UNIVERSITY
OF MIAMI
FACULTY SENATE

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MEMORANDUM

To: Donna E. Shalala, President

From: Richard L. Williamson
Chair, Faculty Senate

Date: April 22, 2010

Subject: Faculty Senate Legislation #2009-27(B) – Establishment of the Miller School of Medicine Master of Science in Biostatistics

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At its April 21, 2010 meeting, the Faculty Senate unanimously approved the proposal from the Miller School of Medicine to establish the Master of Science in Biostatistics within the Division of Biostatistics within the Department of Epidemiology and Public Health (DEPH).

As part of its approval, the Faculty Senate called for consultation and continuing conversation between this and other cognate programs/schools as the degree develops and asked the interested schools to report on this matter at its next scheduled meeting in August 2010.

The proposal is enclosed for your reference.

This legislation is now forwarded to you for your action.

RW/rh

Enclosure

cc: Thomas LeBlanc, Executive Vice President and Provost
Pascal Goldschmidt, Dean, Miller School of Medicine
Bertrand Clarke, Professor, Department of Medicine, Division of Biostatistics
J. Sunil Rao, Chief, Division of Biostatistics

CAPSULE: Faculty Senate Legislation #2009-27(B) – Establishment of the Miller School of Medicine Master of Science in Biostatistics

PRESIDENT'S RESPONSE

APPROVED: _____ DATE: 4/28/2010
(President's Signature)

OFFICE OR INDIVIDUAL TO IMPLEMENT: DEAN PASCAL GOLDSCHMIDT

EFFECTIVE DATE OF LEGISLATION: IMMEDIATELY
(if other than June 1 next following)

NOT APPROVED AND REFERRED TO: _____

REMARKS (IF NOT APPROVED): _____

UNIVERSITY OF MIAMI
MILLER SCHOOL
of MEDICINE

To: Dr. Richard Williamson
Chair, Faculty Senate

From: J. Sunil Rao, Ph.D., Chief, Division of Biostatistics
Bertrand Clarke, Professor, Department of Medicine, Division of Biostatistics, and Center for Computational Sciences

Subject: Proposal for a Master's Degree in Biostatistics
Author: Bertrand Clarke, Professor, Department of Medicine, Division of Biostatistics, and Center for Computational Sciences

Date: April 9, 2010

Purpose and Goals

Since the wide spread availability of high speed computing and the increasing sophistication of data gathering in the medical and health science fields, quantitative methods have played an increasing and increasingly important role in biomedical research. Indeed, it is hard to publish research papers in many of these fields without a proper statistical analysis of the data collected. This trend has been supported by the established quantitative history of the behavioral and social sciences because so many chronic health problems are linked to behavior. In coming years, the role of quantitative methods in general, and biostatistical methods in particular, is likely to continue to increase rapidly. Indeed, whole new classes of data involving many thousands of observations per subject are becoming common and researchers will rely increasingly on sophisticated biostatistical analyses to reach scientifically defensible conclusions.

It is important to distinguish between statistics as a field and biostatistics as a subfield. The prefix `bio' pertains to the fact that the subjects of the experiment are living organisms for medical research. This introduces specialized features and complexities that do not commonly occur in other branches of statistics. Overall, the goal of biostatistics is to analyze stochastic data collected in the biological sciences and is an evolving field even though there are several established areas of study such as clinical trials and survival analysis.

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A graduate program that equips its graduates to analyze traditional classes of data well and provides the foundational work for further intellectual development is an essential component to the UMMSM scientific enterprise. Overall, there are three goals the proposed program will satisfy:

i) Feed a PhD program in biostatistics.

ii) Train Master's graduates who will have the ability to support doctoral level biostatistics and work with a certain amount of independence.

iii) Generate revenue that will more broadly support the graduate program in biostatistics.

The fastest way to a PhD program in biostatistics is to start a Master's program. Indeed, it would permit the existing faculty to acquire the skills, infrastructure and extra personnel to launch a PhD program that would have a good chance of success. Essentially, the Master's program proposed below over two years contains the first 1.5 years of a PhD program. That is, only about 1 semester's worth of courses would be particular to a Masters program; the rest are necessary for a PhD program.

Second, good Master's students would support the existing PhD level statisticians who often work for a funded researcher at UM. It is often the case that a funded researcher does not have the quantitative skills to supervise a Master's level statistician, but a PhD level statistician does. Master's level statisticians are less expensive than PhD level statisticians so hiring them would be a more efficient allocation of scarce funding dollars. It is currently the case that many of the biostatistics faculty in the Department of Epidemiology and Public Health are paid for work that could be done just as well by a Master's graduate. As a separate but related point, a high quality Master's graduate with some years of experience often can work with little supervision in specific subject matter disciplines provided the class of techniques needed does not change too quickly over time.

Third, there is evidence that a successful Master's program can, over time, recruit enough paying students to cover the marginal costs of a program. Indeed, some of the funding would come from funded researchers paying Master's students to do analyses in the context of a Consulting Practicum course (see Sect. 3(d) (ii)) where they would be guided by the instructor. The

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proposed program is expected to be of special interest to international students who would be supported by their home country's government or institute.

The intellectual goal of the program derives from the fact that at the present time, UM does not have an active undergraduate or graduate program focused on statistics or biostatistics. Increasing the biostatistical capacity at UM will fill a gap helping UM to join the ranks of top AAU universities.

Department of Epidemiology and Public Health
Leonard M. Miller School of Medicine
1120 NW 14th Street Room 9th floor • Miami, Florida 33136
Phone: 305-243-2209

Proposal for a Master's Degree in Biostatistics

1. Rationale

a) Title of Degree. Master of Science in Biostatistics

b) Purpose and Goals.

Since the wide spread availability of high speed computing and the increasing sophistication of data gathering in the medical and health science fields, quantitative methods have played an increasing and increasingly important role in biomedical research. Indeed, it is hard to publish research papers in many of these fields without a proper statistical analysis of the data collected. This trend has been supported by the established quantitative history of the behavioral and social sciences because so many chronic health problems are linked to behavior. In coming years, the role of quantitative methods in general, and biostatistical methods in particular, is likely to continue to increase rapidly. Indeed, whole new classes of data involving many thousands of observations per subject are becoming common and researchers will rely increasingly on sophisticated biostatistical analyses to reach scientifically defensible conclusions.

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A graduate program that equips its graduates to analyze traditional classes of data well and provides the foundational work for further intellectual development is an essential component to the UMMSM scientific enterprise. Overall, there are three goals the proposed program will satisfy:

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have the quantitative skills to supervise a Master's level statistician, but a PhD level statistician does. Master's level statisticians are less expensive than PhD level statisticians so hiring them would be a more efficient allocation of scarce funding dollars. It is currently the case that many of the biostatistics faculty in the Department of Epidemiology and Public Health are paid for work that could be done just as well by a Master's graduate. As a separate but related point, a high quality Master's graduate with some years of experience often can work with little supervision in specific subject matter disciplines provided the class of techniques needed does not change too quickly over time.

Third, there is evidence that a successful Master's program can, over time, recruit enough paying students to cover the marginal costs of a program. Indeed, some of the funding would come from funded researchers paying Master's students to do analyses in the context of a Consulting Practicum course (see Sect. 3(d) (ii)) where they would be guided by the instructor. The proposed program is expected to be of special interest to international students who would be supported by their home country's government or institute.

The intellectual goal of the program derives from the fact that at the present time, UM does not have an active undergraduate or graduate program focused on statistics or biostatistics. Increasing the biostatistical capacity at UM will fill a gap helping UM to join the ranks of top AAU universities.

c) Demand and Job Market.

Demand for high quality Master's level statisticians and biostatisticians outstrip the supply by a wide margin and is likely to do so for many years to come. For instance, a recent New York Times article is headed: For Today's Graduate, Just One Word: Statistics, see http://www.nytimes.com/2009/08/06/technology/06stats.html. The article describes the demand for statistics across a wide variety of fields.

Separately, the president of the American Statistical Association wrote to the Director of the NIH on 15 December 2009, see http://docs.google.com/viewer?a=v&q=cache:9WhlRKfGxJMJ:www.amstat.org/outreach/pdfs/CollinsDecember2009.pdf+amstat+december+collins&hl=en&gl=us&sig=AHIEtbT2nQEPlSO-pwpsxR5MIbyqPvZW2A, describing the demand for biostatisticians and emphasizing the importance of Master's degrees across a variety of application domains. Partially because of this the NIH is funding summer training in biostatistics, see for instance, http://grants.nih.gov/grants/guide/rfa-files/RFA-HL-09-009.html.

These national trends are also apparent from the job market listings and can be seen in microcosm at UM. Demand for high quality Master's graduates is pervasive throughout the Medical Campus and RSMAS. The demand is so high that many of the PhD statisticians are addressing Master's level problems. Given the likely turnover of personnel in the coming years the supply of statistically trained people relative to the demand will probably become even more unbalanced. This is hinted at by the Bureau of Labor Statistics (BLS), see http://www.bls.gov/oco/ocos045.htm#emply, where the job outlook for biostatistics is projected at 13% growth from 2008-2018. The BLS notes 13% is the average increase over

all professions but indicates that many people doing statistics/biostatistics will have titles that do not indicate the statistical nature of the work.

Two major employers outside the academic world that hire biostatisticians en masse are the pharmaceutical companies and government agencies. More generally, statisticians are also hired by the financial services industry, consulting companies, hospitals, and a variety of large companies that undertake industrial research. Indeed, all large businesses rely on statistics for marketing. Demand for graduates has remained strong despite the economic downturn and a having a degree in biostatistics that emphasizes foundational concepts as proposed here would make our graduates competitive for jobs outside the usual boundaries of biostatistics narrowly defined.

