# Appendix A
# Graduate and Professional Enrollment and Degree Data

## Table A1 - Graduate & Professional Enrollment Fall 2000 through Fall 2009, UM and Peers

Source: IPEDS, except where noted*

| Institution | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | F00 to F09 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Minnesota (IPEDS)** | **13,657** | **14,461** | **16,220** | **17,000** | **18,238** | **18,358** | **18,289** | **18,589** | **18,583** | **18,423** | **34.9%** |
| Florida | 12,434 | 12,876 | 13,342 | 13,876 | 14,299 | 15,081 | 15,802 | 16,536 | 16,820 | 17,063 | 37.2% |
| **Minnesota (STIX)** | **13,625** | **14,424** | **15,233** | **15,757** | **16,398** | **16,328** | **16,808** | **16,940** | **16,922** | **16,722** | **22.8%** |
| Michigan | 13,691 | 13,701 | 14,500 | 14,514 | 14,705 | 14,526 | 14,470 | 14,959 | 15,034 | 15,466 | 13.0% |
| Ohio State | 12,203 | 12,428 | 12,821 | 13,126 | 13,486 | 13,093 | 13,339 | 13,359 | 13,503 | 13,666 | 12.0% |
| Washington | 10,152 | 10,552 | 10,854 | 11,173 | 11,467 | 11,876 | 11,688 | 11,648 | 10,278 | 13,225 | 30.3% |
| Texas | 11,834 | 12,007 | 12,600 | 13,043 | 13,000 | 12,818 | 12,660 | 12,711 | 12,595 | 12,827 | 8.4% |
| Illinois | 10,051 | 10,545 | 11,052 | 11,232 | 11,055 | 11,029 | 11,266 | 11,431 | 11,829 | 12,404 | 23.4% |
| UCLA | 11,879 | 12,166 | 12,700 | 11,340 | 11,020 | 10,814 | 11,179 | 11,548 | 11,684 | 11,863 | -0.1% |
| Wisconsin | 10,961 | 11,061 | 11,176 | 11,333 | 11,377 | 11,355 | 11,389 | 11,397 | 11,258 | 11,729 | 7.0% |
| Michigan State | 9,024 | 9,353 | 9,740 | 9,689 | 9,428 | 9,488 | 9,699 | 9,973 | 10,305 | 10,781 | 19.5% |
| UC-Berkeley | 8,599 | 8,859 | 9,310 | 9,859 | 9,923 | 10,065 | 10,057 | 10,304 | 10,245 | 10,300 | 19.8% |
| Indiana | 7,693 | 7,806 | 8,151 | 8,270 | 8,272 | 8,396 | 8,419 | 8,596 | 8,728 | 9,857 | 28.1% |
| Purdue | 6,998 | 7,234 | 7,657 | 7,999 | 7,908 | 7,840 | 7,941 | 7,924 | 8,328 | 8,552 | 22.2% |
| Iowa | 9,027 | 9,165 | 9,210 | 9,512 | 8,307 | 8,126 | 8,078 | 8,210 | 8,329 | 8,413 | -6.8% |
| Penn State | 6,165 | 6,289 | 6,616 | 6,793 | 6,465 | 6,072 | 6,302 | 6,437 | 6,418 | 6,555 | 6.3% |

* IPEDS data includes inactive students in the zero-credit status. Data reported from UM STIX data includes only active part- and full-time students who are registered for credits.

**Table A2 - Graduate & Professional Fall Enrollment as a Percentage of Total Enrollment**

Source: IPEDS, except where noted*

| Institution | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | F00 to F09 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Michigan | 35.9% | 35.8% | 37.2% | 37.2% | 37.2% | 36.3% | 36.2% | 36.4% | 36.6% | 37.1% | 1.2% |
| **Minnesota (IPEDS)** | **30.0%** | **31.0%** | **33.3%** | **34.4%** | **35.8%** | **35.9%** | **36.3%** | **36.5%** | **36.3%** | **35.7%** | **5.6%** |
| **Minnesota (STIX)** | **30.1%** | **31.1%** | **32.1%** | **32.8%** | **33.4%** | **33.3%** | **33.8%** | **34.3%** | **34.3%** | **33.8%** | **3.7%** |
| Florida | 27.6% | 27.7% | 28.2% | 29.0% | 29.8% | 30.3% | 31.0% | 32.0% | 32.7% | 33.7% | 6.1% |
| UCLA | 32.2% | 32.4% | 33.8% | 30.6% | 30.6% | 30.4% | 30.5% | 30.8% | 30.6% | 30.8% | -1.4% |
| Iowa | 31.9% | 31.9% | 31.0% | 32.0% | 29.2% | 28.6% | 28.0% | 28.2% | 28.6% | 29.0% | -2.9% |
| Washington | 28.1% | 28.2% | 27.2% | 28.5% | 29.3% | 30.3% | 29.6% | 29.0% | 25.9% | 28.8% | 0.7% |
| UC-Berkeley | 27.5% | 27.6% | 28.1% | 29.8% | 30.3% | 30.0% | 29.6% | 29.5% | 28.9% | 28.7% | 1.3% |
| Illinois | 26.1% | 26.8% | 27.6% | 27.8% | 27.2% | 26.3% | 26.4% | 27.0% | 27.4% | 28.3% | 2.1% |
| Wisconsin | 27.0% | 27.0% | 27.3% | 27.7% | 28.1% | 27.8% | 27.8% | 27.4% | 27.0% | 28.2% | 1.2% |
| Texas | 23.7% | 23.7% | 24.1% | 25.4% | 25.8% | 25.8% | 25.5% | 25.3% | 25.2% | 25.2% | 1.5% |
| Ohio State | 25.4% | 25.6% | 25.8% | 25.9% | 26.4% | 25.9% | 25.7% | 25.4% | 25.1% | 24.8% | -0.6% |
| Indiana | 20.7% | 20.6% | 21.0% | 21.4% | 21.9% | 22.1% | 22.0% | 22.0% | 21.6% | 23.3% | 2.5% |
| Michigan State | 20.8% | 21.1% | 21.7% | 21.8% | 21.0% | 21.0% | 21.3% | 21.7% | 22.2% | 22.9% | 2.1% |
| Purdue | 17.6% | 18.1% | 19.1% | 19.8% | 19.7% | 19.5% | 19.6% | 19.5% | 20.1% | 20.8% | 3.2% |
| Penn State | 15.2% | 15.4% | 16.0% | 16.3% | 15.7% | 14.9% | 14.7% | 14.9% | 14.5% | 14.5% | -0.7% |

