UNIVERSITY
OF MIAMI
FACULTY SENATE

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MEMORANDUM

To: Donna E. Shalala, President

From: Richard L. Williamson
Chair, Faculty Senate

Date: April 21, 2011

Subject: Faculty Senate Legislation #2010-19(B) – Establishment of the Miller School of Medicine *Doctor of Philosophy in Biostatistics*

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On April 20, 2011, the Senate voted to establish *Doctor of Philosophy in Biostatistics* in the Miller School of Medicine. This program is building upon the previously added Master of Science in Biostatistics approved through Legislation #2009-27(B).

This legislation is now forwarded to you for your action.

RW/rh

Enclosure

cc: Thomas LeBlanc, Executive Vice President and Provost
Pascal J. Goldschmidt, Senior Vice President and Dean, Miller School of Medicine
J. Sunil Rao, Professor, Department of Epidemiology and Public Health; Chief, Division of Biostatistics
Bertrand Clarke, Professor, Department of Medicine, Division of Biostatics, and Center for Computational Sciences

CAPSULE: Faculty Senate Legislation #2010-19(B) – Establishment of the Miller School of Medicine *Doctor of Philosophy in Biostatistics*

PRESIDENT'S RESPONSE

APPROVED: _____ DATE: 4/21/11
(President's Signature)

OFFICE OR INDIVIDUAL TO IMPLEMENT: DEAN 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 PhD Degree in Biostatistics
Author: Bertrand Clarke, Professor, Department of Medicine, Division of Biostatistics, and Center for Computational Sciences

Date: March 10, 2011

Purpose and Goals

The purpose of the proposed PhD program in biostatistics is to bolster the methodological progress in biostatistics currently underway at the University of Miami by providing another forum, the training of doctoral students in biostatistics, to the existing capacities.

The importance of this purpose has become apparent over the last 20-30 years. The field of biostatistics began to break off from statistics in the late 1980's though some might say the differences became apparent earlier and some might say later. The intellectual reason for the split was that the applications of statistics in biomedical contexts began to require different methodological approaches from those common in other subfields of statistics or more broadly in mainstream statistics. For instance, clinical trials, longitudinal data analysis, missing data, and survival analysis are three subfields of statistics which probably find the majority of their applications in the biomedical sciences. This is not to say the techniques associated with these fields do not have application outside the biomedical sciences. Nor would it be fair to say that techniques from outside the collection of subfields of statistics not usually associated with biostatistics do not frequently come into play in biomedical contexts, especially when data are complex or high dimensional. Nevertheless, there are methodologies commonly associated with biostatistics that merit their own intellectual setting for ongoing development.

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UNIVERSITY OF MIAMI
MILLER SCHOOL
of MEDICINE

More specifically, doctoral students in biostatistics tend to work closely with a small number of advisors (usually one to three). So, doctoral students amplify the intellectual impact of the advisors' work while contributing their energy, insight, and creativity. In addition, having more active biostatistics methodology development will help existing researchers whether in biostatistics, statistics, or

any field of application, keep up with new techniques and improvements to existing techniques. So, the intellectual contribution to the broader research mandate of UM should go beyond the immediate confines of the PhD program. While not the motivating purpose, improving the biostatistics environment should lead to numerous practical benefits including increasing grant funding, making recruitment of first rate faculty easier, and enabling UM to generate more and better research output.

It is well-known that doctoral students are a major source of prestige to universities, second only to the research accomplishments of the faculty. So, although it would not be fair to say that the immediate purpose or central goals of the PhD program is to add prestige to UM, it would be naïve not to recognize that the intellectual standing of UM would be meaningfully increased by producing high quality graduates from a doctoral program in Biostatistics. For instance, a PhD program in biostatistics would fill a gap helping UM to increase its rank among the AAU universities.

The goals of the program while less lofty are crucially important to achieve the purpose of the program. More specifically, there are three goals:

1) Train and graduate PhD students who have demonstrated their ability to generate research in biostatistical methodology of a quality to be published in international peer-reviewed journals.
2) Provide a source of methodological support in biostatistics, and the data analytic support that follows from the methodologies, to researchers at UM.
3) Enhance and generate more research in biostatistical methodology.

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Proposal for a PhD in Biostatistics

1. Rationale:

a) **Title of Degree.** Doctor of Philosophy in Biostatistics.

b) **Purpose and Goals.**

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ii) Provide a source of methodological support in biostatistics, and the data analytic support that follows from the methodologies, to researchers at UM.

iii) Enhance and generate more research in biostatistical methodology.

c) Demand and Job Market.

Within the US, the demand for biostatistics (broadly defined) is substantial and continues to grow. Two important factors that contribute to this growth are the aging of the population and concerns about the environment. The aging of the population has motivated, and will continue to motivate advances in drug discovery and other branches of medical science, especially those that are cost effective. In addition, the health effects from pollution as well as the demands of fisheries, agronomy and meteorology (among other related fields) are expected to contribute to the demand for biostatistically trained personnel. Indeed, the need for PhD level biostatisticians is well beyond the demands of aging and the environment. There are pressing demands for techniques of analysis for complex and high dimensional data. Over time this should permit the development of more complex models of multiple and multilevel interacting processes, including human behavior.

More specifically, the Bureau of Labor Statistics (BLS) website http://www.bls.gov/oco/ocos045.htm#outlook provides a job outlook for statisticians of 13% growth over 2008-2018, roughly the average growth of all occupations under their projections. That is, the demand for individuals with a background in statistics is projected to continue growing -- although the BLS notes that some jobs will have titles other than 'statistician'. While the ongoing recession has led to increased unemployment across almost all job categories, statistics in general has been an exception. Indeed, the Rollins School of Public Health at Emory University noted on 1 December 2010 that 'Employment prospects for Master's and PhD level biostatisticians have been excellent in recent years. Positions as researchers and data analysts are commonly available in industry (e.g., pharmaceutical, consulting), academia (e.g., schools of public health and schools of medicine) and government agencies (e.g., the Centers for Disease Control and Prevention, local or state health departments).'

In fact, it is well-known that, as noted on http://www.health.state.mn.us/pathways/specialtyareas.html that 'The job market for biostatisticians tends to correlate with the biomedical industry job market.' Consequently, it is straightforward to predict that as the population of the US and other countries ages or issues related to health become more important that the job prospects for biostatisticians will improve. However, it must be noted that while the job prospects for statisticians and biostatisticians in particular are not expected to deteriorate much if at all, the kind of jobs available to our

graduates may evolve. For instance, if state budgets are quite constrained then academic jobs and state agency jobs may be less common while job opportunities at pharmaceutical companies and federal regulatory bodies may increase. For a specific example, the Minneapolis Star Tribune noted 8 December 2010 that `healthcare is slowly hiring again but the skill set is shifting' toward information technology and data analyst specialties, driven by regulatory considerations and insurance companies, see http://www.startribune.com/lifestyle/health/111326219.html

Closer to UM, the University of South Florida notes that job prospects for biostatistics graduates are excellent. The demand for well-trained Biostatistical scientists continues to grow as do salaries as asserted in the biostatistics webpage at the school of public health at USF. See http://health.usf.edu/publichealth/epb/sibs/about_biostatistics.htm , dated 5 Jan 2010.

More broadly within the US, CNBC listed `statistician' as the 4th best job in the US. See http://www.cnbc.com/id/40950977?slide=8 where they noted that statistics `Scored High On: Hiring Outlook, Work Environment' and that "The world seems to be living on statistics these days".

Outside the US, similar trends are apparent though often not as well documented. For instance, in Canada, http://www.servicecanada.gc.ca/eng/qc/job_futures/statistics/2161.shtml recently wrote that in Quebec, `... job prospects are good for statisticians ...' ; the other provinces are similar in aggregate.

In the UK, the University of Manchester comments on 9 Nov. 2010 that: ` There is a high demand for biostatisticians in the UK and worldwide.' See http://www.maths.manchester.ac.uk/postgraduate/pgadmission/msc-biostatistics.html . This website also comments positively on growth in pharmaceutical industries and government health service jobs.

It is even more difficult to assess the job market outside the US, UK and Canada. However, the circumstantial indications for the EU are similar. For instance, as of 16 December 2010, the webpage http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-SF-10-063 reports that: `EU trade in medicinal and pharmaceutical products rose by 11% in 2009 despite the global economic crisis.' Since employment prospects for biostatistics graduates tracks the biomedical sector it is likely that biostatistics graduates would have strong employment prospects in the EU in general.

Finally, it is well known that many of the Latin American and Asian countries are growing well economically and have increasingly good job prospects but this is hard to quantify for the general field of statistics and biostatistics. There are continual individual stories of PhD graduates returning to China, India and Japan upon graduation. However suggestive and reasonable this is, it remains anecdotal.

Despite the growth in biostatistics, broadly defined, it must be admitted that there are numerous universities in the US, and elsewhere that have programs that will be similar to what we propose

here. However, we believe that we will have two comparative advantages. First, we have coupled the traditional subfields of biostatistics and the foundational statistics courses with the relatively recently emerged fields of statistics pertaining to complex and high dimensional data. As can be seen from the comparisons in Sec. 8, this is not very common outside pure Statistics Departments. Second, in Sec. 1(d), below we propose a 'PhD minor' that will be routine for all our graduates to complete. There is precedent for this but it does not seem to be extensive. We also note that geographically, the only two schools that offer PhD's in Biostatistics in Florida are UF and FSU. In Annex II we discuss these in more detail. For the present, it is enough to note that our program will compare, we believe favorably, with that of FSU where it seems they have grafted a few biomedical courses onto a standard, if slightly applied, PhD in Statistics. In contrast to UF, however, our program will be much smaller so our course offerings will necessarily be more limited even though they are focused on Biostatistics (and subject matter familiarity). In addition, our biostatistics program will be somewhat less mathematically demanding than at UF. This is a typical difference between pure biostatistics programs and both statistics programs and biostatistics programs lodged in statistics departments.

Although there is little documentation, there is a feeling expressed by several people that within UM, research in some areas in the Schools of Medicine, Marine Science, and Schools of Arts and Science has been more difficult than it should be due to lack of biostatistical support. In fact, 2010 was the first year that persons within DEPH (where the largest grouping of biostatisticians seems to be available) had enough biostatistical infrastructure that they could submit a complex center grant requiring considerable biostatistical expertise relying entirely on capabilities within UM. The proposed program will help continue to fill this gap.

d) Relationship to Other Fields and Interactions with Other Programs at UM.

