UNDERGRADUATE STATISTICS PROGRAM

THE FLORIDA STATE UNIVERSITY

DEPARTMENT OF STATISTICS

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CONTENTS

FOR MORE INFORMATION

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Prospective students are encouraged to visit the University and the Department.

WHAT IS STATISTICS?

Statistics is the mathematical science involved in the application of quantitative principles to the collection, analysis, and presentation of numerical data. The practice of statistics utilizes data from some population in order to describe it meaningfully, to draw conclusions from it, and make informed decisions. The population may be a community, an organization, a production line, a service counter, or a phenomenon such as the weather. Statisticians determine which quantitative model is correct for a given type of problem and they decide what kinds of data should be collected and examined. Applied statistics concerns the application of the general methodology to particular problems. This often calls for use of the techniques of computer-based data analysis. Some examples of statistical problems are:

- Interpretation of evidence linking environmental factors and disease,
- Design of experiments to evaluate effectiveness of pharmaceuticals,
- Mining data to discover target segments in the population,
- Market research to estimate demand for a new product,
- Opinion polling in politics,
- Estimation of the size of an animal population to aid in establishing regulations for conservation,
- Reliability studies for determining warranties,
- Improving the quality of a service or manufactured item,
- Weather forecasting,
- Analysis of errors in scientific experiments, and
- Prediction of stock market prices.

Statisticians are key contributors to scientific methodologies. They use their quantitative knowledge to the design data collection schemes, process the data, analyze the data, and interpret the results. Further, statisticians often make critical evaluations on the reliability of data and whether inferences drawn from can be made confidently. They also help to identify misleading abuses of data that may be portraying an inaccurate account of a situation.

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Theoretical statistics concerns general classes of problems and the development of general methodology. Statisticians generally develop models based on probability theory. Probability theory is the branch of mathematics which develops models for "chance variations" or "random phenomena." It originated as a discipline when mathematicians of the 17th century began calculating the odds in various games of chance. It was soon realized how to make applications of the theory they developed to the study of errors in experimental measurements and to the study of human mortality (for example, by life insurance companies). Probability theory is now a major field with widespread applications in science and engineering. A few examples are:

- Modeling the occurrence of sunspots to improve radio communication,
- Modeling and control of congestion on highways, and
- Reliability theory to evaluate the chance that a space vehicle will function throughout a mission.

According to the American Statistical Association, job characteristics of persons in the statistical professions include the following activities:

- Use data to solve problems in a wide variety of fields,
- Apply mathematical and statistical knowledge to social, economic, medical, political, and ecological problems,
- Work individually and/or as part of an interdisciplinary team,
- Travel to consult with other professionals or attend conferences, seminars, and continuing education activities, and
- Advance the frontiers of statistics and probability through education and research.

THE STATISTICS PROFESSION

We live in a data-driven world. Almost all of us deposit data, usually unaware, into some database on a daily basis. Across all industries, organizations, and disciplines the reliance on data is ever-increasing creating many opportunities for the statistical professional to contribute. These disciplines will depend on the statistical professional for statistical thinking and reasoning to translate data into actionable decisions. According to the American Statistical Association, "With the growth in the use of data comes a growing demand for the services of statisticians, who are experts in the following: producing trustworthy data, analyzing data to make their meaning clear, and drawing practical conclusions from data."   Hal Varian, chief economist at Google put it in these terms, "I keep saying that the sexy job in the next 10 years will be statisticians, and I'm not kidding."

The Statistics profession embraces several areas. Quite often a person interested in some area of study and who is good with numbers may gravitate toward a statistical career while still remaining in that area. Such areas include

- Health and Medicine (Examples: genetics, epidemiology, clinical trials, and pharmacology)

- Business (Examples: economics, engineering, quality, marketing)

- Physical Sciences (Examples: astronomy, chemistry, physics)

- Government (Examples: census, law, national defense)

- Environment (Examples: agriculture, ecology, forestry, animal population)

The American Statistical Association has excellent resources on statistical careers. Information on the profession, statistician roles in various areas, salaries, and a *Career Kit* may be obtained from http://www.amstat.org/careers/otherresources.cfm.

