variables; sampling distributions; limiting distributions; point estimation; confidence intervals; sufficient statistics; Bayesian estimation; maximum likelihood estimation; statistical tests. 3 credits, Letter graded (A, A-, B+, etc.)

AMS 572: Data Analysis I Introduction to basic statistical procedures. Survey of elementary statistical procedures such as the t-test and chi-square test. Procedures to verify that assumptions are satisfied. Extensions of simple procedures to more complex situations and introduction to one-way analysis of variance. Basic exploratory data analysis procedures (stem and leaf plots, straightening regression lines, and techniques to establish equal variance). Offered as AMS 572 or HPH 698. Prerequisite: AMS 312 or permission of instructor Fall, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 597: Statistical Computing Introduction to statistical computing using SAS and S plus. Fall, 3 credits, Letter graded (A, A-, B+, etc.)

BEE 552: Biometry An intensive course in statistical theory and methodology. The analysis of real biological data is emphasized. Topics include analysis of variance, simple multiple and curvilinear regression analysis, correlation analysis, and goodness of fit tests. Spring, 4 credits, Letter graded (A, A-, B+, etc.)

BMI 540: Statistical Methods in Biomedical Informatics: This course introduces probability and statistical modeling and analytical methods commonly used in biomedical informatics.

CSE 544: Probability and Statistics for Data Scientists The course will cover core concepts of probability theory and an assortment of standard statistical techniques. Specific topics will include random variables and distributions, quantitative research methods (correlation and regression), and modern techniques of optimization and machine learning (clustering and prediction). 3 credits, Letter graded (A, A-, B+, etc.)

MAR 504: Statistics and Experimental Design This course has been devised to provide basic background and hands on experience to assist graduate students in developing key skills in an essential aspect of the research enterprise, namely statistics analysis and experimental design. Fall, 3 credits, Letter graded (A, A-, B+, etc.)

Electives

AMS 530: Principles in Parallel Computing This course is designed for both academic and industrial scientists interested in parallel computing and its applications to large scale scientific and engineering problems. It focuses on the three main issues in parallel computing: analysis of parallel hardware and software systems, design and implementation of parallel algorithms, and applications of parallel computing to selected problems in physical science and engineering. The course emphasizes hands-on practice and understanding of algorithmic concepts of parallel computing. Prerequisite: A course in basic computer science such as operating systems or architectures or some programming experience. Spring, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 540: Linear Programming Formulation of linear programming problems and solutions by simplex method. Duality, sensitivity analysis, dual simplex algorithm, decomposition. Applications to the transportation problem, two-person games, assignment problem, and introduction to integer and nonlinear programming. 3 credits, Letter graded (A, A-, B+, etc.)

AMS 550: Operations Research: Stochastic Models Includes Poisson processes, renewal theory, discrete-time and continuous-time Markov processes, Brownian motion, applications to queues, statistics, and other problems of engineering and social sciences. 3 credits, Letter graded (A, A-, B+, etc.)

AMS 553: Simulation and Modeling A comprehensive course in formulation, implementation, and application of simulation models. Topics include data structures, simulation languages, statistical analysis, pseudo-random number generation, and design of simulation experiments. Students apply simulation modeling methods to problems of their own design. This course is offered as CSE 529, AMS 553 and MBA 553. 3 credits, Letter graded (A, A-, B+, etc.)

AMS 561: Introduction to Computational Science This course provides a foundation of knowledge and basic skills for the successful application in graduate research of modern techniques in computational and data science relevant to engineering, the humanities, and the physical, life and social sciences. It is consciously crafted to provide a rich, project oriented, multidisciplinary experience that establishes a common vocabulary and skill set. Centered around the popular programming language Python, the course will serve as an introduction to programming including algorithms, data structures, basic concepts in computer architecture, and elements of object-oriented design. Also introduced will be important concepts and tools associated with the analysis and management of data, both big and small, including basic statistical modeling, aspects of machine learning and data mining, SQL and NoSQL management of massive data, and visualization. Prerequisites: Matriculation in the IACS Advanced Graduate Certificate in Data & Computational Science & Engineering Spring, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 562: Introduction to Scientific Programming in C++ This course provides students with foundational skills and knowledge in practical scientific programming relevant for scientists and engineers. The primary language is C++ since it is a widely-used, object-oriented language, includes C as a subset, and is a powerful tool for writing robust, complex, high-performance software. Elements of Python, Bash, and other languages will be introduced to complement the capabilities of C++, and essential tools for software development and engineering will be employed throughout the course (e.g., makefiles, version control,

