

RESEARCH REPORT

**Integrating Quantitative Reasoning Skills  
into Undergraduate Degree Programs in the  
Behavioral and Life Sciences:  
Understanding How Students are  
Accomplishing this Goal**

Loretta G. Goldberg, PSM  
*Computational Biosciences*  
*Department of Mathematics and Statistics*  
*College of Liberal Arts and Sciences*  
*Arizona State University*

Rosemary Renaut, PhD  
[renaut@asu.edu](mailto:renaut@asu.edu)  
*Research Advisor*  
*Department of Mathematics and Statistics*  
*College of Liberal Arts and Sciences*  
*Arizona State University*

Research Conducted Spring 2006

**Report Submitted: June 30, 2006**



# Table of Contents

Table of Tables .....	5
Table of Figures .....	6
Summary of Key Findings .....	7
Introduction.....	11
Research Goal .....	11
Scope.....	12
Focus.....	13
Background.....	13
Methods.....	15
Results.....	17
Mathematical Studies (MA) Requirement.....	17
B.A. Psychology .....	18
B.S. Psychology .....	19
B.S. Biological Sciences.....	19
Summary .....	19
Mathematical Studies (CS) Requirement.....	31
B.A. Psychology and B.S. Psychology.....	31
B.S. Biological Sciences.....	31
Summary .....	32
Performance in Mathematics .....	46
Computing GPAs.....	47
When are Mathematics Courses Taken?.....	48
Minority Information .....	49
GPA Data Obtained .....	49
Conclusion / Remarks.....	56
<i>Appendix A: Glossary of Terms .....</i>	<i>58</i>
<i>Appendix B: Sample Queries .....</i>	<i>61</i>
B.1: B.S. Degrees in Behavioral and Life Sciences (Ever) .....	61
B.2: B.S. Degrees in Behavioral and Life Sciences (Current).....	62
B.3: Behavioral and Life Sciences Students with Minority Status.....	64
B.4: B.S. Psychology Students with Minority Status .....	65
B.5: B.A. Psychology Students with Minority Status.....	67
B.6: B.S. Biology Students with Minority Status .....	67
B.7: MA courses for All B.A. Psychology Students.....	68
B.8: Math GPA for B.S. Psychology Students with Minority Status .....	72
B.9: Math GPA for B.A. Psychology Students with Minority Status .....	74
B.10: Math GPA for B.S. Biology Students with Minority Status.....	75
B.11: Upper Level GPA for B.S. Psychology Students with Minority Status.....	76
B.12: Upper Level GPA for B.A. Psychology Students with Minority Status.....	78
B.13: Upper Level GPA for B.S. Biology Students with Minority Status .....	78
B.14: All Behavioral and Life Sciences Students.....	79
B.15: All B.S. Psychology Students .....	80
B.16: All B.A. Psychology Students.....	81
B.17: All B.S. Biology Students.....	82

B.18: Math GPA for All B.S. Psychology Students .....	82
B.19: Math GPA for All B.A. Psychology Students.....	84
B.20: Math GPA for All B.S. Biology Students.....	84
B.21: Upper Level GPA for All B.S. Psychology .....	85
B.22: Upper Level GPA for All B.A. Psychology Students.....	87
B.23: Upper Level GPA for All B.S. Biology Students .....	87
<i>Appendix C: GPA Summary Data</i> .....	88
C.1: B.A. Psychology Majors .....	89
Academic Year: 2002-2003 .....	89
Academic Year: 2003-2004 .....	89
Academic Year: 2004-2005 .....	89
C.2: B.S. Psychology Majors.....	90
Academic Year: 2002-2003 .....	90
Academic Year: 2003-2004 .....	90
Academic Year: 2004-2005 .....	90
C.3: B.S. Biological Sciences (excluding CLS) .....	91
Academic Year: 2002-2003 .....	91
Academic Year: 2003-2004 .....	91
Academic Year: 2004-2005 .....	91
C.4: B.S. Biological Sciences by Major .....	92
Academic Year: 2002-2003 .....	92
Academic Year: 2003-2004 .....	93
Academic Year: 2004-2005 .....	94
<i>Appendix D: Extracting GPA Data from Database</i> .....	95
D.1: Computing Mean GPA Values .....	96
D.2: Generating Tab-delimited Data Files.....	98
D.3: Example SAS File.....	99

## Table of Tables

Table 1. Degree programs in the Behavioral and Life Sciences.....	12
Table 2. Progression of General Studies Numeracy Requirements.....	17
Table 3. Current MA Requirements for the Behavioral and Life Sciences.....	21
Table 4. MA courses taken by 138 B.A. Psychology Graduates 2002-2003.....	22
Table 5. MA courses taken by 148 B.A. Psychology Graduates 2003-2004.....	23
Table 6. MA courses taken by 137 B.A. Psychology Graduates 2004-2005.....	24
Table 7. MA courses taken by 85 B.S. Psychology Graduates 2002-2003.....	25
Table 8. MA courses taken by 89 B.S. Psychology Graduates 2003-2004.....	26
Table 9. MA courses taken by 102 B.S. Psychology Graduates 2004-2005.....	27
Table 10. MA courses taken by 143 B.S. Biological Sciences Graduates 2002-2003.....	28
Table 11. MA courses taken by 151 B.S. Biological Sciences Graduates 2003-2004.....	29
Table 12. MA courses taken by 159 B.S. Biological Sciences Graduates 2004-2005.....	30
Table 13. Current CS Requirements for the Behavioral and Life Sciences.....	33
Table 14. CS courses taken by 142 B.A. Psychology Graduates 2002-2003.....	34
Table 15. CS courses taken by 158 B.A. Psychology Graduates 2003-2004.....	35
Table 16. CS courses taken by 128 B.A. Psychology Graduates 2004-2005.....	36
Table 17. CS courses taken by 102 B.S. Psychology Graduates 2002-2003.....	38
Table 18. CS courses taken by 113 B.S. Psychology Graduates 2003-2004.....	39
Table 19. CS courses taken by 101 B.S. Psychology Graduates 2004-2005.....	40
Table 20. CS courses taken by 176 B.S. Biological Sciences Graduates 2002-2003.....	42
Table 21. CS courses taken by 139 B.S. Biological Sciences Graduates 2003-2004.....	44
Table 22. CS courses taken by 91 B.S. Biological Sciences Graduates 2004-2005.....	45
Table 23. Data Points for Statistical Analysis.....	53

## Table of Figures

Figure 1. Course Pathways for MA Requirement.....	18
Figure 2. Number of B.A. Psychology Graduates per Academic Year .....	20
Figure 3. Number of B.S. Psychology Graduates per Academic Year.....	20
Figure 4. Number of B.S. Biological Sciences Graduates per Academic Year.....	21
Figure 5. MA courses taken by 138 B.A. Psychology Graduates 2002-2003 .....	22
Figure 6. MA courses taken by 148 B.A. Psychology Graduates 2003-2004 .....	23
Figure 7. MA courses taken by 137 B.A. Psychology Graduates 2004-2005 .....	24
Figure 8. MA courses taken by 85 B.S. Psychology Graduates 2002-2003 .....	25
Figure 9. MA courses taken by 89 B.S. Psychology Graduates 2003-2004.....	26
Figure 10. MA courses taken by 102 B.S. Psychology Graduates 2004-2005 .....	27
Figure 11. MA courses taken by 143 B.S. Biological Sciences Graduates 2002-2003 ...	28
Figure 12. MA courses taken by 151 B.S. Biological Sciences Graduates 2003-2004 ...	29
Figure 13. MA courses taken by 159 B.S. Biological Sciences Graduates 2004-2005 ...	30
Figure 14. CS courses taken by 142 B.A. Psychology Graduates 2002-2003 .....	34
Figure 15. CS courses taken by 158 B.A. Psychology Graduates 2003-2004.....	35
Figure 16. CS courses taken by 128 B.A. Psychology Graduates 2004-2005.....	36
Figure 17. CS courses taken by 102 B.S. Psychology Graduates 2002-2003 .....	38
Figure 18. CS courses taken by 113 B.S. Psychology Graduates 2003-2004 .....	39
Figure 19. CS courses taken by 101 B.S. Psychology Graduates 2004-2005 .....	40
Figure 20. CS courses taken by 176 B.S. Biological Sciences Graduates 2002-2003 ....	41
Figure 21. CS courses taken by 139 B.S. Biological Sciences Graduates 2003-2004 ....	43
Figure 22. CS courses taken by 91 B.S. Biological Sciences Graduates 2004-2005 .....	45
Figure 23. Pivot displaying 2002-2003 B.S. Psychology Students with Minority Status	66
Figure 24. Pivot displaying 2002-2003 B.A. Psychology Students with Minority Status	67
.....	
Figure 25. Pivot displaying 2002-2003 B.S. Biology Students with Minority Status .....	68
Figure 26. Pivot displaying MA courses of minority B.A. Psychology Students .....	71
Figure 27. Pivot displaying MA courses with grades of B.A. Psychology Students.....	72
Figure 28. Pivot displaying Mathematics courses of minority B.A. Psychology Students	75
.....	
Figure 29. Pivot displaying Mathematics courses of minority B.S. Biology Students....	76
Figure 30. Pivot displaying all 2002-2003 Behavioral or Life Sciences Students .....	80
Figure 31. Excel spreadsheet containing GPA data for minority students .....	99