There are many schools that offer Master's degrees in Biostatistics so UM would be a latecomer to this business. Nevertheless, the opportunities are great enough that much remains to be gained especially by a well-designed, high-quality program such as explained below. For instance, the University of Michigan states ``Demand for Biostatistics graduates is high and graduates from our program have a variety of attractive job offers." See http://www.sph.umich.edu/biostat/programs/, which was last updated 19 January 2010.

Within Florida, there are two universities which offer a Master's degree in biostatistics. Florida State University has a degree program in biostatistics and the University of Florida has a degree in Statistics that can be designed to include all the courses that would be required for a Master's in Biostatistics. In addition, the University of South Florida (USF) and Florida International University (FIU) offer Masters' in Public Health programs with specialties in biostatistics. FIU's program is very small and the USF program only accepts 2-3 biostatistics masters' students per year. These programs would provide competition to a program here and we would want to benchmark against them. On the other hand, all but the program at FIU are far enough away geographically that students wishing to be based in South Florida would likely have UM as their first choice. Moreover, graduates from a program at UM would be very attractive to South Florida employers.

Nationally, the demand for biostatistics (broadly defined) is large and growing. This is primarily due to the aging of the population motivating recent advances in drug discovery and other branches of medical science. The resulting increase of medical costs is often driving the desire for more cost efficient therapies. The popular concern for environment (broadly defined to include agronomy and meteorology among other related fields) also contributes to the demand for biostatistically trained people.

Outside the US, many of the same trends are present as in the USA and for the same reasons. The trends are just as pronounced in Canada and Western Europe. In Latin America, the job market for biostatisticians is unclear because throughout much of Latin America Statistics is regarded as part of econometrics and located chiefly in Schools of Business Administration. The Asian markets such as Japan, Korea, and China are growing but to date they mostly seem to hire their own graduates or graduates exclusively from elite schools in the US. India generates enough of its own statisticians at this time as does the Muslim world (which is a much smaller market).

d) Relationship to Other Fields and Interactions with Departments.

The Master's in Biostatistics is to be initially situated in the Division of Biostatistics within the Department of Epidemiology and Public Health (DEPH). The plan is that, in the near future, DEPH will become a School of Public Health at which time the Division of Biostatistics will become a department.

The proposed Biostatistics Master's program course list includes one of the DEPH courses *Fundamentals of Epidemiology* as a required course. In addition, one of the courses offered by DEPH (Survival Analysis) would become one of the required courses in the Master's program described below.

One of the courses, the Consulting Practicum in the second semester of the second year of the proposed Biostatistics program, will be supervised practical applications of previously studied theory. In this context, researchers from subject matter fields, chiefly other Departments in the School of Medicine would be able to benefit from data analysis in their areas of research.

It is possible, indeed likely, that some of the courses proposed below would be of interest to PhD students in other Departments. For instance, Generalized Linear Models seems not to be offered elsewhere at UM and might be of interest to scientists analyzing categorical data. Likewise, Longitudinal data seems not to be offered elsewhere at UM and might be of interest to PhD students making repeated measurements on subjects over time. Analogous comments apply to the Survey of Statistical Computation course.

At present, DEPH is revamping several of its PhD courses including *Advanced Statistical Methods I and II*, 603 and 605. In the future, these courses will be taught by the Biostatistics Division and may be integrated into the Biostatistics Master's program since they may include topics often not part of traditional biostatistics. This would add breadth to the course offerings listed below.

From the reverse direction, there will be courses offered in other departments that would be of interest to Biostatistics Master's students. As a generality, they are taught from a different perspective and even when they cover analogous material they emphasize different aspects. Nevertheless, the Division would welcome the breadth such opportunities would provide our students as long as the integrity of the program were not compromised. Thus, on a case-by-case basis the Graduate Program Director would approve substitutions for the core courses below if the student in question would still be adequately prepared by the completion of our program. Instances of this follow.

There are courses offered by the Mathematics Department *MTH 524* and *MTH 525* which might be accepted in place of either *Probability and Distribution Theory* or *Inference* in the program below. This would depend on the detailed syllabi of the courses and the statistical background of the student: The more extensive the statistical background of the student, the reasonable such a substitution would be. Likewise, the Department of Management Science

offers a multivariate analysis course *MAS 602*. This might be acceptable in lieu of the Multivariate course described below if the student had a satisfactory theoretical background.

The Psychology Department offers one course that covers both multiple regression and multivariate statistics and another that covers multivariate correlation methods (632, 633). Together, these courses would probably be acceptable in place of the multivariate course below, depending on the exact syllabi and orientation of the instruction.

The Department of Marine Biology and Fisheries offers a course called *Advanced Biometrics in Marine Science 615*; again, depending on the background of the student and the detailed syllabi of the courses this might be acceptable in place of multivariate statistics below.

The Department of Educational Psychology offers item response theory, structural equation modeling and multilevel modeling (673, 674). These do not overlap with the courses in our program below, however, they could serve as an acceptable alternative for certain students interested in that area.

As a consequence of this, it is easy to imagine cross-listing courses with other departments to increase the breadth of educational experience available to UM students. In some cases, to take advantage of specialized skills, is possible that faculty members outside the Division of Biostatistics would be invited to teach for the Division.

At the advising level, as opposed to the direct instruction level, it is recognized that Biostatistics derives much intellectual impetus from other fields of study. So, Biostatisticians and often seek deep interactions with fields such as Medicine, Epidemiology, Biology, Marine Science, Computer Science, Electrical Engineering, Mathematics, Behavioral Sciences (e.g., Psychology), and Econometrics among others. The pragmatic consequence of this is that any of these fields may be a source of thesis topics, funding, and courses germane to the proposed Biostatistics program. The faculty in many of these departments would therefore be desirable as thesis advisors and co-advisors. This would typically be worked out on a case-by-case basis since the selection of an advisor is primarily the responsibility of the student. However, as noted below, at least one of the advisor and second reader would be in the Division.

e) Relationship to Undergraduate and Professional Programs.

The three main ways the proposed program would interact with existing undergraduate and professional programs are:

i) Supplying prerequisites to our students or students to our program. Other Departments at UM have statistics courses at the undergraduate level. This includes Mathematics, Psychology, Engineering, Management Science, Marine Biology and Fisheries amongst others. In many cases, these courses would be good prerequisites for prospective Masters in Biostatistics to complete. Indeed, Track B students below (those admitted but not having a satisfactory Statistical preparation) could take some of these existing courses remedially. At this time there is no evidence of any

undergraduate course that overlaps with any of the courses described below. Moreover, none of the courses proposed below overlap necessarily substantially with existing graduate courses that are described above. (Even where there is some overlap in content, the perspective is very different.)

ii) *Interdepartmental collaboration.* Existing programs might wish to include courses offered from a Division of Biostatistics. Specifically, some of the Biostatistics courses might be appropriate for a biostatistics stream within the MPH. In addition, Marine Biology and Fisheries might want to include some of our first year courses as electives in their programs. It is possible that the Departments of Mathematics, Biomedical Engineering and Electrical and Computer Engineering might wish to include our courses in their graduate programs.

iii) *Relationship to other programs.* Despite the huge demand for statistics and biostatistics at UM, it seems that there is no active program at UM with its primary focus as Statistics or Biostatistics. While there is a Master's program in Statistics on the books offered jointly by the Departments of Mathematics and Management Science, the program has not admitted students for over two years and it seems there are only two students left in the program.

2. Physical Resources

a) Library analysis.

i) Resources, services, and subject specialists currently available. There are two libraries that have physical collections of biostatistics and statistics books, the Richter and Calder libraries. Richter is part of the Coral Gables Campus and Calder is part of the Medical Campus. They are somewhat independent since medical school libraries are part of a different library system, however Richter is the central library for UM.

All the major journals needed for a Master's in biostatistics are currently available. Most of them are online and available from any part of the library system.

Libraries may or may not hold textbooks for courses, although they do hold books in the general topics areas of courses. For instance, using the Richter search engine at http//ibisweb.miami.edu, with search terms like the names of proposed courses in Sect. 3(d), e.g., Generalized Linear Models, Clinical Trials, and Design of Experiments, revealed an array of books. However, few are from the last 2 years. A similar search at Calder using the search engine http//callcat.med.miami.edu revealed some books also.

ii) Additional library resources and their estimated cost. In Biostatistics, courses are usually based on a single textbook and various journal articles. Syllabi are usually quite linear in the sense that they teach a collection of related ideas in a logical sequence each lecture of a course building on the previous lectures. The textbook is usually mandatory since the instructor will teach from it, often assign exercises from it, and use it for examples of analyses. Thus, the role of extra books, such as it would

be desirable for a library to stock, is to contribute to intellectual breadth by allowing the student alternative sources for the same material. Students often find the presentation of a topic in one book more congenial than in another for strictly idiosyncratic reasons.

Obviously, the proposed program would benefit from an expanded collection of books related to the courses proposed in Sect. 3 (d). In an ideal world, an initial outlay would be around $10k. This is justified from the following reasoning. First, the courses listed below probably require about 12 different textbooks and it would be nice if the library could have 3 copies of each. At $100 per copy, this means $3600. The entire Wiley Reference Collection in Biostatistics costs $2000 and we suggest that other reference books – say 2 per course over 11 courses at $100 a piece would be a further $2200. Given that some of these might be electronic books (which are more expensive), some might be quite recent (and so more expensive), and a collection really should have more than just the minimal number of books for optimal student learning we suggest the total ($3600 + $2000 + 2200 = $7,800) should be rounded up to at least $8500. At best this would correspond to 7 books (at $100 each) that were not specifically course related. A budget of $10,000 would be much better, allowing for a more reasonable number of some 22 books to be acquired.