The PhD in Biostatistics is to be situated in the Division of Biostatistics within the Department of Epidemiology and Public Health (DEPH).

Thus, the PhD in Biostatistics will have interactions with other divisions in DEPH. At present there is only one other division, Epidemiology, but others are planned. Currently, the PhD in Epidemiology formally requires two advanced service courses in biostatistics. In addition, two other biostatistics courses have long been available to Epidemiology students; one (Survival Analysis) is included in the program described in Sec. 3(d), the other (Clinical Trials) is not at a high enough level to be acceptable for graduate credit in a Biostatistics program. No changes are contemplated in the Epidemiology program although for the current semester (Spring 2011) it is expected that the Epidemiology doctoral students will be the plurality of students taking the two news courses the Biostatistics Division is offering (Survey of Statistical Computing and Generalized Linear Models). These are included in the PhD program in Biostatistics described in Sec. 3(d) below.

Beyond DEPH, there will ideally be numerous relationship with other fields and programs at UM. The fact is that there are many Departments and Divisions that offer courses that might be of interest to our students and there are courses (see Sec. 3 below) that we plan to offer that we think would complement other programs nicely.

Accordingly we intend to implement a 'PhD minor program' at the interdepartmental level. This is just a more comprehensive and formal way to develop 'cognates' within a PhD program. PhD minors in biostatistics or biostatistics are already in place at universities as varied as U. of Arizona, SPH, U. of Minnesota, SPH, and Stanford (PhD minor in statistics), NC State (PhD minor in statistics) as well as less formally at other universities; see Sec. 8 for some examples. The core idea is that the student in the subject matter department takes course credits in biostatistics equivalent to between 4 and 6 standard 3-credit graduate courses. Sometimes there is an extra criterion that the courses be closely related to the student's thesis work or that a member of the Statistics or Biostatistics Department be on the student's advisory committee. One obvious PhD minor we would want to be able to offer to our students would be in genetics and genomics. At the time of writing, we believe that a PhD minor could be of interest to MBF at RSMAS and Biology at Coral Gables but we would want to offer a PhD minor in biostatistics to any unit on campus that was interested.

In addition to making arrangements with other Departments/Division to offer their students PhD minors we would seek to negotiate a parallel 'PhD minor' for our Doctoral students. For instance, for some PhD students in biostatistics, marine applications might be of great interest. So, while planning a PhD minor in biostatistics option for students in (say) the Division of Marine Biology and Fisheries we would also plan a Marine Biology and Fisheries PhD minor option for our students. The ideal would be to ensure all of these PhD minors were reciprocal so that students pan-UM would have more intellectual opportunities and the faculty in diverse departments would have more chances to interact.

We comment that the exact requirements for a PhD minor would depend on which Department or Division the Division of Biostatistics was partnering with. Subject to that, we would ensure reasonable comparability across all the PhD minors we set up.

It is safe to say that given the statistical and biostatistical expertise evident at various places at UM but outside the Division of Biostatistics, the course requirements for a PhD minor in Biostatistics could include courses already taught in the student's Major Department or in a third Department. Indeed, there are some courses such as CAE 643 entitled Risk Analysis taught in the Civil, Architectural and Environmental Engineering Dept, EPS 662 Item Response Theory in the School of Education, and MBF 615 Advanced Biometrics in Marine Science that might be appropriate for credit toward a PhD in Biostatistics in place of some of the courses described in Sec. 3(e)(ii). Note that courses such as these do not overlap with any in our program below. A further benefit of our proposed program would be that we could (and would) propose joint development of courses in biostatistics to other Departments that might be interested.

e) Relationship to Undergraduate and Professional Programs.

The 3 main ways the proposed program would interact with existing undergraduate and professional programs are:

i) Other programs can supply prerequisites to our students or students to our program. Other Departments at UM have statistics courses at the undergraduate and graduate level. This includes Mathematics, Psychology, Engineering, Management Science,

Marine Biology and Fisheries amongst others. In some cases, these courses would be good prerequisites for our PhD students in Biostatistics to complete. Indeed, Track B students below (those admitted but not having satisfactory preparation in some way) could take some of these existing courses remedially. No current undergraduate course appears to overlap with any of the courses described below. Moreover, none of the courses proposed below overlaps substantially with existing graduate courses.

ii) Increased Graduate Course Offerings. We hope that existing programs might wish to include courses offered from a Division of Biostatistics, especially those programs focusing on biomedical sciences. 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. Reciprocally, we hope our students will take advantage of the course offerings in biostatistics and statistics in other Departments that we are unable to offer; the Graduate Program Committee described below would have as part of its mandate the tailoring of the PhD program to individual students and this would naturally lead to students taking courses outside the Division of Biostatistics. (This is apart from the breadth a PhD minor in a subject matter specific field would offer.)

iii) Relationship to other programs. Despite the huge demand for statistics and biostatistics at UM, it seems that there is only one program at UM with its primary focus as biostatistics: The Master's program recently started in the Division of Biostatistics in DEPH. 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 unfortunately not admitted students for over two years and it seems there are only two students left in the program. It is the express position of the Biostatistics Division to encourage the retention of the Statistics Master's degree and its elaboration into a Statistics PhD. Most major universities offer both a PhD in Statistics and PhD in Biostatistics. Such programs, and the departments that host them, are complementary and UM should have both.

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.

These libraries may or may not hold textbooks for courses, although they do hold books in the general topics areas of courses. For instance, the Richter search engine at http//ibisweb.miami.edu revealed an array of statistics and biostatistics books. However, few are recent. A similar search at Calder using the search engine http//callcat.med.miami.edu revealed a smaller collection. Again, not very many were recent.

The journal collection is similarly constrained. All the major journals minimally needed for a Master's in biostatistics are currently available -- mostly they are online and available from any part of the library system. However, while this was minimally sufficient for a Master's program in Biostatistics it is not really adequate for a PhD program.

ii.) *Additional library resources and their estimated cost.* For the purposes of a PhD program there are three improvements to the library collection that are important. They are:

a) Update the collection of texts
b) increase the journal subscriptions to include all the major and secondary journals
c) increase the subscription to JSTOR to include the full suite of statistically oriented journals.

Our present view is that item b) is less important than items a) and c). The reason is that web searches can usually turn up important recent research even before it appears in journals so the recent issues of journals may not be so crucial. However, our view is that items a) and c) are essential because the collection of recent books is quite limited and the back issues of statistical journals currently available on JSTOR at UM omits too many important journals.

To help remedy this, the Chief of the Division of Biostatistics commits to fund library acquisitions of statistically oriented textbooks at the rate of 2.5k per year for a minimum of 5 years. Taking $125 as the base price for a single textbook this amounts to buying about 20 books per year. This means that it will take 2-3 years for the collection of books to be reasonably current – and that is precisely the time that our first cohort of students will require the most recent material.

Furthermore, Prof. J. P. Renaud, Librarian Associate Professor at the Richter Library has estimated that "The JSTOR Mathematics and Statistics Collection would cost $5460 to purchase the file collection, and then $4244 annually for continued access." Prof. S. Rao, Chief of the Division of Biostatistics has agreed to pay for this for the present fiscal year and anticipates being able to fund it for a total of five years. It is essential that this be done as soon as possible since faculty may want to use important papers to supplement lectures and already want to use references unavailable on JSTOR in their research. The Biostatistics Division is pleased to be able to do this as a contribution to the general intellectual atmosphere of UM.

3. Incremental costs:

Even after 5 years it will be essential for the collection to be kept current and to maintain JSTOR access or equivalent. We suggest that the above numbers, adjusted for inflation, would be adequate in the future although increases would be helpful.

We comment that the recent trend in statistics is for journals to be entirely online and to be freely available. So, item b) above may continue to decrease in importance. Important examples of recently started free online journals include Bayes Analysis, the Electronic Journal of Statistics, Int. J. Biostatistics, and J. Machine Learning research. Sankhya has been freely available since its inception. In addition, an increasing number of articles or pre-prints are available online via ArXiv, ProjectEuclid and, citeseer. This is another reason item b) may be less important in the future.

a) 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 minimally adequate for the Master's and PhD programs in Epidemiology and the Master's in Biostatistics. However, the anticipated growth in DEPH's existing programs apart from the present proposal, will exceed the capacity of the current teaching and computing infrastructure within a year or two irrespective of the addition of a Biostatistics PhD. Since the Biostatistics PhD program is anticipated to be small (around 10 students) we can make use of the three conference rooms on the 9th floor of CRB and the seminar room CRB 988. These are not ideally equipped as classrooms, however, they are serviceable for instructional purposes.

Thus, 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. 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 they are fully operational, however, the combination of the Master's and PhD in Biostatistics with the other programs in DEPH 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 Chair 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.

b) Other Physical Requirements for a PhD Program.

Two more categories of space are important for a PhD program. The first is desk space for the students. We suggest that it will be most efficient for students to have their own laptops and a cable to connect them while they work at their desks. So, from existing space on the 10th floor of CRB, PhD students will be assigned cubicles for quiet work and study.

The second is a common area for debate, discussion, and possible presentations (mostly informal).In part, this can be provided by the Public Health Students' Association common room. Even though this room is mostly for socializing, it is a location at which biostatistical discussions can occur. However, it is a less suitable location for students to interact with subject matter specialists. So, students will be able to make use of the large and small conference rooms on the 10th floor of CRB.

4. **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, Bayesian methods, 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 and are generally driven by predictive performance more than by modeling success. (The reason for the distinction is that successful models do not often generalize beyond the specific data set used to construct them and so might be regarded more as data summarization than accurate modeling.) The first years of the program below are mostly traditional but they do permit inclusion of the emerging topics at many points. In contrast, the advanced courses tend to weight the emerging subfields more than the traditional subfields.

b) Evaluation of Current Undergraduate and Graduate Curricular Structure.

At present, there is no undergraduate program in statistics or biostatistics. However, there are undergraduate courses in statistics and biostatistics, usually at a second or third year level. 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 or PhD degree.

Moreover, it is possible that some of these courses might serve as graduate credit for students making up deficiencies (provided they are 500-level). There are no proposed changes to existing undergraduate offerings.