## Summary of Key Findings

The majority of students earning a <b>B.A. degree in Psychology</b> satisfy their MA requirement with either College Algebra (MAT117) or Finite Mathematics (MAT119). The majority of the B.A. Psychology students that take a calculus course at ASU take Brief Calculus (MAT210).....	24
The majority of students earning a <b>B.S. degree in Psychology</b> satisfy their MA requirement with Brief Calculus (MAT210), as a calculus course is a requirement for this major. ....	27
The majority of students earning a <b>B.S. degree in the Biological Sciences</b> satisfy their MA requirement with Brief Calculus (MAT210).....	30
Even though all of the curriculum check sheets for the <b>Biological Sciences</b> programs list MAT251, Calculus for the Life Sciences, students are taking Brief Calculus (MAT210) instead. ....	31
For the 2002-2003 and 2003-2004 academic years, approx 70% of the <b>B.A. Psychology</b> students took a course meeting the CS requirement at ASU. For the 2004-2005 academic year, only 52% of the B.A. Psychology students took a course at ASU meeting the CS requirement. ....	37
For the 2002-2003 academic year, approx. 80% of the <b>B.S. Psychology</b> students took a CS course. For the 2003-2004 academic year, approx 77% of the B.S. Psychology students took a CS course. For the 2004-2005 academic year, only 64% of the B.S. Psychology students took a course at ASU meeting the CS requirement.....	41
The CS requirement for students obtaining a <b>B.S. in Biological Sciences</b> is as varied as the programs themselves. Tables 20-23 show a wide variety of courses being used to satisfy this requirement. CSE180, Computer Literacy appears to be the most popular course taken .....	46
Across the three academic years for which data was collected, 40 out of 63 MBB students took MAT351. It appears that currently approx one-third of the MBB students are	

getting permission to satisfy their CS requirement with a course other than the course that is documented as required..... 46

As program changes, focused on freshman and sophomore level courses, are evaluated, it may be important to determine whether the fact that fewer students are taking their CS classes at ASU is the result of higher levels of transfer students. If the decrease indicates that students are avoiding these classes, then curriculum changes are truly needed!..... 46

None of the upper level electives in psychology require calculus as a prerequisite. In the Life Sciences, Biometry (BIO 415) and Statistical Analyses in Environmental Science (PLB 430) list Brief Calculus (MAT 210) or its equivalent as a prerequisite. .... 48

It should also be noted that when calculus is required as a prerequisite, it is Brief Calculus (MAT 210), not Calculus for Life Sciences (MAT 251) that is noted in the ASU General Catalog. .... 48

The percentage of minority students earning a **B.A. in Psychology** increased from 15% to 22%, while the number of students graduating increased by 21% in the same time frame. The percentage of minority students earning a **B.S. in Psychology** increased from 13% to 23%, while the number of students graduating increased by 24% in the same time frame. The percentage of minority students earning a **B.S. in one of the Biological Sciences** increased from 7% to 14%, while the number of students graduating remained steady (overall increase of 2%)...... 49

When looking at all of the **B.A. Psychology** students for each academic year, the mean Math GPA is higher when the MAT course is taken late. This may be the result of students having overlapping information from other courses, or being more experienced at studying when taking their MAT course..... 50

When all of the **B.A. Psychology** students for all three years are combined, students taking MAT “early” have a mean Upper GPA that is 0.07 grade points higher. Statistical analysis is required to determine if this is significant. .... 50

In 2002-2003, the 9 minority **B.A. Psychology** students taking math late performed better than the 18 students taking math early. In 2003-2004 and 2004-2005 the trend was

reversed, with students performing better in their major and overall, when math was taken early..... 51

Approximately 1/5 of the **B.S. Psychology** students that take Math at ASU take it late. During all three years the percentage of students not taking their Math at ASU appears to be higher than within the **B.A. Psychology** students. Approximately 1/3 of the B.S. Psychology students satisfy their mathematics requirement outside ASU..... 51

For minority students earning a **B.S. in Psychology**, performance in their upper level electives is higher when math is taken early, regardless of whether their MAT GPA was higher or lower as a result of “early” versus “late”. ..... 51

Approximately 1/3 of the **B.S. Biological Sciences** students satisfy their mathematics requirement outside ASU. Of the remaining students, 16-19% take their calculus late in the degree program. .... 52

In 2002-2003, the **B.S. Biological Sciences** students that took their math early had a higher Math GPA, but there was no difference in their major GPA as a result. In 2003-2004 the students taking Math early performed better overall by 0.2 grade points. In 2004-2005, the difference in performance when Math is taken early or late is much less (0.04-0.05)..... 52

Minority **B.S. Psychology** students taking math early appear to do better or the same in their major, than those taking it late..... 52

For minority students earning a **B.A. in Psychology**, the performance in Math is slightly higher when taken later; taking it early has some impact on the performance in the Upper Level electives. The impact on the overall GPA is negligible..... 54

For minority students earning a **B.S. in Psychology**, the performance in Math is no different when taken later; taking it early has some impact on the performance in the Upper Level electives and overall GPA..... 54

For all students earning a **B.A. in Psychology**, the performance in Math is discernibly higher when taken later; it can not be determined whether the timing of taking Math has an impact on Upper GPA or overall ASU GPA. .... 55

For all students earning a **B.S. in Psychology**, the performance in Math is discernibly higher when taken later; it cannot be determined whether the timing of taking Math has an impact on Upper GPA or overall ASU GPA ..... 55

It is surprising, based on a reading of all the self-advising and curriculum check sheets for the various degree programs, that students are not taking Calculus for the Life Sciences (MAT 251). It is also surprising that many student requiring calculus are waiting until way late in their degree programs to take it all. For students to benefit from the curriculum changes proposed, students taking Math at ASU will need to be directed toward these classes including the changes. .... 56

## **Introduction**

A Research Plan has been proposed by faculty of the School of Life Sciences (SoLS) and the Department of Mathematics and Statistics which is aimed at improving the quantitative reasoning skills of biological and behavioral science students<sup>1</sup>. This plan will focus on changes to freshman and sophomore level courses.

To appropriately assess the impact of the curriculum changes made under this research plan, the coursework completed as a part of the existing curriculum needs to be understood. The focus of the research documented in this report is to determine the coursework currently being taken to attain/improve quantitative reasoning skills. Student performance in this coursework will be assessed with respect to performance in coursework taken to satisfy the student's major requirements.

Within the degree programs of behavioral and life science majors, the courses that teach quantitative reasoning skills are generally the courses taken to satisfy the General Studies Requirements for Mathematical Studies (MA) and (CS). The coursework that represents the core of a student's major is the upper level courses in their major. For example, for a Psychology major this would be courses with a PGS or PSY prefix and a course number of 300 or higher.

## **Research Goal**

The goal of this research is to provide benchmark data for recent graduates from Behavioral and Life Science degree programs. This data will attempt to answer the following questions:

- What courses does a student in Behavioral or Life Science degree programs take which teach quantitative/mathematical reasoning skills?
- When (as a freshman, sophomore, etc.) does the student take these courses?
- How well does a student perform in these courses?
- How well does a student perform in their upper level major courses?
- What recommendations or expectations might be obtained from this data?

---

<sup>1</sup> A glossary of terms has been provided in the appendix of this document.

The goal of the proposed research plan is to improve quantitative reasoning skills through a series of curriculum changes. This research will provide benchmark data for recent graduates. As curriculum changes are made, additional student data will be collected and compared to this benchmark data. The results of this comparison will provide a means of assessing the impact of the curriculum changes.

## Scope

The scope of this study is programs leading to a Bachelors degree in the Behavioral or Life Sciences. Data was collected for the degree programs listed in the table below. The code values in the table are those used to select data from the ASU Data Warehouse.

<b>Degree</b>	<b>Code</b>	<b>Major</b>	<b>Code</b>
B.A.	21	Psychology	2001
B.S.	31	Psychology	2001
B.S.	31	Biology with a Concentration in Biology and Society	0400
B.S.	31	Biology	0401
B.S.	31	Plant Biology	0403
B.S.	31	Plant Biology with concentration in Environmental Science and Ecology	0404
B.S.	31	Molecular Biosciences and Biotechnology	0408
B.S.	31	Plant Biology with concentration in Plant Biochemistry and Molecular Biology	0409
B.S.	31	Microbiology	0411
B.S.	31	Conservation Biology	0420
B.S.	31	Clinical Laboratory Sciences <sup>2</sup>	1296

**Table 1. Degree programs in the Behavioral and Life Sciences**

<sup>2</sup> The Clinical Laboratory Sciences program is structured differently than the other programs leading to a B.S. in Biological Sciences. This program is expected to move to the ASU East Campus at some point in the future. Per Dr. Rosenberg, the ongoing analysis of programs within the School of Life Sciences excludes the Clinical Laboratory Sciences program.

## **Focus**

The focus for the curriculum changes described in the Proposed Research Plan is the freshman and sophomore level courses<sup>3</sup>. The specific courses at this level are courses that may be used to satisfy the General Studies Requirements for Mathematical Studies (MA and CS). In addition to determining the courses taken to satisfy these requirements, benchmark data will be collected for coursework taken to meet the requirements of the student's major.

## **Background**

All undergraduate students at Arizona State University are required to satisfy General Studies requirements as a part of earning a Bachelors degree. Currently these requirements include 6 credit hours of Mathematical Studies (MA and CS). These 6 credit hours are broken into 3 credit hours of Mathematics (MA) and 3 credit hours of Computing/Statistics/Quantitative Applications (CS)<sup>4</sup>.

All of the courses that may be taken to satisfy the University's MA requirement are provided by the Mathematics and Statistics Department, within the College of Liberal Arts and Sciences. During the spring of 2006 the list of courses meeting the MA requirement included 14 courses.