THE DEPARTMENT OF STATISTICS
FLORIDA STATE UNIVERSITY

The courses offered by the Department encompass three important areas: *Applied Statistics, Statistical Theory, and Probability.* An individually tailored program emphasizing one or several of these areas of concentration may be developed by the student in consultation with an academic advisor. The advisor is appointed when the student declares the major of Statistics, upon becoming a junior at Florida State University. At that point the student enrolls in the statistics courses that will constitute his or her major.

Research is a vital, dynamic activity in the Department, supported by grants, contracts and development programs in numerous areas such as biostatistics, image processing and analysis, probability and statistical theory, environmental science, quality control, and reliability theory. Students benefit from their formal and informal contacts with a faculty so actively involved in scientific research. Furthermore, courses offered by the department are kept up-to-date in accord with latest developments in statistical theory and practice.

Consulting is another key activity in the Department. Through its Statistical Consulting Center, the Department assists University and State researchers in planning experiments and data analysis.

Leading to the B.S. degree in Statistics, the undergraduate program prepares individuals to embark upon careers as statisticians or statistical specialist in an outside field. Also, the program provides an opportunity for continued academic study as it will form a suitable foundation that can be applied toward work on the M.S. or Ph.D. degree. Such advanced training is offered by the Department itself, making the overall curriculum one of the most comprehensive statistics programs in the nation. Indeed, the department is one of only five statistics departments which have been supported by the National Science Foundation as "centers of excellence." Also, the Department has been designated in the state of Florida as a "program of

distinction." Therefore, the Department of Statistics at Florida State University represents a unique opportunity for students considering a career in the statistical profession.

THE UNDERGRADUATE MAJOR IN STATISTICS AT FLORIDA STATE

Essential to the undergraduate major in Statistics is a basic core of statistical computing and probability consisting of the courses, STA 3024 for the statistical computing and STA 4442 or STA 4321 for the probability. (Course descriptions are listed beginning on page 16.) Additionally, 15 more hours of statistics courses numbered at the 3000 level or higher are required. There is ample latitude in the timetable to include more than seven statistics courses, if desired. Besides the above-mentioned regularly offered courses, the courses STA 4930r and STA 4905r provide ways to achieve even greater scope and individual flexibility in a program of studies.

The major in Statistics also includes the mathematics courses MAC 2311-2312 (Calculus I and II), and MAS 3105 (Applied Linear Algebra I). Students anticipating graduate study in statistics are strongly encouraged to take MAC 2313 (Calculus III) as well as additional mathematics courses such as MGF 3301 (Introduction to Advanced Mathematics) and MAA 4226-4227 (Advanced Calculus I and II).

Complementing the major in Statistics, a minor is selected from any of the departmental or interdepartmental fields approved by the College of Arts and Sciences. Choices range from just about any field including biology, economics, criminology, and psychology. Usually the minor consists of 12 semester hours in a selected department and 15 semester hours in an interdepartmental field. A minor in mathematics may include MAC 2311, MAC 2312, and MAS 3105.

For students double majoring in Statistics and another discipline, the department's overlap policy permits six (6) credit hours of coursework counted toward the other major

to be counted toward the Statistics major requirements. This overlap limit excludes prerequisite coursework and collateral Mathematics courses (MAC2311, MAC2312, and MAS3105).

A grade of "C−" or better must be earned in each statistics and mathematics course counted toward the major. At least nine semester hours of statistics courses counted toward the major must be taken in the Department of Statistics at The Florida State University. Other statistics courses must be approved by the department. The computer competency requirement for the major is satisfied by STA 3024.

THE UNDERGRADUATE MINOR IN STATISTICS
AT FLORIDA STATE

Persons majoring in other disciplines may wish to elect a minor in Statistics. It is possible to minor in Statistics with minimal mathematical prerequisites, if desired.

The minor consists of 12 semester hours in statistics courses including at least one of STA 2122, STA 2171, 3024, 3032, 4321 or 4442 with the remaining three coming from an STA course numbered at the 3000 level or higher. The courses should be selected in consultation with the director of the undergraduate statistics program.