In terms of graduate programs, again there are no structural changes to existing offerings. Specifically, the existing Master's program in Statistics jointly offered by the Departments of Management Science and Mathematics is not operational. However, there are some graduate courses offered by the Department of Mathematics -- MTH 524, MTH 525, and MTH 542 -- that are listed below in the outline of our proposed program. This arose from discussions that have occurred between members of the Department of Mathematics and the Division of Biostatistics (involving Profs. G. Galloway, S. Rao, V. Pestien, S. Ramakrishnan and B. Calrke) to ensure the existing MTH courses will be appropriate for the anticipated student enrollment in the proposed program.

As a comment, there are various graduate level courses (such as DEPH 501 and DEPH 502) that are at an introductory level and could be used to satisfy prerequisites for admission to the proposed PhD program. However, such courses would not be accepted for credit in the PhD Biostatistics program.

There is a newly started Master's program in Biostatistics that became operational as of May 2010. At this time, there are no students formally enrolled although due to existing demand from students in other programs we have started two of the new courses and intend to start at least one more for Fall 2011. We are currently recommending admission for several students we think are qualified.

It is anticipated that there will be 3 types of interaction between the Master's program in Biostatistics and the proposed PhD program. First, the Master's program may supply students to the PhD program. Second, students who start the PhD program and do not have a Master's degree may be awarded a Master's degree if they complete all the requirements of the Masters program and do not complete their PhD. This option will be offered at the discretion of the Biostatistics Program Graduate Committee (see Secs. 5 and 6 below). Third, there will be considerable overlap in the PhD and Master's in Biostatistics program in terms of required courses during the first two years. This will permit enhanced course offerings within the Biostatistics Division.

At present, three courses offered within the Biostatistics Division are included in the Basic Track A Biostatistics PhD program: *Survey of Statistical Computation 525, Generalized Linear Models 575 and Survival Analysis 651.*

c) Anticipated additions, deletions, and changes in current curricular structure resulting from the new program.

All the curricular changes associated with the Proposed PhD program are additions, specifically advanced level courses that lead to PhD thesis work. This is detailed below in part (e).

d) Anticipated cooperative or interdisciplinary work with other components of the University or with any extramural agency.

It is anticipated that the PhD program would interact with other parts of UM in two ways. First would be the PhD minors that would be required of every Biostatistics PhD student. That is, upon entry into the program, every PhD biotatistics student would be obligated to choose an area outside of biostatistics in which to take a minimum of four courses. This will be decided on a case-by-case basis for each student and will be negotiated by the Division of Biostatistics with other units on campus.

Second, a student's thesis work will often involve an investigator outside the Biostatistics Division, who would then normally be on the student's thesis committee. The typical scenario would be the following. Some laboratory or clinical based researcher would have collected data and have questions he/she wanted to answer from it. However, the data would not be of a sort that could be analyzed using a standard technique. So, under the guidance of an advisor a PhD student would develop techniques for analyzing the data and similar data sets that might be collected. There are many variants on this: The student might develop designs for the data collection, the student might use several techniques on the data (some new and some established) as a way to compare the inferences, the student might be involved in interim analyses of the data as it is being collected etc. Naturally, the principal advisor would ensure that the methodological problem a student attempted was suitably abstracted so any solution found would be broadly applicable.

e) Detailed description of the proposed program.

First, 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) 4 further courses in statistics or biostatistics. These four courses are to include a general introduction, linear regression, introductory mathematical statistics and at least one more course (commonly drawn from survey sampling, multivariate, time series, nonparametrics, etc.) (5) At least two further courses in statistics, biostatistics or related fields. The issue here for the fourth course in (4) and the two courses in (5) is not the specific material but the statistical sophistication from having studied some aspects of the field more extensively.

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

Note that admission to the PhD program requires 2 more courses in statistics, biostatistics and related fields than the Master's program in Biostatistics does.

ii) First, we give a summary of the structure of the program.

Year 1

Fall

MTH 542	Statistical Analysis (Applied Linear Regression)	3 credits
MTH 524	Introduction to Mathematical Statistics I	3 credits
	Elective	3 credits
BST	Topics in Biostatistics Research	1 credit
		10 credits

Spring

MTH 525	Introduction to Mathematical Statistics II	3 credits
BST	Generalized Linear Models	3 credits
	Elective	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
	Elective	3 credits
BST	Topics in Biostatistics Research	1 credit
		10 credits

Spring

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

Year 3

Fall

BST	Advanced Statistical Theory	3 credits

	Advanced Statistical Computing or Consulting	
BST	Practicum	3-4 credits
	Elective	3
BST	Topics in Biostatistics Research	1 credit
		10-11 credits

Spring

BST	Advanced Survival Analysis	3 credits
BST	High Dimensional and Complex Data	3 credits
	Elective	3 credits
BST	Topics in Biostatistics Research	1 credit
		10 credits

We comment that Advanced Statistical Computing and the Consulting Practicum assume that the student already has the equivalent of BST 525 Survey of Statistical Computing.

Note that fully 6 courses have been left as electives to permit a PhD minor. The last two years of the overall 5 year program are understood to be thesis work. It is also understood that during a student's third year (if not before) he or she will be in the process of finding an advisor and searching for a good thesis topic, usually in the context of one of the advanced courses. This means the descriptions of the advanced courses (see below) must remain flexible to accommodate student research aspirations.

In contrast with the Master's program, there are four courses deleted to permit the PhD minor and 4 different courses added in Year 3 that are at a substantially higher level than any in the Master's program. (PhD students in the Consulting Practicum would be expected to function at a higher level than the Master's students.)

The core teaching faculty will be K. Arheart, H. Brown, B. Clarke, J. Clarke, R. Duncan, D. Feaster, O. Gomez, H. Ishwaran, S. Messinger, I. Reis, J. S. Rao, T. Sengul, and H. Xie. Further faculty members at the senor levelare expected to be hired in the coming two years; one position is currently being advertised. Aspects of the qualifications of the existing faculty are discussed in the next section. In principle, if each existing faculty member taught 2 courses per year 26 courses could be taught. Given the demands on Biostatistics faculty resources for the MPH and PhD in Epidemiology (a total of 5 courses, one with 4 sections and one overlapping with the present Master's and PhD programs), the 12 courses below, plus the two 1-credit courses, plus the Master's in Biostatistics courses not included here (there are 2) it is clear that the teaching load is within the capacity of the faculty.

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

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 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 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 Graduate 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 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 Advanced Statistical theory
Fall Semester
3 Credits
This course covers the mathematical basis of inference including formal proofs of consistency and asymptotic normality of parameter estimators, the formal properties of exponential families, asymptotic expansions, and key estimator classes. This course will typically include recent developments in statistical theory.

Prerequisites: BST 5XX Inference

Possible textbooks: Lehmann, E. and Casella, G. (1999) Theory of Point Estimation 2nd Ed. DasGupta, A. (2008) Asymptotic Theory of Statistics and Probability.

BST 6XX Advanced Statistical Computing
Fall Semester
3 Credits
This course covers the contemporary use of computing in statistics including MCMC, the EM algorithm, importance sampling, bootstrapping, simulation, and numerical optimization techniques such as simulated annealing and steepest descent.

Prerequisites: BST 5XX Inference

Possible textbooks: Liu, J. (2004) Monte Carlo Strategies in Scientific Computing, Springer.

Thisted, R. (2000) Elements of Statistical Computing. CRC Press

Gentle, J. (1998) Random number generation and Monte Carlo Methods.

(There are few textbooks; most instructors use their own material and code.)

BST 6XX Advanced Survival Analysis
Fall Semester
3 Credits
The theoretical basis of concepts and methodologies associated with survival data and censoring: nonparametric tests, missing data, and competing risk models. Much of the theory is developed using counting processes and martingale methods. Material will also be drawn from recent literature.

Possible textbooks: Pintile, M. (2006) Competing Risks: A Practical Perspective, Wiley and Sons.

Ibrahim, J., Chen, M. and Sinha, D. (2001) Bayesian Survival analysis. Springer.

Little, R. and Rubin, D. (2002) Statistical Analysis with Missing Data, Wiley and Sons.

Prerequisites: BST 5XX Inference

Possible textbook:

BST 6XX High Dimensional and Complex Data
Fall Semester
3 Credits
This course covers the key techniques for high dimensional and complex data including unsupervised learning, multiple comparisons procedures, dimension reduction, shrinkage methods, model selection, and prediction. Typically, this course will include recent material from the leading journals and researchers.

Prerequisites: BST 5XX Inference

Possible textbook: Clarke, B. Fokoue, E., Zhang, H. Principles and Theory for Complex Data, Springer 2009.

For background: Hastie, T. Tibshirani, R. and Friedman, J. 2009 Elements of Statistical Learning 2nd Ed.

We comment that two courses, BST 525 (Survey of Statistical Computing) and BST 575 (Generalized Linear Models) listed above, have already been started as they are required for the

Master's program. Currently, they are mostly taken by PhD students in the Epidemiology program.

f) Teaching Style.

i) 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, Inference, and Advanced Statistical Theory* would not typically have a computing lab, neither would the 1-credit seminar course. The Advanced Statistical Computing could be taught largely in the computing lab.

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 applications as well as provide a 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 of Biostatistics 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 reports on topics in the course or one longer paper on a single topic in the course. Alternatively, the student could computationally 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 would be possible. Indeed, it is the policy of the Division of Biostatistics that teaching style is an aspect of the intellectual freedom of the instructor aside from covering the syllabus; this is especially so for thesis advising.

ii) Exam structure. The following examination structure was proposed by Prof. S. Green, Dept. of Biology as the culmination of a general discussion of examination structures that spanned two meetings.We envision a written Diagnostic Exam at the end of the first year of study to ensure the student has made up deficiencies adequately and is making adequate progress. This would be required of all students (Master's and PhD). It would cover all the basic foundational material every graduate should have thoroughly assimilated. Students who perform poorly on this exam would be required to demonstrate their mastery of the material in some other way and this would be done on a case-by-case basis. If they failed to do so, they would not be permitted to get any degree from the Biostatistics Division. Passing this examination would signal that any students who came into the program with

deficiencies had made them up during their first year. This exam would be administered by a Committee formed by the GPC and results would be reported to the GPC. There would be a second Comprehensive Examination, combined oral and written, at a substantially higher level than the Diagnostic Exam. The Comprehensive Examination would be normally taken at the end of the third year of study. Passing it would signal the progression to Candidacy. This examination would be tailored to the student, administered by the Supervisory Committee, and probe areas related to the thesis topic. However, at the Supervisory Committee's discretion, this exam could also include background material beyond the thesis topic that the Supervisory Committee believes is important for the student to know at this stage.

