



PROGRAM REVIEW REPORT

Department of Statistics
College of Arts and Sciences

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I. Executive Summary

A. Summary of the Self Study Document

If data be the food of knowledge, play on . . . Interpretation of data is an integral part of the work of government officials, engineers, scientists, businessmen, educators, social scientists, lawyers, and those in the medical sciences, all of whom must be able to collect, analyze, and interpret data in order to present intelligible information to the scientific community and the general public. In this age of computers, large quantities of data are produced which must be summarized and deciphered. The science of analyzing these data is called **Statistics**. Thus, at the heart of any research university, there must be a competent statistics department.

When the statistics program was established at Florida International University, it was recognized that satisfying the above stated diversity of needs would have to be the prime directive for the program. Thus, the program was developed with the following four goals:

1. Teaching of basic statistical methodology to students who are majoring in fields other than the mathematical sciences. This includes the fields of business, engineering, the physical and biological sciences, education, the social sciences, and the health sciences.
2. Preparing students who major in mathematics, economics, and statistics for careers where data analysis is an essential part of their professions.
3. Preparing its majors for entry into graduate programs in statistics.
4. Conducting research that will lead to the creation of new techniques in data analysis and to add to the research output of the many fields in the statistical profession.

The statistics program was one of the initial programs at Florida International University and began as part of the Mathematical Sciences Department. In 1987 this department was split into three units, one of which was the Department of Statistics.

From its inception and throughout its existence, the program has developed a variety of undergraduate and graduate-level statistical service courses tailored to meet the needs of numerous departments at the university. This policy has enabled the department to satisfy its clients and maintain a high level of quality in the teaching of the subject. A major portion of the student credit hours (SCH) produced by the department comes from these service courses.

In addition to its all-important service component mentioned above, the department offers a baccalaureate degree program (BS) and a master's degree program (MS). Both of these programs impart a good balance of theoretical and applied statistics. It is quite difficult to get an accurate count of our majors, especially when some students are part time and do not register every semester. The most accurate source we have is the number of active folders in the department's files. The BS program has had a sharp increase in the last two years (2004-2005 and 2005-2006).

In the fall of 2002 and 2003 there were approximately 9 to 10 majors. In the fall 2005 this number had increased to 15. This is a typical number for an undergraduate program in statistics. The graduate program has also grown from four students in fall 2004 to nine in fall 2005. Despite the growth, overall enrollment in the program has been low. A major reason for this has been the lack of financial support from the university. Throughout the United States, many of those who apply for a graduate program in statistics are foreign students who need financial support. Thus, having started the program with only one assistantship for out-of-state students had greatly limited the growth of this program. However, last fall the university stopped distinguishing between out of state and in state assistantships. Every graduate student on an assistantship automatically qualified for a tuition waiver. This has increased our assistantships to a total of 4. In addition, in the fall of 2006, we will also be able to use our on-line funds to generate one more assistantship thereby having a total of 5 assistantships! This will greatly enhance our ability to recruit quality graduate students and we plan to start an active recruitment program this year. It has been noteworthy that despite the limited resources, all the graduates from our graduate program have achieved great success, be it in getting admission in a good Ph.D. program or finding employment with the industry, federal government or as a college instructor.

A successful program that the department runs in conjunction with the Department of Mathematics is the Certificate Program in Actuarial Studies. This program has received outside funding from the insurance industry in the form of scholarships and summer internships. Our graduates have an outstanding record of passing the first two exams required for certification as an actuary, and several of them have been offered well paying jobs by insurance companies.

The steep growth in the university's undergraduate and graduate programs has placed a heavy burden on the teaching staff. The vast majority of the students at the university must take at least one statistics course. Thus, the demand for classes increases with the number of students in attendance. In spite of the enrollment growth, there had been no growth, but rather a decrease in the number of faculty. This had led to a heavy dependence on adjuncts and non-regular faculty (visiting instructors) with the number of courses taught by such faculty hovering between 35-40%. This is true even for the fall of 2006, when two of our faculty members are teaching classes with over 150 students in them. The availability of qualified adjuncts in southeast Florida is very limited, and this has made it difficult for the department to maintain a high level of instruction in each of our courses.

The large classes, the unavailability of graders, and the lack of sufficient faculty lines also have had a detrimental effect on research productivity and grant proposal efforts. Since more faculty time is spent grading exams and/or homework, less time is spent pursuing research. Also, because the department can barely afford to grant release time from those courses that only the regular faculty can teach, there is little incentive to expend the effort to apply for research grants.

Thus so far, the most important concern shared by the faculty had been the lack of faculty lines, particularly lines for tenure-earning faculty. Over the last five academic years we lost 4 members of the ranked faculty (three at the Associate Professor level) and 2 instructors, and we will be losing Sam Shapiro (a professor) in one year. During the same period, we succeeded in recruiting only 2 assistant professors and three instructors. At the present time we have a total of 9

tenure/tenure track faculty and 4 instructors (one is employed half time). Not only had the number of ranked faculty been declining, but also the ratio of ranked faculty to majors and enrollments had diminished considerably. However, in the recent past, this has changed somewhat. We have been given the authority to search for another assistant professor and one instructor for the following year and while these are replacement lines (and not incremental lines) to replace people whom we will be losing or have already lost to retirement/resignations, at least this will allow us to maintain the same number of faculty as before. We have also received the authority to hire one additional instructor to replace 4 adjunct classes and that is welcome news! However, in order to become more research oriented and generate grants, we **still need to hire more tenure track faculty**. This is especially true in light of the university's desire to increase its research productivity, expand its graduate programs, and increase its student enrollment.