In conversations with representatives of Calder library, it was revealed that the libraries suffered a 500k cut to their budgets in FY 2010 and there will be a similar cut in FY 2011. At this time, FY2012 does not look to be any different.
So, at this time funding for improvements to the existing library holdings in biostatistics has not been identified. However, it is anticipated that the Division will be hiring 6 new faculty members over the coming years and this will provide intellectual depth to the program and motivation to seek more library support.

iii) Incremental needs per year above ii). The essential issue will be to maintain (or expand) purchases of books in the general area of Biostatistics and Statistics so the collection does not become outdated. One way to estimate the cost of an ideal acquisition program is to compare it to what biostatistics faculty members would like. Again, use USD$100 as the benchmark price of a new book in the general area of Biostatistics. Assume that each faculty member would like the library to buy 2 books per year in his/her field and there are some 20 statisticians scattered around UM. Then $4000 ($2 \times \$100 \times 20$) would be a reasonable cost per year not counting inflation. In an ideal world, the library would buy these books so the faculty member would not have to. However, the same points made at the end of item ii) hold.

iv) Demonstrate that the libraries' resources are adequate. As noted in item i), Richter does have a small collection of books in biostatistics and a full suite of journals. While a larger collection as described in ii) and iii) would be better, it is not essential at this time. That is, the present library holdings are minimally adequate for instruction at the Master's level.

b) Teaching and Computing Infrastructure.

At present, DEPH has one dedicated classroom approximately 1,039 square feet, and one computer lab, approximately 710 square feet. The classroom seats 25 students and contains a fully-equipped lecture podium with a computer/monitor, DVD player, VHS player, microphone, and document camera. The classroom has a ceiling-mounted LCD projector operated from the classroom podium with a touch-screen. The classroom also contains a large portable whiteboard, a pull-down projection screen, and a student bulletin board for seminar notices, announcements, and other important communications and events.

The computer lab contains 8 computer stations and 4 printers and the Division has funding in place to upgrade this as needed. The room can also be used as an overflow classroom when necessary. There is enough room in the computer lab to permit up to 14 computers. Software available in the lab includes Microsoft Office (Word, Excel, Access, PowerPoint, Publisher), Adobe Acrobat, SAS, SPSS, NCSS/PASS, Arc GIS, MPLUS and STATA.

The Graduate Programs in DEPH do not have any traditional laboratory equipment or space. Currently, the single classroom and single computer lab in DEPH is adequate for the Master's and PhD programs in DEPH. However, major growth in DEPH's existing programs, will exceed the capacity of the current teaching and computing infrastructure.

For the first academic year of operation, it will be possible to use existing facilities since only a few students are expected and a full slate of courses is unlikely to be offered. Specifically, if there is not enough time in the classroom, a meeting room in CRB would suffice. If computing facilities are constrained, then the students might have to work later or earlier in the day or on weekends. In many programs, it is expected that students will work outside standard office hours.

Once it is fully operational, however, the Master's in Biostatistics will require a doubling of the existing facilities. Specifically, an extra classroom and computing lab will be needed. The Chief of Division, J. Sunil Rao, is currently in discussions with the Head of Epidemiology and Public Health (Jose Szapocznik) and the Office of Research to obtain and remodel the space required for all the Division of Biostatistics activities.

c) Other physical equipment necessary for the graduate program.

Two more categories of space needed for a well-run Master's program are a common room and desks at which students can work quietly.

First, it is expected that the Public Health Students' Association (PHSA) based in DEPH, would welcome the incoming students in biostatistics as members of their organization. The PHSA has a lounge (room 929 of the Clinical Research Building) and this would be ideal for a common room. This socialization is part of the graduate education experience because this is the area where students would work together on solving problems assigned in class, share information on the job market, compare progress through the program, discuss their thesis

work informally (away from their advisors) as well as get more experience talking about statistical ideas with each other and with non-biostatisticians.

Second, it would be very desirable for students in the second year of their program who are involved in consulting work or working as teaching assistants to have desks where they can meet subject matter researchers or students. This is projected to be 4-5 students when the program is fully operational. At present, only PhD students in DEPH are given desks. However, as discussions proceed with the office of research and a PhD program is developed this space will become available.

3. Curriculum

a) Major divisions.

Roughly, biostatistics has two branches. The traditional arm comprises model based subfields such as Clinical Trials, Survival analysis and generalized linear models. The emerging arm comprises dimension reduction, model selection and prediction, and extensive use of nonlinear and difficult-to-interpret model classes. Sometimes this is referred to as Data Mining and Machine Learning. These subfields do not by-and-large require an overall model; they are efforts to find serviceable models. The program below is mostly traditional but is designed to permit rapid inclusion of the emerging subfields as they increase in prevalence. The curriculum below is intended to include the traditional arm of Biostatistics, but the course descriptions are flexible enough that they can include the more recent emerging arm as DEPH builds its expertise in those areas.

Separately from the two arms of Biostatistics, there are levels of sophistication. It is helpful to think of statistical problems as coming in three levels. The lowest level consists of relatively routine problems that require only the skilled use of an existing technique. The challenge here is to identify the technique and implement it intelligently. The mid-level consists of problems that can be solved only by relatively routine modifications of existing methods. The highest level of problems consists of the development of new methods or their properties or, at least, major modifications of existing methods.

A typical Master's graduate should be able to handle the lowest level, which are the routine problems. A top Master's graduate with some experience would be able to do some of the mid-level problems as well. It would only be an unusual Master's graduate or a PhD graduate who would be able to handle top level problems.

Consequently, initially, the Master's program would be aimed at ensuring its graduates could solve mid-level problems from the traditional arm of Biostatistics.

b) Evaluation of current undergraduate and graduate curricular structure.

At present, there is no undergraduate program in Statistics. However, there are undergraduate courses in Statistics and Biostatistics, usually at a second or third year level, although arguably there might be one or two at a fourth year UG level. These courses could be used to satisfy prerequisites for admission to a Biostatistics Master's degree. Moreover, it

is possible that some of them might be allowed for Graduate Credit for students making up deficiencies. There are no proposed changes to existing undergraduate offerings.

In terms of graduate programs, again there are no structural changes to existing offerings. There is no Biostatistics degree offered in any form at UM and the existing Master's program in Statistics is not operational. In addition, as noted above, there are some graduate courses which might be accepted in lieu of certain courses in our program below so as to add breadth to the Master's experience. None of these courses are the same as those proposed below.

As a comment, there are various graduate level courses (such as DEPH 501 and DEPH 502) which care at an introductory level and so could also be used to satisfy prerequisites for admission to the proposed Master's in Biostatitics program. Such courses would not be accepted for credit in the Master's of Biostatistics program.

At present, two courses offered within DEPH are included in the Basic Track A Biostatistics Master's program: *Fundamentals of Epidemiology 521* and *Survival Analysis 651*.

c) Current/anticipated work with other parts of UM or external agencies.

Initially, it is anticipated that the Master's program would interact with other parts of UM by training their personnel or doing simple statistical analyses for them in the context of a Consulting Practicum. Over time, we expect that our students would be involved in longer term consulting projects in the context of an RA-ship (for strong students in the second year of the program) and possibly solving some of their research problems in the context of a Major Paper or Master's thesis.

d) Detailed description of program.

Next, we describe the two tracks for the degree and provide course descriptions for all the new courses we intend to introduce.

i) Sample tracks. Whether a student is Track A or Track B, the program requirements at completion are the same. They are as follows:

Track A: Students who meet prerequisite requirements
(1) a minimum of three semesters of calculus including partial derivatives and techniques for solving multiple integrals, (2) One semester of linear algebra, (3) one semester of probability theory, (4) four undergraduate courses in statistics or biostatistics. These four courses are to include a general introduction, linear regression, introductory mathematical statistics and at least one further course, typically drawn from multivariate analysis, nonparametrics, survey sampling and time series.

Track B: Do not meet all prerequisite requirements
During their first year it is expected they will make up any deficiencies. This will be decided on a case-by-case basis by the Graduate Program Director.

ii) New course descriptions. The courses below apply to both Track A and Track B:

BST 5XX Applied Linear Regression
Fall Semester
4 Credits
This course is designed to give the student a thorough knowledge of linear regression. Topics include fitting a straight line through a set of data points using the principles of ordinary least squares, forming confidence intervals and testing hypotheses about regression parameters, examining residuals, determining influential points, testing goodness of fit, testing collinearity, checking model assumptions. Tests of single and multiple parameters will be explored as well as partial, semi-partial, multiple, and serial correlations. Model building techniques as well as data transformations including dummy coding will be explored. The use of matrix algebra to solve the regression equations as well as the geometric interpretation of the regression will also be examined. This course will require the use of SAS and will include a 1 hour lab. Prerequisites: At least one course on linear regression and one on linear algebra, or permission of instructor.

Possible textbooks:

Applied regression Analysis -Draper & Smith
Methods and Applications of the Linear Models-Hocking
Applied Linear Statistical Models - Kutner et al.

