#### Department of Statistics UPIII - Action Items (October 13, 2008)

Historically the Department of Statistics has had three priorities which have been vital to the educational and research missions of the College and University: a large undergraduate service teaching obligation, a large interdisciplinary service responsibility to educate masters and doctoral students of numerous disciplines, and a research consulting commitment to graduate students, faculty, and administrative and non-academic units. Embracing these priorities has been rewarding but costly in terms of time and resources. (See any of our last 10 Annual Reports.)

While serving the broader needs of the University community, we have also developed several high quality degree programs. It should be noted that every major research university in the country relies heavily upon the support of a stand-alone PhD-granting department of statistics. With fewer than 70 of these departments nationally, we at UW are the smallest, yet our faculty's strength and variety of consulting expertise easily rivals that of our largest national comparators. Because of the value the Department of Statistics adds to UW's research and graduate missions we must continue our commitment to interdisciplinary consultation and collaboration at least at the current level, and we must also maintain and enhance the vitality of our own programs.

Now, with the University's endorsement of APII and its proposal of UPIII, our department sees new needs and new opportunities for interdisciplinary education and research at UW. The possibilities for the application of sophisticated statistical methodo logies and for the development of new statistical methods of analysis are enormous, in fact beyond our current resources. To be truly effective in these expansions we must develop a 21<sup>st</sup> Century Department of Statistics that can meet the projected and still unknown demands of 21<sup>st</sup> Century research. As the character of the university grows and evolves so must the capacity of the Department of Statistics to support the new University of Wyoming envisioned in APII and UPIII. No where is this more evident than in the area of Computational Science.

Although the area of Computational Science is rather recent to UW (found in APII and in UPIII Motifs 2 and 5), it has a much longer history for us in Statistics. At UW we have conducted joint research, have committed our resources to joint faculty (interdisciplinary associations), and have provided statistical modeling and computing expertise for over three decades. A list of some of these connections includes: life sciences (Zoology – Drs. McDonald and Gerow; Neuroscience – Dr. Bieber; Ecology – Drs. Ogle and Barber); Geology – Drs. Borgman and Huzurbazar, business sciences (Economics – Dr. Birch; Finance/Accounting – Dr. Bonett; Business – Dr. Cochran), and engineering (Drs. Anderson-Sprecher, Robinson, and Wulff).

For much of these three decades we have offered coursework (Computational Statistics, GeoStatistics, BioStatistics, Engineering Statistics), graduated numerous minor degree students (undergraduate and graduate), participated on many hundreds of MS and PhD student thesis and dissertation research projects, and consulted with every life, earth, and engineering science on campus. We have had faculty involvement on all of the EPSCoR, BRINE, and Cobra grants; we are participating in the new EPSCoR and IMBRE grants; and we are working with NCAR and SER. Nearly every MS and PhD program at UW has benefited from our interdisciplinary work and our contributions in computational science. In summary, we have a long standing commitment (Motif 1 of UPIII) to most of the areas of distinction listed in Motif 2.

This has been our past. It is also our present and future since eight of the above-mentioned professors are still with our Department. Furthermore, at least three of our faculty (Barber, Huzurbazar, and Ogle) have active research and teaching interests in what may be called modern advances in statistical computation and modeling. Without question we have made and continue to make strong contributions to Computational Science at UW. The Action Items in the Computational Science Cluster in the next section are based on our past achievements and propose a future that directly links our goals with nearly every designated area of distinction.

The proposed action items may appear ambitious in light of our current size, but they are in truth quite small when viewed from the perspective of the University's goals described above. At present capacity, we cannot both bring to life our vision and maintain our current commitments to UW's service and research needs. The addition of faculty and graduate students (Action Items 1 and 2) will enable us to continue to meet our historic commitments to the educational mission of the university and also to meet the near future needs of a major research university.

## Action Items (AI)

## Computational Science Cluster (AI 1, 2, 3, and 4)

AI 1. Expand our department's emphasis in computation and develop a new interdisciplinary program with the Department of Mathematics in Mathematical and Statistical Modeling with Scientific Computing (MS)<sup>2</sup>C. The (MS)<sup>2</sup>C program reflects a major participation in the Interdisciplinary Program in Computational Science (ICS) and will be the means through which we plan to expand our interaction with several instructional and research areas of distinction on campus: Computer Science, SER, Ecology, Geology/Geophysics, WYGIS, and Molecular Biology. Directing our energy and resources to computation along with the (MS)<sup>2</sup>C program will enable us to develop our first programmatic identity beyond our service nature past. This expansion will require 4 additional FTE faculty; however, all 4 positions will ideally be joint with one or more of the areas of distinction listed above.

AI 2. Obtain funding to recruit and support additional doctoral graduate students for the  $(MS)^2C$  program. Numbers of new GAs must be substantial, but in keeping with stated University goals for expansion of assistantships. Monies will come from institutional support of the ICS and  $(MS)^2C$  programs, and from departmentally obtained grant funding.