This report highlights some of the achievements that have been accomplished in the last few years. In spite of the limitations mentioned above, the department has consistently exceeded its SCH productivity goals, handled the increased enrollment, and continued to publish new research papers. In fact, some of the faculty have received international and national recognition for their contributions. The department has been able to handle the increased demand for graduate courses, has started its own master's degree program, and looks with pride at the accomplishments of the actuarial program. Also, one faculty member received one research grant from the EPA; another received a three-year grant from NASA; and others received some minor grants.

B. List of People Who Helped Prepare the Document

The entire department helped write the document, however the principal architects of the document as it stands today are Samuel Shapiro and Sneh Gulati. A list of specific faculty contributions is:

I.	Executive Summary	Samuel Shapiro
II.	Response to Recommendations from Previous Reviews	Sneh Gulati
III.	Program Description	Ina Howell, Gauri Ghai, Sneh Gulati, Golam Kibria and Ramon Gomez
IV.	Major Changes in Program	Golam Kibria
V.	Student Learning Outcomes	Sneh Gulati and Samuel Shapiro
VI.	Strengths and Weaknesses	Sneh Gulati
VII.	Opportunities to Explore	Hassan Zahedi
VIII.	Threats to Overcome	Hassan Zahedi
IX.	Budget	Zhenmin Chen and Sneh Gulati
X.	Major Findings and Recommendations	Sneh Gulati and Samuel Shapiro

II. Response to Recommendations from Previous Reviews

A. List of Recommendations from Previous Review

The following were the major recommendations from the previous review in 1997:

1. Create an M.S. Program
2. Promote the Actuarial Sciences Program
3. Collaborate with Other Departments

B List of Actions Taken in Response to Previous Reviews

The department has responded reasonably well to the recommendations from its last program review in 1997. In particular, the following has been accomplished.

1. An M.S. degree program in Statistics was created in 2000. However, as pointed out in the previous section, the department had been unable to recruit a sufficient number of graduate assistants to bring vitality to the program. Only three (with only one of them being for an out of state student) teaching assistantships had been assigned to the program by the college and that was a great impediment to the recruitment of good graduate students. As mentioned earlier though this is changing and we hope to be able to recruit more students in the future.

2. It has continued to promote the Actuarial Studies program

3. The department has reached out to other departments. When the MS program in statistics was developed, some areas of application were included as options. To this end, several departments such as Biological Sciences, Environmental Studies, Industrial Engineering, Economics, and others were contacted for the purpose of allowing students from the statistics master's program to enroll in their graduate level courses. Likewise, these departments were informed that their students could enroll in the graduate level courses that the department offered. This move was intended to encourage interdisciplinary education and research. To this date many graduate students from other departments enroll in statistics courses taught by the department. Likewise, some statistics graduate students have enrolled in courses offered by other departments because of their interests in interdisciplinary work. The department has also initiated talks with the School of Public Health to jointly offer an MS degree program in Biostatistics.

III. Program Description

A. Degrees Offered

The Department of Statistics offers a master's degree program (M.S.) and a baccalaureate degree (B.S.) program in statistics, a minor in statistics, and a certificate program in Actuarial Studies. The latter program is jointly administered with the Department of Mathematics. A major function of the department is to provide statistical training for many of the other programs at the University, both at the undergraduate and graduate levels.

1. Master's Degree Program

The Master of Science degree program emphasizes a balanced study of course work in statistical methods and theory with optional concentrations in Environmetrics/Biostatistics and Reliability Analysis/Quality Control. This is a 36-credit-hour program that gives students the choice of either taking ten graduate-level courses and a thesis, or taking twelve graduate-level courses and a comprehensive examination. Of the 36 credit hours, 18 correspond to basic core courses (Data Analysis I and II, Mathematical Statistics I and II, Design of Experiments, and Linear Models) and 12 correspond to four elective courses that may or may not relate to an optional area of concentration; the remaining 6 credit hours are either for a thesis or for two other approved elective courses. The Statistics Graduate Director generally does the academic advising for each student in the program. A student who opts to write a thesis must select a professor who is from the department and who is also willing to serve as his/her major professor. In consultation with the student, the major professor invites at least two other professors to join the student's thesis committee. At least two members of this committee, including the major professor (or one of the co-major professors, if applicable), must be professors from the Statistics Department. The department's Graduate Committee must approve the composition of the thesis committee. The major professor is responsible for directing the student's thesis and for chairing the thesis committee.

2. The Baccalaureate Degree Program

The baccalaureate degree program offered by the department emphasizes a balance of statistical theory and data analysis. The lower division prerequisites, which include three semesters of calculus, linear algebra, a course with lab in either biology, physics or chemistry and a computer programming language, are intended to provide students with a sound preparation prior to undertaking the requirements for the major. At the core of the program are the two-course sequences, Introduction to Mathematical Statistics I and II, and Statistical Methods I and II. Students are encouraged to take the latter sequence in their first year in the program; the former, which is taken either in the first year, or second after the prerequisite Multivariable Calculus has been taken and passed. The program also requires the following courses: Introduction to Design of Experiments, Statistical Quality Control, and Introduction to Regression Analysis. In addition to these courses, majors must take a course in Technical Writing from the English Department and choose three elective courses, of which two must be approved statistics courses, while the third may be an approved statistics, mathematics, or computer science course. Courses such as Non-Parametric Methods, Statistical Computing, Statistical Models, Multivariate Methods, Probability Theory, and others are available to students for their elective options. Students must earn a grade of 'C' or better in each course that is required for the program. In addition to the above, each major must take STA 3951, Oral Presentation in Statistics, in their final semester. This course requires students to do a project based on the material studied in the program and it assesses their ability to give a competent oral presentation.

3. The Statistics Minor Program

The minor program currently being offered is less mathematically rigorous than that for the major and it emphasizes applied statistics, as opposed to a balance of theory and methods. To be accepted into this program, a prospective student must have had one introductory statistics course or Calculus II. Once in the program, students are required to take the two-course sequence in Statistical Methods plus two other statistics courses that are chosen from a list of approved elective options. Thus the requirements in the minor program are very flexible. All courses that are part of the minor program must be passed with a grade of 'C' or better. The minor program has no other requirements.