(See: http://etd.library.miami.edu/grad/committees.html for a general discussion of the committee structure appropriate to PhD programs.)

iii.) Expected distribution of graduate students among advisors. At present there are only 5 faculty members who do research in biostatistical methodology and who would be clearly qualified to guide PhD students (H. Brown, B. Clarke, J. Clarke, H. Ishwaran, and S. Rao). While this seems small, other programs such as the Biostatistics Section at Brown University only seem to have 6 faculty members in methodology. Importantly, further hires of methodology researchers into the Division of Biostatistics are anticipated in the coming years, possibly up to six. (One search is ongoing at present.) Even with five faculty members, given that the program is about 5 years long and a student can realistically be expected to spend half that time on thesis work the burden is equivalent to 5 students requiring an advisor at steady state. This amounts to one PhD student per faculty member, meaning a faculty member would nearly always have a PhD student on average. This is feasible, and probably desirable.

g) Faculty.

i) CV's of teaching and advising faculty. It can be seen that for each proposed course there are at least 2 faculty members 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.

Roughly, the proposed program requires 12 courses worth 3 credits each in biostatistics plus the one credit per semester seminar course. This is 12 times .15 + .1 = 1.9 FTE's. The existing Master's program adds .2 FTE's and the service teaching requirements add .6 (501), .15(502)and .45 (603-604-605). All but .45 FTE's of this teaching for (501 and 604) is sourced from outside the Biostatistics Division and likely will continue to be. This means the total teaching burden on the Biostatistics faculty will be 1.9 + .2 + .45 = 2.55 FTE's. If this were divided equally among the 13 Biostatistics faculty this would be about .21 FTE per faculty member or about 4 credit hours per year. On top of this there will be administrative and advising requirements which are hard to estimate, but may

amount to .5 for administering the graduate program and roughly speaking guiding a PhD student is like teaching a 1.5 credit course. Again, spread evenly over the existing faculty this is feasible and the effort will be reduced a little once the currently advertised position is filled and reduced further as future hires are made.

ii.) Estimate the need for additional faculty. While it is feasible to teach the proposed program using the existing faculty, many existing faculty have other commitments e.g., to other Departments or to grant funded work, and so would not be as available. Moreover, while there are several faculty who could teach Advanced Computing, Advanced Clinical Trials, Advanced Survival Analysis, Complex and High Dimensional Data with preparation there are many faculty for whom this would be a great burden. So, in the interest of ensuring sufficient redundancy in teaching capacity it is recommended that future hires be evaluated as to their ability to teach these advanced courses. Ideally, four new faculty would be hired one each capable of teaching one of the advanced courses. This would ensure some redundancy of teaching expertise and be desirable in case a faculty member was unwilling or unable to teach for a semester.

The Chief of the Biostatistics Division, as a condition of his hiring, has permission to hire up to six more faculty members over the coming 4 years. There is no doubt that this will increase the teaching capacity of the Division substantially. In particular, the anticipated hires mean the teaching capacity of the Division will enable the Biostatistics Division to run a PhD Program as well as fulfill other obligations.

iii) Interaction of the proposed program with other graduate programs. As noted before, there are three main ways the proposed program would interact with other programs. The first is via the PhD minors described in Sec. 1 (d) – either we supply students to other programs or they supply students to us as part of their PhD minor. Second, apart from a PhD minor, students in our program might take courses in other programs and students in other programs might take our courses purely out of breadth or interest. Third, assuming a thesis candidate is working on a problem motivated by the research of a faculty member at UM the faculty member would be expected to serve on the student's thesis committee. Finally, we would enjoy the opportunity to develop joint programs and joint courses with other units at UM but such interactions cannot be developed until the present PhD proposal is implemented.

5) Students:

a.) Estimate the number of students in the program and the pool from which they will be selected.

We anticipate 10-11 students at steady state. The program should take five years so our goal is to enroll five strong students every two years; this allows for some attrition due to students failing examinations in their first or third year or choosing other career directions . Overall, we hope to graduate two students per year. There are two pools from which students will be drawn: Students who already have a Master's degree in biostatistics or a closely related field and students who only have a BSc in biostatistics or a closely related field. Closely related fields include statistics, the statistical end of computer science, mathematics graduates who focused on real analysis and probability, some branches of engineering (such as electrical) in which probabilistic modeling is central, and some branches of quantitative psychology, among others.

There is no competing PhD in Biostatistics program in South Florida so initial recruitment would focus on South Florida, students who wanted to move here, and foreign students. That is, we expect most of our students to be either local or from overseas. We do not anticipate that very many of our students will be domestic outside South Florida, at least initially. It must be noted that FSU and UF are both state universities with long established programs that routinely offer teaching assistantships to their students in Statistics/Biostatistics for their duration of study (these assistantships normally carry a tuition waiver). There are many other such schools and they can be expected to compete effectively with us on finances and on program quality.

b.) Requirements for admission to and expected retention of students in the proposed program.

There will be one Biostatistics Graduate Committee (BGC) to oversee graduate programs in Biostatistics. The BGC will have 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. H. Xie.

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 Division Chief and the third will be chosen by the GPD. The BGC will review and rank all applications by intellectual merit for the PhD in Biostatistics program. Each year the top students as ranked by the BGC will be recommended for admission and recruited by the Committee up to the capacity of the program. The BGC may interview students or take other actions to recruit top applicants.

The requirements for admission to Track A are in Section 3(d). It is not common 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 most applicants coming out of a BSc program would likely be short several 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 Graduate School and UM-MSM requirements (TOEFL, GRE, GPA etc.), 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 as currently taught, 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 and pass the Diagnostic Examination. 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 of the graduate faculty, require remedial work of students who are not deemed to be making adequate progress. Also, by majority vote of the graduate faculty at such a meeting, a student making insufficient progress may be required to leave the program. In extreme cases, the Division reserves the right to require a student to leave the program at the end of a semester. (We comment that there are existing guidelines by which to determine if a faculty member in biostatistics is eligible to be in the Graduate Faculty; if these are met the Chair of DEPH can request a faculty member be admitted to the Graduate Faculty.)

The Diagnostic Examination will be given once a year, usually at the end of the spring semester examination period. The examination will be entirely written and administered during one four hour sitting. It will be set and marked by a Committee of three faculty in Biostatistics who will provide recommendations to the GPD for each student who wrote the exam. The GPD will discuss the recommendations at a meeting of the GPC and these will be taken forward to a full meeting of the Biostatistics Graduate Faculty who will vote on each student individually.

The Comprehensive examination will normally be administered at the end of the third year of study. It will have a written component based on course work and possibly on the areas of biostatistics germane to the student's anticipated thesis work. There will also be an oral component during which the student presents his or her ideas for a thesis. The oral presentation will usually be based on a write up of the student's ideas. The Comprehensive Exam Committee for a student will consist of the anticipated principal thesis advisor and at

least two other graduate faculty members. At least one of these will be in biostatistics (the field, not necessarily the division); the others may be in the subject matter area of the motivating problem for the thesis.

It is expected that not all students admitted to the PhD program will complete the PhD program. If the student must leave the program and a leave of absence is not a feasible, the PhD program will grant a Master's degree in Biostatistics to students who satisfy the following. (1) The student writes to the GPC formally requesting the Master's degree be awarded in lieu of the PhD. (2) The student has completed at least four semesters of full time study in the PhD program in courses approved by the GPC. (3) The student has either passed the Diagnostic Examination or made up for any deficiencies detected by the examination (to the satisfaction of the GPC). (4) The student has prepared a document that can be treated as either a Major Paper or as a Master's thesis. If the document is to be treated as a Major Paper, it must be submitted to both an adviser and a second reader for approval. If the document is to be treated as a Master's thesis, then the usual guidelines for Master's theses must be followed, see 4(f)(ii) for the webpage. If there is an existing PhD dissertation committee, it converts to either a Master's thesis committee or to an Advisor and Second Reader (in the case of a Major Paper). If no dissertation committee has been formed the GPC will arrange for a suitable Master's Thesis Committee to be formed or for members of the Graduate College to serve as Advisor or Second Reader for a Major Paper. (5) Six weeks after the written request from the student is received, the student's stipend (if applicable) will be discontinued. (6) Three months after the written request from the student is received, the student will be required to leave the program and discontinue all support contingent on being in the program, regardless of whether the requirements of the Master's degree have been satisfied unless the GPC grants an extension due to health, legal, or other extreme contingencies.

Students who are registered in the PhD program and making satisfactory progress may request a Master's degree 'along the way'. Such a request must be made in writing to the GPC within two weeks of the student passing his/her Comprehensive Examination at which time the student must have either a Master's Thesis Committee or an Adviser and Second Reader in place. Usually, the Master's Thesis or Major Paper will be based on the written portion of the Comprehensive Examination, but need not be. The Master's Committee or Adviser/Second Reader must pass the student's written work within four months of the end of the student's Comprehensive Examination. If the student elects this option, the material used in the Maser's thesis or Major Paper will not count for credit in a subsequent PhD thesis.

c) Teaching Assistants and Teaching Support.

Up to four graduate courses offered by the Biostatistics Division will require teaching assistants. These are Applied Linear Regression, Survey of Statistical Computing, Advanced Statistical Computation and the 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.

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 students to act as teaching assistants in DEPH range from $10-$15/hour, depending on the work required of them. The hours of work range from a couple of hours/week (2-3) to 15 hours/week. This paradigm will change substantially as the enrollment in the various other programs (PIBS, MD/MPH, and MPH) increases and computing labs are added. This is reflected in the budgeting below.

We comment that the Biostatistics Division has recently hired a system administrator. This person's remit will include the management of computing labs for the graduate programs. Specifically, he will ensure the computing lab has the proper software and functionality, as well as providing support to instructors and computational training to teaching assistants for BST and the EPH biostatistics courses taught in DEPH.

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

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. S/he 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; this is routinely done in PIBS already. The BGC may have to emphasize recruitment from India, China,

and Latin America. There are also costs associated with promoting graduates of the 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 PhD program will be under the GPD supported by the GPC. 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 on the performance of all students in the program at the end of each semester. The BGC monitors progress of students in the program including passing the Diagnostic Exam and Comprehensive Exam, helping to ensure that students find thesis advisors in a timely fashion. In addition, the BGC organizes and oversees preparation and administration of degree requirements. This includes setting committees for the Diagnostic Exam, approving Supervisory Committees and Advisors, and ensuring Comprehensive Exams are conducted properly. The BGC will also decide on any remedial steps to be taken by Track B students and students who do not perform well enough on the Diagnostic Exam or Comprehensive exam. The BGC does the hiring of teaching assistants where funds permit, ensures they get any necessary training, and assigns them to courses.