* IPEDS data includes inactive students in the zero-credit status. Data reported from UM STIX data includes only active part- and full-time students who are registered for credits.

## Table A3. Changes in UM Graduate & Professional Enrollment from Fall 2000 to Fall 2010
## CIP Classification versus Degree-objective Category

Source: UM STIX data base*

| CIP Class \ Degree-obj Category | Certificate | Medical fellow/ resident | Non-degree | Professional doctorate** | Professional masters | Research doctorate*** | Research masters | Total |
|---|---|---|---|---|---|---|---|---|
| 51. Health Professions and Related Programs | 169 | | -128 | 766 | 488 | 56 | -380 | 971 |
| 52. Business, Management, Marketing, And Related Support Services | 5 | | -32 | | 689 | -8 | -9 | 645 |
| 14. Engineering | 1 | | 54 | | -35 | 287 | 9 | 316 |
| 44. Public Administration And Social Service Professions | 11 | | -1 | | 265 | 9 | -20 | 264 |
| 13. Education | 228 | | 15 | | -156 | 85 | -10 | 162 |
| 26. Biological And Biomedical Sciences | | | 5 | | 55 | 120 | -20 | 160 |
| 30. Multi/interdisciplinary Studies General | 4 | | 32 | | 30 | 51 | 28 | 145 |
| 04. Architecture And Related Services | | | 5 | | 98 | | 24 | 127 |
| 60. Residency Programs | 5 | 146 | -29 | | | | | 122 |
| 27. Mathematics And Statistics | 8 | | | | 92 | 84 | -74 | 110 |
| 22. Legal Professions And Studies | | | -2 | 100 | -4 | | | 94 |
| 11. Computer And Information Sciences And Support Services | | | 2 | | 1 | 77 | 4 | 84 |
| 45. Social Sciences | | | 1 | | -5 | 67 | 9 | 72 |
| 40. Physical Sciences | | | | | -1 | 41 | -7 | 33 |
| 42. Psychology | 4 | | | | | 6 | 19 | 29 |
| 09. Communication, Journalism And Related Programs | 9 | | | | | 4 | 14 | 27 |

| CIP Class \ Degree-obj Category | Certificate | Medical fellow/ resident | Non-degree | Professional doctorate** | Professional masters | Research doctorate*** | Research masters | Total |
|---|---|---|---|---|---|---|---|---|
| 41. Science Technologies/Technicians | | | | | | | 15 | 15 |
| 31. Parks, Recreation, Leisure And Fitness Studies | | | | | -7 | 17 | -4 | 6 |
| 50. Visual And Performing Arts | | | | 18 | -28 | 0 | 3 | -7 |
| 05. Area, Ethnic, Cultural, Gender, and Group Studies | | | | | | -14 | 1 | -13 |
| 03. Natural Resources And Conservation | | | -1 | | | 8 | -21 | -14 |
| 38. Philosophy And Religious Studies | | | | | | -14 | -1 | -15 |
| 19. Family And Consumer Sciences/human Sciences | 4 | | -11 | | -3 | 3 | -10 | -17 |
| 54. History | | | | | | 6 | -23 | -17 |
| Other | | | -17 | | | | | -17 |
| 24. Liberal Arts And Sciences, General Studies And Humanities | | | 4 | | -32 | | | -28 |
| 23. English Language And Literature/letters | | | -1 | | -1 | -7 | -22 | -31 |
| 16. Foreign Languages, Literatures, And Linguistics | 1 | | -1 | | | 0 | -37 | -37 |
| 01. Agriculture, Agriculture Operations, And Related Sciences | | | 1 | | 2 | -53 | -25 | -75 |
| Total | 449 | 146 | -104 | 884 | 1,448 | 825 | -537 | 3,111 |

* Excludes students enrolled in zero-credit option; includes active students only. Cells with tan shading highlight growth of > 200 students and cell with light green shading highlights decrease of >200 students (as mentioned in the text).

** Professional doctorates are those encompassed by the current IPEDS category “doctor's degree - professional practice”. This includes the following degrees awarded at UM: M.D., D.D.S., D.V.M., Pharm.D., J.D., D.M.A, D.P.T, Au.D., and D.N.P.