The current University requirement for Mathematics (as of academic year 2005-2006) is that all students have the level of knowledge obtained in Precalculus. Prior to this year, the requirement was that all students have the level of knowledge obtained in College Algebra. The University's Grade Point Average (GPA) requirement for a Bachelors degree is 120 credit hours with an overall average of greater than or equal to a C (2.0). However the College of Liberal Arts and Sciences (CLAS), which encompasses both the Psychology Department and the School of Life Sciences, specifically requires that

---

<sup>3</sup> Implied focus is students starting their college coursework at ASU and progressing through courses offered at ASU. Student transferring in from the Community Colleges are likely to have already satisfied the lower level course requirements and the General Studies Program requirements.

<sup>4</sup> Refer to the Arizona State University General Catalog for a detailed description of these requirements.

students obtain at 2.0 or higher in the course satisfying their MA General Studies requirement<sup>5</sup>.

The courses that may be taken to satisfy the University's CS requirement are provided by numerous Colleges/Departments within the University. During the spring of 2006 there were 67 courses meeting the CS requirement. The goal of this requirement is to be able to apply problem solving and analysis skills, and thus many departments develop courses specific to their degree programs. Examples of courses designed to meet the CS requirement include the following:

- the course "Intro to Statistics (PSY230)" is required for all students receiving either a B.A. or B.S. degree in Psychology.
- the course "Mathematical Methods for Genetic Analysis (MAT 351)" was designed specifically to meet the CS needs of the Molecular Biosciences and Biotechnology (MBB) program within the School of the Life Sciences.

Other programs may list suggested courses and allow students to take any course that meets the University's CS requirement. The purpose of the Mathematics (MA) and Computing or Statistics (CS) General Studies Requirements is to assure that each Arizona State University Undergraduate has a foundation with respect to mathematical reasoning and computation. For the Bachelors of Science (B.S.) programs in behavioral and Life Sciences, these courses are just that, a foundation. The minimum University requirement of Precalculus would only provide the prerequisite for the Mathematics requirements of these programs.

The goal of the proposed Research Plan is to incorporate curriculum changes which would provide a better integration of mathematics and reasoning skills into the behavioral and life sciences. This would include the following: modifications to existing courses taken by students in these programs to satisfy their MA and CS requirements; new courses which would be better tailored to these programs and meet the University's requirement for MA and CS; and modification to existing degree programs courses. Curriculum changes in each of these areas are either underway, or have been proposed.

---

<sup>5</sup> A student cannot get a D (1.0) in the course meeting their MA requirement, and then get a B (3.0) in something else to bring their average up. They must retake the MA requirement to get a C (2.0) or higher.

The goal of this research is to generate benchmark data that can be used to assess the impact of the curriculum changes. To assess the impact of these changes, we need to determine the following:

- What courses do students graduating with a degree in Biological Sciences or Psychology take to satisfy their MA and CS requirements?
- How do students perform in the course they take to satisfy their MA and CS requirement?
- How does this performance compare to their performance overall?
- When (freshman, sophomore, etc.) do students with additional MA or CS requirements (i.e. Calculus and MAT351) satisfy these requirements?

Historical data will be used to answer these questions and provide baseline information which may be used to determine how curriculum changes impact student performance.

## **Methods**

Arizona State University's Data Warehouse has been used to retrieve information for students graduating with degrees in Psychology and Biological Sciences. The Data Warehouse contains records on a per semester basis. The records include students graduating each semester, courses taken, grades received, and the requirements met by the courses.

In addition to collecting data from the ASU Data Warehouse the following resources were utilized to gain an understanding of the degree programs of interest:

- Curriculum checklists from the School of Life Sciences:  
<http://sols.asu.edu/ugrad/checksheets.php>. These checklists are available for multiple catalog years and for each degree program.
- Psychology major course requirements:  
<http://www.asu.edu/clas/psych/dinfo/undergrad/majorminreqs.htm>
- Course requirements for each Biology major from the ASU General Catalog.
- Course listings for each degree program.

- Psychology: <http://www.asu.edu/clas/psych/dinfo/undergrad/courses.htm>  
or from the ASU General catalog
- Biology – from the ASU General Catalog
- Mathematics – from the ASU General Catalog
- Lists of courses that satisfy each general studies requirement  
<https://sec.was.asu.edu/coursedb/genstudies/genstudies.jsp>. These lists are available on a per semester basis, as the course content and whether the course meets the General Studies requirement may change
- First Year Math Self Advisement [http://math.asu.edu/fym/self\\_advisement.html](http://math.asu.edu/fym/self_advisement.html)
- E-mail dialog with Dr. Matthew Isom, responsible for First Year Math curriculum
- E-mail dialog with Professor Morris Okun, undergraduate director for Psychology department.
- Consultation with undergraduate advisor in the Life Sciences

To collect the necessary information, an understanding of how the requirements of each degree program have evolved within the time that currently graduating students have been enrolled at ASU is needed. Benchmark data will be established using students graduating during the 2002-2003, 2003-2004, and 2004-2005 academic years (students may graduate during the fall through summer to be considered part of an academic year).

The students graduating during each school year met the requirements of numerous catalog years. As a result, the courses taken by them meet a changing set of requirements. The current Mathematical Studies (MA and CS) General Studies Requirements evolved from Numeracy requirements, denoted by N1, N2, and N3. Each student was required to take 6 credit hours of numeracy. The MA and CS general studies requirements were established for the 2000-2001 catalog year. The MA requirement replaces the N1 requirement. The N1 requirement was expected to assure competency in College Algebra. The CS requirement replaces the N2 and N3 requirements. These requirements encompassed computing, statistics, and quantitative applications. The guidelines for these general studies requirements are summarized in Table 2.

Catalog Yr	Applies to:	N1	N2/ N3	MA	CS	Total
1994-1999	students needing College Algebra	3	3			6
1994-1999	students competent in college algebra	0	6			6
1999-2000	all	3	3			6
2000-2005	all			3 <sup>a</sup>	3	6
2005-2006	all			3 <sup>b</sup>	3	6

**Table 2. Progression of General Studies Numeracy Requirements**

- a. Starting in 2000, MA requirement must be satisfied within first 30 credits at ASU (continuous enrollment in MA required until satisfied – continuous enrollment can be waived by College.)
- b. Starting in 2005, MA requirement raised to Precalculus.

## Results

### ***Mathematical Studies (MA) Requirement***

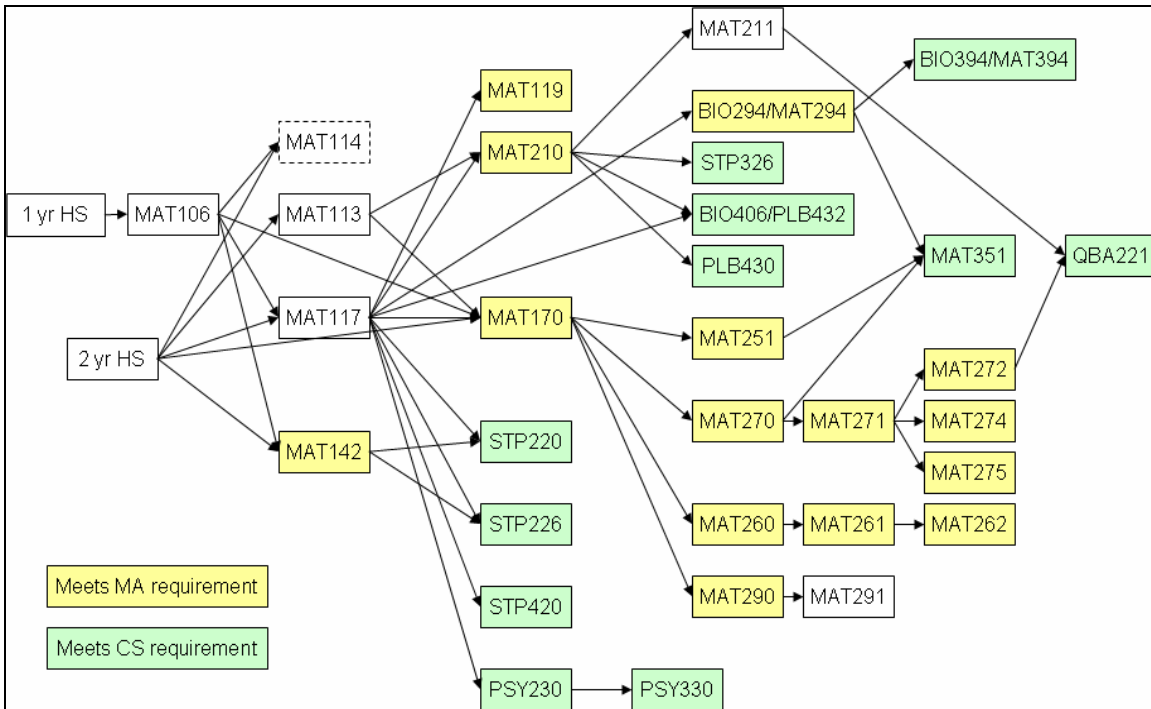
The courses that may be taken at ASU to meet the General Studies, Mathematical Studies (MA) requirement are limited to those shown in Figure 1.<sup>6</sup>

The current University requirement for Mathematics (starting fall 2005) is that all students attain the level of knowledge obtained in Precalculus. If a student enters ASU, not ready to take a Precalculus course, they will be required to begin taking the prerequisites to Precalculus within their first 30 credit hours. They are required to continue enrolling in Mathematics courses until the Precalculus requirement is met. In Figure 1, the 100 level courses without shading are the courses a student might take to satisfy prerequisite requirements.

MAT170 is Precalculus. Students that are required to take a Calculus course as part of their major, and have not already taken Precalculus elsewhere, should take this course to satisfy their MA requirement. MAT119 and MAT142 are currently the only other courses which satisfy the MA requirement and are below the level of calculus.