The proposed course structure in Sec. 3 is not rigid. On the other hand, it provides reasonable coverage of the fields in Biostatistics. Flexibility is, however, desirable, and this will be added by the students being allowed to appeal to the BGC for course substitutions. The policy of the BGC will be that course substitutions will be approved as long as the intellectual standing of the program is not compromised.

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. If the disputants are not satisfied by the within-Division process, the next step for either would be to make their case to the Senior Associate Dean for Graduate and Post-Doctoral Studies and then to the Dean of the Graduate School if the Associate Dean's decision is appealed.

ii) Policy making mechanism. There will be a meeting at the end of each semester after the course marks are submitted and the diagnostic and Comprehensive Examinations are administered. It is at these meetings that decisions about individual students will be made. These meetings 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 the Division of Biostatistics, and doing applied or theoretical research in statistics or biostatistics. (Note that this does not require a faculty member in the program to have a primary appointment in the Biostatistics Division, only that a faculty member be appointed to the program.) 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 and Chief of Biostatistics are members. 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 finances of the program can be summarized as follows. The first five years of the program are primarily covered by the recruitment package of the recently hired Division Chief Sunil Rao; extracts from the educational and research components of his package are found in Annex I, along with a spreadsheet giving the year-over-year budget items.

We plan to accept five students per two year period, thee students in odd years of the program and two students in even years of the program. We anticipate that out of these five students one will not complete the degree. This may be due to inability, e.g., failing examinations, or due to changed career interests of the student, or due to the student wanting to do a thesis no one in the Division was competent to advise. Since the program is five years we expect to graduate about two students per year. Thus, at steady state we anticipate ten students, though sometimes there might be eleven (an average of 10.5 students) since we admit either 2 or three per year.

The cost of instruction, computing and technical supplies, and space is funded from the education portion of Rao's recruitment package.

Redacted

We have examined the Biostatistics programs at 20 universities. Ten came from the official list of universities that are used for comparables at UM. These are listed in the report Accelerating Ambition: Strategic Plan 208, see p. 6. (The document can be found at:

http://docs.google.com/viewer?a=v&q=cache:83Hnscv7w3IJ:www.miami.edu/index.php/office_of_accreditation_and_assessment_oaa/um_strategic_plan/+/office_of_accreditation_and_assessment_oaa&hl=en&gl=us&pid=bl&srcid=ADGEESgBMawjykaZe8K_0V_zjeFc5LPsFYHVUjVcjglRi1iMtDLZjTkyRBJYbpTR-yY6jc3j-MdX3N52ejgibuqHi6hpjRdMIQgByEFvO2QNrWgNUzwbjl673o7jmniIwZUkkpXvFDFI&sig=AHIEtbTdGBRzckJuNMzgYlgwLsBGFmHSGA.)

The other 10 came from suggestions that arose at meetings held to discuss the general proposal. In Annex II, we first present some details on the 'official ten' and then turn to the other 10. Specifically, we provide the link for the webpage for each of these PhD programs, an indication of the examinations PhD candidates must pass (not including the thesis defense), the availability of support, and expected duration. For each school we also provide some comments about how the program compares to the one we have proposed here.

In this part of the proposal we merely summarize the key results of the comparisons given in Annex II. In comparing the course work required of students there are four important points. First, most programs have two exams; at least one of the exams has a written component. Typically, there is also some examination of the actual thesis work the student proposes to do or complete. Second, the programs vary in terms of their course requirements. Most require approximately 2.5 years of full time course work; a few only require 2 years, a couple require fully 3 years. We attribute this to the admission policies (how many pre-requisites the program has and how well applicants satisfy them). Moreover, some of the programs that require 2 years of coursework include summer semesters. Third, none of the programs seem to emphasize the most modern techniques. They tend to be relatively traditional with the exception of certain biostatistics programs that are housed in Statistics Departments. Fourth, apart from the exceptions noted in Sec. 1 (d), none of the main universities who would be our natural competitors have as well developed a PhD minor program as we propose. The general consequence of this is that we are at the high end of course requirements for PhD students (but three are higher and several are at the same level). If the PhD minor in a related field were omitted and the courses covering more contemporary topics were omitted, we would be a little below the typical course requirements of other programs.

It is also important to compare the examination structure of the program we propose with the examination structure of the existing programs. In fact, our exam structure is broadly similar to most of the existing programs. However, examination structures evolve over years. This reflects changing aspects of fields, changing attitudes of faculty and changing student admissions among other forces. That is, there is no one structure that seems to fit any given program for very long. So, what we have proposed here is a sort of consensus achieved over a series of meetings and discussions with interested parties at UM as well as a consideration of how other programs operate. Briefly, essentially every program has a written component to its examination structure (usually the first examination) and the majority have an oral component, usually as part of the second examination. A large majority have some evaluation of a student's thesis proposal. It might only be

a small part of the second examination or it may be the focus of the second examination. In most schools, it is standard for students who do not complete a PhD but successfully finish the first two years of a program to be awarded a Master's degree if they do not already have one in Biostatistics; this is a practice we would follow as it is just and good for morale.

We summarize some key features of the comparisons in Annex II in the table on the next page. The note UG (for undergraduate) for NYU, Tulane, and USC indicate that their Biostatistics degree is notably short on Biostatistics courses or is at an uncomfortably low biostatistical level (e.g., their graduates are unlikely to be able to publish in international peer refereed journals in biostatistical methodology, but perhaps in subject matter journals with collaborators). In some cases, these programs lean heavily on many courses in subject matter disciplines.

It is worth noting the funding discrepancies among the schools. The note None? means that little or nothing was said about funding or that funding was reliant on grant money. These schools are Harvard, Yale, USC, and Tulane. However, Tulane, USC and Yale seem to have rather weak programs in terms of biostatistics that we would not want to emulate. Harvard's level is harder to evaluate. Nevertheless, it seems notably stronger than the other three although its quality is probably in the mid-range overall. Curiously, NYU has a notably weak program even though it offers full funding. It is not clear why.

Rochester?

School	Coursework (Yrs)	PhD Minor	Written Exam	Oral Exam	Thesis Proposal	Other Exams	Funding
CMU	2+	Not Req.	N	N	Y (oral)	Written project	Full
Emory	2+	Not. Req.	Y	N	N	2 more written exams	3 Yrs
NYU	2.5	UG	Y	N	Y (oral)		Full
Tulane	3	UG	Y	Some cases	Y (oral)		None?
Rochester	2	Not.	Y	N	Y (oral)	one more	Full

		Req.				written exam	
USC	2	UG	Y (2 parts)	N	Y (oral)		None?
Brown	2	Not Req.	Y	N	Y (oral)		Full
Yale	2	Req. UG?	Y (inclass + take home)	N	N		None?
Harvard	2.5+	Req.	Y	N	Y (oral)		None?
UW	2.5	Not. Req.	Y	N	Y (oral)	two more written exams	Full for most?
U Mich	3	Req.	Y (two parts)	N	Y (oral)		Full for most?
Madison	3+	Not req.	Y	N	Y (oral)		Full
MN	2.5	Not req.	Y	N	Y (oral)		Full
JH	2	Req.	Y	Y	Y (oral)		Full?
UF	3+	Not req.	Y	N	Y (oral)	Written thesis proposal	Full
FL State	2+	Not req.	Y	Y (presentation)	Y (oral)		Full

Finally, we comment that Biostatistics programs situated in Statistics Departments tend to have higher mathematical demands. That is, the PhD in biostatistics is a direction pursued after all the foundational statistics theory courses have been completed. This is the case more-or-less for CMU, UF and Madison. Also, biostatistics programs at schools with strong statistics departments tend to be more mathematically rigorous because of interactions between the biostatistics and statistics departments. This is the case for MN, UW, U Michigan, and Brown. (NYU, however, is an exception to this.) Overall, this leads us to encourage the formation of statistically oriented groups in Mathematics, RSMS, Engineering, Psychology, Business Administration or elsewhere at UM. The Division of Biostatistics is also charged with developing a pan-campus Center for Statistical Science and very much wants the participation of other units on campus. Statistics and Biostatistics are rapidly growing and spreading fields and are continuously enriched by varied intellectual approaches.

Chief of Biostats Recruitment Package

FIRST FIVE YEARS

Redacted

Dr Sunil Rao

Education Programs

Redacted

Dr. Sunil Rao

Biostatistics Research

Biostatistics Core

Personnel (FTE) from other components: DO NOT FILL THIS TABLE			Year 1	Year 2	Year 3	Year 4	Year 5
Director of Core Facility	Core Manager	FTE					
Tenure Track Faculty	Ten Professor	FTE					
	Ten Professor	FTE					
	Ten Associate Prof	FTE					
	Ten Associate Prof	FTE					
	Ten Assistant Prof	FTE					
	Ten Assistant Prof	FTE					
Research Faculty	Professor	FTE					
	Professor	FTE					
	Associate Scientist	FTE					
	Associate Prof	FTE					
	Associate Prof	FTE					
	Assistant Prof	FTE					
	Assistant Prof	FTE					
	Assistant Scientist	FTE					
	Assistant Scientist	FTE					
Total FTE from Other Components		FTE	0.0	0.0	0.0	0.0	0.0

Educ Effort: 30%

Primary Research Faculty:		Year 1	Year 2	Year 3	Year 4	Year 5
Tenure Track Faculty	Ten Professor					1
	Ten Professor				1	1
	Ten Professor		1	1	1	1
	Ten Associate Prof					
	Ten Associate Prof		1	1	1	1
	Ten Associate Prof			1	1	1
	Ten Associate Prof					1
	Ten Assistant Prof					
	Ten Assistant Prof				1	1
	Ten Assistant Prof		1	1	1	1
Research Faculty	Professor					
	Professor					
	Associate Prof					
	Associate Prof					
	Assistant Prof					
	Assistant Prof					
	Assistant Prof					
			2	2	4	6
Post Doctoral Fellows						
Senior Technicians						
Junior Technicians			10	12	16	20
Graduate Students - Masters				7	10	10
Graduate Students - PhD			1	1	2	2
Administrative Assistant						
Other			3	4	6	8
Total Primary Research Faculty Headcount			16	28	38	46
Total Primary Research Headcount (Including Faculty)						

Capital Investment	$000s	Year 1	Year 2	Year 3	Year 4	Year 5
Total Capital Investment to attract senior faculty						
Renovation costs						

Research Expenses		Year 1	Year 2	Year 3	Year 4	Year 5
Wet Lab supplies	($000's)					
Chemicals	($000's)					
Software	($000's)					
Other	($000's)					
Shared Resources - FACS	(hours)					
Confocal microscopy	(hours)					
Other	(hours)					
Animals - Housing	($000's)					
Animals - Other	($000's)					
Administrative ($000's)	($000's)					

Research New Space Requirements	Year 1	Year 2	Year 3	Year 4	Year 5
Administrative Space		685	870	1110	1350
Total Research Space Requirements		685	870	1,110	1,350
Additional sf per year		685	185	240	240

Annex II: Comparisons

In this section, we give the raw data that was compiled into the table in section 8 of the main proposal. Our comparisons fall into two classes: the first is to the 'official ten universities to which UM compares its self and the second is 10 further universities that arose during the discussions that led to this proposal.