BST 5XX Introduction to Probability and Distribution Theory
Fall Semester
3 Credits
Fundamental probability and distribution theory needed for statistical inference. Probability, discrete and continuous distributions, transformations of random variables, joint conditional and marginal distributions and probability. Expectation, generating functions, limit theorems, modes of convergence. Prerequisites: At least one course on probability theory, 3 courses on calculus, introductory mathematical statistics or permission of instructor.

Possible textbook:

Statistical Inference by Casella and Berger (2nd Ed.). Chapters 1-4.

EPH 521 Fundamentals of Epidemiology
Fall Semester
3 Credits
Principles and methods of epidemiology. Descriptive epidemiology, environmental and other risk factors; detection of outbreaks, basic demography, etiologic studies. Prerequisite: Permission of Instructor

BST 6XX Topics in Biostatistics Research
Fall Semester
1 Credit
This course will be a series of weekly seminars on current topics in Biostatistics.
Prerequisite: Permission of Graduate Program Advisor if the student is Track B.

BST 5XX Inference
Spring Semester
3 Credits
This course will cover the fundamentals of theoretical statistics. Topics include: point and interval estimation, hypothesis testing, convergence concepts, Bayesian inference, nonparametric statistics and bootstrap resampling. This course is excellent preparation for advanced work in statistics and machine learning. Perquisites: BST 5XX Applied Linear Regression and BST 5XX Introduction to Probability and Distribution Theory.

Possible textbook:

Statistical Inference by Casella and Berger (2nd Ed.). Chapters 5-9

Other Recommended Texts:
Wasserman, L. (2004). All of Statistics: A concise course in statistical inference.
Bickel, P. J. and Doksum, K. A. (1977). Mathematical Statistics.
Lee, P. M. (1988). Bayesian Statistics: An Introduction.
Knight, K. (2000) Mathematical Statistics
Rice, J. A. (1977). Mathematical Statistics and Data Analysis, Second Edition.
DeGroot, M. H. Probability and Statistics, Second Edition
Hogg, McKean and Craig, Introduction to Mathematical Statistics (6^{th} edition)

BST 5XX Generalized Linear Models
Spring Semester
3 Credits
Review of the General Linear Model for Normal Data; Extending the General Linear Model (non-normal error structure, exponential class, linear and non-linear link functions; Theory of Estimation and Model Fitting; Theory of Inference; Case Studies from Medicine; Extended GLMS (e. g., overdispersed models, quasi-likelihood models, etc.). Prerequisites: BST 5XX Applied Linear Regression, BST 5XX Introduction to Probability Theory and Distributions.
Co-Requisite: BST 5XX Inference

BST 5XX Survey of Statistical Computation
Spring Semester
3 Credits
This course will provide an introduction to statistical computation in both the R statistical language and SAS. Topics in R will include Basics (entering and exiting the program, reading data, accessing and creating variables, subsetting data), Missing Values, Graphics, Introduction to Programming, Writing Functions, and Statistical Functions

(Descriptive Statistics, Modeling, Multivariate Techniques). Topics in SAS will include Basics (as above), Structure of SAS programs, Missing Values, Comparison Operators, Flow Control, Statistical Summary Functions. Topics will be illustrated by specific examples. Prerequisites: BST 5XX Applied Linear Regression, BST 5XX Introduction to Probability and Distribution Theory or Permission of Instructor

Possible textbooks:

R texts:

Data Manipulation with R. Springer Series: Use R. Spector, Phil
Bioconductor Case Studies. Springer Series: Use R. Hahne, F., Huber, W., Gentleman, R., Falcon, S.

SAS texts:

Mastering the SAS System, 2nd Edition, by Jay A. Jaffe, Van Nostrand Reinhold
Quick Start to Data Analysis with SAS, by Frank C. DiIorio and Kenneth A. Hardy, Duxbury Press.
How SAS works: a comprehensive introduction to the SAS System, by P.A. Herzberg, Springer-Verlag
Applied statistics and the SAS programming language, by R.P. Cody, North-Holland, New York

BST 6XX Survival Analysis
Fall Semester
3 Credits
Statistical methods for analysis and interpretation of survival data arising from clinical trials. Topics include survival curves, estimation of sample size and survival curves, proportional-hazard models, time dependent variables, prognostic indices. Prerequisites: Permission of Grad Program Director if the student is Track B and BST 5XX Applied Linear Regression and BST 5XX Introduction to Probability and Distribution Theory.

BST 6XX Applied Modern Multivariate Analysis
Fall Semester
3 Credits
Review of matrix algebra; numerical and graphical summaries of multivariate data; multivariate normal distribution; MANOVA; principal components analysis; canonical correlation analysis; decision theory; discrimination and classification; cluster analysis; modern extensions and applications (e.g., analysis of high throughput-omics data) introduced with each section as appropriate. Prerequisites: BST 5XX Applied Linear Models, BST 5XX Inference

BST 6XX Design of Experiments
Fall Semester
3 Credits
This course is designed to give the student a thorough knowledge of the techniques used to analyze continuous data from many different types of experiments using ANOVA and ANCOVA. Topics will include completely randomized, randomized block, and randomized factorial designs. Confounded designs such as balanced incomplete blocks, Latin and Greco-Latin squares, nested, and split-plot/repeated measures will also be studied. Response surface and mixture model designs will also be explored.
Prerequisites: BST 5XX Applied Linear Regression, BST 5XX Inference

BST 6XX Longitudinal Data
Spring Semester
3 Credits
This course is an introduction to longitudinal data analysis and graphical representations. It reviews and critiques simple analyses, including ANOVA (for balanced or nearly balanced data) and MANOVA approaches (for balanced data). Mixed model approaches such as covariance pattern analysis and growth curves with random coefficients are introduced and compared to Generalized Estimating Equation approaches. Residual diagnostics and model selection through use of fit statistics are presented. The course includes models for discrete longitudinal data including binary, ordered, nominal and count data. Missing data approaches and assumptions are discussed throughout.
Prerequisites: BST 6XX Applied Modern Multivariate Analysis, BST 5XX Inference, BST 6XX Design of Experiments

Possible textbook:

Hedeker, D. & Gibbons, R. D. Longitudinal Data Analysis. Wiley-Interscience, 2006.

BST 6XX Advanced Clinical Trials
Spring Semester
3 Credits
This course builds on the study of various types of clinical trials presented in EPH 604. It presents design alternatives and components of protocol development in clinical trials at a sophisticated mathematical and statistical level focusing on: 1) ethical considerations, 2) bias and its statistical, 3) data monitoring, interim analysis, adaptive design and stopping rules, 4) safety assessment and monitoring, 5) clinical data management, 6) power and sample size determination, and 7) meta-analysis. The statistician's and other investigators' role in trial implementation, closeout and reporting of results of trials will also be covered.

Prerequisites: BST 5XX Inference, BST 6XX Design of Experiments, EPH 604 Clinical Trials (or equivalent).

Possible textbook: Piantadosi, S. Clinical Trials: A Methodologic Perspective. 2nd Ed. Wiley and Sons 2005.

BST 6XX Consulting Practicum
Spring Semester
4 Credits

Over the course of the semester each student works on a series of projects, possibly alone, possibly within a group context. Projects come from a researcher normally in a subject matter field. The student meets the researcher, learns what the problem is, and analyses the data. Students will usually write a report and give a presentation to be evaluated by the instructor. It is understood that students may be required to learn material (statistical, computational, or subject matter specific) not in any of the courses they have taken. Prerequisites: All earlier courses and Permission of Instructor
Co-requisite: BST 6XX Longitudinal Data, 6XX Clinical Trials
Note: The work done by students in this course under the guidance of the instructor may involve pay for services rendered to an experimentalist. The instructor for this course will coordinate with the Biostatistics Graduate Committee and the Statistical Consulting Core in the Clinical and Translational Science Institute on these funding issues.

iii) Proposed schedule of required courses.

Year 1

Fall

BST	Applied Linear Regression	4 credits
BST	Introduction to Probability and Distribution Theory	3 credits
EPH 521	Fundamentals of Epidemiology	3 credits
BST	Topics in Biostatistics Research	1 credit
		11 credits

Spring

BST	Inference	3 credits
BST	Generalized Linear Models	3 credits
BST	Survey of Statistical Computation	3 credits
BST	Topics in Biostatistics Research	1 credit
		10 credits

Year 2

Fall

BST	Survival Analysis	3 credits
BST	Applied Modern Multivariate Analysis	3 credits
BST	Design of Experiments	3 credits
BST	Topics in Biostatistics Research	1 credit
		10 credits

Spring

BST	Longitudinal Data	3 credits
BST	Advanced Clinical Trials	3 credits
BST	Consulting Practicum	4 credits
BST	Topics in Biostatistics Research	1 credit
		11 credits

There is a total of 42 hours of course credits. Additionally students will be required to write a Major Paper (3 credits) or a Thesis (6 credits). A major paper would be less ambitious than a thesis involving a re-analysis of an existing data set for instance to demonstrate facility with a variety of analytic techniques.

The core teaching faculty will be K. Arheart, H. Brown, B. Clarke, J. Clarke, R. Duncan, D. Feaster, O. Gomez, S. Messinger, I. Reis, J. S. Rao, T. Sengul. Further faculty members are expected to be hired in the coming two years. It should be noted that these courses are standard and foundational so most biostatisticians would be able to teach any of them. The qualifications of the existing faculty are discussed in the next section.

e) Teaching Style.

The main teaching style in most of the courses would likely be direct instruction via lecture sessions backed up by practical experience in a computer lab. In some cases, the computing lab would be at the discretion of the instructor. For instance, the theory courses *Introduction to Probability and Distribution Theory* and *Inference* would not typically have a computing lab, neither would the 1-credit seminar course. In some cases–the Consulting Practicum and the Survey of Statistical Computation--a course could be taught mostly or entirely in the computing lab with an emphasis on training students interactively.