Figure 1 includes BIO294/MAT294 and BIO394/MAT394. These are new courses described as part of the Proposed Research Plan. This figure illustrates the General Studies requirements satisfied by these courses, as well as possible prerequisites to these courses.

<sup>6</sup>Figure is based on fall 2006 listing: <https://sec.was.asu.edu/coursedb/genstudies/genstudies.jsp>



**Figure 1. Course Pathways for MA Requirement**

The student data collected for this research reflects students that would have started their degree program prior to Precalculus being a University requirement. For students earning a B.S. degree, this does not directly impact the courses they take, as they are required to take calculus beyond this requirement. For students earning a B.A. in Psychology it must be noted that many of the graduates for whom data was collected were not required to take Precalculus. For example, in previous years, MAT113, MAT114, and MAT117 fulfilled the Mathematical studies (MA) requirement. This information is reflected in the database queries described in Appendix B.

### **B.A. Psychology**

The current self-advising guide for obtaining a B.A. in Psychology<sup>7</sup> indicates that Finite Math (MAT 119) or Calculus (MAT 251,260,270,290) should be taken. Note that Brief Calculus (MAT 210) is not listed. Prior to the fall of 2004, the self-advising guide indicated MAT119 or higher.

<sup>7</sup> <http://www.asu.edu/clas/psych/dinfo/undergrad/bareq06.html>

## **B.S. Psychology**

The current self-advising guide for obtaining a B.S. in Psychology<sup>8</sup> indicates that Calculus (MAT 251,260,270,290) should be taken. Of these suggested courses only MAT 251 and MAT 270 still exist as course offerings. Note that Brief Calculus (MAT 210) is not listed. Prior to the fall of 2004, the self-advising guide specifically listed Brief Calculus (MAT 210) as the course to take; no other calculus course was listed.

## **B.S. Biological Sciences**

The check sheets available for each degree program in the Biological Sciences reflect guidelines through the 2005-2006 Academic Year<sup>9</sup>. For each degree program, calculus is required, and MAT251 which is Calculus of the Life Sciences, is noted as the example. Older check sheets indicate any calculus and list MAT 210 and MAT251 as examples.

These checklists do not include the Clinical Laboratory Sciences Program. This program is structured differently than the other programs leading to a B.S. in Biological Sciences. For example, when the University requirements increased from College Algebra to Precalculus, the requirements of the Clinical Laboratory Sciences Program increased from MAT117 to MAT 142.

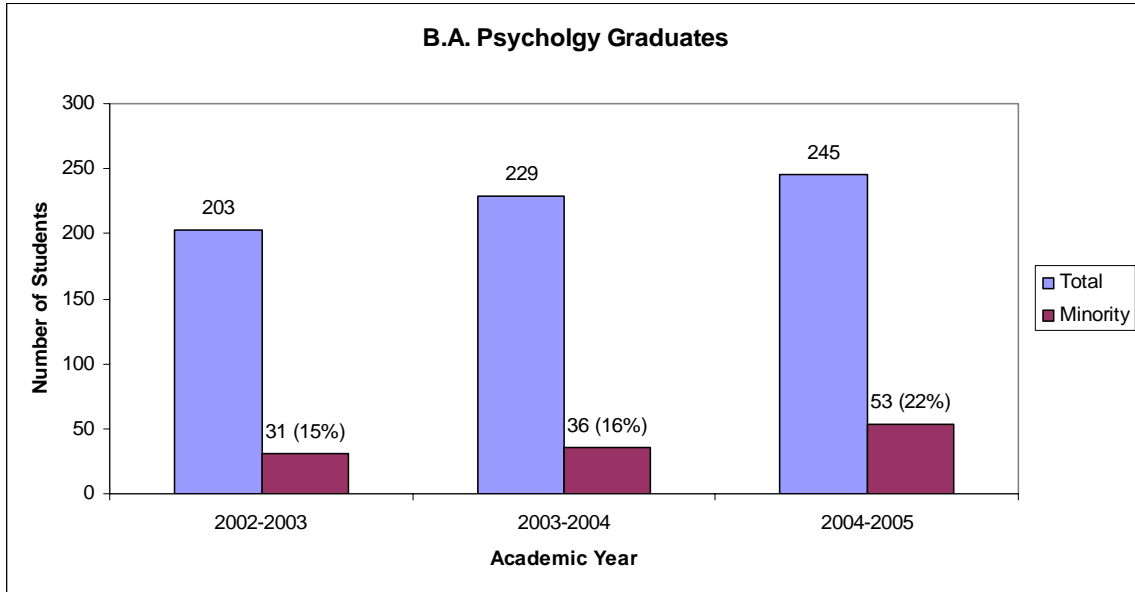
## **Summary**

The data collected for this report is for students graduating in the behavioral and life sciences/biological sciences during the 2002-2003, 2003-2004, and the 2004-2005 academic years. The number of students that data has been collected for is indicated in Figures 2 through 4. The most recent Mathematical Studies (MA) requirements for the behavioral and life sciences are listed in Table 3.

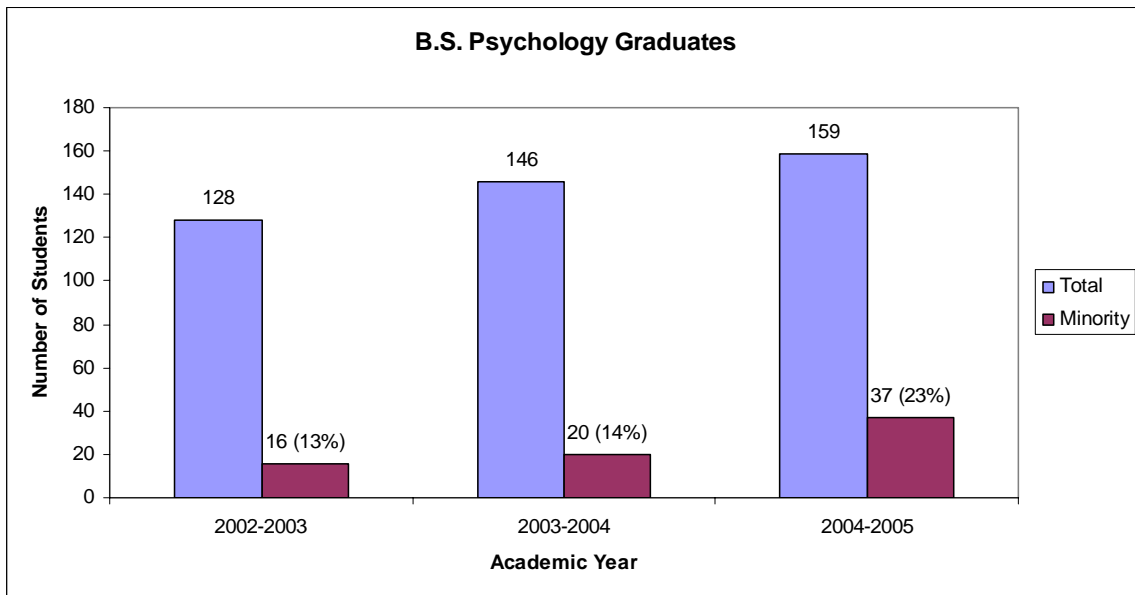
---

<sup>8</sup> <http://www.asu.edu/clas/psych/dinfo/undergrad/bsreq06.html>

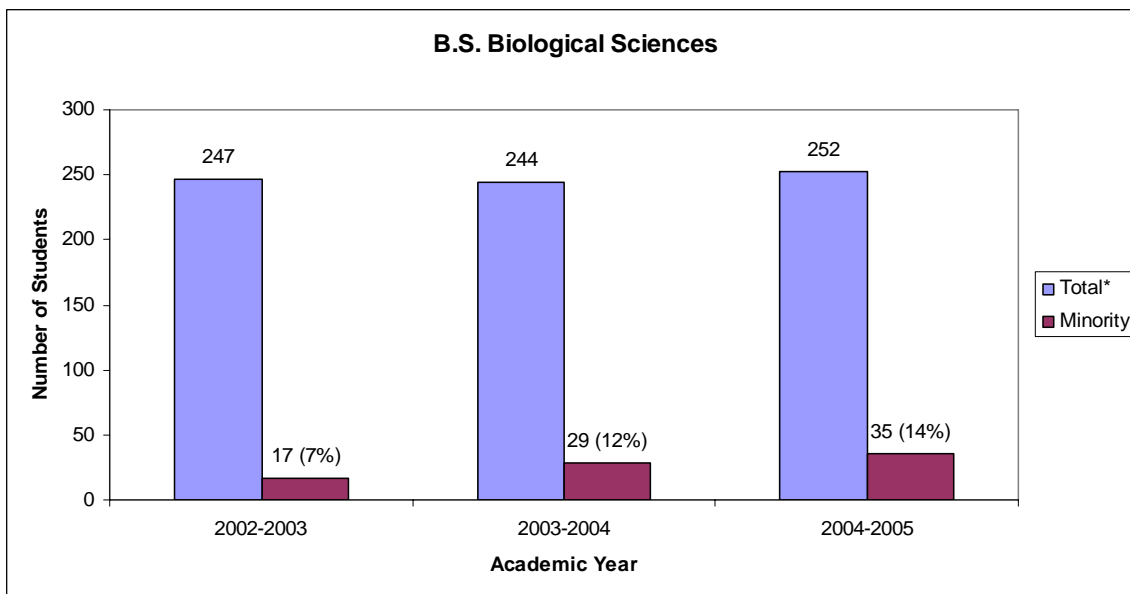
<sup>9</sup> <http://sols.asu.edu/ugrad/checksheets.php>



**Figure 2. Number of B.A. Psychology Graduates per Academic Year**



**Figure 3. Number of B.S. Psychology Graduates per Academic Year**



**Figure 4. Number of B.S. Biological Sciences Graduates per Academic Year**  
 \*Totals exclude students in the Clinical Laboratory Science (CLS) program.