4. The Certificate Program in Actuarial Studies

The Certificate Program in Actuarial Studies is jointly offered with the Department of Mathematics and was implemented after 1991. The program emphasizes the mathematical and statistical aspects of the actuarial science and the goal is to prepare students for the first two or three examinations that are administered jointly by the Society of Actuaries and the Casualty Actuarial Society. To be admitted into this program, students must have three semesters of calculus and a course in computer programming. The coursework for the certificate consists of 20 credit hours and involves courses such as Mathematical Statistics, Linear Algebra, Numerical Analysis, Operations Research, Regression Analysis, and others. A minimum combined GPA of 3.0 and no grade lower than 'C' in these courses is necessary to earn the certificate.

5. Cooperation with other Undergraduate Programs

One of the most important responsibilities of the Department of Statistics is the role it plays in the teaching of undergraduates majoring in disciplines other than statistics. The department plays this role by offering a variety of service courses. These courses have been tailored to meet the requirements of the corresponding programs and were developed by joint consultation with the appropriate departments. Most of the undergraduate students the department serves are from programs in psychology, business administration and related fields, biology, computer sciences, engineering and various health science disciplines. A proposal for a new track in the biology program to prepare students for graduate work in biology has been approved. This new program would have a more rigorous, two semester statistical sequence.

6. Cooperation with Other Graduate Programs

In addition to our own graduate degree program, the Department also offers a number of graduate level statistics courses for MS and Ph.D. students from other programs. Graduate students from programs in biology, dietetics and nutrition, environmental sciences, education (various programs), several programs in engineering, occupational therapy, physical therapy, and psychology are required to have one or two graduate courses in statistics. Some departments list these courses as electives within their programs.

B. The number of Majors

The following table gives the headcounts of the number of statistics students at the graduate and the undergraduate (majors) level over the last four years

Level	2002-2003	2003-2004	2004-2005	2005-2006	4 year Average
Undergraduate	10	9	10	15	11.0
Graduate	4	5	7	7	5.8

C. The Number of Minors

The following table gives the number of statistics minors over the last four years

2003	2004	2005	2006	4 year Average
10	10	8	6	8.5

D. University Core Curriculum Courses delivered

The department delivers four UCC courses: namely, STA 2023 (3 credit hours), STA 2122 (3 credit hours), STA 3111 (3 credit hours) and STA 3145 (3 credit hours). These are all introductory statistics courses geared towards different fields. STA 2023 is primarily offered for the school of business, STA 3111 for biology majors while 3145 is for health professionals. We typically teach about 600-650 students every semester in STA 2023, about 100-150 in STA 3111 and about 60 in STA 3145.

One of the UCC requirements is to prepare students to master concepts and ideas in deductive reasoning and quantitative thinking as well as to ensure that students will become proficient in the art of reasoning critically, solving problems, and analyzing data. Each of the above mentioned courses trains students to describe data and to make inferences from them through the use of word problems and therefore train the students in deductive reasoning, quantitative thinking and analyzing data.

E. Faculty/ Student Ratio

The following table gives the total annual FTE's taught by the Department of Statistics and corresponding faculty/student ratio:

Level	2002-2003	2003-2004	2004-2005	2005-2006	4 year Average
Total FTE's	355	381	405	440	395.25
Faculty/Student Ratio	26.3	30.48	32.4	38.26	31.86

F. Percentage of Students who go on to Graduate or Professional Schools

The following table shows the percentage of students who go on to professional schools or graduate schools (to the extent data are available)

Percentage of students who go on to graduate or professional schools	2002-2003	2003-2004	2004-2005	2005-2006
	Two students graduated and both returned to their home countries	No data available	No data available	50% of the contacted students are pursuing graduate studies

G. Graduate Degrees Awarded

The following table shows the percentage of students who go on to professional schools or graduate schools (to the extent data are available)

	2002-2003	2003-2004	2004-2005	3 Year Average
Bachelors	3	1	4	2.67
Masters	3	1	1	1.33

III. Major Changes in the Program

The following describes some of the areas and factors that suggest changes in the instruction of statistics and education of statisticians along with corresponding strategies that we have pursued and must pursue in the future in order to keep up with new trends and meet demands as dictated by the society, occupation and the students.

1. Application of Computer Technology – Occupational Demand and Societal Need

Statistics is a science of data analysis, and to take advantage of the latest technological advances in this discipline, knowledge of the use of computers has become a vital part of being a statistician. In order to analyze data, the statistician must know how to use statistical software and how to create computer code when no suitable software is available. Knowledge of statistical software products such as SAS, S-Plus, Minitab, SPSS, Excel, etc. is essential for the practicing data analyst. Organizations of all kinds (commercial, industrial, educational, public, etc.) use one or more of these products to analyze their data. It is important, therefore, that learning the use of these software products be part of our curriculum. Some of our undergraduate courses (STA 3112, STA 3123, STA 3163, STA 3164 and STA 4202) and many of our graduate courses are taught using one or more of these statistical software packages, albeit not necessarily in a thorough way. The instruction on the use of these packages has been made difficult due to limited computer laboratory facilities at our disposal. Most of the available computer labs are not large enough to hold 50 students (the typical enrollment in our undergraduate service course

sections) and many of these labs do not even have the most important of the statistical software products, namely SAS. Furthermore, even if students go to a computer lab (with suitable software installed on the computers) to work on their own on homework assignments, they may not be able to get the necessary technical assistance should they stumble on software-related problems. Clearly, there is a need to enhance the university's computer facilities along with appropriate statistical software technical support.