AMS 570: Introduction to Mathematical Statistics Probability and distributions; multivariate distributions; distributions of functions of random variables; sampling distributions; limiting distributions; point estimation; confidence intervals; sufficient statistics; Bayesian estimation; maximum likelihood estimation; statistical tests. 3 credits, Letter graded (A, A-, B+, etc.)

AMS 571: Mathematical Statistics Sampling distribution; convergence concepts; classes of statistical models; sufficient statistics; likelihood principle; point estimation; Bayes estimators; consistence; Neyman-Pearson Lemma; UMP tests; UMPU tests; Likelihood ratio tests; large sample theory. Offered as HPH 697 or AMS 571. 3 credits, Letter graded (A, A-, B+, etc.)
online code repositories, debugging, etc.). Fall, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 573: Categorical Data Analysis Measuring the strength of association between pairs of categorical variables. Methods for evaluating classification procedures and interrater agreement. Analysis of the associations among three or more categorical variables using log linear models. Logistic regression. Prerequisite: AMS 572 Spring, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 577: Multivariate Analysis The multivariate distribution. Estimation of the mean vector and covariance matrix of the multivariate normal. Discriminant analysis. Canonical correlation. Principal components. Factor analysis. Cluster analysis. 3 credits, Letter graded (A, A-, B+, etc.)

AMS 578: Regression Theory Classical least-squares theory for regression including the Gauss-Markov theorem and classical normal statistical theory. An introduction to stepwise regression, procedures, and exploratory data analysis techniques. Analysis of variance problems as a subject of regression. Brief discussions of robustness of estimation and robustness of design. 3 credits, Letter graded (A, A-, B+, etc.)

AMS 598: Big Data Analysis The rapid advancement of modern technologies in all walks of research and business has introduced tremendous amount of data and the related big data mining tasks such as real-time credit card processing and fraud detection, high dimensional RNA sequencing analysis, and risk management of high frequency trading data measured in milliseconds. Traditional data processing and analysis techniques are no longer adequate -- they have to be revised and customized to parallel computing paradigms, at the same time, modern data mining tools are being created and evolved, at their own fast pace, to accommodate the analysis of various big data problems. This course is subsequently created to enable the timely education of a new generation of competent data analysts. This course introduces the application of the supercomputing to statistical data analyses, particularly on big data. Implementations of various statistical methodologies within parallel computing framework are demonstrated through all lectures. The course will cover (1) parallel computing basics, including architecture on interconnection networks, communications methodologies, algorithm and performance measurements, and (2) their

applications to modern data mining techniques, including modern variable selection/Dimension reduction, linear/logistical regression, tree-based classification methods, Kernel-based methods, non-linear statistical models, and model inference/Resampling methods. Prerequisites: AMS 572, AMS 573 and AMS 578 Fall, 3 credits, Letter graded (A, A-, B+, etc.)

BEE 569: Bayesian Data Analysis and Computation: An applied course in Bayesian analysis and hierarchical modeling for advanced graduate students in Ecology & Evolution or related sciences. Topics will include probability theory, Bayesian analysis, and MCMC methods such as Gibbs, sampling and Metropolis-Hastings sampling, as well as applied issues regarding the choice of prior distributions, posterior convergence, censored and missing data, and model checking and comparison. The course will be taught using WinBUGS and JAGS as accessed via the R packages R2WinBUGS and R2jags, respectively. Offered in the Fall.