*** Research doctorates are those encompassed by the current IPEDS category “doctor's degree - research/scholarship.” This category includes the Ph.D. and Ed.D. degrees.

## Table A4 - Masters Degrees Conferred 2000-01 through 2009-10, UM and Peers

Source: IPEDS

| Institution | 2000-01 | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 | 2009-10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Florida | 2,396 | 2,686 | 2,797 | 2,961 | 2,877 | 2,985 | 3,062 | 3,337 | 3,544 | 3,751 |
| Michigan | 3,042 | 2,944 | 3,431 | 3,446 | 3,563 | 3,292 | 3,347 | 3,336 | 3,479 | 3,596 |
| **Minnesota** | **2,316** | **2,459** | **2,546** | **2,677** | **2,798** | **2,962** | **3,019** | **3,188** | **3,115** | **3,419** |
| Illinois | 2,168 | 2,437 | 2,703 | 2,756 | 2,622 | 2,545 | 2,582 | 2,655 | 2,677 | 3,074 |
| Washington | 2,103 | 2,306 | 2,526 | 2,556 | 2,560 | 2,662 | 2,628 | 2,631 | 2,668 | 2,922 |
| Texas | 2,544 | 2,612 | 2,637 | 2,841 | 2,900 | 2,829 | 2,684 | 2,975 | 2,893 | 2,906 |
| UCLA | 2,008 | 2,106 | 2,303 | 2,488 | 2,545 | 2,402 | 2,296 | 2,571 | 2,634 | 2,707 |
| Ohio State | 2,340 | 2,457 | 2,515 | 2,606 | 2,685 | 2,718 | 2,635 | 2,576 | 2,679 | 2,695 |
| Indiana | 1,582 | 1,620 | 1,663 | 1,680 | 1,783 | 1,828 | 1,838 | 1,745 | 1,905 | 2,251 |
| UC-Berkeley | 1,617 | 1,739 | 1,834 | 1,896 | 2,040 | 1,980 | 1,966 | 2,053 | 2,033 | 2,046 |
| Michigan State | 1,776 | 1,879 | 1,914 | 2,091 | 2,004 | 1,867 | 1,910 | 1,817 | 1,942 | 1,936 |
| Wisconsin | 1,907 | 1,818 | 2,019 | 2,022 | 1,996 | 1,789 | 1,944 | 1,910 | 1,811 | 1,919 |
| Iowa | 1,254 | 1,280 | 1,370 | 1,358 | 1,412 | 1,449 | 1,296 | 1,361 | 1,303 | 1,457 |
| Penn State | 1,165 | 1,107 | 1,079 | 1,252 | 1,191 | 1,150 | 1,131 | 1,267 | 1,312 | 1,419 |
| Purdue | 1,284 | 1,340 | 1,392 | 1,583 | 1,548 | 1,420 | 1,377 | 1,326 | 1,321 | 1,342 |

## Table A5. Doctoral Degrees (Research and Professional) Conferred, UM and Peers

Source: IPEDS

| Institution | 2000-01 | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 | 2009-10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Florida | 1,412 | 1,514 | 1,532 | 1,658 | 1,665 | 1,732 | 1,957 | 2,107 | 2,028 | 2,127 |
| **Minnesota** | **1,302** | **1,233** | **1,279** | **1,307** | **1,455** | **1,536** | **1,667** | **1,563** | **1,594** | **1,618** |
| Ohio State | 1,287 | 1,392 | 1,314 | 1,342 | 1,432 | 1,549 | 1,501 | 1,611 | 1,617 | 1,596 |
| Michigan | 1,217 | 1,284 | 1,260 | 1,365 | 1,406 | 1,514 | 1,496 | 1,483 | 1,576 | 1,534 |
| Texas | 1,311 | 1,226 | 1,269 | 1,299 | 1,404 | 1,443 | 1,358 | 1,439 | 1,379 | 1,382 |
| UCLA | 1,168 | 1,132 | 1,174 | 1,251 | 1,225 | 1,271 | 1,307 | 1,361 | 1,382 | 1,358 |
| Wisconsin | 1,271 | 1,257 | 1,274 | 1,213 | 1,314 | 1,261 | 1,425 | 1,407 | 1,430 | 1,355 |
| UC Berkeley | 1,101 | 1,152 | 1,095 | 1,169 | 1,151 | 1,110 | 1,280 | 1,218 | 1,216 | 1,245 |
| Washington | 975 | 928 | 962 | 991 | 1,003 | 1,124 | 1,130 | 1,125 | 1,176 | 1,224 |
| Illinois | 933 | 919 | 918 | 882 | 971 | 998 | 1,018 | 1,067 | 1,081 | 1,066 |
| Michigan State | 725 | 751 | 745 | 774 | 774 | 768 | 855 | 770 | 876 | 921 |
| Iowa | 892 | 890 | 801 | 847 | 924 | 887 | 926 | 926 | 937 | 920 |
| Purdue | 648 | 601 | 666 | 662 | 763 | 785 | 837 | 840 | 882 | 845 |
| Indiana | 688 | 612 | 659 | 647 | 683 | 667 | 651 | 695 | 729 | 718 |
| Penn State | 526 | 519 | 503 | 539 | 571 | 646 | 664 | 643 | 703 | 718 |