2. On-line Education – Societal Need and Student Demand

The demand for on-line courses is growing. Teaching via the internet is a rapidly developing technology that allows one to offer courses and course materials on the web. On-line courses enable a student to access the learning resources independent of time and location from anywhere the internet is available. This provides an opportunity for an individual to learn statistics even if a student has a full time job. The department initiated its first on-line course (STA 6166) in the fall of 2003. Since then the department has been steadily increasing its on-line course offerings offering up to 4-5 sections of various service courses every semester on-line. The enrollment in our on-line courses has gone from 42 in the fall of 2004 to 257 in the summer of 2006!

In addition, most faculty use technological tools like power point presentations and computer software in their classrooms. A sizeable number also use WebCT as an instructional tool and all faculty post their syllabi and course material on the web.

3. Fewer Domestic Students – Student Demand

One of the disturbing trends in the United States is the decrease in the number of domestic students in technical areas such as statistics. This has occurred in spite of labor department forecasts that the statistics profession is one that will be requiring an increasing number of individuals in the future. Therefore, it is very important for the department to recruit more domestic students. The recruitment committee of this department is dedicated to promoting our program in high schools and colleges in the Miami area. The American Statistical Association (ASA) has established education workshops for advanced placement statistics (APS) and is providing material for the K-12 Curriculum for use in schools. They have developed written materials to help elementary and secondary school teachers make statistics more accessible to students. Our recruitment committee is trying to bring some of those students in local APS programs into our bachelor program.

4. High Demand for Biomedical and Environmental Statistics – Societal Need

Biostatistics is the application of statistical techniques to scientific research in biology and in the health sciences such as medicine, pharmacology, and public health. Biostatisticians play essential roles in designing studies, analyzing data, and creating methods to determine major risk factors for a variety of diseases. Environmental statistics deals with the application of statistical methodology in the study of environmental problems and/or conditions. The use of statistics in these fields of application has increased steadily in recent years. Evidence for this trend is based on a number of factors, including the creation of relatively new journals and publication of new

books dedicated to these fields of application. The demand for biostatistics as well as environmental statistics is growing. This department is currently offering a Master of Science degree program that includes some orientation in biostatistics and environmental statistics. Until recently, the department did not have faculty specializing in these areas of application. However, to promote research in these important areas, and to supervise graduate students also interested in these fields, the department has started recruiting faculty specializing in biostatistics. Two years ago, the department hired one faculty member whose primary area of research is biomedical research and has hired another biostatistician who started in the fall of 2006. The department has also developed a biostatistics course which it offers at least once a year.

In addition, the department and the School of Public Health of FIU have been collaborating to develop a joint Ph.D. program in Biostatistics. The two departments have met several times to discuss the program and have written up an initial proposal for it as well.

5. Need for Actuaries – Societal Need

Actuaries play an important role in the insurance industry: car insurance, life insurance, pension plans, retirement benefits, unemployment insurance, windstorm insurance etc. The public and private sectors increasingly rely on statistical information for decision making, regulation, control and planning. Therefore, actuarial science has become a subject that more and more students are pursuing. Currently, the departments of mathematics and statistics jointly offer a certificate program in actuarial studies, but what is needed is an in depth exploration of the feasibility of offering a more expanded program in actuarial sciences; perhaps a degree, which will train the students for the certification exams.

6. Demand for Service Courses – Student/ Societal Demand

Statistics is one of the fastest growing occupations in the United States. The number of statistical jobs and the general use of statistics by professionals have both grown nationwide. Use of statistical analyses is a prerequisite for anyone working in the sciences, as an engineer or as a social scientist. Due to the increase use of statistics in almost all professional occupations, an increasing number of programs are requiring or recommending that their majors take a statistics course. This growth has placed an increased demand on the Statistics Department to offer a wide variety of service courses both at the graduate and undergraduate levels. Recently a course was adapted for students in the Hospitality Management program and both biology and marine sciences programs have changed their requirements to include two statistics classes. In fact, statistics is one of the universal subjects for any university. It is mandatory for most students to take at least one statistics course in their program of study. The demand for service courses at FIU has increased each year with the growth of the number of students.

Several factors that have caused this growth are enumerated below.

1. Service courses for disciplines throughout university: The department offers service courses for many of the departments in the university. Most students at this university need at least one statistics course to complete their degree program. Since most graduate students must prepare a paper (dissertation or thesis) based on their research that often requires the analysis of data, the demand for graduate statistics courses has grown. Several members of our faculty assist graduate students with the design and/or analysis of their experiments that are necessary components of their theses and dissertations. The demand for these courses will continue to increase as the enrollment at the university grows, especially in the area of graduate programs.

2. Biostatistics course: Because of the increased use of statistics by researchers in the health and biological sciences, the department introduced a new course in biostatistics. The demand for this and other related courses is expected to increase even more after the university starts a medical school program.

3. Environmental statistics course: The department developed a new statistics course for the environmental sciences, environmental geology, earth science, and environmental engineering students to provide them with an opportunity to learn the special statistical techniques that are being used in these fields. The demand for this course will grow with the expansion of these programs.

4. Data analysis courses: The department offers two general applied data analysis courses for graduate students. Though these courses were initially designed for statistics majors, some graduate students from other departments or units (for example, Economics, Engineering, Health Science, Environmental Studies, and Biology) enroll in these courses, for they help them analyze their own research data that are often used for their masters' theses or dissertations. Demand for these courses will continue to grow with the growth of the university's graduate programs.

5. Design of Experiments: The demand for a graduate course in the design and analysis of experiments has grown to the point that in the fall 2005 there were 58 students enrolled. This is too many students for the instructor to work with especially assisting them with their projects and it was necessary to split the class into two parts in the fall 2006 semester.