A. The Official Ten

Four of the official ten, Brandeis, Case-Western, Syracuse, and Vanderbilt do not have a PhD program in Biostatistics. For Brandeis and Syracuse this is not a surprise: These seem to be primarily undergraduate institutions and do not seem to have a full suite of PhD programs. Case-Western has recently undergone a re-organization so they have replaced their PhD program in Biostatistics with a focus on data analysis; in short they are planning to give up their capacity for innovative analyses. (This was driven by the fact they lost their training grant since too many faculty capable of being thesis advisors left.) Vanderbilt, by contrast, is in the process of developing a graduate program in Biostatistics in particular a PhD program according to their webpage http://biostat.mc.vanderbilt.edu/wiki/Main/GradAppProcess, due to begin Fall 2011. The other six universities are Carnegie-Mellon, Emory, NYU, Tulane, Rochester and USC. For these, and the other universities in the next subsection, we provide a link, a note on the exam structure, comments on the support offered to students, and comments on the apparent duration of the program, as far as possible from web searching.

1) Carnegie-Mellon University

See: http://www.stat.cmu.edu/research#biostatistics , http://www.stat.cmu.edu/programs/graduate/the-phd-program-in-statistics for program description. There is a written project in lieu of a Diagnostic Exam and an oral Thesis proposal in lieu of the Comprehensive Exam. There are 5 advanced statistics courses required of PhD students and presumably this necessitates the precursor courses.

As a Statistics Department, it is likely that students are offered full support for the duration of their program provided they make adequate progress. Indeed: http://www.stat.cmu.edu/programs/graduate/applying-for-admission notes: "The Department of Statistics attempts to provide financial aid for as many of its students as possible, including both Master's and Ph.D. candidates. Financial aid awards include assistance with tuition and opportunities for graduate assistantships."

Moreover, "When the students are done with their coursework, to help them launch into their dissertation, they write a report synthesizing the ideas gleaned from reading multiple sources on a statistical topic that might lead to a dissertation topic. This project counts in lieu of a comprehensive exam. Students are also required to show a dimension of strength in either probability, statistics, statistical computing or data analysis."

The webpage says the MS and PhD can be done in 4 years; this would likely be an exceptional student but CMU is an elite university so it may happen regularly.

2) Emory University

http://www.sph.emory.edu/cms/departments_centers/bios/degree_programs/phd.html

Students who take BIOS 510 and 511 (much like the Intro Prob and Dist. Theory and the Inference courses here at UM) must take a written exam in the summer following enrollment in these courses. This is much like our proposed Diagnostic Exam. All students must take the PhD Methods Qualifying exams in the summer following enrollment in four of the advanced courses. They must also take the PhD Theory Qualifying exam in the summer following enrollment in three other advanced courses. The program has fewer required courses (can be done in a little over 2 years) than ours and they are more narrowly focused on the basic theory.

All full-time students admitted to the Biostatistics PhD program at Emory either are offered tuition and stipend awards by the university, or have individual fellowships from outside funding sources. This support is renewable for up to two additional years, conditional upon satisfactory academic progress.

Roughly, it looks as though top students might finish in four years. The typical student probably takes 5.

3) New York University

http://www.med.nyu.edu/biostatistics/phd/index.html

"Candidacy for the Ph.D. is achieved through a Qualifying Examination, and the completed dissertation is then defended in a final oral examination. The Qualifying Examination consists of two stages: a written examination and the writing and oral defense of a specific research project proposal (doctoral dissertation outline)."

All successful Ph.D. applicants qualify for graduate assistantships. Currently, these pay a stipend of $22,000 per year plus tuition costs.

There are three required courses (only one in Biostatistics) and an unspecified number of courses required in basic sciences. A total of 72 credits is required; at most 36 can be dissertation credits.

Overall, this PhD seems mostly to focus on subject matter disciplines of biostatistics rather than Biostatistics per se. That is, graduates appear roughly to have the equivalent of a PhD minor in Biostatistics rather than a PhD in Biostatistics with a PhD minor in a related field.

4) Tulane University

http://www.sph.tulane.edu/publichealth/bio/phd.cfm

There is a written exam:
There will be a written comprehensive examination administered by the department upon completion of the required amount of coursework. Individual departments also may require

an oral examination. A minimum of three faculty members will be selected by the department to conduct and collaboratively evaluate the required examinations. Students have two attempts to pass the examination; the second attempt must take place within a year of the first.

After successful completion of the comprehensive examination, the student should form a dissertation committee and develop a prospectus. A prospectus of the dissertation research should be publicly presented and approved by the committee at least one semester before the dissertation defense.

There is also a thesis proposal (probably oral):
After successful completion of the comprehensive examination, the student should form a dissertation committee and develop a prospectus. Following the successful defense of the prospectus, the student is admitted to PhD candidacy and can proceed to completion of the dissertation.

No indication of support.

The coursework fills three years (60 credits) completely and is quite broad, though it does not look as though much depth is achieved in the courses. Indeed, it looks more like a really strong applied Statistics undergraduate program; it is not clear that students can realistically do strong methodological work without taking more course work. Our program is not so broad and later courses depend on earlier courses more than in Tulane's program. Our program is also more contemporary.

5) University of Rochester

http://www.urmc.rochester.edu/education/graduate/phd/statistics/program/#phd

There are three separate examinations. The first two are written, the third is an oral thesis proposal: "All Ph.D. students take a comprehensive examination at the beginning of the second year. Ph.D. students take another written examination at the beginning of the third year. Both examinations cover material in the areas of probability, inference and data analysis. After beginning research on a dissertation topic, Ph.D. students take an oral qualifying examination, consisting largely of a presentation of a thesis proposal to a faculty committee, the student's Thesis Committee."

Doctoral students are typically provided a fellowship award, which includes an annual stipend, a full tuition scholarship, and single coverage health insurance while they are enrolled and making satisfactory progress toward the Ph.D. degree. The stipend is $25,500 for the 2010-11 academic years (July 1, 2010 through June 30, 2011). Stipend amounts are reviewed annually and generally increased from $500 to $1,000.

The course work normally takes about two years. It is focused on the foundations and theory. While it is a bit narrower than what we propose here the differences are not large. There are some touches of modernity e.g., bioinformatics and regular seminar courses on statistical literature.

6) University of Southern California

http://keck.usc.edu/Education/Academic_Department_and_Divisions/Department_of_Preventive_Medicine/Divisions/Biostatistics/Education_and_Training/PhD_Programs.aspx

There are two examinations: A written screening examination consisting of two parts, theoretical and applied. A student failing the Screening Examination may be given a second opportunity to retake either or both portions of the Screening Examination. Students failing the examination for the second time will terminate with the MS degree upon satisfactory completion of 33 units and an acceptable thesis.

After this there is an oral examination for the thesis proposal. A written draft of the background and methods sections of the proposed dissertation must be submitted prior to the exam. The dissertation should be oriented toward a theoretical-methodological application to a problem area in the biological or health sciences.

No indication of support.

It seems that 33 credits would be the minimum required amount of course work. This would correspond to about 11 courses or two years. The course list and descriptions are quite broad and, like Tulane's, appear to be a strong applied undergraduate program in statistics, but with more of an emphasis on subject matter courses. Again, it is not clear that students can realistically do strong methodological work without taking 4-6 more courses.

Overall, in terms of course work, Tulane and USC appear much weaker than what we propose. NYU and CMU are much stronger and Rochester and Emory are broadly comparable. So, this situates our proposal roughly in the middle. The schools which provided support information were the 4 stronger programs and they provided more support than the School of Medicine at UM routinely does. The two weaker programs were the ones that did not provide easily obtainable information.

B. 10 More Programs:

For good measure we also look at 10 more programs. The overall import from these is that the program we have proposed remains a little at the high end in terms of the amount of course work required. However, if one looks only at the Biostatics courses it is a little at the low end; the difference is the PhD minor. The PhD minor as we have proposed here is more extensive than the analogous requirements of most other programs though arguably not by much if at all when the comparison is restricted to Biostatistics Departments situated in schools of public health.

The exam structure we propose (first year written exam and third year oral) is also not unusual. It is slightly more typical to have a written exam at the end of the second year but this is more common among schools that provide more support to graduate students than the School of Medicine will.

1) Brown University

http://www.stat.brown.edu/Grad/Courses.aspx

There are two examinations. The first is written and normally taken at the end of the second year of study. The second is oral and is mostly a thesis proposal.

Full funding:
All students admitted to the PhD program receive an offer of funding in the form of a fellowship, teaching assistantship, traineeship, or research assistantship. The funding package includes tuition, health insurance and an annual stipend of around $25,000.

For all Ph.D. students, twenty four credits are required of students matriculating in the program without a master's degree; sixteen are required beyond the master's. As a generality, students with suitable preparation can complete the course work in 2 years. The program is much like what the present proposal would be without the PhD minor, i.e., if the courses listed as electives were filled with 3 traditional Biostatics courses and one that was in a more contemporary subject.

2) Yale

http://publichealth.yale.edu/biostat/curriculum/phd/requirements/index.aspx

The examination covering epidemiological methods includes both an in-class and a take home portion. One faculty member is responsible for coordinating this examination, and the examination content is developed by the overall faculty. The specialty area examination is usually developed by an expert in the field following discussions with the candidate and biostatistics advisor.