## Table A6. Graduate Programs, UM and Peers

| Institution | Number of Graduate Programs* | Source | Notes |
|---|---|---|---|
| Wisconsin | 173 | http://www.grad.wisc.edu/education/mas/toc.html | |
| Penn State | 161 | http://bulletins.psu.edu/bulletins/whitebook/index.cfm?letter=A | |
| **Minnesota** | **160** | **http://www.grad.umn.edu/Programs/select_program.html?l=t** | **Includes certificates, but not minors** |
| Iowa | 156 | http://www.uiowa.edu/admissions/graduate/programs/program-details/index.html | |
| Indiana | 154 | http://graduate.indiana.edu/graduate-degree-programs.php | Does **not** include +/- 45 PhD minors |
| Michigan | 153 | http://www.rackham.umich.edu/dig/ & https://secure.rackham.umich.edu/academic_information/programs/index.php#notrackham | 116 Rackham, 37 Non-Rackham |
| Michigan State | 144 | http://www.reg.msu.edu/academicprograms/Programs.asp?PType=GR | |
| UCLA | 139 | http://www.gdnet.ucla.edu/departments.html | |
| Illinois | 135 | http://courses.illinois.edu/cis/2011/fall/programs/graduate/grad_majors.html | |
| Florida | 135 | http://gradschool.ufl.edu/downloads/brochure-2010-2011.pdf | See pgs 16 - 19 |
| Ohio State | 130 | http://www.gradsch.osu.edu/graduate-programs-degrees.html | |
| University of Washington | 124 | http://www.grad.washington.edu/Programs/gradprogs.aspx | |
| Texas | 119 | http://www.utexas.edu/ogs/admissions/programs.html | |
| Purdue | 108 | http://www.gradschool.purdue.edu/index.cfm & http://www.gradschool.purdue.edu/programs/academic.cfm | |
| UC-Berkeley | 103 | http://grad.berkeley.edu/admissions/list.shtml | |

* Best estimate, based on institutions' websites.

## Appendix B. Inter- vs Intra-University Comparisons in Median Time to Degree

In the body of the text, we argued that measures of Ph.D. program efficiency, such as time to degree, should be used to identify outliers rather than to make judgments based on small differences, and that inter-program comparisons need to be made cautiously, especially between STEM and non-STEM fields. In this appendix, we illustrate how the NRC data can be used to compare U of M programs with national norms on Median Time to Degree (MTTD)[1] and also on any of the metrics the NRC collected.

We identified outliers in MTTD at the U of M and then compared these programs with the same programs at other AAU universities. We examined the highest MTTD programs at Minnesota to find out whether they were also outliers nationally among similar programs. In general, they were not only slow in comparison to other U of M programs, but slow in comparison to similar programs elsewhere. For example, the two longest MTTD among the U of M graduate programs included Anthropology (10.3) and Philosophy (9.5). Is this because a Ph.D. in Philosophy or Anthropology requires more time than other programs, or because our departments happen to be slower than other such programs? The NRC data provide a clear answer. Both our Anthropology and Philosophy Departments rank near the highest of AAU Anthropology and Philosophy Departments in MTTD. Most Anthropology programs have a MTTD of 6-8.5 years compared to 10.3 at Minnesota. Most AAU philosophy programs have a MTTD of 5-7 years compared to 9.5 at Minnesota. Similarly, other U of M programs with the longest MTTD exceed the average of their fields.

[1] For the purposes of data collected for the NRC rankings, time to degree was calculated based on elapsed time from students' initial entry into the program, regardless of initial degree objective, to the date the degree is awarded.

## Appendix C
## Bostrom Efficiency Index: A Measure of Student Outcomes in UM Ph.D. Programs

*Bostrom Index*: From milestones and dates captured in the University's student information system, it is possible to compute other commonly used data points such as time-to-candidacy, time-to-degree, and completion rates for cohorts. The Graduate School created a composite index of program efficiency based on number of years to degree and completion rates. Every outcome is awarded "points," where receiving the PhD is worth 15 points, leaving with a masters from the program but not the PhD is worth 5 points, and leaving without a degree is worth zero points. The elapsed time spent in the program is deducted (1 year = 1 point; maximum 10 points deducted).

*Program Efficiency:* The Bostrom Index showed a great deal of variation across programs and within colleges in years to completion of the Ph.D. and the dropout rates of graduate students. Current eight-year completion rates vary from a low of 13-14% in Linguistics, French and Anthropology to a high of over 80% in Pharmaceutics, Child Psychology and Microbiology, Immunology & Cancer Biology. Anything below 50% indicates as many drop-outs and non-completions as completions over an eight year period, and 30 out of 97 programs fall below that standard.

*Predicting Student Outcomes with Student Input Data:* Graduate programs routinely use Graduate Record Exam (GRE) scores as one means of evaluating applicants' readiness for graduate school. GRE scores (three to four separate components) are reported to the U of M as part of the admissions process. Through the student information system it is then possible to compute average scores of applicants by graduate program, and subgroups such as admitted students and matriculated students.

Table C-1 contains data on University of Minnesota graduate students over a five year period from 2006-2010. It addresses the question, separately, for STEM and non-STEM programs, "to what extent do any of the four GRE scores help predict years to completion and completion rates for U of M graduate programs"? We address this question by making use of GRE scores for program matriculants over this period of time, and by using the Bostrom Index of program efficiency, developed for our subcommittee. We do so separately for programs in science and technology because they weight the relative importance of the four GRE scores quite differently than non-science and non-technology programs. In fact, the findings for the two different types of programs are significantly different in some particulars.