6. Student Recruitment Committee: To promote within the community both the bachelor's and master's programs in statistics and the statistics profession itself, the department formed a faculty committee to deal with this task. The committee, formed a few years ago, has participated in job fairs at various schools and colleges in Miami, and it has explained to the students of these schools the career opportunities available for statisticians. There has been a steady increase in the number of undergraduate majors in part due to the work of this committee and in part due to the growth of jobs available in the field. This kind of effort to promote the statistics discipline among domestic students will continue with the hope and expectation that the number of statistics majors in our programs will continue to increase.

While there has been a tremendous amount of growth in the demand for service courses, unfortunately, due to limited faculty we are not able to offer sufficient courses or sections of a course each term. As a result the number of adjunct instructors and closed classes has grown over the years. In the fall 2005 term almost every undergraduate service course was closed and many students were left without a statistics course. If this situation continues for too long, it could affect the quality of education.

Thus in conclusion, to catch up with the rapidly changing world as it pertains to the field of statistics, to continue our program effectively, and to increase our level of performance and academic standing in our field, it is imperative that we have a dedicated laboratory space for our students and be able to hire more tenure track faculty.

IV. Student Learning Outcomes:

The table below describes the academic learning compacts for the department of Statistics. These compacts were developed in the fall of 2005 and were implemented in the fall of 2006. As a result, no assessment of the students based on the compacts has been conducted so far.

Mission Statement
The mission of the department is to graduate individuals who know how to collect, analyze, and interpret data. They should be able to carry out the computational procedures necessary to extract relevant information from data and have the ability to express the information contained in the data orally and in writing. The department will strive to help students develop these skills and attempt to graduate those who have the analytical capability to work as professional statisticians or to do graduate work in the field.
Student Learning Outcomes
FIU Statistics graduates should be able to do the following:
Content/Discipline Knowledge
1.Design an experiment and collect data in a meaningful way to insure that they can be meaningfully analyzed
2.Demonstrate the computer skills needed to perform the analysis
3. Demonstrate a strong command of the principles associated with parametric and non-parametric statistics.
4. Identify various career options available after a degree in statistics
Critical Thinking
1. Determine the proper procedures needed to analyze a data set to obtain meaningful information.
2. Demonstrate the ability to read and understand material in statistical texts and articles.
3. Use information technology and statistical software appropriately.
Oral and Written Communication
1. Demonstrate the writing skills to prepare a technical report describing the results of a study
2. Demonstrate the skills to given an oral presentation of the results of a study.

Direct and Indirect measures of Student Learning Outcomes
Content/Discipline Knowledge
1. The department will use embedded questions in the final exams to assess content/discipline knowledge.
2. All graduating students will be required to design a study and analyze relevant results, referred to as the senior project .The department will use a scoring rubric to assess the ability to design an experiment, collect and analyze relevant data.
Oral and Written Communication
1. Students will be required submit a written report on their senior project as well as present it orally to a panel of faculty members. The department will use a scoring rubric to assess the students' oral and written communication.
Critical Thinking
1. The department will use embedded questions in the final exams to assess critical thinking skills.
2. The students will be required to use computer software to analyze the data for the senior project. The department will develop a scoring rubric to assess the appropriate use of computer software on this project.

V. Strengths and Weaknesses

A. Strengths

The department's strengths are evident in all three areas: research, teaching and service.

Considering the heavy teaching load (15 credits per year for tenured and tenure-track faculty after their third year), the faculty maintains a high productivity level in research and some of its members have achieved recognition at the national and international level for the quality of their publications. Some of these members are routinely invited to present their work each year at national and international conferences. Overall, the faculty publishes about ten to twelve refereed research papers per year in journals of international repute and it has authored four books.

The department offers a large number of courses, including several service courses to numerous departments at the university, including, but not limited to, the departments/colleges of business, nursing, dietetics and nutrition, engineering, biology, environmental studies, psychology and education. The departmental policy has always been to design courses that meet the needs of specific programs and to offer the courses at times that are convenient to their students. Our graduate level courses serve not only our own students, but also those from other departments. The quality of the instruction of our permanent faculty has been consistently very high with the faculty receiving very high teaching evaluations as well as winning several teaching awards. Our faculty has won both PEP (1) and TIP (9) awards as well as FIU Foundation Excellence in Research (4) and Excellence in Teaching (5) awards.

The faculty of the Department of Statistics is also very active in the area of service, at both the university level and the professional level. At the university level, the faculty has served on (and continue to serve on) several university-wide committees, for example, the Faculty Senate, the Athletic Council, the Technology Committee, etc. One faculty member has in fact been awarded the University Distinguished Service Medal. At the professional level, several members hold important positions in the South Florida Chapter of the American Statistical Association (ASA) and have successfully conducted many seminars and meetings. One faculty member served as Chairperson of the Council of Chapters of ASA, which is one of the two major branches of the national association. In addition, three members of the faculty serve as associate editors of international journals, one has served as an editor of two international journals, and all of them provide invaluable service to the profession by reviewing papers for journals. Some members of our faculty are also active in providing service to the community. In fact, one faculty member is serving on the Florida Commission for Hurricane Loss Projection Methodology and chaired it for two years in the past. This commission is run by the State Board of Administration in Tallahassee and is charged with ensuring that hurricane models used by insurers in the state of Florida meet certain standards. Two faculty members have also been involved with researchers from the International Hurricane Center in the development of the Public Hurricane Loss Model.