4 credits, Letter graded (A, A-, B+, etc.)

BEE 692: Seminar Student seminars on selected topics. Fall or Spring, 0-2 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit

BMI 501: Introduction to Biomedical Informatics: Introduces the unique characteristics of clinical and life science data and the methods for transforming data to improve human health.

CSE 564: Visualization The course emphasizes a hands-on approach to scientific, medical, and information visualization and visual analytics. Topics include: traditional visualization techniques, the visualization process, visual perception and cognition, basic graphics and imaging concepts, visualization of sampled, observed, and computed data, volume and flow visualization, information visualization, human-computer interaction, and the coupling of intelligent computing with visualization 3 credits, Letter graded (A, A-, B+, etc.)

CSE 519: Data Science Fundamentals Knowledge discovery in data is #the non-trivial process of identifying valid, novel, potentially useful, and ultimately understandable patterns in data# (Fayyad et al. 1996). Large-scale data generated by humans and machines is available everywhere. Acquiring the fundamental skills on how to analyze and understand as well as 2) manage and process these large datasets are crucial in today's data-driven world, for producing data products that solve real-world problems. This course will cover the fundamental concepts in data science, to equip students with the key skillset toward becoming good data scientists. Major topics include scoping projects, data preparation, statistics basics, visualization, statistical learning, data mining, various types of structures. 3 credits, Letter graded (A, A-, B+, etc.)

CSE 545: Big Data Analytics The course will cover concepts and standard tools used to analyze, so called, Big Data. Specifically, it will cover algorithmic approaches to analyzing large datasets: MapReduce, graph analytics, text analytics, streaming algorithms, as well as modern distribution analysis platforms (e.g. Hadoop, Spark). 3 credits, Letter graded (A, A-, B+, etc.)

CSE 634: Data Mining Concepts and Techniques Data Mining is a new, promising and flourishing interdisciplinary field drawing work from areas including database technology, artificial intelligence, machine learning, pattern recognition, high-performance computing, and data visualization. It focuses on issues relating to the feasibility, usefulness, efficiency and scalability of techniques for automated extraction of patterns representing knowledge implicitly stored in large databases, warehouses, and other massive information repositories. The course gives a broad, yet indepth overview of the field of data mining and presents one or two techniques in rigorous detail. Prerequisite: Database course 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

EST 589: Technology-Enhanced Decision Making: This course examines the use of technological devices, especially computers, as aids in decision making. A treatment is given of the cognitive science and artificial intelligence methods used in the structure and operation of some systems that support human decision making. Medical diagnosis systems, business and industrial planning systems, and computer aided dispatch

systems are discussed. In addition, the application of high technology in air traffic control systems is examined. 3 credits.

GRD 520 – Introduction to Science Policy

Science, technology and innovation (STI) are ubiquitous part of life and we must understand these concepts in order to develop effective policies. This 1-credit hour course is designed to teach engineering and science graduated students the main concepts in science, technology and innovation policy.

JRN 500 –Introduction to News Media Concepts and Institutions: Students will learn how news media decisions are made about which stories to cover and how prominently to cover them; how the press weighs such values as freedom, privacy and national security; how the press attempts to deal with issues of scientific uncertainty and conflicting information. In exploring the culture and practices of American journalism, the course will focus on recent coverage of science, health and environmental developments. This course is intended for graduate students in health and science who seek a better understanding of the rapidly changing media context in which they will work, as well as for journalism master's students. 3 credits. Spring, Summer.

JRN 522: Communicating Science to Decision-Makers: Learning how to effectively communicate science to decision makers is increasingly important for scientists and health professionals. We are living in a time where we are facing large, complex, interdisciplinary scientific questions that require clear and vivid communication. Policy and management decisions must be based on sound science, whether it be speaking on a panel for local policy makers on coastal zoning and climate change, meeting with your Senator about increased funding for basic research and innovation, working with federal agencies to advise them on research advances to inform health policy, or talking to community groups about public health or environmental epidemics. This course provides you with the skills, practice, and knowledge you need to clearly and vividly communicate complex science to decision makers (e.g., Congress, local officials, community groups, etc.) in a variety of forums and settings. There will be interactive discussions, hands-on practice and activities around the role of science and policy. 3 credits.