A grade of "C−" or better must be earned in each course counted toward the minor. At least six semester hours in statistics courses counted toward the minor must be taken in the Department of Statistics at The Florida State University. Other statistics courses must be approved by the department.

CERTIFICATE IN SAS PROGRAMMING AND DATA ANALYSIS

The certificate program in SAS Programming and Data Analysis is designed to provide students with in-demand programming and statistical computing skills using Statistical Analysis

Software (SAS), a leading statistical and data analytics software tool. Focus will be placed on applications that require data management and statistical analyses. The SAS Institute has partnered with FSU in awarding the certificate adding an extra important credential for students seeking employment or entering into graduate school.

To qualify for the certificate, 12 credit hours of STA courses containing a SAS component must be taken. This consisting of the core course, STA 3024, and three elective courses selected from the following: STA 4202, STA 4203, STA 4664, STA 4702, and STA 4853. Applicants will also submit a binder of coursework involving SAS. Students may find the binder beneficial in obtaining employment as it can serve as a portfolio of their SAS work.

JUNIOR/COMMUNITY COLLEGE PREPARATION
FOR THE PROGRAM

Calculus

It is strongly urged—though not mandatory—that the prospective statistics major include at least one year of calculus in their program of study at the junior institution. This would also apply to a prospective statistics minor if emphasis in mathematical statistics or probability is desired. For an applied statistics minor, no special mathematical preparation beyond algebra is needed.

Foreign Language

The College of Arts and Sciences requires that B.A. and B.S. students demonstrate competency in a classical or modern foreign language. Students may fulfill this requirement by CLEP examination, by certification in the Modern Language Department, or by completing coursework through the intermediate level (2200 or equivalent course). Students with a 2.5 GPA may take foreign language courses on a satisfactory/unsatisfactory basis. A student taking coursework to fulfill the language requirement must make at least a C- on any course taken for a letter grade.

Transfer credit is awarded for any portion of this requirement fulfilled as part of an Associate in Arts degree at a Florida public junior college. It is thus advantageous for a prospective transfer student to include some foreign language in the junior college program.

OTHER ASPECTS OF THE UNDERGRADUATE STATISTICS PROGRAM

Honors Program

The Upper Division Honors Program in the College of Arts and Sciences offers the opportunity for independent study including pre-graduate research activity. Flexibility and scope in the program of studies would be achieved using the courses STA 4930r (Selected Topics) and STA 4905r (Directed Individual Study).

In order to qualify for honors work, transfer students with junior standing must complete a minimum of one full semester at Florida State University with a 3.20 grade point average as well as have a 3.20 average on their transfer work. Exceptions to these criteria will be based on recommendations of the directing professor and the department chairman.

A written thesis, called an honors thesis, on a topic in applied or theoretical statistics will be required from an honors student. This thesis will generally be 15 to 20 pages in length. An applied thesis can involve an actual problem faced by a consulting client, or can be a statistical analysis. The content of this thesis need not be original research. The thesis must be submitted at least 3 weeks prior to the defense date which may be up to the last day of classes.

Completion of the program is recognized on the student's permanent record, in the commencement program, and by the issuance of a diploma-type certificate.

Statistical Computing

The Department and the FSU ACNS (Academic Computing and Network Services) provide students access to various statistical programs. These include SAS, SPSS, Minitab, Stata, R, and others.

Reading Room

For use by Statistics students and faculty, the Department maintains the Frank Wilcoxon Memorial Reading Room, containing the most essential books, periodicals and statistical tables,

and a collection of reprints and mimeo reports. The Paul A. M. Dirac Science Library maintains a complete collection of books and journals related to statistics, mathematics, and associated areas.

Undergraduate Student Research Participation

Opportunities sometimes arise for undergraduates to participate in a significant way in special research projects. For example, one Statistics major helped plan an experiment and analyzed resulting data for a project of the Department of Biology, funded by the National Science Foundation, on the use of habitat management and biological control instead of pesticides, herbicides and fungicides to maintain the campus landscape. Besides valuable experience, the student received academic credit and financial compensation.