B. Weaknesses

The department's major weakness has been the lack of an adequate number of faculty to teach our courses. The number of students taking statistics courses has been steadily increasing. The department started a Masters program in the fall of 2000 and therefore is now required to offer more courses than it did six years ago. However, we actually lost faculty during the same period. The number of ranked faculty in the department for 2006-2007 will be 9 and the total number of faculty will be 13 (equivalent to 12.5 FTE), whereas in AY 2000-2001, we had 11 ranked faculty. The number of teaching faculty is also less than what we had in 2000-2001 (N = 14, 13.5 FTE). Resignations and retirements had not generally been matched by the recruitment of a proportional number of equivalent new faculty members. Over the last five academic years we have lost 4 members of the ranked faculty (three at the Associate Professor level) and 2 instructors. In return, we have succeeded in recruiting 2 assistant professors and three instructors. Not only has the number of ranked faculty declined, but also the ratio of ranked faculty to majors and enrollments decreased as well. As a result, as mentioned earlier, a very high percentage (between 35 – 40%) of our courses has been taught by non-regular faculty (adjuncts who teach one to two courses and visiting instructors who teach four courses per semester!). At the last departmental review in 1997, approximately 33% of all courses were taught by non-regular faculty. In the fall of 2001, the percentage of courses taught by non-regular faculty was up to 41% rising even further to 46% in the fall of 2003. In the fall of 2004 there was a little improvement, but the percentage was still as high as 38%. Since the fall of 2005, the number has dropped down to about 35%, still extremely high! There are not many professional statisticians in the Miami area because of the lack of sufficient industries in this area. Therefore, getting well qualified adjuncts instructors is very difficult. Many of the adjuncts used by the department are marginally qualified to teach basic courses. Fortunately, the new lines that have been approved along with the university's recent effort in converting adjunct lines to instructor lines will alleviate the problem. We will be able to cover more courses with the additional faculty we will be hiring and that combined with the large classes we have started offering will reduce our dependence on adjuncts. However, as mentioned earlier, while the staffing situation has been improving, we still need to hire tenure track faculty to increase research productivity. Hiring more instructors will make us primarily an instructional department which is not in keeping with the university's goal of being a top rated research university.

In the same spirit of the lack of sufficient instructors, the teaching load of the regular faculty is too heavy and comes at an expense. The faculty has less time to focus on research activities, and in order to keep up their current level of productivity, most end up sacrificing family and personal life. Another consequence of this is that most of our service courses are closed each semester and with the new restriction on the number of students who can enroll in a classroom, many students are unable to get a course needed for graduation, increasing the time necessary to earn a degree. It is not possible to offer more sections since we do not have the faculty to staff the courses and there are insufficient qualified adjuncts available.

Another area of weakness has been the lack of success in attracting a sufficient number of graduate students. This came mainly from an insufficient number of graduate assistantships. In the past, we had only one out-of-state assistantship from the college that we could offer to incoming graduate students. This translated to only one out-of-state student being able to join our

master's program. Since many well-qualified students pursuing graduate studies in statistics tend to be foreign students, this limited the department's ability to expand its graduate program and reach a critical mass. However, as mentioned earlier, this situation has changed; we have more assistantships now and should be able to recruit more high quality students.

The department lacks a dedicated laboratory for its students. The existence of such a space will allow us to incorporate statistical software into more of our courses in addition to having a place which the statistics majors could call their home. We could use the space for mentoring and advising students as well.

The department also lacks sufficient office space for its teaching staff (including non-regular faculty). Moreover, the main office assigned to the department is too small to accommodate the secretary's desk, necessary file cabinets that contain confidential information, and various other office equipment such as a fax machine, printers, a scanner, a shredder, and computers.

Finally there is very little support for research-related activities of the faculty. Travel funds are very limited and cause the faculty to assume a substantial portion of the cost to attend conferences. While the department has colloquium funding, it is by far not enough to invite a sufficient number of outstanding statisticians to give talks at the department, which is essential to fostering new research projects and collaborations.

The department's graduation rate (.25) appears to be lower than the college average (.44), but one should note that approximately one-half of the rates are always below the average. The rate varies from discipline to discipline. It is probably common that the rate in mathematical disciplines is relatively low. For example, the graduation rates for Computer Science and Computer Engineering are 0.27 and 0.25, respectively. (These numbers were obtained from the School of Computer Science.) Moreover, both our undergraduate and graduate programs are small and thus the value of our current graduation rate does not really reflect the potential rate of our programs.

VI. Opportunities and Threats

A. Opportunities

The opportunities can be divided into four categories.

1. The major strength of the department is in the specialization, expertise and diverse experiences of our faculty, especially in the statistical modeling, reliability and life testing areas. This provides the department with an excellent opportunity (which is rather unique because of the nature of statistics field) to be an active partner and complement almost all other areas at FIU that are highly active in research. These include many of the most successful and rapidly growing areas such as Environmental Sciences, Environmental Engineering, Biological Sciences, College of Health, Forensic Sciences, and areas in the College of Education and the College of Business where the emphasis is on quantitative methods. The department has an excellent

opportunity to be a partner and an instrumental factor in the success of our new highly regarded Law School, in the areas of discrete data analysis and a growing field of Legal Statistics. The department has also had the opportunity to be involved in the extremely important field of hurricane loss modeling. Two faculty members are involved in the development of the public hurricane loss projection model housed at the International Hurricane Center at FIU. The department also has the opportunity to be in a position to play an essential role in the realization and success of the future health sciences programs and the medical school by providing expertise and collaborative efforts in interdisciplinary research areas in the fields of Survival Analysis and Statistical Analysis of Clinical Trials, Design of Experiments and Biostatistics in general. Our department and the School of Public Health of FIU have shown strong desire to jointly develop a Ph.D. program in Biostatistics. As a matter of fact, the two departments have met several times to discuss the program and have written up an initial proposal for it as well.

2. Because of the need for statistical analysis in almost all scientific research and objective decision-makings, most of our experienced faculty are in constant demand for serving on various graduate committees. This gives us a unique opportunity, through our research and service on different committees, to be true active participants in the collective efforts of transforming FIU to a top research university.

3. We have an excellent opportunity to serve many of the majors at FIU by providing the essential and often required statistics service courses both at the undergraduate and the graduate level. We have an excellent opportunity to be a partner in the development of undergraduate and the graduate curricula of many of the existing and future programs, especially Ph.D. programs. An excellent comprehensive statistics program is a necessary part of any top research university.