It turns out that for non-STEM programs, when we examine all matriculating students we find that programs' average quantitative GRE scores are fairly good at predicting which programs will have the highest proportion of matriculants finishing, and finishing in a timely fashion. The data in Table 1A take all matriculants and compare those who finish in a timely fashion with those who do not. The greatest difference appears to be in their quantitative GRE scores, which correlate with the Bostrom Index at .45. They have fewer (proportionately) who either fail to finish (drop out) or are still in the program but have not yet finished the degree. For this set of programs, looking at the quantitative GRE scores appears to give some leverage on predicting which programs will more successfully move more students along to a timely completion.

The results for the science and technology programs are quite different, however. Table 1B shows that the best predictors for timely success in these programs are the verbal and area GRE scores of the matriculating class. Incoming students are often selected on the basis of their quantitative GRE scores, so the entering classes all tend to have high quantitative scores. Among this set of matriculants, it seems that those who have the greatest field knowledge and the greatest verbal abilities are able to move through their graduate studies most efficiently.

An ancillary purpose of this analysis is to explore how interrelated the four GRE scores are when examining U of M graduate programs at the aggregate level. It turns out that among the non-science, non-technology programs mean GRE scores are highly correlated. Programs with the highest average quantitative GRE scores also tend to have the highest verbal and area GRE scores; those with high average written GRE scores also tend to have matriculants with the highest verbal and area scores. Even given this commonality among mean scores, it is the programs with the highest quantitative scores that prove to have the highest scores on the Bostrom Efficiency Index.

Among the science and technology programs, GRE scores are not as highly correlated. In fact, the mean verbal and quantitative GRE scores by program are uncorrelated. And although the correlations are not quite statistically significant, it is the programs with the highest area and verbal mean GREs that prove to have the highest scores on the Bostrom Efficiency Index.

**GRE Scores Correlated With One Another & With Bostrom Completion Index: By Field**

**Table C1. Summary of Findings Non-Science and Non-Technology Programs (N=38)**

| | Matriculants' Verbal GREs | Matriculants' Quantitative GREs | Matriculants' Area GREs | Matriculants' Written GREs |
|---|---|---|---|---|
| **Five Yr. Bostrom Index** | -0.21 | 0.45* | -0.07 | -0.18 |
| **Verbal GREs** | 1.00 | 0.31 | 0.43* | 0.70* |
| **Quant GREs** | | 1.00 | 0.37* | -0.07 |
| **Area GREs** | | | 1.00 | 0.40* |

**Table C2. Summary of Findings Science & Technology Programs (N=55)**

| | Matriculants' Verbal GREs | Matriculants' Quantitative GREs | Matriculants' Area GREs | Matriculants' Written GREs |
|---|---|---|---|---|
| **Five Yr. Bostrom Index** | .23 | -.08 | .25* | .16 |
| **Verbal GREs** | 1.0 | .05 | .29* | .74* |
| **Quant GREs** | | 1.0 | .00 | -.25* |

| | | | | |
|---|---|---|---|---|
| **Area GREs** | | | 1.0 | .18 |

***Significant at .05 level**

## Appendix D. NRC Rankings of Ph.D. Programs

Table D1 presents results of the 1995 NRC rankings of graduate programs. It identifies the programs at the University of Minnesota that were ranked in the top 10% and the next 10% (10-20%). At that time, programs were evaluated based on their national reputation as measured by a national survey of program faculty. Five University of Minnesota programs were considered to be among the top 10% of programs nationally: Chemical Engineering, Psychology, Mechanical Engineering, Geography and Economics.

Tables D2 and D3 present the results of the 2010 NRC rankings of graduate programs, using two different methodologies, one labeled the R-based and the other labeled the S-based rankings. The regression-based (or R-based) rankings are most akin to the 1995 rankings in that they have a strong reputational component; rankings for programs were obtained by a survey of a sample of associated faculty members. These rankings were then repeatedly sampled and regressed on 20 quantitative measures of quality determined by the NRC to produce a distribution of rankings for each program. The survey based (or S-based) rankings, however, rely on faculty weights of the importance of each quantitative measure of quality (as opposed to the regression based weights), ostensibly eschewing the reputational component.[2] These two rankings sometimes result in very different rank-orders of quality, and so we will attend to both sets in this analysis.

Bearing in mind that many more programs were evaluated in the 2010 rankings, when we identify programs in the top 10% of either the R or the S rankings, the University of Minnesota has more programs in both the top 10% and 20% in 2010.[3] The list includes Germanic Studies, Chemical Engineering, Psychology, Kinesiology, Child Psychology, Mechanical Engineering, Entomology, Chemistry, Animal Sciences, Ecology Evolution & Behavior, Natural Resource Science and Management, Nursing, Veterinary Medicine, Geophysics and Aerospace Engineering.

Programs that were in the top 20% in 1995 and in the 10-20% range in either the R or S ratings in 2010 include Economics, Mathematics, Electrical Engineering, History, Civil Engineering and Political Science. Programs not in the top 20% in 1995 but that are in the 10-20% range in either the R or S ratings in 2010 include Nutrition, Materials Science & Engineering, Geology, Plant Biological Sciences, Neuroscience, and American Studies.