Major	MA Requirement
B.A. Psychology	Math (MAT 119) or Calculus (MAT 251,260,270,290)
B.S. Psychology	Calculus (MAT 251, 260, 270, 290)
B.S. Biology with a Concentration in Biology and Society	Calculus (e.g., MAT251)
B.S. Biology	Calculus (e.g., MAT251)
B.S. Plant Biology	Calculus (e.g., MAT251)
B.S. Plant Biology with concentration in Environmental Science and Ecology	Calculus (e.g., MAT251)
B.S. Molecular Biosciences and Biotechnology	Calculus (e.g., MAT251)
B.S. Plant Biology with concentration in Plant Biochemistry and Molecular Biology	Calculus (e.g., MAT251)
B.S. Microbiology	Calculus (e.g., MAT251)
B.S. Conservation Biology	Calculus (e.g., MAT251)
B.S. Clinical Laboratory Science	MAT142

**Table 3. Current MA Requirements for the Behavioral and Life Sciences**

The Mathematical Studies requirement (MA) replaced the Numeracy requirement (N1) in the fall of 2001. The benchmark data collected for this requirement includes courses satisfying either the MA or N1 requirement. Figures 5 through 7 and Tables 4 through 6 demonstrate the number of B.A. Psychology students taking each MA course, and their performance in each course (i.e. a grade distribution). The data reflects a subset of the number of students graduating with a B.A. in Psychology, as this requirement may be satisfied by coursework taken outside ASU.

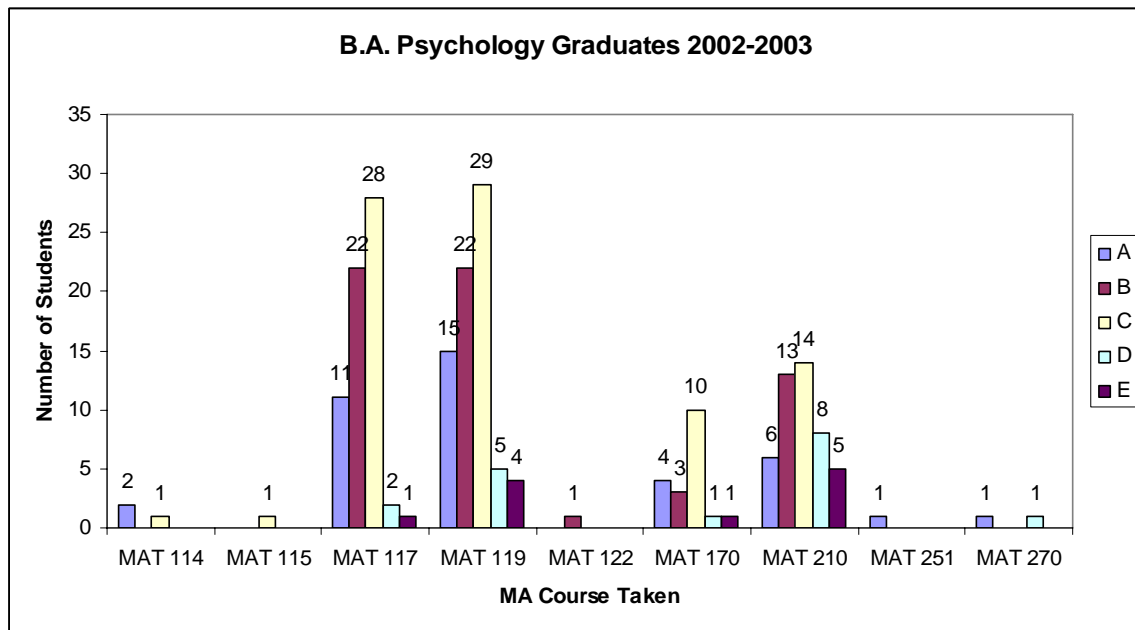


Figure 5. MA courses taken by 138 B.A. Psychology Graduates 2002-2003

Grade /Course	MAT 114	MAT 115	MAT 117	MAT 119	MAT 122	MAT 170	MAT 210	MAT 251	MAT 270	Count
A	2		11	15		4	6	1	1	40
B			22	22	1	3	13			61
C	1	1	28	29		10	14			83
D			2	5		1	8		1	17
E			1	4		1	5			11
Count	3	1	64	75	1	19	46	1	2	212

Table 4. MA courses taken by 138 B.A. Psychology Graduates 2002-2003

Figure 5 and Table 4 include data for 138 out of 203 students (22 out of 31 minority students). 104 courses met the MA requirement; the remaining 108 courses met the N1 requirement.

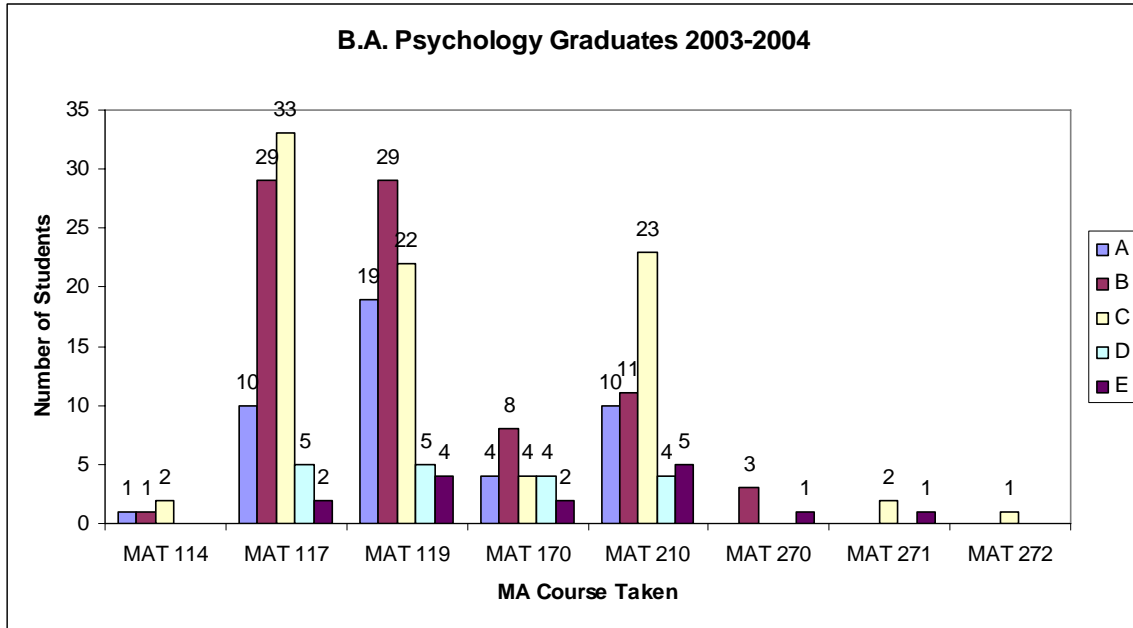


Figure 6. MA courses taken by 148 B.A. Psychology Graduates 2003-2004

Grade / Course	MAT 114	MAT 117	MAT 119	MAT 170	MAT 210	MAT 270	MAT 271	MAT 272	Count
A	1	10	19	4	10				44
B	1	29	29	8	11	3			81
C	2	33	22	4	23		2	1	87
D		5	5	4	4				18
E		2	4	2	5	1	1		15
Count	4	79	79	22	53	4	3	1	245

Table 5. MA courses taken by 148 B.A. Psychology Graduates 2003-2004

Figure 6 and Table 5 include data for 148 of 229 students (28 of 36 minority students). 173 courses met the MA requirement; the remaining 72 course met the N1 requirement.

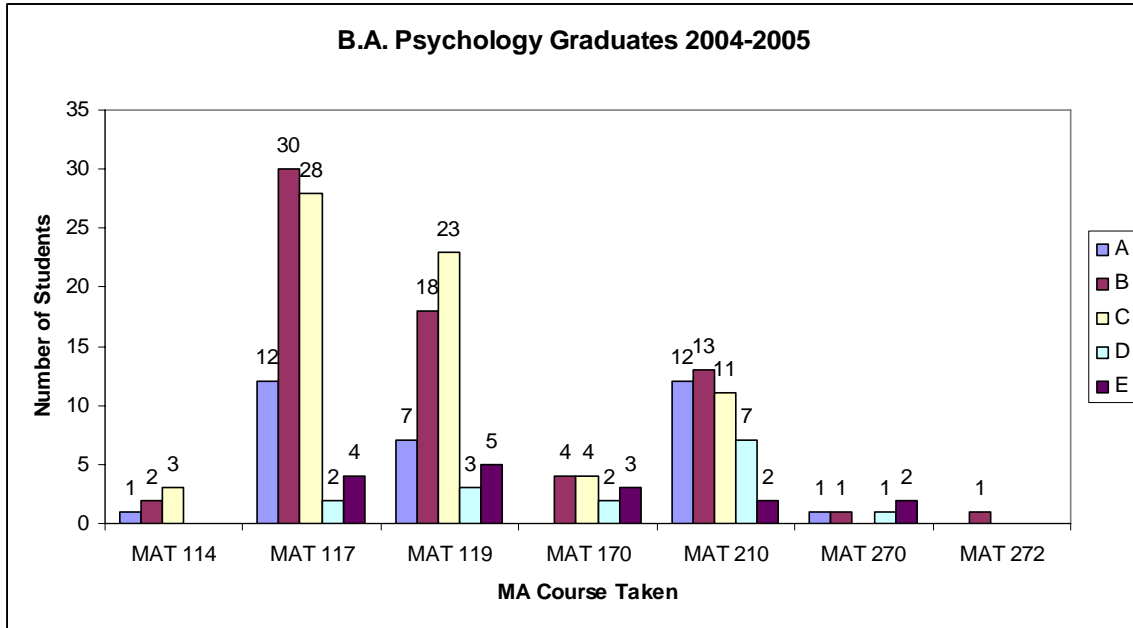


Figure 7. MA courses taken by 137 B.A. Psychology Graduates 2004-2005

Grade/ Course	MAT 114	MAT 117	MAT 119	MAT 170	MAT 210	MAT 270	MAT 272	Count
A	1	12	7		12	1		33
B	2	30	18	4	13	1	1	69
C	3	28	23	4	11			69
D		2	3	2	7	1		15
E		4	5	3	2	2		16
Count	6	76	56	13	45	5	1	202

Table 6. MA courses taken by 137 B.A. Psychology Graduates 2004-2005

Figure 7 and Table 6 include data for 137 out of 245 students (24 of 53 minority students). 162 courses met the MA requirement; the remaining 40 courses met the N1 requirement.