JRN 530 The Big Story: Science Issues Seminar: Students will be exposed to selected current issues in health, science, environment and technology, providing the context reporters need to provide sophisticated coverage. The course will be built around a series of visits by scientists and medical professionals who will discuss topics in which they are expert. Students will prepare for these encounters, question the experts, participate in the discussions, and produce journalistic reports. Topic areas will vary but may include climate change, energy research, food and drug safety, stem cell research, racial and economic health disparities, health care funding, ocean pollution, computer privacy, nanotechnology, and space exploration. 3 credits. Fall.

MAR 507: Marine Conservation The fundamental concepts of conservation science, a synthetic field that incorporates principles of ecology, biogeography, population genetics, systematics, evolutionary biology, environmental sciences, sociology, anthropology, and philosophy toward the conservation of biological diversity will be presented within the context of the conservation of marine resources. Examples drawn from the marine environment emphasize how the application of conservation principles varies in different environments. Prerequisite: Enrollment in MCP or MAS program or permission of instructor Fall, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 514: Environmental Management This is an introduction to environmental management, and will focus on the interplay between science and public policy. Concepts include problem identification and definition, collection and analysis of relevant data to produce information, and the roles of public perception and action in ultimately determining outcomes when consensus is not reached. Specific fields to which these concepts will be applied will be solid waste management and coastal management. Current local problems will be used to illustrate the broader conceptual issues. Offered as MAR 514, EST 540 and CEY 501. Prerequisite: Permission of instructor Offered in Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 516: Ecosystem Science for Fisheries Management: Provides an overview of the scientific basis behind and the models that are typically used to inform Ecosystem-based Fisheries Management (EBFM). The course will review single species fisheries models with which students should be familiar. Extensions of single-species models, multispecies models and full systems models will be introduced. Advantages and disadvantages of each approach will be presented and how to implement the science into Fisheries Management will be discussed. The course requires familiarity with quantitative methods, but emphasizes current literature and case studies as main learning elements.

MAR 536: Environmental Law and Regulation This course covers environmental law and regulations from inception in common law through statutory law and regulations. The initial approach entails the review of important case law giving rise to today's body of environmental regulations. Emphasis is on environmental statutes and regulations dealing with waterfront and coastal development and solid waste as well as New York State's Environmental Quality Review Act (SEQRA) and the National Environmental Policy Act (NEPA). This course is cross-listed with CEY 503. 3 credits, Letter graded (A, A-, B+, etc.)

MAR 553: Fishery Management Survey of the basic principles of and techniques for studying the population dynamics of marine fish and shellfish. Discussion of the theoretical basis for management of exploited fishes and shellfish, contrasting management in theory and in practice using local, national, and international examples. Includes lab exercises in the use of computer-based models for fish stock assessment. Prerequisite: Calculus I or permission of instructor Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 587: GIS: Display and Analysis of Environmental Data Elements of Geographic Information Systems (GIS) with an emphasis on environmental applications, especially those related to marine and coastal systems. The course includes hands-on exercises to familiarize students with GIS capabilities. A project will be required. Spring, 3 credits, Letter graded (A, A-, B+, etc.)

MAR 566 – Air Pollution and Its Control- This course provides an overall picture of air pollution caused by gas phase species and airborne particulate matter. The sources of air pollution and their effect on air quality on an urban, regional, and global scale will be addressed. The causes of London type smog and modern photochemical smog are discussed. The health impacts of primary and secondary air pollutants are assessed. The causes and consequences of the stratospheric ozone hole and subsequent policy regulations are discussed. The natural greenhouse effect and our current understanding of global warming are addressed.