Another project was a survey conducted for the *Tallahassee Democrat*, a local newspaper, in order to determine public attitudes on newspapers and other communication media. The survey was executed as a joint project of the statistics course STA 4222 (Sample Surveys) and the Statistical Consulting Center. The interviewing was carried out by undergraduate Statistics majors and other interested students and was paid for by the *Democrat.*

SOME SAMPLE PROGRAMS OF STUDY

Two sample programs follow. The first emphasizes applied statistical methodology and the second, statistical methodology, theory, and probability. They second option is recommended for those wishing to pursue graduate studies. It is assumed that a student has had an introductory statistics course at the 2000-level or higher before their junior year.

A minor other than mathematics is usually recommended, since mathematics is automatically part of the program. However, if a minor of mathematics is selected, the courses MAC 2311, 2312, and MAS 3105 may be counted toward the required 12 hours. This would increase the number of elective hours in the program.

Language credit earned for an Associate in Arts degree may be used to reduce the 12 hours listed. This also would increase the number of elective hours.

Sample Program #1 - Emphasizing Applied Statistical Methodology

Junior Year

Fall			Spring	
STA 3024	3		STA 4202	3
MAC 2311	4		MAC 2312	4
Language	4		Language	4
Minor	3		Minor	3
	14			14

Senior Year

Fall			Spring	
STA 3032	3		MAS 3105	4
STA 4203	3		STA 4664	3
STA 4442	3		STA 4853	3
Language	4		Minor	3
Minor	3		Elective	3
	16			16

Sample Program #2 - Emphasizing Statistical Methodology, Theory, and Probability
(Assumes MAC 2311, Calculus I, is taken prior to the junior year.)

<u>Junior Year</u>

<u>Fall</u>		<u>Spring</u>	
STA 3024	3	STA 4202	3
MAC 2312	4	MAC 2313	5
Language	4	Language	4
Minor	3	Minor	3
	14		15

<u>Senior Year</u>

<u>Fall</u>		<u>Spring</u>	
STA 4321	3	STA 4322	3
STA 4203	3	STA 4702	3
MAS 3105	4	STA 4853	3
Language	4	Minor	3
Minor	3	Elective	3
	17		15

COMBINED BACHELOR'S / MASTER's DEGREE

The combined BS/MS degree program in the Department of Statistics is designed for academically strong students who wish to pursue an accelerated program culminating in a Bachelor of Science degree in statistics and a Master of Science degree in applied statistics. This five-year program allows up to 15 credits of coursework to be dually counted toward both the BS and the MS degree. An undergraduate student wishing to enroll in this program must meet the following criteria:

1. Completion of at least 12 credits of mathematics or statistics in the undergraduate statistics major at FSU with a GPA of at least 3.200.
2. Completion of at least 60 credits at FSU with a GPA of at least 3.000. Transfer students must have completed at least two semesters and 24 credits at FSU with the same minimum GPA.

Undergraduate students may apply as early as the second semester of their sophomore year. If accepted, they should take the GRE at the end of their junior year and apply to the graduate school during the first semester of their senior year.

In order to remain in the accelerated program a student must maintain at least a 3.000 GPA in all course work and at least a 3.200 GPA in statistics courses at or above the 4000 level. The student must also be successfully admitted to the graduate school in the first semester of their fourth year. Application to the graduate school should be done as soon as possible after the student's junior year. The student must take the GRE and score a minimum of 1100. Students not accepted into the graduate school may not continue with the accelerated program.

Undergraduate work may be funded by the usual financial aid, Bright Futures scholarships, etc. Student may apply for graduate funding in the form of teaching assistantships once they have been admitted to the graduate school.

Once a student has completed the requirements for the undergraduate degree (at the end of the fourth year), they will be awarded the Bachelor of Science degree. When the requirements for the master's degree are met they will receive the Master of Science degree.