Note that each year reflects more students meeting the MA requirement. With each subsequent year, a smaller percentage of the students are graduating under a catalog that predates the MA requirement. **The majority of students earning a B.A. degree in Psychology satisfy their MA requirement with either College Algebra (MAT117) or Finite Mathematics (MAT119). The majority of the B.A. Psychology students that take a calculus course at ASU take Brief Calculus (MAT210).**

Figures 8 through 10 and Tables 7 through 9 demonstrate the number of B.S. Psychology students taking each MA course, and their performance in each course (i.e. a grade distribution). The data reflects a subset of the number of students graduating with a B.S. in Psychology, as this requirement may be satisfied by coursework taken outside ASU.

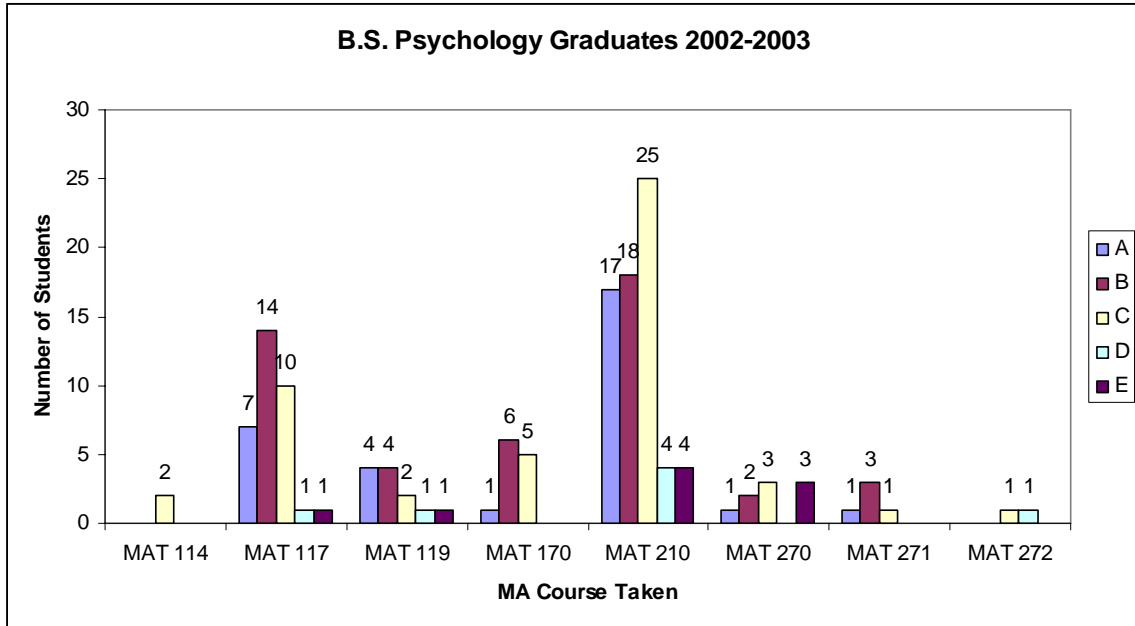


Figure 8. MA courses taken by 85 B.S. Psychology Graduates 2002-2003

Grade/ Course	MAT 114	MAT 117	MAT 119	MAT 170	MAT 210	MAT 270	MAT 271	MAT 272	Count
A		7	4	1	17	1	1		31
B		14	4	6	18	2	3		47
C	2	10	2	5	25	3	1	1	49
D		1	1		4			1	7
E		1	1		4	3			9
Count	2	33	12	12	68	9	5	2	143

Table 7. MA courses taken by 85 B.S. Psychology Graduates 2002-2003

Figure 8 and Table 7 include data for 85 out of 128 (11 of 16 minority students). 41 courses met the MA requirement; the remaining 102 courses met the N1 requirement.

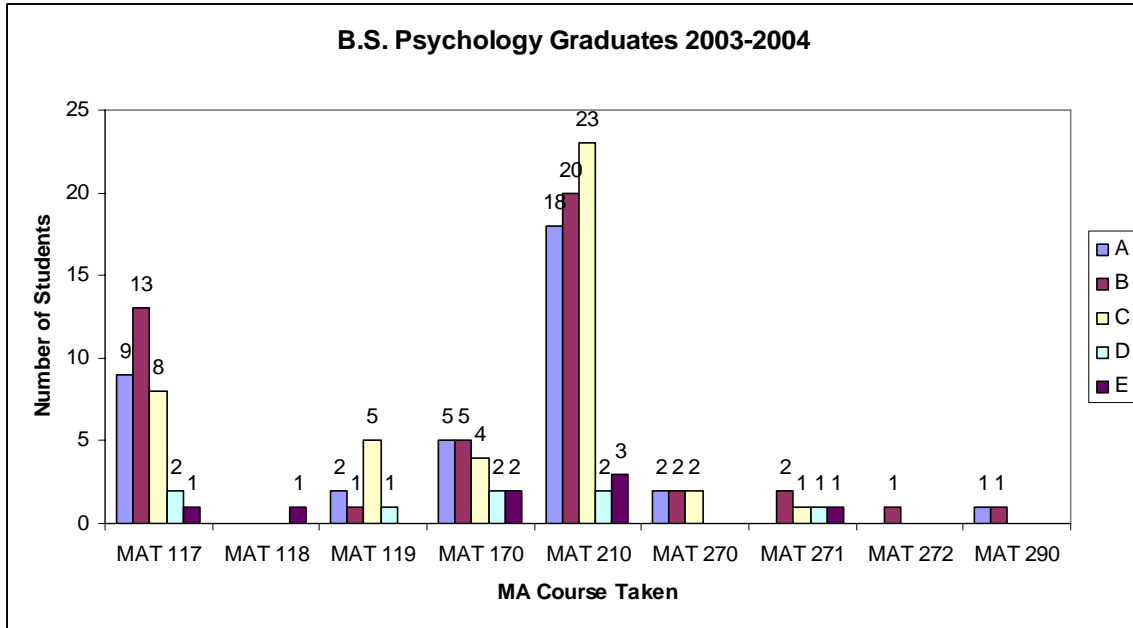


Figure 9. MA courses taken by 89 B.S. Psychology Graduates 2003-2004

Grade/ Course	MAT 117	MAT 118	MAT 119	MAT 170	MAT 210	MAT 270	MAT 271	MAT 272	MAT 290	Count
A	9		2	5	18	2			1	37
B	13		1	5	20	2	2	1	1	45
C	8		5	4	23	2	1			43
D	2		1	2	2		1			8
E	1	1		2	3		1			8
Count	33	1	9	18	66	6	5	1	2	141

Table 8. MA courses taken by 89 B.S. Psychology Graduates 2003-2004

Figure 9 and Table 8 include data for 89 out of 146 (16 of 20 minority students). 81 courses met the MA requirement; the remaining 60 courses met the N1 requirement.

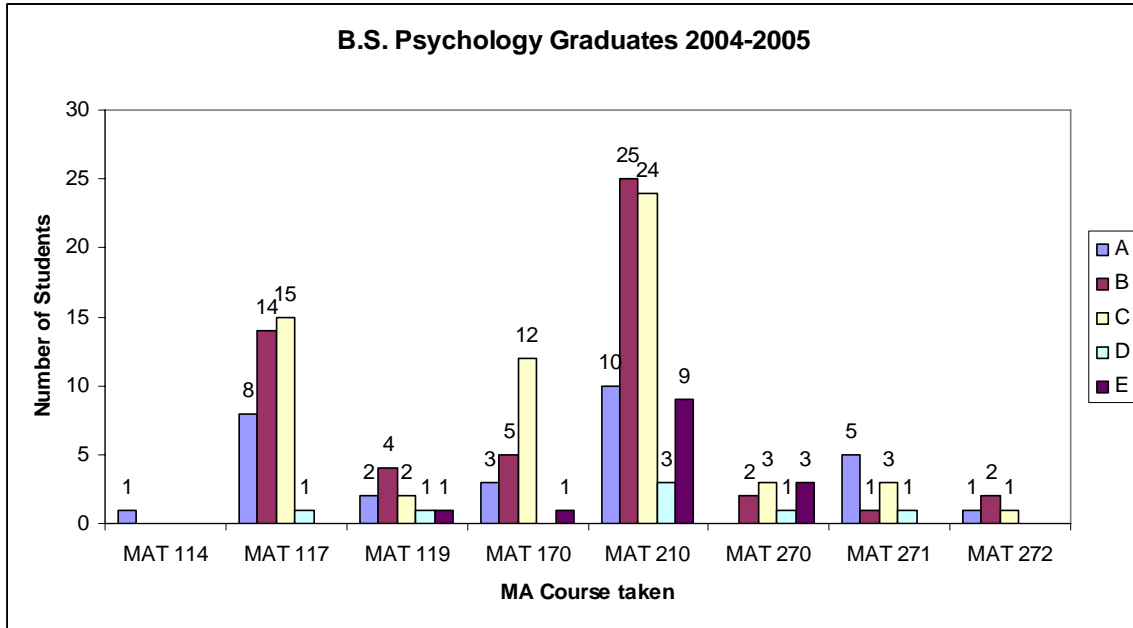


Figure 10. MA courses taken by 102 B.S. Psychology Graduates 2004-2005

Grade/ Course	MAT 114	MAT 117	MAT 119	MAT 170	MAT 210	MAT 270	MAT 271	MAT 272	Count
A	1	8	2	3	10		5	1	30
B		14	4	5	25	2	1	2	53
C		15	2	12	24	3	3	1	60
D		1	1		3	1	1		7
E			1	1	9	3			14
Count	1	38	10	21	71	9	10	4	164

Table 9. MA courses taken by 102 B.S. Psychology Graduates 2004-2005

Figure 10 and Table 9 include data for 102 out of 159 (28 of 37 minority students). 127 courses met the MA requirement; the remaining 37 courses met the N1 requirement.