4. The Actuarial Certificate Program, which is offered jointly with the Mathematics Department, has given us an excellent opportunity to serve our students, our city, our state and the many interested clients around the nation by providing trained individuals in this field. Indeed, most of our graduates in mathematics and statistics who have been very successful in the job market are those who have graduated from the Certificate Program in Actuarial Studies. In 1996, the company formerly known as American Bankers Insurance Group, in recognition of the excellence of our program and the outstanding performance of our graduates who were nominated for an internship in their organization, established an annual scholarship of \$750, with an opportunity of a paid summer internship, to be awarded exclusively to an outstanding undergraduate student who is enrolled in the Certificate Program in the Actuarial Studies at FIU. Almost all of the students (including the four undergraduate students who received the American Bankers awards) in the Certificate Program who had an opportunity of a summer internship at the American Bankers (due to their excellent performance during their paid summer internships) were offered upon graduation a high paid full time position at that organization. Some presently have managerial positions in that company. With the exception of two students who decided to pursue a graduate degree in Statistics, all are currently working for the Assurance Groups (formerly known as American Bankers Insurance Group). This year, American Bankers Assurance Groups has increased the amount of scholarships for our Certificate Program from \$750 to \$1000. Currently, we are funded for two scholarships for this academic year and we are in the process of selecting two qualified students for these awards. Almost all of the students who have graduated from our program (those we know that have taken the Actuarial Exams)

have passed the Society of Actuarial Organizations' professional exams for mathematics and statistics (in the old system prior to year 2000) and the Society's combined mathematics and probability exam under the new system started in 2000. In fact we were able to verify that all 10 graduates who have taken the Society's exams have passed the Mathematics and Statistics Exam(s), and some have passed several of the more advanced exams. Due to the reputation and excellent performance of our graduates in the job market, the National Council on Compensation Insurance, Inc. has requested the opportunity for an on-campus visit with our students for the purpose of recruiting students for their summer internship positions. This will give us another opportunity to make another partnership with the business sector in the State of Florida. If there were additional funding for at least two faculty in the Actuarial Science areas, adequate funding and closer interdisciplinary cooperation with the Decision Sciences and Finance Departments, this program could offer a degree program by the year 2008 with a potential expected student enrollment possibly higher than the current enrollments in statistics and mathematics programs combined.

B. Threats:

1. Lack of Adequate Funding for Personnel, Research and Instructional Purposes

The major threat to the program is lack of resources. During the last six years, since the inception of our Master program, the number of courses needed to be offered and the number of students in most of our courses have been steadily increasing. Today, we have fewer faculty members with a terminal degree in statistics than in AY 2000-2001. Presently, adjuncts and visiting instructors teach a high percentage of our courses. Most of them have no office or office support. Offices and office equipment are in poor condition. While we will have more instructors in 2007, the support structure for them in terms of space and facilities still remains questionable. Budget for traveling and other commodities is not adequate; for instance, often the funding is not even enough to cover the expense of presenting a paper at a conference. Many of our classes that have enrollment caps of 50 are full to capacity with no funding for graders or dedicated teaching assistants. Funding for a small statistics library and an adequate number of teaching assistants to run it is needed. Considering the high dropout rate in statistics courses it is important to have a statistics laboratory with adequate support. We believe that such a lab would reduce failures in the statistics courses. Adequate funding for these resources is perhaps the cheapest and most effective way for increasing the success of our students and faculty.

2. Lack of Adequate Interdisciplinary Collaborations.

The interdisciplinary collaboration with Biology, Environmental Studies, Environmental Engineering, and many other disciplines is presently very limited. The reasons are perhaps, partly due to the attitude of competition rather than cooperation and sharing of resources among colleges, and within the college, among the departments. There is not an adequate, real and clear university-wide, college-wide or departmental level policy to encourage such cooperation. The real solution to this problem requires a top leadership intervention, perhaps at the Provost level, with a clear and real incentive for interdisciplinary work.

3. New Immigration Law and Extensive Paper Work for the International Students.

Many of the students in the sciences and statistical areas are international students. The new immigration law with its extensive required paper work and the university's lack of adequate funding for assistantships are two serious obstacles for recruiting some highly qualified students from abroad.

VII. Budget

The Department of Statistics currently has thirteen regular faculty members (one of them is half-time) and one visiting instructor. The total amount of salaries of the regular faculty members is \$754,957. The salary of the one visiting instructor is \$38,000. There are four teaching assistants in the department (three assigned to the department and one paid for by the Dean's Office.) The current stipend for each graduate assistant is \$8,000 which is far below other universities and other departments within the college and **should be increased**. No student can be expected to support themselves on \$8,000 a year and the assistantship is the only source of income for foreign students. The department would consider this fact for the estimate of future cost. The following would then describe our steady state budget:

	Recent Year	3rd year	6th year	10th year
Regular Faculty Salaries	\$754,957	\$800,934	\$875,200	\$985,046
Visiting Faculty Salaries	\$38,000	\$40,314	\$44,052	\$49,581
Graduate Assistants Stipends	\$32,000	\$33,949	\$37,097	\$41,753
Total	\$824,957	\$875,197	\$956,349	\$1,076,380
Note: Current budget with no incremental investment beyond inflation and annual salary increase. Based on 3.5% living cost increase.				

As mentioned earlier, the department of statistics is short of faculty and graduate assistants. A large portion of the courses are taught by adjuncts. To maintain and/or improve the quality of teaching and research, the department needs to recruit at least three new faculty members. The department should also be given three additional assistantships. The total amount of salaries of the new faculty members is around $3 \times \$65,000 = \$195,000$. The start-up expense for the new faculty members is $3 \times \$15,000 = \$45,000$. To accommodate the new faculty members, at least two additional offices are needed. One statistics lab is also needed. Therefore the following table shows the proposed increments in our budget over the next six years.