The seminar series course to be taken each semester is an integral part of the training program because it will permit students to keep up with recent developments in statistical methodology and application as well as provide forum for topics not covered in the other courses. The idea is that one faculty member would be in charge of either finding a seminar speaker each week or giving the seminar him/herself. Thus, a faculty member could use this course as a way to develop materials for a new course or as a way to learn a new area of statistics by teaching it. Also, visitors to the Division would be encouraged to give a presentation in the context of the course. The faculty member in charge of the course would require the students to attend the lectures, and marks for the course would be based on work the student submitted derived from the lectures. For instance, the student could write several short papers on various topics in the course or one longer paper on a single topic in the course. The student could implement one of the methods presented in the course or develop examples of a theoretical topic.

In general there would be no prohibition on other teaching styles–organizing students into groups to do larger scale projects and give presentations for instance. Indeed, it would be the policy of the Division that teaching style is an aspect of the intellectual freedom of the

instructor aside from covering the syllabus; this is especially so for advising, whether the student writes a Major Paper or Thesis. Students in the Consulting Practicum could be paid for their work by researchers in subject matter disciplines.

f) Advising capacity.

Students will typically be required to write a Major Paper (3 credits) or in some special cases a Thesis (6 credits). In a Major Paper, a student is expected to explain a collection of related methods in some branch of statistics, use several of them to solve a motivated problem, explaining and contrasting the results. In a Thesis a student would be expected to explain a collection of related methods in some branch of statistics, motivate and develop a non-trivial variation on one of them, elucidate its properties and use it to solve a problem of interest, and compare the new method to some established methods.

In the Major Paper option a student would have an adviser and a second reader. Both the adviser and the second reader would have to approve the Paper. At least one of the two advisory roles (supervisor and second reader) must be a qualified statistician or biostatistician approved by the Biostatistics Graduate Committee.

Theses must be prepared according to the rules of the Graduate School, see

http://etd.library.miami.edu/grad/committees.html

4. Faculty

a) CV's of teaching and advising faculty. See attached.

It can be seen that for each proposed course there are at least 2, often 4 or 5 faculty members who are capable of teaching it. In addition, the majority have teaching experience at the graduate level in biostatistics. Most also have advising experience at the Master's or PhD level.

b) Estimate the need for additional faculty.

At the present time, there are enough faculty members to run a Master's program given the anticipated number of students. It would be desirable to have additional faculty since the existing faculty will be stretched thin.

Roughly, the proposed program will absorb the equivalent of a little more than two faculty FTE's. This can be seen by the following calculation. The 11 new courses proposed amount to 8 times 3 + 2 times 1 + 2 times 4 = 35 credit hours; at .05 of an FTE per year per credit hour , 35 times .05 = 1.75 FTE's. Adding time for advising and administration increases this to a little over 2 FTE's. Note that this burden is likely to begin modestly and increase up to its steady state level over 2, perhaps 3 years.

As noted before, the existing PhD level biostatistics faculty do an appreciable amount of work that does not require a PhD due to a lack of Master's level personnel. Thus, the existing biostatistics faculty can allocate effort to teaching in the Master's program partially by assigning the Master's level work they do to Master's students in the consulting course. In addition, Master's level work can be assigned to the consulting core to be established as part of the Clinical and Translational Science Institute (CTSI). This consulting core will have at least three 3 FTE's.

Also, there will be new faculty members hired into the Division of Biostatistics: The incoming Chief has the funding in place. These new faculty members will teach and advise as part of the future PhD program. Such faculty will also teach in the Master's program because most of the required courses in the Master's in Biostatistics program constitute the first part of a PhD program.

The net effect is that future hires should more than make up for the increased demands on the existing faculty. That is, there will be an increase in biostatistics consulting, teaching and advising capacity over the coming years.

c) Interaction with other graduate programs.

As suggested in Sec. 1(d), there are many opportunities for interaction with other graduate programs. The most obvious is that there are courses offered by other departments that might be more appropriate for individual students in the proposed Master's program. This would depend on the specific interests of the student.

Second, some of the courses proposed in Sec. 3 might be of interest to students in other programs. The statistical consulting course and the generalized linear models course may be the most obvious ones.

Third, it is easy to imagine cross-listing courses. For instance, there are several multivariate courses already offered at UM. Our proposed course differs from these because it includes the analysis of high throughput –omics data which pose unique difficulties. It may make sense to teach a course on high-dimensional data jointly with another department.

Separate from this student level interaction, it would be desirable to develop joint programs such as a Master's in Biostatistics with an emphasis on epidemiology or on behavioral and social science applications. However, such interactions cannot be developed until the proposed program is operational.

5. Students

a) Number and Pool

It is estimated that the total number of students in the Master's program will hover around 25 FTE's at steady state. About 20 of these FTE's are expected to be full-time Master's students

supported by their employers, their own financial reserves, or their home governments. Essentially this means recruiting 10 such students per year. This will be difficult in the early years of the program since it will not be widely recognized. However, over time the program will be better established and be in a stronger position to recruit effectively.

It is anticipated that the first year a Master's in Biostatistics operates will have mostly, perhaps only, tuition remission students because a program must be operational before very many students from outside UM would be willing to pay for it. During the second year, it is possible to start getting an appreciable number of students from outside UM. However, this will be difficult because it will take a minimum of two years to produce a graduate and not being able to point to successful graduates will handicap recruiting. Realistically, though some would say pessimistically, it is only in the third year at the earliest that it is reasonable to expect a substantial number of paying students. It will also take time for recruitment efforts to be refined enough to be effective.

As noted in Sect. 1, there is no competing Master's in Biostatistics program in South Florida so initial recruitment would focus on South Florida and students who wanted to move here, as well as foreign students.

It must be noted that FSU and UF are both state universities that routinely offer teaching assistantships to their Masters students in Statistics/Biostatistics and these assistantships normally carry a tuition waiver. Moreover, there are a wide variety of excellent Master's in Biostatistics programs that, like FSU and UF, do not require students to pay out of pocket for their education. In addition, tuition at UM is quite high at $1538/credithour 2010/11 academic year; the likely total annual cost for a full time student at UM is over 40K. This is not too far off the usual total costs at other private universities even though these universities usually have had recognized Biostatistics Master's degrees for many years. Accordingly, the most effective recruitment strategy may be local and foreign students rather than domestic outside South Florida.

About 5 of the anticipated 25 student FTE's at steady state are expected to be tuition remission students. In practice these will mostly be part time students. So, assuming 2.5 FTE's per year, and noting the limit on the number of credit hours a UM employee can earn, it is expected that each student will take one course per semester. Assuming each semester represents 12 credits and the typical course is 3 credits this means four courses per semester is a good approximation to the average number of courses per semester for a Track A student. So, a typical part time tuition remission student represents ¼ of a regular full time student. Thus, 2.5 FTE's amounts to roughly 10 part-time students. Note that this quick calculation uses 12 credits/semester. In fact, most students would take 10 credits/semester the extra 2 credits/semester would be earned over the summers.

b) Requirements for admission and retention

There will be one Biostatistics Graduate Committee (BGC) with a minimum of 3 members, headed by the Graduate Program Director (GPD) who will be a Full or Associate Professor

with tenure. The initial GPD will be Prof. B. Clarke and the other two members will be Prof. J. S. Rao and Prof. J. Clarke.

The GPD normally serves for three years but this may be extended. During the tenure of a GPD he/she may not accept any other major administrative posts in the Division or DEPH. One of the other two members of the BGC will be chosen by the Head or Division Chief and the third will be chosen by the GPD. The BGC will review and rank all applications by intellectual merit for the Master's in Biostatistics program. Each year the top students as ranked by the BGC will be admitted and recruited by the Committee up to the capacity of the program. The BGC may interview students or take actions to recruit top applicants.

The requirements for admission to Track A are in Section 3(d). It is not common, however, for Biostatistics applicants to have such a strong background. However, almost all students from quantitative programs such as computer science, engineering, mathematics, and psychology would satisfy the calculus, linear algebra and probability requirements and have 2 of the four statistics courses. That means the most applicants would be short one or two undergraduate courses in statistics which they would have to make up during their first year. Students with at least a minor in statistics or biostatistics would have no deficiencies.

In addition to demonstration of language proficiency and the other requirements of levels of administration above the Division of Biostatistics, the minimal requirements for admission are 1) A completed bachelors degree in a quantitative field, 2) Completion with B or better of courses that are the equivalent to EPH 501, EPH 502, 3) Some evidence of experience with computing, 4) Completion with B or better of a course focused on multivariable calculus (differential and integral).

Thus, applicants not having sufficient background in linear algebra, probability theory, or a sufficiently extensive background in statistics/biostatistics may be admitted provided it is believed by the admissions committee that the student can successfully complete the first year program while making up all deficiencies, i.e., ensuring that the Track B student has the same intellectual achievement in Biostatistics as a Track A student would minimally have by the end of the first year of the program.

Exceptions to these minimal criteria for Track B may be made if there is some other compelling achievement the student has made that demonstrates both intellectual fitness for the program and a commitment to the field of Biostatistics/Statistics more generally. (Top computer science, mathematics, engineering or quantitative psychology graduates who happened to lack more than one or two courses would be examples.)