Note that each year reflects more students meeting the MA requirement. With each subsequent year, a smaller percentage of the students are graduating under a catalog that predates the MA requirement. **The majority of students earning a B.S. degree in Psychology satisfy their MA requirement with Brief Calculus (MAT210), as a calculus course is a requirement for this major.** For these students, mathematics courses below MAT210 represent prerequisites to the calculus course required by their major.

The Psychology department is currently working on changing the MA requirement for the B.S. Psychology program. Students are already required to take calculus. Calculus for the Life Sciences (MAT251) will be a specific requirement. The data in displayed above demonstrates that this will be a significant change to what students have been taking.

Figures 11 through 13 and Tables 10 through 12 demonstrate the number of B.S. Biological Sciences students taking each MA course, and their performance in each course (i.e. a grade distribution). The data reflects a subset of the number of students graduating with a B.S. in the Biological Sciences, as this requirement may be satisfied by coursework taken outside ASU.

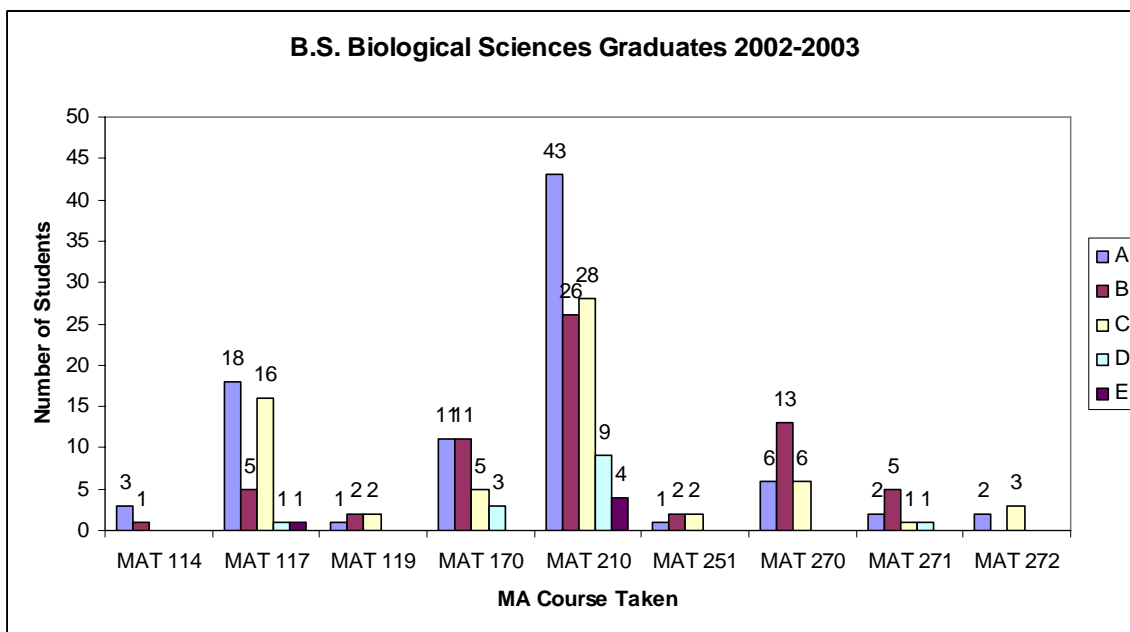


Figure 11. MA courses taken by 143 B.S. Biological Sciences Graduates 2002-2003

Grade/ Course	MAT 114	MAT 117	MAT 119	MAT 170	MAT 210	MAT 251	MAT 270	MAT 271	MAT 272	Count
A	3	18	1	11	43	1	6	2	2	87
B	1	5	2	11	26	2	13	5		65
C		16	2	5	28	2	6	1	3	63
D		1		3	9			1		14
E		1			4					5
Count	4	41	5	30	110	5	25	9	5	234

Table 10. MA courses taken by 143 B.S. Biological Sciences Graduates 2002-2003

Figure 11 and Table 10 include data for 143 out of 247 (12 of 17 minority students). 54 courses met the MA requirement; the remaining 180 courses met the N1 requirement.

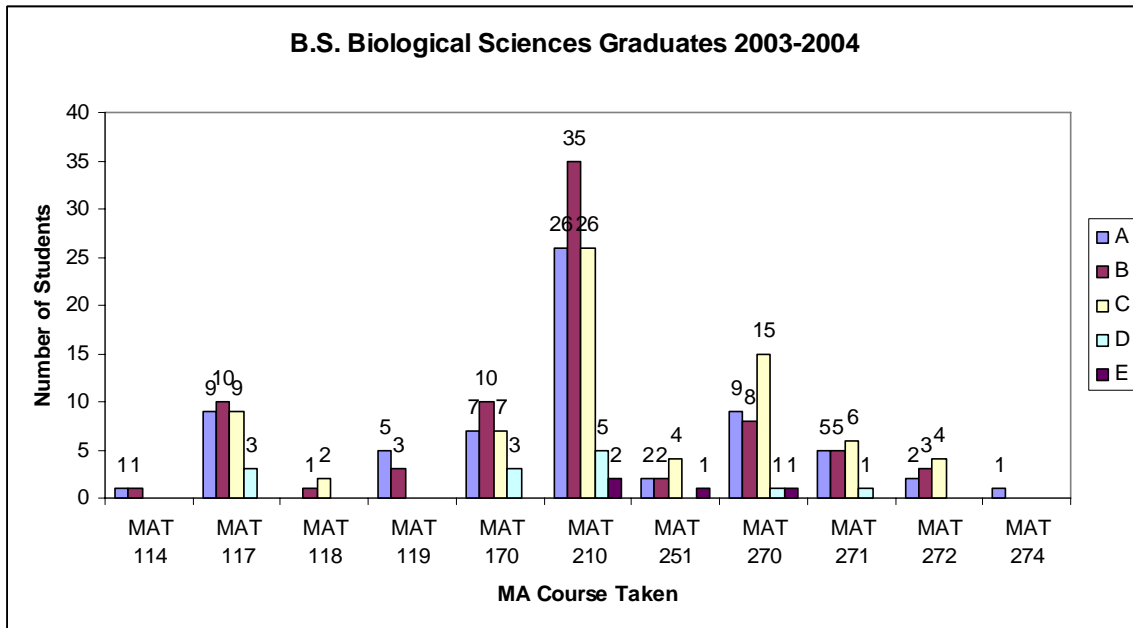


Figure 12. MA courses taken by 151 B.S. Biological Sciences Graduates 2003-2004

Grade/ Course	MAT 114	MAT 117	MAT 118	MAT 119	MAT 170	MAT 210	MAT 251	MAT 270	MAT 271	MAT 272	MAT 274	Count
A	1	9		5	7	26	2	9	5	2	1	67
B	1	10	1	3	10	35	2	8	5	3		78
C		9	2		7	26	4	15	6	4		73
D		3			3	5		1	1			13
E						2	1	1				4
Count	2	31	3	8	27	94	9	34	17	9	1	235

Table 11. MA courses taken by 151 B.S. Biological Sciences Graduates 2003-2004

Figure 12 and Table 11 include data for 151 out of 244 (16 of 29 minority students). 119 courses met the MA requirement; the remaining 116 courses met the N1 requirement.