The table below gives a sample timeline for the completion of the combined BS/MS degree. Note that all requirements for the BS and MS must be met in addition to the courses listed here. Courses marked with an asterisk (*) are taken while enrolled as an undergraduate but will count for both the BS and MS degree. Any 5XXX level course offered by the Department of Statistics may be counted toward both the BS and MS degree except STA 5126. For details, see the undergraduate statistics handbook maintained by the department. This is just one of many sample programs. Inclusion of summer courses will change this timeline significantly. A student must always take at least 21 credits of graduate courses while enrolled as a graduate student.

Example of a typical course program for a BS/MS combined degree:

Year	Total Credits	Relevant courses	Special Events
Freshman	30	**Fall**: MAC2311, STA 2122 **Spring**: MAC2312, STA3024	
Sophomore	30	**Fall**: MAC2313 **Spring**: STA4202, STA 4321, MAS3105	Apply to the department during Spring for entry into the BS/MS program.
Junior	30	**Fall**: STA4203 **Spring**: STA5325*, STA4202	Apply to graduate school in early fall. Take GRE at end of year
Senior	30	**Fall**: STA5326*, STA5166* **Spring**: STA5167*, STA5000 elective	Apply to graduate school in early fall. Complete BS in May.
UG Total	120		
Graduate	21	**Fall**: STA5168, STA5000 elective(x2) **Spring**: STA5000 elective(x4)	Complete MS in May
Grad Total	36 (includes "*")		

STATISTICS COURSE DESCRIPTIONS

Among the courses offered by the Department of Statistics, those of interest to undergraduate Statistics majors or minors are described here. Each course carries 2, 3, or 4 semester hours as indicated in the parentheses.

STA 2122   Introduction to Applied Statistics (3)
Sample variation, frequency distributions, hypothesis testing, confidence intervals, analysis of variance, contingency tables, correlation, regression.
Prerequisite: MAC 1105.
Special Note: Only two hours credit given for STA 2122 if "C-" or better previously earned in STA 2023. No credit given for STA 2122 if "C-" or better earned in QMB 3200, STA 2171, or STA 3032.

STA 3024   SAS for Data and Statistical Analyses (3)
This course will introduce the student to the SAS programming language in a lab-based format. The objective is for the student to develop programming and statistical computing skills to address data management and analysis issues using SAS. The course will also provide an extensive survey of some of the most common statistical tools in use today and provide decision-making strategies in selecting the appropriate statistical method for the data at hand.
Prerequisite: Introductory statistics course at or above the 2000 level or consent of the instructor.

STA 3032   Probability and Statistics for Scientists and Engineers (3-5)
This course will cover calculus-based probability, discrete and continuous random variables, joint distributions, sampling distributions and the central limit theorem. Topics include descriptive statistics, interval estimates and hypothesis tests, ANOVA, correlation, simple and multiple regression, analysis of categorical data, and statistical quality control.
Prerequisite: MAC2312

STA 4102   Computational Methods in Statistics I (3)
Prerequisite: At least one previous course in statistics above STA1013; some previous programming experience; or permission of the instructor. Matlab and a programming language (C/Fortran) will be used. Floating point arithmetic, numerical matrix analysis, multiple regression analysis, non-linear optimization, root finding, numerical integration, Monte-Carlo sampling, survey of density estimation.

STA 4103   Computational Methods in Statistics II (3)

A continuation of STA 4102 in the discussion of numerical and non-numerical algorithms for use in simulation and statistical software.
Prerequisite: STA 4102 or consent of instructor.

STA 4202 Analysis of Variance and Design of Experiments (3)
One- and two-way classifications, nesting, blocking, multiple comparisons, incomplete designs, variance components, factorial designs, confounding.
Prerequisite: STA 2122, 2171, 3032, 4322 or QMB 3200

STA 4203 Applied Regression Methods (3)
General linear hypothesis, multiple correlation and regression, residual analysis, and model identification.
Prerequisite: STA 2122, 2171, 3032, 4322 or QMB 3200.

STA 4222 Sample Surveys (3)
Simple and stratified random sampling, proportions, ratios, selection of sample size.
Prerequisite: a course in statistics above STA 1013, or consent of instructor.