To pass from first year to second year, the student must pass all the courses in first year with a grade of B or better. In addition, the GPD will hold a meeting of the Biostatistics Division members at the end of each academic year to discuss the progress of all the students. At this time, the Division may, by majority vote, require remedial work of students who are not deemed to be making adequate progress. Also, by majority vote at such a meeting, a student making insufficient progress may be required to leave the program.

c) Teaching Assistants and Teaching Support

Four courses will require teaching assistants. These are Applied Linear Regression, Statistical Computation, Applied Modern Multivariate, Consulting Practicum. The teaching assistant will be required to mark problem sets, hold office hours, review code generated by students, and do other tasks as needed by the instructor to ensure the smooth functioning of the course. As noted in Sec. 7 below, the cost of teaching assistants is expected to be less than the funding brought in by students working on data analytic problems in the context of the consulting practicum.

In addition, the Division will require one half-time systems support person to ensure the computing lab has the proper software and functionality, as well as to provide support to instructors and computational training to teaching assistants.

Students may be qualified to work as Teaching Assistants for any course they have taken and done satisfactorily well in, as determined by the BGC.

Currently, stipends for Master's students to act as teaching assistants range from $10-$15/hour, depending on the work required of them. The typical pay is usually between $12 and $13 and the hours of work may be a couple hours/week (2-3) or range up to 15 hours/week.

The cost of a full-time systems administrator for an academic department is usually around 65K-70K in Miami. The range depends on degree of experience, whether the person is Windows or Unix based, and the detailed description of duties.

6. Administration

a) Administrative increments

i) *Secretarial help.* The Office of Graduate Studies supports the application process. In addition, we will need a half-time Program Coordinator to help answer specific questions and help manage the admission decision process and aspects of the program that are disjoint from the course work, e.g., language testing, arranging training for teaching assistants in conjunction with the systems administrator, keeping copies of examinations and so forth. The Program Coordinator plays an important role in recruitment and retention since s/he is often the first person a prospective graduate student contacts. S/he will also need a budget for long distance phone calls internationally. She also serves as support to the Graduate Program Director in terms of managing graduate students, teaching assistants and their training.

ii) *Office equipment and supplies.* Computer with ISP, printer, and lots of storage. Also, will need storage area for original copies of many documents including written exams, reference letters, internal memos and policies, theses, records of post-degree employment etc. Since most program coordinators need ongoing training in various areas (cultural training, language skills, familiarity with standardized testing procedures, etc.) there will need to be a budget for maintenance of skills.

iii) Promotional costs. The Division must prepare, update and mail out information to applicants as well as to universities who may be supplying us with applicants. Economies of scale can be achieved by pooling resources with the existing promotional efforts of DEPH to produce a single integrated brochure. The GPD (or designate) may need to speak to prospective students as part of recruitment. Computer based communications such as Skype will help to cut costs. The BGC may have to emphasize recruitment from India, China, and Latin America.
There are also costs associated with promoting graduates of a Master's program: Limited funds from the Division will be available to support students to go to conferences for job fairs or to present their work.

b) Administration and Academic Direction.

The administration and direction of the Masters program will be under the GPD. The GPD reports to the Chief of the Biostatistics Division.

i) Day-to-day administration. The BGC is responsible for recruitment, admission, and initial academic advising of admitted students. This initial advising is to orient incoming students to the program structure, appropriate course selection, and familiarize them with the computing environment. (Usually, the systems administrator orients the students to the computing environment, but this is overseen by the BGC.) On behalf of the BGC, the GPD reports an evaluation of performance of all students in the program at the end of each semester. The BGC monitors progress of students in the program, helping to ensure that students seek and find advisors for theses or major papers in a timely fashion. In addition, the BGC organizes and oversees preparation and administration of degree requirements such as remedial work required of students, approving advisors and second readers of Major Papers and Theses. The BGC does the hiring of teaching assistants where funds permit, ensures they get any necessary training, and assigns them to courses. The BGC will also play a role in conjunction with the instructor of the Consulting Practicum and the CTSI Consulting Core to help arrange for funding of students in return for their work as consultants.

The proposed course structure in Sec. 3 may seem a bit rigid. However, it was formed as the consensus view of the ideal biostatistics Masters' program as envisaged by the biostatistics faculty members in DEPH over a series of meetings. Two benefits of the course structure are that the curriculum covers the field well and it is clear enough that it can put forward rapidly. Flexibility is, however, desirable, and this will be added by the students being allowed to appeal to the BGC for course substitutions. The BGC will also decide on any remedial steps to be taken by Track B students.

The GPD receives any complaints from students about the conduct of teaching or other aspects of the graduate program that cannot be resolved satisfactorily between the immediate disputants.

ii) Policy making mechanism. There will be a meeting at the end of each semester after the course marks are submitted at which decisions about individual students can be made.

These will be conducted according to Robert's Rules of Order. A majority of the faculty in the Graduate Program in Biostatistics must vote in favor of any given motion, action or recommendation in order for it to be binding on the Biostatistics program. Members of the graduate program are full time faculty members at UM holding professorial ranked appointments as statisticians or biostatisticians, in DEPH and the Division of Biostatistics, and doing applied or theoretical research in statistics or biostatistics. No action, motion, or recommendation may be implemented without such a majority vote in its favor. Records of motions passed and decisions made will be maintained by the Program Coordinator and open to perusal by any faculty member associated with the program.

At any regular faculty meeting of the division motions pertaining to the graduate program may be brought forward by anyone involved in the program. In addition, at the meetings held at the end of every semester, any member of the graduate program may bring motions forward for consideration and voting.

This does not preclude the GPD from calling a meeting at other times or the Chief of the Biostatistics Division from calling a meeting. However, only members of the Graduate Program may vote on matters pertaining to the Graduate Program.

Motions, actions and decisions made by the Graduate Program in Biostatistics will be taken by the GPD to the Graduate Program Executive Committee (GPEC) of which the GPD would be a member. At GPEC meetings that included discussion of policy formed by the Graduate Program in Biostatistics, the Chief of Division of Biostatistics would attend at his/her discretion. Also, the GPD will report motions, actions, and decisions taken by the Graduate Program in Biostatistics to the Curriculum Committee as needed.

7. Budget

The Budget information has been redacted for the web version of the legislation.

To view this information, please contact the Faculty Senate office.

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assistants, GPD, and office supplies. [illegible]
as an administrative duty in DEPH.)

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To view this information, please contact the Faculty Senate office.

8. Comparisons to 5 Other Master's in Biostatistics Programs

For comparison purposes the 5 schools are:

Harvard University
Johns-Hopkins University
University of Michigan (Ann Arbor)
University of Washington (Seattle)
University of North Carolina-Chapel Hill.

Harvard and Johns-Hopkins were chosen because they are private universities and UM would have to compete with them for students. The other three universities were chosen because they are recognized as offering excellent Master's in Biostatistics degrees.

The ranking of programs is necessarily somewhat arbitrary; other programs that often come up on `top 10 lists' in the US include Columbia, University of Minnesota, UCLA, and Stanford. See:http://chronicle.com/stats/productivity/page.php?year=2007&primary=4&secondary=136&bycat=Go for one such ranking from 2007; there are numerous others.

First, a survey of the Biostatistics the biostatistics programs at these universities was done. A combined list of all the regular graduate level biostatistics courses offered at these universities has approximately 17 courses. Note that courses not deemed to be at the graduate level have not been included. The 17 courses are (in no particular order):

Inference I and II, Linear models, Categorical data analysis, Multivariate, Survival analysis, Nonparametric and robust methods, Statistical computing, Longitudinal models, ANOVA/Linear Mixed Models, Nonlinear Regression, Classification, Hypothesis testing, Clinical Trials, Bayesian statistics, High-dimensional data, Epidemiological studies.

Clearly, it is impossible to offer all these courses at 3 credits each and require a capstone project. So, the list of courses in Section 3 represents a condensation of these 17 courses. For instance, high dimensional data is combined with multivariate analysis, Bayesian statistics would be part of *Inference*, ANOVA/Linear mixed models would be partially in *Applied Linear Regression* and partially in *Design of Experiments*, and *Nonparametric and Robust Methods* and *Classification* would likely be part of the seminar series.

a) Contrast with Harvard Biostatistics.

The Track A version of proposed program here actually contains more material than the Master's in Biostatistics at Harvard. The program at Harvard includes many courses that look to be at an undergraduate level. For instance, there is an Introduction to Biostatistics course at Harvard that looks like a combination of EPH 501 and 502 which are pre-requisites for our proposed program. In addition, there is a separate course on Ethical Basis of Public Health which is important but not strictly Biostatistics.

Further information on the Harvard program can be found at:
http://www.hsph.harvard.edu/biostats/publications/handbook/

b) Contrast with Johns-Hopkins Biostatistics.

Similar comments apply to Johns-Hopkins as to Harvard. For instance, Methods in Biostatistics I and II – worth 8 credits -- are largely undergraduate level. In addition, Johns-Hopkins has few courses with higher numbers of credits than the present proposal. Loosely, for both Harvard and Johns-Hopkins, the first year of their programs correspond to a good portion of what an undergraduate statistics or biostatistics major would take in his/her third and fourth year.

Further information is available at:
http://www.biostat.jhsph.edu/academics/program/ScM_1styrcurr_09-10.pdf

c) Contrast with University of Michigan Biostatistics.

All of the core courses and Biostatistician/Statistical electives in the Master's in Biostatistics program at Univ. Michigan are included in the proposed program. Michigan's program includes subject matter courses ('cognate requirements') that the proposed program here does not. Also, Michigan includes more Epidemiological requirements than the present proposal does. Otherwise put, the program proposed here is somewhat more focused on biostatistics than at Michigan.