		Next Year	3rd year	6th year
Regular Faculty Salaries		\$195,000	\$206,876	\$226,058
Graduate Assistants Stipends		\$24,000	\$25,462	\$27,823
Statistics Lab	Room *	\$15,000	\$15,914	\$17,389
	Desks and Chairs	\$20,000	\$0	\$0
	Computers **	\$104,000	\$110,334	\$120,565
	Salary ***	\$50,000	\$53,045	\$57,964
Total		\$408,000	\$432,847	\$472,984

Proposed Increments

The rationale for the proposed increments is clear. It is the minimal requirement for the survival of our department. While we cannot predict the returns on the investments in dollar amounts, having additional faculty and graduate students will mean that we will be able to offer the courses needed by the university, offer better quality classes and increase the productivity of our department. Currently on an average a faculty member of the department generates about 800 FSCH per academic year and therefore two additional faculty will lead to an increase of at least 1500 FSCH/AY.

VIII. Major Findings and Recommendations

These recommendations are based on the relationship between the program, the environment and the strengths and weaknesses of the unit.

A. Faculty Salaries

The salaries (as documented in the UFF-FIU salary report for 2004-2005) for most professors in the Department of Statistics fall well below the national median. National salaries for academic statisticians for the year 2004-2005 are shown in the table below. The new Assistant Professor hired last year has a salary \$3500 less than the median. The other Assistant Professor, who has been at FIU for two years, earns a 9-month salary of that is \$1,964 below the median. Similarly, we have two Associate Professors that have been at this rank for over thirteen years and their average salary is only \$66,069. This is \$2,931 below the national median. The salaries of the full professors while being lower than that of the national median are closer to the national median. In summary, all of the tenured and tenure-track faculty at the department earn salaries that are below the national median with a sizeable percentage earning below the lower quartile!

Faculty Salaries: (Based on data published by the American Statistical Association's 2004-2005 Salary Report for Academic Statisticians). The lower quartile and the median nine-month salaries of statistics professors at research universities.

Rank	Years of Experience	Lower Quartile	Median
Assistant Professor	0 to 1	\$60,923	\$66,000
	2	\$60,500	\$65,000
	4 to 5	\$62,100	\$70,000
Associate Professor	6 to 8	\$61,750	\$68,538
	13 or more	\$61,675	\$69,000
Professor			
	0 to 1	\$78,100	\$84,859
	6 to 7	\$83,000	\$107,000
	25 to 30	\$86,013	\$113,700

B. Recommendations to improve instruction and curriculum:

1. Each elementary statistics course should have a laboratory session attached to it. Statistics is an applied science and should be taught as such. This improvement is being incorporated in other statistics programs in this country. The students should have the opportunity to design experiments, collect data and analyze them. One way of doing this is to attach a one credit hour lab course to each of the elementary courses. Needless to say, this would require permission from the departments we serve and might burden the students with more credit hours. In the absence of permission, we should, at the very least, require our majors to take such a course. The infrastructure for this course is already in place, since it has been taught previously at FIU. When it was offered, it was an enormous success. Most students who were enrolled in the class said that they had developed a better understanding of the material presented. Unfortunately the department had to drop the lab course due to lack of sufficient funds, space and faculty to teach it. The department needs to start offering such a lab on a regular basis. It is hoped that more lab courses will be offered a few years later if we can have some additional faculty, funding and the space for the lab.

2. Having our own computer lab with computers dedicated to our students would greatly enhance the quality of our instruction. This would allow students to learn interactively as the professor demonstrates certain distributional properties or a technique on the computer. Moreover, most of our courses require the use of computer software. An instructor would be able to teach students how to use the software much more efficiently in a computer laboratory rather than in a classroom. The lab would also be useful for holding statistical seminars, particularly when statistical software has to be used during presentations.

The statistics lab in mind would need to have sixty computers with the following software installed:

- a. SAS and SAS/IML on Solix
- b. SAS and SAS/IML for Windows
- c. SPSS on Solix
- d. SPSS for Windows
- e. Minitab on Solix
- f. Minitab for Windows
- g. S-Plus
- h. Microsoft Office
- i. FTP (Windows Version)

Since the Department of Statistics does not have enough manpower to maintain a lab, the University Technology Support center would have to assign somebody to manage it.

C. Future Direction of the Program.

The department will continue in its efforts to achieve national and international recognition. The short-term goals of the department are strengthening the M.S. program and the statistical consulting center. Another short-term goal of the department is to streamline its biostatistics track to fit in with the University's goal of starting a medical school. In the long run, the department envisions more of its faculty involved in grant writing and bringing in funds. The department also envisions strengthening its involvement with the centers in the University, for example, the International Hurricane Center. This can lead to several applied research projects and therefore increased funding. However little of this can be done if the number of tenure earning faculty lines is not increased in proportion to the increasing teaching demands. Also the high usage of adjuncts and visiting instructors has degraded the quality of the teaching effort of the service courses and it is getting very difficult to hire even marginally acceptable adjuncts. This trend must be reversed.

Final Conclusion/ Summary

This report can be summarized as follows.

1. The Department of Statistics has done an excellent job in meeting its commitments to provide a quality education for both majors and non-majors.
2. The department has been efficiently managed and has been able to cope (although not without sacrifices) with the financial constraints placed on it. In spite of being understaffed, it has generated, each year, more FTE's than planned.
3. The staffing problem had reached a crisis but it is under control now.
4. More resources for travel and research activity are needed.
5. A lab space is urgently needed for the students.

It is urgent that sufficient steps be taken now to relieve the staffing problem. While we have been granted two assistant professor lines and two instructor lines in the last two years, these have been replacement lines and not incremental lines. Additional lines are needed to cover our teaching and research needs. The projected growth in enrollment at the university will further worsen the staffing problem.