AI 3. Work with the Department of Mathematics to develop a recruiting strategy to attract high quality PhD students for the (MS)<sup>2</sup>C program. This strategy will include the development of a jointly sponsored and maintained Web page, and the holding of a symposium of computational science professionals to increase visibility among researchers and potential students.

Justification for AI 1, 2, and 3 (UPIII Motifs 1, 2, and 5, A&S College Themes 3, 4, and 7)

Although Mathematics and Statistics could work with the Interdisciplinary Program in Computational Science (ICS) independently, both departments believe it greatly benefits us and the ICS if we work together. As the action items indicate, our contributions to ICS extend beyond the joint (MS)<sup>2</sup>C program, but much of our commitment is still squarely reflected in this program. Our ability to meet the commitments of the (MS)<sup>2</sup>C program and from ICS while still meeting our essential educational commitments to the broader UW community will necessitate expansion upon and be yond our current resources, in both faculty and graduate students.

Although we need to build programmatic strength within our own discipline to attain critical mass (Motif 1), given our long inter- and multi-disciplinary history such strength has always been considered from an applications context (College Theme 7). As such the 4 new faculty positions we are seeking would ideally be joint between us and one or more of the units listed in AI 1, building upon our past connections in the areas of designated distinction in an effort to enhance these relationships (Motif 2). Ideally, 2 of these four positions would be split 75% in Statistics and 25% in the other identified area, and the other 2 would be split 25% in Statistics and 75% in the other identified area (such as Dr. Kiona Ogle's position between us and Botany).

In order to attract highly qualified doctoral students to UW we will need to develop an aggressive/proactive recruiting strategy. In today's market this means Web Page development. However, an aggressive strategy only gains visibility; without financial support it will be impossible to attract exceptional students. We expect a carrying capacity of between 12 and 15 additional doctoral students, and a minimum starting number of six new students.

AI 4. Enrich our computational curriculum. This curriculum must include courses both to fully develop the  $(MS)^2C$  program and to enrich our service curriculum.

Many of the basic computational courses in Statistics already exist, but it will be necessary to expand our curriculum in two directions. First, the development of the  $(MS)^2C$  program will require new doctoral level courses. Second, our association with other units in ICS will require additional service courses at both the undergraduate and graduate levels. All new coursework must be offered often enough to facilitate student progress towards completion of their degrees. (UPIII Motif 1 and 2, A&S College Themes 3, 4, and 7).

#### **Departmental Action Items**

AI 5. Improve the educational environment of our USP courses.

Smaller size classes are pedagogically superior to large size classes, for well established reasons. In a smaller class we would be able to interact with the students more personally and for more hours each week; we could monitor understanding and performance throughout the entire semester rather than simply on a binge basis surrounding scheduled tests; and students would thus learn the material better and faster, and could apply the material in a more appropriate manner. Introductory statistics is the foundation for many discipline-specific methods courses, so a better introductory course should improve students' potential for success in their undergraduate research experiences. Given that we teach about 1000 introductory statistics students each academic year, we calculate that we would need 15 year-long graduate assistantships to deliver 40 smaller classes of 25 students each (20 classes each semester). Each senior GA would be responsible for teaching two of these small classes and first year graduate students would be used only in an assisting capacity for the first year. Thus we would need 10 assistantships for senior GAs and 5 for first year GAs. We also require a GA to effectively teach our engineering statistics course (STAT 4220). To achieve this goal we would need 8 assistantships beyond our current allocation. (A&S College Themes 1 and 2). As H.G. Wells stated, "Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write." Such restructuring will also bring our department in line with other departments in A&S, such as math and English.

AI 6. Continue to improve graduate student recruiting, especially for the PhD program.

All across the country recruitment of students into degree programs in statistics is becoming more challenging every year. Doctoral granting departments of statistics are typically found only in the largest and most prestigious institutions. Thus we are competing for students with only the very best universities in the nation and the world. This arguably makes recruiting for us considerably more challenging than for any other department at UW. We need to be constantly vigilant and ever working toward better recruiting strategies. The effort in completing this action item will be linked to AI 3. (UPIII Motif 1, A&S College Themes 3 and 4)

AI 7. Improve the educational relevance, de livery, and assessment of our USP courses.

Introductory Statistics is one of the most challenging courses to teach at UW (true across the nation). This fact is primarily attributable to the material presented in the course: a student's first exposure to uncertainty (randomness, error), research (hypotheses), analysis, and the judgment required to interpret numerical information. Couple these topics with fear, anxiety, and a large impersonal environment and we arrive at a course which is constantly in need of attention to its topics, its delivery, and its assessment. (A&S College Themes 1 and 2)

AI 8. Continue to improve assessment of all degree programs.

AI 9. Refine and enhance the coursework and degree requirements of the Applied MS degree. This will include comparison of requirements for the Applied MS, BS, and PhD degrees.