Little information on funding: Many faculty have grants which can be supplemented to provide training related expenses and stipends to students. In addition, there are some opportunities for University fellowships and for NIH traineeships for those interested in studying statistical methods with applications in Mental Health Epidemiology.

There are a minimum of 13 required courses that in principle could be completed in 2 years for a strong student who came in with no deficiencies. More realistically, the program looks like it would take 2.5 years to complete the course work. Three of the courses are in a subject matter discipline corresponding to the PhD minor proposed here. All the courses listed are traditional and the program looks very applied i.e., the methodology must be applicable to a specific data set and students are warned that using a routine method will not be enough for a PhD. Thus, this program is unlikely to lead students to go beyond variations on existing methodology.

3) Harvard

http://www.hsph.harvard.edu/biostats/publications/handbook/greenbook003.html#toc1

Students must take and pass two examinations. The first is a written exam normally taken in the fall semester of the second year of study. Successful completion of the written examination is a prerequisite for taking the oral examination. The oral examination is a thesis proposal. In preparation for the oral examination, the student must decide on a specialized topic on which he/she wishes to be examined. The student will prepare a written report summarizing the topic and reviewing the relevant literature.

It seems that the only support offered is via grant money. See:
http://www.hsph.harvard.edu/administrative-offices/student-financial-services/

It is hard to assess the typical duration of the program. 45 credit hours of course work seems to be required along with 10 more from a cognate and consulting requirement (one course). Effectively, this must amount to a minimum of 2 years, more likely 2.5 to 3.

Overall, the course offerings seem very traditional and computational, but nevertheless broad including such atypical topics (for a biostatics program) as sequential analysis, statistical genetics, computational biology, public health surveillance, and health program evaluation. The program is broader than the one proposed here, but it is not obviously very focused.

4) University of Washington

http://www.biostat.washington.edu/grad/phd

There seem to be fully 4 examinations pre-dissertation. There is a written first year theory exam and a pair of second year exams: one theory the other applied. Finally, there is a thesis proposal examination usually completed in the third or fourth year of study.

There are several funding sources. See: http://www.biostat.washington.edu/pro/financial

It is unclear how much support this really is; at least 5 are supported fully throughout their study.

At least 14 courses are required amounting to about 2.5 years of course work, see:
http://www.biostat.washington.edu/node/1269

The required courses are all basic theory; however, there is ample room for electives that would include various specialized topics within Biostatistics. This program is likely quite similar to the one proposed here although perhaps a little more theoretical. Indeed, it should be noted that parallel to the PhD minor part of the present proposal there is a biology project required of Biostatics PhD students. This project is to be completed in the third year of study.

5) University of Michigan

http://www.sph.umich.edu/biostat/programs/irrelevantms.html

There are two written examinations: one six hour theory exam and one six hour applications exam, normally taken at the end of the second year of study. Later, there is an oral examination of the thesis proposal at a relatively early stage of the work.

All students are considered for financial support. There are four types of financial support: Graduate Student Instructor (GSI), Graduate Student Research Assistant (GSRA), Training Grants and Fellowships. It seems that most students are fully supported for their duration of study.

There are 1.5 years of foundational Biostatics theory course work. There is also a requirement of about 4 courses of Biostatics electives. Four epidemiology courses are required and there is a cognate requirement of some 3 courses. Together this amounts to about 3 years of course work. This program is similar to the one proposed here except that there is no necessary epidemiology requirement and our PhD minor requirement will be a little more demanding than the cognate requirement at Michigan.

6) **The University of Wisconsin Madison**

http://www.biostat.wisc.edu/Biostatistics_Program/biostatprogphdgrad.htm
There are two examinations a student must pass. The first is a written exam usually taken in the second or third year, based on theory covered in the core statistics curriculum. The second is a thesis proposal examination.

Essentially all students are supported by TA-ships or RA-ships for the duration of study. There is a little over 3 years of course work, see:
http://www.biostat.wisc.edu/Biostatistics_Program/biostatprogphdsample.htm

Roughly, the PhD with a Biostatistics option adds a few requirements to those of the basic statistics PhD. These include Clinical Trials, Epidemiology, one more statistical course (Survival Analysis or Statistics for Molecular Biology), and one biology course. There is also a requirement for collaborative research or consulting in Biostatistics. In comparison with the program proposed here, this PhD is more mathematically demanding and statistical, but less traditionally biostatistical. Also, the requirements for interaction with biomedical science are less than what are required here.

7) **University of Minnesota**

http://www.sph.umn.edu/programs/biostatsphd/index.asp

There is a written exam and an oral exam. The written exam is taken at the end of year 1 (advanced students) or at the end of year 2 (weaker background). The oral exam is taken before year 3 or 4, resp. and seems to be a thesis proposal.

Aid awards are typically in the form of graduate teaching or research assistantships, which carry a salary, full tuition benefit, and the option to participate in a health insurance plan for which the University covers 95 percent of the premium. About 10 to 15 graduate

assistantships are awarded to new students each year. Thus, over a 5 year program there must be around 60 or so funded students.

As indicated on http://www.sph.umn.edu/programs/biostatsphd/curriculum.asp There is 2.5 years of courses and a minimum of 24 thesis credits, i.e., about 2 years. The courses are overall more focused primarily on basic theory and secondarily on traditional topics. This differs from the program proposed here because we include PhD minors and while we have basic theory courses we have left room for some specialized topics and computation as well as permitted a focus on more recently emerged topics.

8) Johns-Hopkins University

http://www.biostat.jhsph.edu/index.html

There are three pre-dissertations examinations. The first is a comprehensive written examination at the end of the first year. The second is a 'practice' oral exam, usually taken no later than six months after the end of the fourth term of the second year; the purpose is to evaluate students' ability to communicate statistical ideas and concepts. Students should prepare a paper/proposal related to their potential thesis topic. The third examination is the real thesis proposal examination, typically taken at the beginning of the third year.

"Top candidates are offered assistantships which last five years and include full tuition, health insurance, and a living stipend starting from $20,000 per year over the five years of study. In exchange, students are required to apprentice with faculty as research and teaching assistants for up to 20 hours per week." It is unclear how many students this means, presumably more than 5 per year.

It is unclear how many years of coursework this program requires. There seems to be 7 terms of course work total that is expected to be completed before the end of the second calendar year of study. That is, there are 4 terms per year and effectively the first 7 are course work. In addition, some 18 credits outside Biostatistics are required. This amounts to a minor in a subject matter discipline much as we have proposed (although half the credits must be within the SPH). In effect this amounts to a little less than 2.5 calendar years of course work or about three years in a semester system. Otherwise, the JHSPH PhD in biostatistics is more focused on the foundational theory of statistics and does not obviously include the traditional courses in Biostatistics such as Clinical Trials or Survival Analysis unless they are buried inside a course with a generic name such as Advanced Methods in Biostatistics I,…., VI.

9) University of Florida

Note that this is a Statistics Department that offers all the courses one might want to get a PhD in Biostatistics. See: http://www.stat.ufl.edu/academics/grad/grad_student_man.shtml

There are two examinations. The first is written and focuses on the core theory courses. The second is a thesis proposal examination in two parts. The first part is the written proposal itself which is examined separately from the oral exam on the proposal.

Most students receive some kind of financial support. Since UF is a large state school and the degree is offered in a statistics department it is likely that most students get a TA-ship over the academic year and seek support for some kind of applied work over the summer.

A minimum of 90 credits beyond the bachelor's degree is required for the doctoral degree. Formal course work accumulated by students (beyond the bachelors' degree) is typically around 60 credit hours. For students with a TA-ship taking 18 credits per year this is a little over three years. Likely, students are able to take some credits over the summer or may take an extra few credits in some semesters or continue taking courses while writing their dissertation.

10) Florida State University

Again, this is a Statistics Department that offers the courses one might want to get a PhD in Biostatistics. See: http://stat.fsu.edu/graduate/

This written examination is offered at the beginning of each spring semester. It is normally taken at the beginning of the spring semester of the second academic year of work in the department.

There is a written examination normally taken at the beginning of the Spring semester of the second year of study. Also, there is a pair of oral examinations that are based on the thesis proposal. The first is a presentation of the proposal in a lecture format; the second is the examination of the material by the supervisory committee.

Financial support for most (if not all) PhD students is provided for their duration of study. The two main ways are through TA-ships and RA-ships. TA-ships are more common and some are available during the summer.

There are approximately 36 semester credit hours i.e., 12 courses that are minimally required to get the PhD and this takes about 2 years. However, this is regarded as minimal and many students take more courses. Overall, the courses requirements for the PhD in Biostatistics include most of the foundational theory courses but add electives that are either applied or include biological content e.g., computational biology, molecular dynamics algorithms and applications, and bioinformatics. This means that some traditional fields of biostatistics are neglected such as clinical Trials, Survival Analysis, and longitudinal data. Effectively this means that the FSU PhD in Biostatics is essentially a regular PhD in stat with something like a minor in certain biomedical applications. This contrasts with the program proposed here that really includes the core fields of biostatistics with the statistical foundations and a PhD Minor.

UNIVERSITY OF MIAMI
GRADUATE SCHOOL

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MEMORANDUM

DATE: March 14, 2011

TO: Richard Williamson
Chair, Faculty Senate

Terri A. Scandura

FROM: Terri A. Scandura
Dean, The Graduate School

SUBJECT: New Program – Ph.D. in Biostatistics

At the February 17, 2011, meeting of the Graduate Council, the new program Doctor of Philosophy in Biostatistics was approved unanimously by those present, the second reading was waived.

cc: John Bixby
Sunil Rao
Bertrand Clark
Office of Planning, Institutional Research and Assessment

UNIVERSITY OF MIAMI
MILLER SCHOOL
of MEDICINE

10. March 2011

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 PhD degree program in biostatistics. In my role as Sr. Associate Dean for Graduate & Postdoctoral 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 proposals for, first, a Master's program (approved last year), and second, a PhD 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. Equally important will be to have a group of outstanding researchers who can devise new methods of analysis to keep up with the incredible wealth of new data. The graduates of UM's PhD Program in Biostatistics will be well equipped to serve this role. Together with the Biostatistics Master's degree program, this PhD program will provide a critical foundation for the expansion of our research efforts in Biostatistics.