These results show that almost all of the top programs from 1995 have remained top programs in the 2010 ratings, and that in addition, a number of programs have improved their relative standing while other, newer programs have achieved top rankings.

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[2] A more detailed explanation of both methodologies can be found at: http://www.nap.edu/rdp/.

[3] While the differences in methodologies between the 1995 and 2010 NRC studies are substantial, the most visible difference between the two assessments is probably that in the most recent iteration the NRC eschewed a ranking in favor of a range of ranking associated with the 5th and 95th percentile of an programs range of ranking. To determine if a program was in the top 10th or 20th percentile, the range of rankings we evaluated to identify if the associated cut point was included in the range of ranking. This is akin to traditional hypothesis testing and can be interpreted as 'failing to reject' the hypothesis that program was in the top 10th or 20th percentile.

## Table D1. Top Minnesota Programs - Based on 1995 NRC Rankings

| **Top 10%** | | | |
|---|---|---|---|
| **Program Name** | **No. Programs** | **Rank** | **Relative Rank** |
| Chemical Engineering | 93 | 1 | 1.1% |
| Psychology | 184 | 7 | 3.8% |
| Mechanical Engineering | 110 | 8 | 7.3% |
| Geography | 36 | 3 | 8.3% |
| Economics | 107 | 10 | 9.3% |

| **Top 10-20%** | | | |
|---|---|---|---|
| **Program Name** | **No. Programs** | **Rank** | **Relative Rank** |
| Mathematics | 139 | 14 | 10.1% |
| Ecology and Evolutionary Biology | 129 | 15 | 11.6% |
| Chemistry | 168 | 21 | 12.5% |
| Political Science | 98 | 13 | 13.3% |
| Electrical and Computer Engineering | 126 | 18 | 14.3% |
| Physics | 147 | 22.5 | 15.3% |
| Immunology & Infectious Diseases | 180 | 34 | 18.9% |
| History | 111 | 21.5 | 19.4% |
| Civil and Environmental Engineering | 66 | 13 | 19.7% |
| Statistics | 65 | 13 | 20.0% |
| Biochemistry, Biophysics, and Structural Biology | 193 | 39 | 20.2% |

## Table D2. Top Minnesota Programs Based on NRC 2010 Regression Based (R-Based) Ranking

| **Top 10%** | | | |
|---|---|---|---|
| **Program Name** | **No. Programs** | **New R-Rank: 5%** | **Relative Rank** |
| Germanic Studies | 29 | 1 | 3.4% |
| Chemical Engineering | 106 | 4 | 3.8% |
| Psychology | 236 | 10 | 4.2% |
| Kinesiology | 41 | 2 | 4.9% |
| Child Psychology | 236 | 15 | 6.4% |
| Mechanical Engineering | 127 | 9 | 7.1% |
| Entomology | 28 | 2 | 7.1% |
| Chemistry | 178 | 13 | 7.3% |
| Animal Sciences | 60 | 5 | 8.3% |
| Ecology, Evolution, and Behavior | 94 | 8 | 8.5% |
| Natural Resource Science and Management | 33 | 3 | 9.1% |
| Nursing | 52 | 5 | 9.6% |
| Veterinary Medicine | 60 | 6 | 10.0% |

| **top 10-20%** | | | |
|---|---|---|---|
| **Program Name** | **No. Programs** | **New R-Rank: 5%** | **Relative Rank** |
| Geophysics | 140 | 15 | 10.7% |
| Nutrition | 44 | 5 | 11.4% |
| Hispanic and Luso-Brazilian Literatures and Linguistics | 60 | 7 | 11.7% |
| Electrical Engineering | 136 | 16 | 11.8% |
| Economics | 117 | 14 | 12.0% |
| Materials Science and Engineering | 83 | 10 | 12.0% |
| History | 137 | 19 | 13.9% |
| Microbiology, Immunology and Cancer Biology | 78 | 11 | 14.1% |
| Applied Economics | 28 | 4 | 14.3% |
| Geology | 140 | 20 | 14.3% |
| Computer Science | 126 | 19 | 15.1% |
| Applied Plant Sciences | 116 | 18 | 15.5% |
| Mathematics | 126 | 20 | 15.9% |

| | | | |
|---|---|---|---|
| Aerospace Engineering and Mechanics | 31 | 5 | 16.1% |
| Political Science | 105 | 17 | 16.2% |
| Mass Communication | 83 | 14 | 16.9% |
| Civil Engineering | 130 | 22 | 16.9% |
| Plant Biological Sciences | 116 | 20 | 17.2% |
| Neuroscience | 94 | 17 | 18.1% |
| American Studies | 22 | 4 | 18.2% |
| Physics | 160 | 31 | 19.4% |