Further information is available at:
http://www.sph.umich.edu/biostat/programs/msmph.html

d) Contrast with University of Washington Biostatistics:

Of the 5 programs compared here, the program at UW most closely resembles the proposed program in terms of overall curriculum. However, there are numerous small differences: For instance there is a 6 credit subject matter discipline requirement and slightly more statistics courses jointly aimed at Epidemiology at UW not present in the program here and the proposed program here has a full course on Generalized Linear Models which goes beyond the Categorical data course at UW. The program here also has a comparatively advanced Clinical Trials course since there is already an introductory level Clinical Trials course in EPH. Also, the allocation of the topics within the curriculum among courses is different from the present program to the UW program. In addition, there are many more courses at UW from which to choose electives (owing to the size of the program at UW). UW also has a written examination at the end of the first year; the present program does not but this may be added in the future.

Further information is available at:
http://www.washington.edu/students/crscat/biostat.html
http://www.biostat.washington.edu/node/63
http://www.washington.edu/students/crscat/stat.html#stat512

e) Contrast with University of NC-CH Biostatics.

Overall, the Master's program at UNC-CH in comparison to the program proposed here is more classical. For instance, UNC-CH has required courses on Sample Survey, Demography, and Public Health Study design that go beyond the coverage of those topics in the present proposal. On the other hand, UNC-CH does not have an analogous Clinical Trials course and the coverage of Generalized Linear Models is less. Nevertheless, the core theory and methods courses parallel the courses in the present program a little more closely than do those of UW. That is, the allocation of material to courses at UNC-CH is closer to the proposed program than the allocation of material to proposed program is to that of UW. UNC-CH also has a written examination at the end of the first year; the present program does not but this may be added in the future.

Further information is available at:
http://www.sph.unc.edu/bios/degrees_and_certificates_170_531.html#MS

f) Within-state comparison.

For completeness, we make the following comments about the two universities in Florida that already offer Master's programs in Biostatistics.

The website for the course offerings at the Department of Statistics at UF is
http://www.stat.ufl.edu/academics/grad/grad_offerings08.html

It can be seen that the Master's in Statistics course descriptions provide a selection of courses that would be broadly comparable to what the present program offers. However, the Statistics Department at UF has a large graduate program and Biostatistics is just one arm of it. So, the course selection is much more extensive.

The website for the Department of Statistics at FSU is http://stat.fsu.edu/graduate/

It can be seen that the Biostatistics Master's degree is primarily applied and subject matter driven rather than treating Biostatistics as a field in its own right. This is partially because the Biostatistics Master's degree is run from the Department of Statistics which at FSU has many subject matter experts. In addition, the FSU Master's in Biostatistics has many fewer courses specified; the decisions are left to the student and his/her major advisor.

9. Annex: Ten-year Projection

The appended Excell spreadsheets provide details to justify the summary in Sec. 7. Recall, Sec. 7 presents the summary of costs and revenues overall to UM. The first two pages, YR1 Lead and YR2 Lead, show the anticipated financial standing of the program during its two startup years; these generate the entries in the third and fourth columns in the table of Sec. 7. These two sheets show that costs increase faster than revenues. However, as indicated in column 5, during the third year the revenues catch up and exceed expenditures. This arises because, as seen on the spreadsheet entitled YR1 Steady State, a full complement of paying students has been registered more than doubling the revenues (due to the funded work in the practicum and funded major paper work as well as the increased tuition receipts).

Sheets four and five (YR2 Steady State and YR3 Steady State) correspond to columns six and seven in the table of Sec. 7 and summarize revenues and expenditures for years 4 and 5 of the program's operation.

The last five sheets extrapolate for a further five years to show the year over year effect of being at steady state as defined in Sec. 7, namely admitting 10 paying students per year, half of whom can do funded work in the Practicum of their section year and obtain funding for their thesis work while tuition rates and salary rates increase year over year as described in Sec. 7. It can be verified that UM overall breaks even during the third year of operation while the Division of Biostatistics only recoups its investment by year ten. We caution against taking the results of extrapolation beyond more than a couple of years too seriously and have included these last 5 sheets primarily to provide a reference point for future comparisons.

It can be seen that, overall, the program is projected to be self-financing and will generate revenues that can be used to fund other functions of the Division. However, recruitment will pose a substantial challenge. Thus, it would be imprudent to rely on income the program is projected to generate until the size of incoming classes and their quality has stabilized.

Pages 33-42

The Budget information has been redacted for the web version of the legislation.

To view this information, please contact the Faculty Senate office.

UNIVERSITY OF Miami

MEMORANDUM

February 18, 2010

Dr. Sunil Rao
Chief of the Biostatistics Division
Department of Epidemiology and Public Health

Dear Professor Rao;

On behalf of the Department of Biomedical Engineering, I would like to offer every encouragement to you in your efforts to develop a Master's Program in Biostatistics. I and our faculty know very well the importance of biostatistics not in our research and academic activities but also in the biomedical industry. Any biomedical product whether it is a device or pharmaceutical, has to go through rigorous biostatistical analysis. Certainly other health care and insurance organizations need biostatistics as well. Such a need creates jobs and your proposed program will certainly will respond to these needs. Miami and tri-county area leads Florida in health care jobs and biostatisticians will be in more demand in future years. As reported by the Bureau of labor Statistics, statistician employment in Florida is projected a 20% increase (years 2008-2018) compared to a 12% increase nationwide.

My general impression is that the demand for your graduates would be strong, especially with pharmaceutical companies, where salaries can be quite high indicating the strength of the demand. A similar strong demand is present in the health care insurance industry. I am sure this demand will be increasing in the next several years no matter what happens to the health care reform.

I foresee many ways in which your proposed program and our Department could interact in the future. We certainly can offer joint courses and serve as joint advisors to graduate students in their projects and theses. Our graduate students will also enjoy having more elective courses available from this program.

Yours sincerely,

Ozcan Ozdamar, PhD
Professor and Chair

Department of Biomedical Engineering
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UHealth
UNIVERSITY OF MIAMI HEALTH SYSTEM
UNIVERSITY OF MIAMI
MILLER SCHOOL
of MEDICINE

Pascal J. Goldschmidt, M.D.
Senior Vice President for Medical Affairs and Dean
Chief Executive Officer, University of Miami Health System

February 12, 2010

J. Sunil Rao, Ph.D.
Department of Epidemiology and Public Health
University of Miami Miller School of Medicine
Clinical Research Building, Suite 1054
Miami, FL 33136

Dear Dr. Rao, Sunil

On behalf of the University of Miami M. Leonard Miller Medical School (UMMSM), I wish to express my strong and unequivocal support for the development of a Master's program in biostatistics. As you know, I championed your hire at UMMSM precisely so that you could develop a major University-wide initiative in biostatistics.

It is well-known that many Medical Schools, including ours, have a chronic shortage of biostatisticians, although they are crucial to the success of our modern-day, highly interdisciplinary scientific enterprise. Your proposed program will provide the University and South Florida scientists with critically needed analysts for their programs of research.

Increasing the role of biostatistics at UMMSM is not unique to our School. Many medical schools have recognized the growing role and importance of biostatistics in their research efforts and this trend is likely to persist for the foreseeable future.

You have my full support in your efforts.

With warmest regards,

Pascal J. Goldschmidt, M.D.
Senior Vice President for Medical Affairs and Dean
Chief Executive Officer, University of Miami Health System

PJG:mml

UNIVERSITY OF Miami

March 8, 2010

Professor J. Sunil Rao
Chief of the Biostatistics Division
Department of Epidemiology and Public Health
University of Miami

Dear Prof. Rao:

On behalf of the Department of Management Science, let me offer every encouragement to you and your faculty in your efforts to develop a Master's degree program in Biostatistics.

In the Department of Management Science, we offer graduate courses on the use of statistical analyses for business purposes. These courses include forecasting, statistical process control, design of experiments, and regression analysis. While these areas may differ somewhat from the techniques common in biostatistics, we do see enough common ground that we think your efforts would be complementary and supportive to ours. With the School of Business Administration's new emphasis on health care and its administration, I would anticipate and encourage joint research and teaching among our faculties and would expect that some faculty would even hold joint appointments in our departments.

The recent 2010-2011 report from the Bureau of Labor Statistics lists job prospects for statisticians as above average in general, but indicates that careers in biostatistics and public heath are especially good. With the government's increasing emphasis and support of public health care, I see the job market in biostatistics as very strong. Graduates of your proposed program should be well prepared to find gainful employment in the field or to pursue doctoral level study and research.

I am in enthusiastic support of your proposal.

Sincerely,

Edward Baker

Edward Baker
Professor and Chair

Department of Management Science
School of Business Administration
401 Kosar/Epstein Faculty Office Wing
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UHealth
UNIVERSITY OF MIAMI HEALTH SYSTEM

UNIVERSITY OF MIAMI
MILLER SCHOOL
of MEDICINE

José Szapocznik, Ph.D.
Chair

March 25, 2010

Dr. Sunil Rao, Director
Division of Biostatistics
Department of Epidemiology and Public Health
University of Miami Leonard M Miller School of Medicine
1120 N.W. 14th Street, # 1065
Miami, FL 33136

Dear Dr. Rao:

It is with great enthusiasm that I endorse your efforts to create a Master's in Biostatistics. I write this letter wearing several hats: as Chair of the Department of Epidemiology and Public Health, as Associate Dean for Translational Research and Community Development and as Director of the Miami Clinical and Translational Science Institute.