The new PhD program 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 Sr. Associate Dean

Office of Graduate & Postdoctoral Studies • Leonard M. Miller School of Medicine
1120 NW 14th Street Room 604.1 L/C M857 • Miami, Florida 33136
305-243-1094 • Fax: 305-243-3593 • E-mail: ogs@med.miami.edu

UHealth
UNIVERSITY OF MIAMI HEALTH SYSTEM

UNIVERSITY OF MIAMI
MILLER SCHOOL
of MEDICINE

José Szapocznik, Ph.D.
Chair

February 11, 2011

Dear Dr. Rao,

It is with great enthusiasm that I endorse the establishment of a new PhD in Biostatistics. I write this letter on behalf of the Department of Epidemiology Public Health in my role as Chair, and as Director of the Miami Clinical and Translational Science institute.

As Chair, I believe the PhD program will support our MPH, MSPH and Epidemiology programs, particularly for students who are quantitatively oriented. The PhD program will provide teaching assistants to the computer lab portions of several EPH biostatistics courses as well as provide a greater range of biostatistics courses available to students in our current programs.

As Director of the Clinical and Translational Science Institute, I can speak to the scarcity of biostatisticians on our campus, at our University and across the nation. UM scientists throughout the University suffer from the very low number of biostatisticians who can offer analytic, consulting and methodological support. UM scientists will have access to the latest methods to support their research, something that has been essentially unavailable in the past.

The proposed PhD program will not only meet the University's needs, but also produce graduates for a growing job market. Finally, I would like to add that a doctoral program 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 and enhance our overall research excellence.

Sincerely,

José Szapocznik
Chair, Department of Epidemiology and Public Health
Director, Clinical Translational Science Institute

Department of Epidemiology and Public Health | Office of the Chair
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UHealth
UNIVERSITY OF MIAMI HEALTH SYSTEM

UNIVERSITY OF MIAMI
MILLER SCHOOL
of MEDICINE

February 10, 2011

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

RE: Ph.D. Degree in Biostatistics Proposal

Dear Prof. Rao:

I am writing this letter in support of the Ph.D. Degree in Biostatistics proposal. On February 8, 2011, 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 in this proposal.

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

Sincerely,

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

Office of Faculty Affairs
1611 NW 12th Avenue, Suite I (D2-6), First Floor, Park Plaza West Garage | Miami, FL 33136
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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 15, 2011

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 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 Ph.D. program in biostatistics. As you know, I supported 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 outstanding proposed program will provide the University and South Florida scientists with methodological support for developing and understanding analytic techniques to yield improved data analysis 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
COLLEGE of
ARTS & SCIENCES

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March 4, 2011

Professor Sunil Rao
Director of the Division of Biostatistics
Department of Epidemiology and Public Health
University of Miami

Dear Professor Rao:

I have reviewed your proposal for a Ph.D. program in Biostatistics, and I have discussed the proposal with several of my colleagues who have excellent research credentials in the field of statistics. All of us strongly support your plans to establish this new program. Biostatistics has become an essential component of contemporary scientific inquiry, and the establishment of such a program would be of great benefit to the University of Miami.

We recognize that it is quite standard for a biostatistics program to be housed in a school of medicine or public health, and we are confident that the geographic separation of your program from the College of Arts and Sciences would not be an impediment to our scholarly collaboration. Indeed, you and Bertrand Clarke have discussed with Victor Pestien and S. Ramakrishnan the tailoring of several of our 500-level statistics courses for inclusion within Year 1 of your proposed curriculum. 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. We look forward to our mutual cooperation in guiding our respective graduate students towards achieving their research goals.

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
Professor and Chair of Mathematics

UNIVERSITY OF MIAMI
COLLEGE of
ARTS & SCIENCES

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Prof. S. Rao
Chief, Biostatistics Division
Dept. of Epidemiology and Public Health

Dear Prof. Rao:

On behalf of the Computer Science Department, 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 who does not require relatively sophisticated computer 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.

Let me comment that the structure of your program is quite interdisciplinary. This will help encourage students to learn some of the biological science behind their thesis topics as well as enable those of us in the information sciences to have more contact with that branch of the scientific world. Apart from, speeding scientific progress, I foresee that all of us will be intellectually enriched by the interaction.

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

Sincerely,

Dr. Hüseyin Koçak,
Chair, Department of Computer Science
University of Miami
College of Arts and Sciences

UNIVERSITY
OF MIAMI

Professor Kathryn Tosney
Chair of Biology
Director of SEEDS
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24 Feb 2011

Dear Colleagues,

We have examined the proposed doctoral degree program in Biostatistics and support its establishment at the University of Miami.

Professor Bertrand Clark and his colleagues have met and consulted with the relevant faculty members in the Department of Biology and not only do we see no conflict with our offerings, but also we can envision its establishment as being an enhancement to the graduate students enrolled in our own doctoral program.

Sincerely yours,

Kathryn Tosney
Prof and Chair

Steven Green
Prof (writing as lead instructor in our department's graduate courses in biostatistics and as a member of the American Statistical Association, Biostatistics section)

UNIVERSITY OF Miami

February 22, 2011

Professor J. Sunil Rao
Director of the Division of Biostatistics
Department of Epidemiology and Public Health
Miller School of Medicine
University of Miami

Dear Professor Rao:

On behalf of the Department of Management Science, I would like to offer our support and encouragement to you and your faculty in your efforts to develop a Ph.D. degree program in Biostatistics.

In the Department of Management Science, we offer graduate courses in applied statistical analysis 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 already find that our faculties share common interests in research problems and methods. With the School of Business Administration's established emphasis on health care and its administration, I would anticipate and encourage further joint research and teaching among our faculties and joint appointments between our departments.

The American Statistical Association asserts that "biostatisticians with advanced degrees can look forward to excellent career opportunities in government, industry, and academia. Recent graduates have found positions with employers as diverse as pharmaceutical companies, university research groups, hospitals, and health-related industries." Additionally, the Bureau of Labor Statistics forecasts a 13% increase in the number of positions for candidates possessing graduate degrees in biostatistics by the year 2018.

You have our enthusiastic support of your proposal.

Sincerely,

Edward Baker

Edward Baker
Professor and Chair

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School of Business Administration
401 Kosar/Epstein Faculty Office Wing
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UNIVERSITY OF MIAMI
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Dept. of Biomedical Engineering
P.O. Box 248294
Coral Gables, FL 33124-0621

Phone: 305-284-2445
Fax: 305-284-6494

March 4, 2011

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 Doctoral 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 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. Certainly these students will also find academic/research jobs in universities and research centers.

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.

In addition, we are willing to work out a PhD minor in Biomedical Engineering for your students. In this minor, your students could take 4-6 courses outside the Biostatistics program to make sure they understand the applications for their work in their primary field of study. We will work out the details of this Minor program as soon as the PhD program is established.

Yours sincerely,

Ozcan Ozdamar, PhD
Professor and Chair

UNIVERSITY OF MIAMI
SCHOOL of
EDUCATION

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Isaac Prilleltensky, Ph.D.
Dean and Professor
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February 24, 2011

Dr. Bertrand Clarke
University of Miami
Center for Computational Science
1120 NW 14 Street
(C213)
Miami, FL 33136

Dear Dr. Clarke

It is with great enthusiasm that the School of Education supports the proposed Ph.D. Program in Biostatistics. We recognize the important benefits that such a program will provide the School of Medicine and the University of Miami as a whole. The creation of such a doctoral program builds necessary infrastructure to support the growing research and teaching components of the School of Medicine and offers a mechanism to enhance the prestige of the School of Medicine through training biostatisticians who are actively advancing statistical methodology used in medical research. As the proposal outlines, the Biostatistics Ph.D. program will not only produce Ph.D. students trained to assume leadership positions in biostatistics and medical research, but will also strengthen the in-house statistical capacity of the School of Medicine in a manner that will improve the quality of research conducted at the School of Medicine and strengthen proposals for funded research. All of these activities are consistent with the institution-wide goal of increasing the University's rank among its AAU peers.

In addition to the direct benefits to the School of Medicine, the Ph.D. program in Biostatistics also promises to offer fruitful synergies for other quantitative areas of inquiry outside of medicine, including the School of Education where the Ph.D. program in Research, Measurement, and Evaluation is training quantitative methodologists specialized for the behavioral and social sciences. Based on the curriculum outlined in the proposal, we anticipate that that some of the proposed courses for the Biostatistics Ph.D. program (survival analysis, the analysis of high dimensional and complex data, and longitudinal data analysis) will enhance the training of our Ph.D. students in Research, Measurement, and Evaluation. Similarly, some of the School of Education's statistics-based courses (such as structural equation modeling, item response theory, and hierarchical linear modeling) can serve as useful electives for students in the Biostatistics Ph.D. program.

The School of Education looks forward to seeing the Ph.D. Biostatistics program come to fruition and exploring ways to synergize this program with the School of Education's doctoral training in quantitative methodology. We are extremely optimistic that the program will be successful in meeting its specified goals, enhancing the research capacity of the School of Medicine, and heightening the prestige of the University of Miami as a whole.

Isaac Prilleltensky
Dean, School of Education

Randall Penfield
Director, Research, Measurement and
Evaluation Program

UNIVERSITY OF MIAMI
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March 09, 2011

Professor Sunil Rao
Chief, Biostatistics Division
Department of Epidemiology and Public Health
University of Miami
Miami, Florida

Dear Professor Rao,

On behalf of the Rosenstiel School of Marine and Atmospheric Sciences (RSMAS), I enthusiastically support your efforts to develop a doctoral program in biostatistics. At RSMAS, we clearly understand the importance of biostatistics for applied research as well as the importance of methodological development in biostatistics.

I am pleased to note that members of your division and our division of Marine Biology and Fisheries (MBF) have already started to discuss how we can work together to provide more opportunities in this field for our faculty members, research staff and students.

We are intrigued by the idea of PhD minors and would be glad to permit those of your students interested in such a minor at RSMAS. We will also be glad to offer some of our courses such as *Advanced Biometrics in Marine Science* (MBF 615) as biostatistical electives for your students. In addition, we look forward to joint development of courses when feasible, for instance in spatial statistics. We hope that such cooperation between RSMAS and the Division of Biostatistics will lead to joint supervision of students as well as collaboration between faculty members.

As you know, RSMAS has a number of extremely capable biostatisticians so we look forward to the benefits growing interaction between our respective groups promises.

Please do not hesitate to contact me if you have any question.

Best regards,

Roni Avissar
Professor and Dean