## Table D3. Top Minnesota Programs Based on 2010 Survey Based (S-Based) NRC Ranking

| **Top 10%** | | | |
|---|---|---|---|
| **Program Name** | **No. Programs** | **New S-Rank: 5%** | **Relative Rank** |
| Entomology | 28 | 1 | 3.6% |
| Chemical Engineering | 106 | 4 | 3.8% |
| Geophysics | 140 | 7 | 5.0% |
| Ecology, Evolution, and Behavior | 94 | 6 | 6.4% |
| Mechanical Engineering | 127 | 10 | 7.9% |
| Child Psychology | 236 | 19 | 8.1% |
| Psychology | 236 | 20 | 8.5% |
| Chemistry | 178 | 17 | 9.6% |
| Aerospace Engineering and Mechanics | 31 | 3 | 9.7% |

| **Top 10-20%** | | | |
|---|---|---|---|
| **Program Name** | **No. Programs** | **New S-Rank: 5%** | **Relative Rank** |
| Germanic Studies | 29 | 3 | 10.3% |
| Materials Science and Engineering | 83 | 9 | 10.8% |
| Electrical Engineering | 136 | 16 | 11.8% |
| Economics | 117 | 14 | 12.0% |
| Natural Resource Science and Management | 33 | 4 | 12.1% |
| Kinesiology | 41 | 5 | 12.2% |
| Nutrition | 44 | 6 | 13.6% |
| Civil Engineering | 130 | 18 | 13.8% |
| Neuroscience | 94 | 14 | 14.9% |
| Epidemiology | 91 | 14 | 15.4% |
| Veterinary Medicine | 60 | 10 | 16.7% |
| Plant Biological Sciences | 116 | 20 | 17.2% |
| Nursing | 52 | 9 | 17.3% |
| Mathematics | 126 | 22 | 17.5% |
| Biostatistics | 91 | 16 | 17.6% |
| American Studies | 22 | 4 | 18.2% |
| Animal Sciences | 60 | 11 | 18.3% |
| History | 137 | 27 | 19.7% |

**Appendix E: Assessment of NRC Metrics**
***Conducted by the Graduate Education Subcommittee in conjunction with Ronald Huesman and Daniel Jones-White, Office of Institutional Research***

Most measures of the quality of graduate programs have tended to focus on the quality of the faculty and students in the programs, or so-called "input" measures. An underlying assumption has been that programs with the most distinguished faculty and the brightest and most prepared students are most likely to produce the best scholars who are most likely to have a profound effect on knowledge in their fields. This has been assumed to be true whether or not the program itself was well-run or designed to serve the needs of students. As long as the program does not seriously impede the best faculty and students from doing their work, they are likely to conduct the best research.

Today, however, a much broader, multidimensional understanding of quality is emerging. It includes the standard "input" metrics of student and faculty quality such as GRE scores and grades, citation indices and academic awards, but it also includes metrics of program efficiency, student experience and satisfaction, the quality and rates of job placement and much more. To recognize this evolving view of the quality of graduate programs, we analyzed existing measures of these various dimensions of quality and identified several additional measures to collect for future analysis. In conducting our preliminary analysis of potential measures of quality, we have focused on "proof of concept" rather than specific program evaluations. We wish to demonstrate that these various dimensions of quality can be measured, the reliability and validity of various metrics can be assessed, and summary indices of the comparative quality of graduate programs at the University of Minnesota can be constructed and collected over time. These measures can, in turn, be immensely useful in supplementing other sources of information to make informed strategic decisions about the size of and support for graduate programs.

To that end, we worked closely with the Office for Institutional Research and with Graduate School staff to conduct a preliminary analysis of as many measures listed in Table 1 as we could. We conducted a series of principal components analyses and factor analyses of the metrics included in the NRC's most recent ratings and we analyzed measures of student quality and program efficiency presently available from the Graduate School at the University of Minnesota. First, using the "objective" measures that formed the core of the 2006 NRC assessments, our analysis of all programs except the Humanities[4] at all AAU Universities (N=2,000+) found the following:

The first principal component was *size*; we recommend that further statistical analysis use size as a control variable not as a measure of quality. When we conducted a factor analysis allowing the factors to be correlated, size did NOT correlate significantly with any of the measures of quality in the NRC data set. As a result, we dropped the size component and re-ran the analysis to identify the remaining substantive principal components, which were:

- *Quality of Faculty (Publications & Awards):* NRC used four measures that formed formed a strong and coherent component, all with high loadings. These measures were publications per faculty; citations per publication; percent with grants; awards per faculty. The most

[4]Results of principal components analyses by field showed essentially similar components for all fields except the humanities.

central (best) measures for this component were citations per publication and awards per faculty. Thus it is clear that it is not quantity of publication, but rather impact of the publications, that matter most for faculty quality. The diversity measure did not load on this component. One measure of quality of students, percent of first year students with external fellowships, also had a significant loading on this component, for obvious reasons--the quality of the faculty determines how many incoming "fellows" the program can recruit. On the basis of this analysis, it is safe to conclude that these five measures from the NRC can be used to assess the quality of faculty in various programs at the University of Minnesota. If a subset of measures is desired, the *average citations per publication* and *awards per faculty* would be the best subset to use.