For over a decade we offered a wide range of applied courses (primarily at the 4000 level) to students in our various degree programs, as well as to undergraduate and graduate students from other departments. This situation brought unusual stresses to the class-room. To resolve the problem we created a separate curriculum uniquely suited to our PhD students (the common first year detailed in our 2006-2007 Annual Report). The Applied MS is still our most popular and arguably signature degree program, and Graduate minors are also in high demand. The Graduate School change in how many 4000 level credit hours can be used in a graduate degree program along with increasing enrollments in our BS degree, have further complicated the situation. We need to make reasoned decisions about the suitability of our service courses and the aptness of the degree requirements in our BS and Applied MS programs. (A&S Themes 3, 4, and 7)

AI 10. Evaluate the role of courses offered through the Outreach School and consider expansion of outreach offerings to create an off-campus certificate program in Statistics.

We are experiencing increased interest in statistics from several "non-traditional" sources, particularly working people desiring career changes. The Applied MS degree is attractive for these potential students, but requires greater commitment than they can easily make. People outside of Laramie are interested in taking courses in statistics to enhance employment options. If we increased Outreach offerings to 4 classes beyond the introductory course (equivalent of an on-campus minor), we could help numerous people obtain a certificate in statistics. This certificate would enhance the employability of almost anyone from any educational background. The demand for our existing online courses also continues to grow. What will be possible for our department will depend both on administrative decisions about Outreach Education over the next few years and on the availability of new resources for creating and teaching online classes. Nonetheless, the time for exploring the needs for outreach education in statistics is now.

As recorded in our last Annual Report, we have accomplished the goals set in all 11 of our last Plan's action items, excepting 7 and 8 (increasing the number of courses offered in the Outreach School and expanding involvement with the College of Education and K-12 programs).

<b>FIME LINES</b>	2009-10	2010-11	2011-12	2012-13	2013-14	
AI 1		2 FTEs	2 FTEs			
AI 2, 5		5 GAs	5 GAs	5GAs		
AI 3, 6	Х					
AI 4		Х	Х	Х	Х	
AI 7, 8	Х	Х	Х	Х	Х	
AI 9	Х	Х				
AI 10		Х				

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Appendix: Letters of Support

Program in Ecology (Steve Jackson)

Wyoming Geographic Information Science Center (Jeff Hamerlinck)

A third letter of support was committed by Mark Northam (SER) and was reportedly sent directly to the Dean's Office.

Department of Botany, 3165 Aven Nelson Building 1000 E. University Avenue La ramie, Wyoming 82071 (307) 766-2380



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B. Oliver Walter Dean, College of Arts & Sciences

Dear Ollie,

I am writing to express my enthusiastic support for the Computational Science action items in the Statistics Department's Academic Plan. I've discussed these with Richard Anderson-Sprecher and Kiona Ogle, and have looked carefully at the planning document.

One of the most important frontiers in ecology is in the mathematical and statistical modeling domain. Mathematics and statistics have been key elements and partners with ecology for the past century, and they will continue to play important roles, probably ever-increasing, in the coming decade. The development of a strong interdisciplinary program in Computational Sciences (ICS) as well as development of the Mathematical and Statistical Modeling with Scientific Computing program (MS)<sup>2</sup>C would substantially enhance research and training in Ecology at UW, and strengthen the Program in Ecology. I would anticipate that many of our PiE doctoral students would pursue the proposed Computational Science minor.

Although I have not canvassed the PiE faculty, I know that there has been widespread discussion of and support for strengthening the computational sciences on campus and articulating them more closely with Ecology. As PiE Director, I endorse the relevant action items in the Statistics Department's Academic Plan.

Sincerely,

Stephen T. Jackson Professor of Botany Director, Program in Ecology Jackson@uwyo.edu

# University of Wyoming

Wyoming Geographic Information Science Center (WyGISC) Department 4008, 1000 E. University Avenue Laramie, WY 82071 USA Agriculture Bldg, Rm 337 • Voice: 307.766.2532 • FAX: 307.766.2744 Web: www.wygisc.uwyo.edu Email: info@wygisc.uwyo.edu Jeffrey D. Hamerlinck Director

Date: May 19, 2008

To: Oliver Walter, Dean College of Arts and Science

From: Jeff Hamerlinck, Director Wyoming Geographic Information Science Center

RE: Letter of Support for the Computational Science Action Items in the Academic Plan for the Department of Statistics

I have reviewed the Computational Science Action Items in the Academic Plan for the Department of Statistics, and have met with the Dr. Bieber (the outgoing department head) and with Dr. Anderson-Sprecher (the incoming department head).

Like many other disciplines, geographic information science is expanding in mathematical and statistical modeling applications. The interdisciplinary computational science program being advanced by the Departments of Mathematics and Statistics would provide opportunities not only in pure computational science, but also within the rest of the UW research community, allowing for immediate applied use of some of the more cutting edge advances being made. Specific to WyGISC, the development of such a program has great potential to diversify and substantially strengthen many of our own research programs, particularly those relating to our collaborative energy and climate related research on campus.

A viable computational science program at UW would also result in the development of joint programs, such as the one presented by the Department of Statistics in its Action Item STAT-02, and improve the general education component of many of the university's existing degree programs, including the new Minor in Interdisciplinary Computational Science.

In conclusion, I envision significant cross-cutting research and educational benefits from development of a computational science program at UW and endorse the central role of the Department of Statistics in bringing such a program to fruition.