STA 4321 Introduction to Mathematical Statistics (3)
Distribution of random variables, conditional probability and independence, multivariate distributions, sampling distributions, Bayes' rule, counting problems, expectations.
Prerequisite: MAC 2313
Special Note: Credit not given for both STA 4321 and STA 4442.

STA 4322 Mathematical Statistics (3)
Sufficiency, point estimation, confidence intervals, hypothesis testing, regression, linear models, Bayesian analysis.
Prerequisite: STA 4442 and MAC 2313

STA 4442 Introductory Probability (3)
Random variables, probability distributions, independence, sums of random variables, generating functions, central limit theorem, laws of large numbers.
Text: Ross, A First Course in Probability, MacMillan.
Prerequisite: MAC 2312
Special Note: Only two hours credit given for STA 3032 if "C-" or better previously earned in STA 4442. Subsequent credit for STA 4442 is not permitted if "C-" or better previously earned in STA 3032.

STA 4502 Nonparametric Methods (3)

Application of nonparametric tests, estimates, confidence intervals, and multiple comparison procedures.
Text: Hollander and Wolfe, Nonparametric Statistical Methods, Wiley & Sons.
Prerequisite: a course in statistics above STA 1013 or consent of instructor.

STA 4664   Statistics for Quality and Productivity (3)
Statistics for quality and productivity; graphical methods, control charts, acceptance sampling, design and experiment for product and process improvement.
Prerequisite: STA 4322 or consent of instructor and one of STA 2122, STA 2171, STA 3032, or STA 4442.

STA 4702   Applied Multivariate Analysis (3)
Inference about mean vectors and covariance matrices, canonical correlation, principal components, discriminant analysis, cluster analysis, computer techniques.
Prerequisite: STA 4203 or 4322

STA 4853   Time Series and Forecasting Methods (3)
Autoregressive, moving average and mixed models, autocovariance and autocorrelation functions, model identification, forecasting techniques, seasonal model identification, estimation and forecasting, intervention and transfer function model identification, estimation and forecasting. Computer experience required: call department for more information.
Prerequisite: STA 2122, 2171, QMB 3200 or equivalent.
Special Note: Subsequent credit for STA 5856 is not permitted.

STA 4905r   Directed Individual Study (2-3)
(S/U grade only). Repeatable to a maximum of 12 semester hours.

STA 4930r   Selected Topics in Statistics, Probability, or Operations Research (2-3)
Repeatable to a maximum of 12 semester hours.

DEPARTMENT OF STATISTICS

CHECKLIST OF COURSE REQUIREMENTS
FOR UNDERGRADUATE MAJORS

Name_____ **FSUSN**_____

I.   LIBERAL STUDIES (36 hours selected from approved courses listed in current catalog).

        See the current catalog for details.

II.   MAJOR COURSEWORK (33 hours including required mathematics)

     A. Statistics courses (21 hrs):

        1.   Core courses (6 hrs):

           STA 3024   (3) _____

           STA 4442 or STA 4321   (3) _____

        2.   Fifteen hours of statistics courses numbered at the 3000-level or higher:

           _____, _____, _____, _____, _____,

     B. Mathematics (12 hrs):

           MAC 2311 (4) _____

           MAC 2312 (4) _____

           MAS 3105 (4) _____

III.   MINOR COURSEWORK (12 hours): See the current catalog for details.

IV.   OTHER COURSEWORK (15 hours): including the equivalent of 12 hours up to the second year foreign language requirement and oral competency: SPC 1016 or 2600 (3).

V.   ELECTIVES (24 hours).

VI.   SEMESTER HOURS REQUIRED FOR GRADUATION <u>120.</u>

VII.   EXIT INTERVIEWS. In order to be eligible for graduation, each student must complete an exit interview with the Department.

VIII. THE COLLEGE OF ARTS AND SCIENCES HAS PREPARED A <u>CHECKLIST OF</u>

<u>GRADUATION REQUIREMENTS.</u> PLEASE SEE THE DEAN'S .