- *Quality of Students*: The NRC included only one measure of student quality, GRE scores--the average Verbal GRE for Humanities and the average Quantitative GRE for Science & Social Science fields. We cannot do a detailed analysis of this construct using NRC data since there is only one measure at one point in time. For now, we are forced to assume that it is a reliable and valid measure. However, see Appendix B for an analysis of GRE scores among U of M programs.
- *Program Completion Efficiency*: The NRC evaluations include measures of program completion rates and time to degree, and those two items formed a strong component with the former loading -.82 and the latter loading .81. Our analysis of separate (more recent) data from the U of M on these same two variables confirms their reliability and validity as measures of program efficiency (Appendix B). We recommend that these two measures should be used to assess program efficiency, primarily to identify outliers, not to make fine-grained distinctions. We also recommend that the primary (but not only) comparisons should be to national norms within fields rather than comparisons across fields, which vary widely in their traditions and needs. For example, many science fields provide ample multi-year postdoctoral grants that, in essence, allow graduate training to continue several years after the Ph.D. is completed. Other fields have no postdocs and, in essence, require the equivalent of postdoctoral training to occur before the Ph.D. is granted. We will later demonstrate how intra-field comparisons can be done using NRC data.
- *Program Student Experience*: The NRC evaluations include measures of whether student work space is provided, the percent of first year students with full financial support, and the average number of Ph.D.'s granted. These three items form a fairly strong principal component, led by the percent of students with full support, which has a loading of .72. The average number of Ph.D.s granted has a moderately strong negative loading (-.41), showing that size has a negative effect on the quality of the student experience. We recommend continuous tracking of these measures.
- *Diversity of Faculty & Students*: The NRC included measures of the percent non-Asian minority students and faculty, percent female students and faculty, and percent international students. These items formed two principal components, the first of which included percent female faculty (.77) and percent female students (.83) as core elements. Percentage of international students and GRE scores both had significant negative loadings on this component. The percentage of non-Asian minority students and faculty formed a a separate component, unrelated to the non-Asian diversity component.

*<u>Subgroup Analyses of NRC Measures:</u>* Many of the results reported immediately above could primarily reflect differences among types of programs so we repeated our analysis separately for Agricultural Sciences, Biological and Health Sciences, Engineering, Physical and Mathematical Sciences, Social and Behavioral Sciences and the Humanities. The results mirrored the overall results with one significant exception: Among Humanities programs, the principle components solution resulted in different components extracted in different order. However, the measures of program efficiency were the same, and the measures of faculty quality were similar, with awards per faculty member and average number of publications providing the best measures. Grants played no role whatsoever for Humanities programs, and "citations per publication" was not included.

## Appendix F: Provost Sullivan Charge Letter

UNIVERSITY OF MINNESOTA

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TO: Robert McMaster, Vice Provost and Dean of Undergraduate Education
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Kathryn VandenBosch, Professor and Head of Plant Biology; Chair of FCC
Marvin Marshak, Professor of Physics, IT
John Sullivan, Regents Professor of Political Science, CLA
Jennifer Windsor, Professor of Speech-Language-Hearing Sciences; Associate Dean for Undergraduate Programs, CLA
William Durfee, Professor of Mechanical Engineering, IT
Robert Ruekert, Professor of Marketing and Associate Dean of Undergraduate Programs, CSOM
Gregory Vercellotti, Professor, Department of Medicine
Cathy Wambach, Associate Professor, Postsecondary Teaching and Learning
Mandy Stahre, graduate student, COGS
Paul Strain, undergraduate student, MSA

FROM: E. Thomas Sullivan, Senior Vice President for Academic Affairs and Provost TS

DATE: May 10, 2010

RE: Short- and Long-term Enrollment Management Committee

It is clear that as we move forward with our continued strategic planning efforts involving both the academic and administrative side of the University a careful plan for enrollment management is essential. The short- and long-term enrollment management will affect our budgets and fiscal health, the curriculum we deliver, faculty/student ratios, and access to the University. We must determine what the appropriate balance is among undergraduate, graduate, and professional education students. What is our particular enrollment niche given our role as the state's primary research institution? What is our comparative advantage?

I have asked Robert McMaster, Vice Provost and Dean of Undergraduate Education, and Henning Schroeder, Vice Provost and Dean of Graduate Education, to co-chair this committee. Suzanne Bardouche, Assistant Vice Provost for Undergraduate Education and Ron Matross, Head Enrollment Management Analyst for the Office of Undergraduate Education, will staff the committee. Other key faculty and administrative staff will be tapped for their expertise on particular matters as needed. I would like you to focus on principles that should guide decision-making. Some of the key questions that I would like this committee to address include:

1. What factors (such as quality, including diversity and international enrollments) should inform our enrollment goals at the undergraduate level, the graduate level, and the

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professional level? Are there different factors applicable to different colleges or programs?

2. At the undergraduate level, how should we determine the correct balance between PSEO, new high school students, and transfer students?

3. What is the relationship between enrollment at various undergraduate levels and the curriculum? Where are the pressure points?

4. How do we determine the appropriate enrollment balances among the colleges? What factors should be used to determine which colleges or programs should grow and which should be smaller?

5. How do we view the transfer relationship between MNSCU and the U of M, in particular for community colleges?

6. How do we determine the optimum balance among undergraduate, professional, and graduate enrollment, college by college?

7. How do we determine the appropriate role and numbers of part-time students?

8. How do we determine the appropriate size of an academic graduate program?

9. What are the appropriate metrics for monitoring the effects and success of enrollment management changes?

10. What is the appropriate balance between financial aid and tuition, and what level is sustainable over the long term?

11. Given the size of the faculty, the campus and its facilities, what is the optimum number of students who can be accommodated and still maintain a high quality educational experience?

I would like to receive a draft report by the end of this summer, and a final report by the end of fall semester 2010.

cc: Sharon Reich Paulsen, Associate Vice President and Chief of Staff to the Provost