As Chair, the masters program will support our MPH, MSPH and Epidemiology program, particularly for students who are quantitatively oriented.

As Associate Dean and Director of the Clinical and Translational Science Institute, I can speak to the scarcity of biostatistically trained personnel on our campus and our University. UM scientists from throughout the University suffer because of the very low number of biostatisticians and masters-level trained analysts. Hence, the Master's program will not only produce graduates for a growing job market already suffering from a scarcity of master's level analysts, but it will also be a boon to our University's scientific enterprise. As I understand it, even second year students in your programs may be able to provide some support to researchers at UM under the guidance of a faculty member. Hence, UM scientists will have access to data analysts even before completing their master's degrees.

Finally, I would like to add that the master's in biostatistics is an essential ingredient of our application to the NIH for the Miami Clinical and Translational Science Institute.

Given the outstanding leadership you provide I have no doubt that your graduates will establish a strong reputation in the field.

Best regards,

José Szapocznik, Ph.D., Professor and Chair
Department of Epidemiology and Public Health
Associate Dean for Translational Research and Community Development

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mpadron@med.miami.edu

UNIVERSITY OF Miami

Office of the Dean

February 15, 2010

Prof. Sunil Rao
Chief of the Biostatistics Division in the
Department of Epidemiology and Public Health

Dear Prof. Rao,

On behalf of the School of Education, let me offer every encouragement to you in your efforts to develop a Master's program in Biostatistics.

There are many obvious synergies that can be developed between our Research, Measurement, and Evaluation program and the proposed Biostatistics program. In addition to co-advising opportunities, it is easy to see informal links created by courses offered by one program that also are useful in the other program. For instance, our courses on latent modeling, structural equation modeling and hierarchical linear modeling would be useful to some of your students just as your proposed Generalized Linear Models course might be useful to our students since it contains a lot of material on categorical data.

It is always difficult to start a new program so we wish you every success and look forward to creating the linkages that can give all our students a richer intellectual experience.

Yours sincerely,

Isaac Prilleltensky
Professor and Dean
School of Education
Erwin and Barbara Mautner Chair in Community Well-Being
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UNIVERSITY OF MIAMI
GRADUATE SCHOOL

Terri A. Scandura, Ph.D.
Dean of the Graduate School

Graduate School
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graduateschool@miami.edu

MEMORANDUM

To: Chair, Faculty Senate

FROM: Dean Terri Scandura
Graduate School

DATE: 26 March 2010

SUBJECT: New Program – Master of Science in Biostatistics

At the March 25, 2010, meeting of the Graduate Council, the new program Master of Science in Biostatistics was approved unanimously by those present after two readings.

cc: John Bixby
Sunil Rao
Bertrand Clark
Office of Accreditation and Assessment
Program Review File

UNIVERSITY OF MIAMI
COLLEGE of
ARTS & SCIENCES

Department of Mathematics
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March 25, 2010

Professor Sunil Rao
Chief of Biostatistics Division
Department of Epidemiology
University of Miami

Dear Professor Rao:

It was a pleasure to meet with you and Bertrand Clarke to discuss your plans to develop a masters degree program in biostatistics. It is clear to us that the establishment of such a program would be of great benefit to the University of Miami, and we would like to lend our enthusiastic support to your efforts.

Members of our department are always enthusiatic about opportunities for scholarly collaboration. Your program would broaden and enhance such activities. Several of our faculty members hold PhDs in statistics from outstanding universities and would especially look forward to cooperating with your biostatistics group.

As we have discussed, several courses regularly offered by our department at the graduate level provide theoretical underpinnings for many concepts in biostatistics. Examples of such courses are: MTH 524 *Introduction to Probability Theory*, MTH 525 *Introduction to Mathematical Statistics*, MTH 542 *Statistical Analysis*, and MTH 625 *Multivariate Analysis*. Our department also offers special topics courses, such as Sampling Theory, Survival Analysis and Time Series Analysis, which may be of further interest to biostatistics students. At the same time, we would expect that some of our own mathematics graduate students would benefit significantly from biostatistics courses offered through your program. Moreover, once your program is up and running, we would be pleased to help in the process of guiding your students towards achieving their research goals, by serving on thesis committees, etc.

The field of biostatistics has seen phenomenal growth in recent years, and we expect this trend to continue for many more years to come. The time is ripe for the creation of this degree program at UM, and we wish you every success.

Sincerely yours,

Gregory J. Galloway, Chair
Professor of Mathematics

Victor Pestien, Associate Chair
Associate Professor of Mathematics

UNIVERSITY OF Miami

February 19, 2010

Prof. Sunil Rao
Chief of the Biostatistics Division
Department of Epidemiology and Public Health

Dear Prof. Rao,

On behalf of the Department of Computer Science, let me congratulate you for undertaking the challenge of starting a new graduate program in Biostatistics.

As you well know, statistics in general and biostatistics in particular are closely allied to Computer Science. It is a rare statistician, even at the Master's level, who does not require sophisticated computing skills including coding, algorithm development, and knowledge of hardware just to practice his/her trade. We foresee many opportunities for interaction at the instructional and advising levels.

Although not a biostatistician myself, many people predict that over the coming years will see an increase in demand for biostatisticians. In addition to the Bureau of Labor Statistics projections of 7-13% growth through to 2018, a column from nature.com from 2007 states that:

I predict that there will be a growing need for trained Masters-level medical informatics and clinical informatics technicians within the next few years. As the number of clinical trials grow, so will the need to tie that information back into drug discovery projects, and the federation of existing bioinformatics and chemical databases with medical and clinical trial data will be necessary. It is on the horizon now.

Again, I wish you every success and look forward to the many opportunities for interaction that your proposed program promises.

Yours,

Hüseyin Kocak
Professor and Chair
Department of Computer Science

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UNIVERSITY OF MIAMI
MILLER SCHOOL
of MEDICINE

Dr. Richard Williamson
Chair, Faculty Senate
325 Ashe Building
Coral Gables, Florida 33146

Dear Richard,

I am pleased to present to the Faculty Senate a proposal to create a new Master's degree program in biostatistics. In my role as Associate Dean for Graduate Studies, I strongly support this proposal.

Statistics in general, and Biostatistics in particular, have not traditionally been major strengths at the University of Miami. In recognition of the importance of this research area, Dr. Sunil Rao was recently appointed founding Chief of the Division of Biostatistics in the Department of Epidemiology & Public Health. Because research and graduate training must advance together, Dr. Rao and Dr. Bertrand Clarke immediately went to work to draft the proposal for this new degree program.

In this new era of genomics, proteomics, systems biology, and other data-rich areas of biomedical study, it is more important than ever to have a trained cadre of biostatisticians to ensure that the vast data sets generated are analyzed appropriately. The graduates of UM's Master's Program in Biostatistics will be well equipped to serve this role. Moreover, the creation of a Biostatistics Master's degree for Biostatistics is the first step in the development of a PhD in Biostatistics; the two degree programs together will provide a critical foundation for the expansion of our research in Biostatistics.

The new Master's program has been extensively discussed, and has obtained the explicit support of the Medical School Council, the Dean, the Executive Dean for Research, and myself. Please let me know if the Senate requires any additional information. Dr. Clarke and I look forward to meeting with the Senate to discuss any suggestions or concerns that might arise.

Yours Sincerely,

John L. Bixby, Ph.D.
Professor and Associate Dean

Office of Graduate Studies • Leonard M. Miller School of Medicine
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UNIVERSITY OF Miami

Office of Research

March 25, 2010

Dr. Sunil Rao
Chief, Division of Biostatistics
Department of Epidemiology and Public Health
University of Miami Miller School of Medicine

Dear Sunil,

In my role as UM's Vice Provost for Research and Executive Dean for Research and Research Training at the Leonard M. Miller School of Medicine, I want to express my strongest possible support and enthusiasm for your efforts to develop a Master's Program in Biostatistics.

Given the growth in the Miller School of Medicine, and the life sciences more generally at UM, the demand for biostatistical support and biostatistical research has grown rapidly. The recent national emphasis of comparative effectiveness research, as part of larger healthcare reform, is just another example of areas which require the close involvement of trained biostatisticians.

Indeed, this is true in the broader economy - locally, nationally, and internationally. Consequently, UM must establish biostatistical programs to support our researchers in a variety of ways and across a variety of biomedical fields. In my view, a master's degree in biostatistics is the best place to start to address the acute shortage of biostatistical expertise.

I look forward to graduates from your new program supporting researchers and PhD level statisticians here at UM and at other institutions, as well as going beyond UM to intellectually challenging and satisfying careers throughout the world.

With best regards,

Richard J. Bookman, Ph.D.
Vice Provost for Research
University of Miami
Executive Dean for Research and Research Training
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UNIVERSITY OF MIAMI
MILLER SCHOOL
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April 9, 2010

Prof. J. Sunil Rao
Chief of Division of Biostatistics
Dept of Epidemiology & Public Health

RE: Master's in Biostatistics Proposal

Dear Prof. Rao:

I am writing this letter in support of the Master's Degree in Biostatistics proposal. On March 9, 2010, the proposal was presented, by Drs. John Bixby and Bertrand Clarke, to the Faculty Council for approval. The Council was unanimously in favor of the proposal and felt that this new program would be very important and would serve as a great asset for the University.

In conclusion, the Medical School Faculty Council appreciates the opportunity to be involved in the approval of such an important item. Good luck with this proposal.

We look forward to seeing this item move forward and implemented in the future as a program of the University of Miami.

Sincerely,

Norman Altman, V.M.D.
Speaker, Medical School Faculty Council