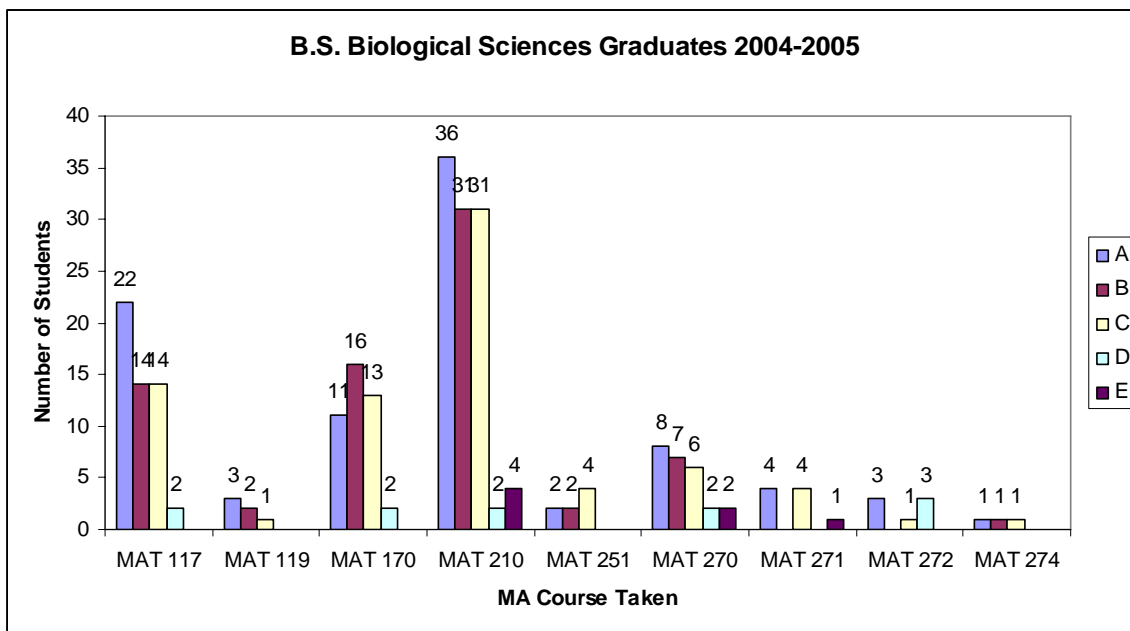


Figure 13. MA courses taken by 159 B.S. Biological Sciences Graduates 2004-2005

Grade/ Course	MAT 117	MAT 119	MAT 170	MAT 210	MAT 251	MAT 270	MAT 271	MAT 272	MAT 274	Count
A	22	3	11	36	2	8	4	3	1	90
B	14	2	16	31	2	7			1	73
C	14	1	13	31	4	6	4	1	1	75
D	2		2	2		2		3		11
E				4		2	1			7
Count	52	6	42	104	8	25	9	7	3	256

Table 12. MA courses taken by 159 B.S. Biological Sciences Graduates 2004-2005

Figure 13 and Table 12 include data for 159 out of 252 (27 of 35 minority students). 194 courses met the MA requirement; the remaining 62 courses met the N1 requirement.

Note that each year reflects more students meeting the MA requirement. With each subsequent year, a smaller percentage of the students are graduating under a catalog that predates the MA requirement. **The majority of students earning a B.S. degree in the Biological Sciences satisfy their MA requirement with Brief Calculus (MAT210).** A calculus course is a requirement for this major. For these students, mathematics courses below MAT210 represent prerequisites to the calculus course required by their major. **Even though all of the curriculum check sheets for the Biological Sciences programs list MAT251, Calculus for the Life Sciences, students are taking Brief Calculus**

**(MAT210) instead.** The proposed curriculum changes for the Behavioral and Life Sciences include changes to MAT251. For these changes to have a significant impact in the Biological Sciences, taking this course to meet the calculus requirement will have to be enforced. Based on the data in the tables above, this would be a significant change to what students have been taking.

### ***Mathematical Studies (CS) Requirement***

The courses that may be taken to meet the General Studies, Mathematical Studies (CS) requirement are much more varied than those satisfying the (MA) requirement. The courses are offered by many different departments, as their goal is to ensure that students can apply problem solving techniques in their chosen field. Figure 1 shows some of the CS courses that are specifically noted in the program requirements or curriculum check sheets for the behavioral sciences and life sciences degree programs.

The Mathematical Studies (CS) requirement evolved from the Numeracy requirements (N2) and (N3). This is also reflected in the curriculum check sheets.

### **B.A. Psychology and B.S. Psychology**

The current self-advising guide for obtaining a B.A. or B.S. in Psychology does not specifically mention the CS requirement. PSY 230, Introduction to Statistics, is a major requirement which meets the CS requirement. Prior to fall 2004, B.A. and B.S. Psychology majors were required to take both PSY230 and a 180 level Computer Science course (CSE180, 181,183,185).

### **B.S. Biological Sciences**

The check sheets available for each degree program in the Biological Sciences reflect guidelines through the 2005-2006 Academic Year<sup>10</sup>. The CS requirements vary from program to program, but have for the most part remained steady over time. These requirements are summarized below (Table 13).

---

<sup>10</sup><http://sols.asu.edu/ugrad/checksheets.php>

## Summary

The most recent Mathematical Studies (CS) requirements for the behavioral and life sciences are listed in Table 13. The CS requirement replaced the Numeracy requirements (N2) and (N3) in the fall of 2001. The courses listed in Table 13 are primarily courses offered by the individual departments, or courses offered by the Department of Mathematics and Statistics. Microbiology is the only program that continues to mention courses offered by the Computer Science department (CSE courses). This reflects an overall trend of departments to either develop their own course to meet this requirement, or work with the Department of Mathematics and Statistics to obtain a course that integrates quantitative reasoning skills with their subject area.

MAT351, Mathematical Methods for Genetic Analysis, is an example of a course developed by the Department of Mathematics and Statistics to meet the CS requirement of a specific degree program. This course was developed for students obtaining a B.S. in Molecular Biosciences and Biotechnology (MBB). This course has been offered since the spring of 2000. From the spring of 2000 through the spring of 2005, 120 undergraduates took this course. Of these students, 60 were Molecular Biosciences and Biotechnology majors. MAT 351 is one of the courses described in the Proposed Research Plan, for which this data is being collected. Curriculum changes to MAT351 are ongoing, in an effort to better meet the needs of the School of the Life Sciences.

<b>Major</b>	<b>CS Requirement</b>
B.A. Psychology	PSY 230
B.S. Psychology	PSY 230
B.S. Biology with a Concentration in Biology and Society	STP226 or STP294 <sup>a</sup>
B.S. Biology	STP226 or STP294 <sup>a</sup>
B.S. Plant Biology	PLB430 or PLB 432 or BIO 415
B.S. Plant Biology with concentration in Environmental Science and Ecology	PLB430 or PLB 432 or BIO 415 or STP420
B.S. Molecular Biosciences and Biotechnology	MAT351
B.S. Plant Biology with concentration in Plant Biochemistry and Molecular Biology	BIO406 or MAT351
B.S. Microbiology	BIO406 or STP226 or STP294 or any CSE course
B.S. Conservation Biology	STP226 or STP294 <sup>a</sup>

**Table 13. Current CS Requirements for the Behavioral and Life Sciences**

a. STP294 Statistics for Biosciences – can't tell online that this course meets the CS requirement. The course number 294 is an omnibus number, when this course gets its own number the CS designation will be more easily discerned.

Figures and Tables 14 through 16 demonstrate the number of B.A. Psychology students taking each CS course, along with their performance in each course. The data reflects a subset of the number of students graduating with a B.A. in Psychology.

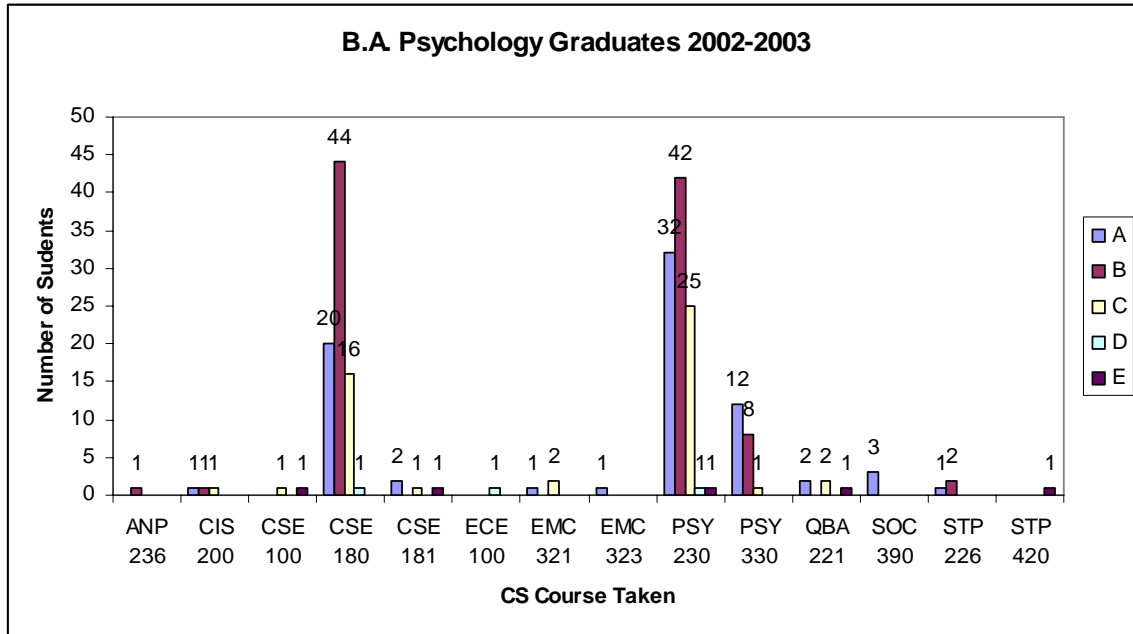


Figure 14. CS courses taken by 142 B.A. Psychology Graduates 2002-2003

Grade/ Course	ANP 236	CIS 200	CSE 100	CSE 180	CSE 181	ECE 100	EMC 321
A		1		20	2		1
B	1	1		44			
C		1	1	16	1		2
D				1		1	
E			1		1		
Count	1	3	2	81	4	1	3

Grade/ Course	EMC 323	PSY 230	PSY 330	QBA 221	SOC 390	STP 226	STP 420	Count
A	1	32	12	2	3	1		75
B		42	8			2		98
C		25	1	2				49
D		1						3
E		1		1			1	5
Count	1	101	21	5	3	3	1	230

Table 14. CS courses taken by 142 B.A. Psychology Graduates 2002-2003

Figure and Table 14 include data for 142 out of 203 students (24 out of 31 minority students). 151 courses met the CS requirement, 47 courses met the N2 requirement, and 32 courses met the N3 requirement.

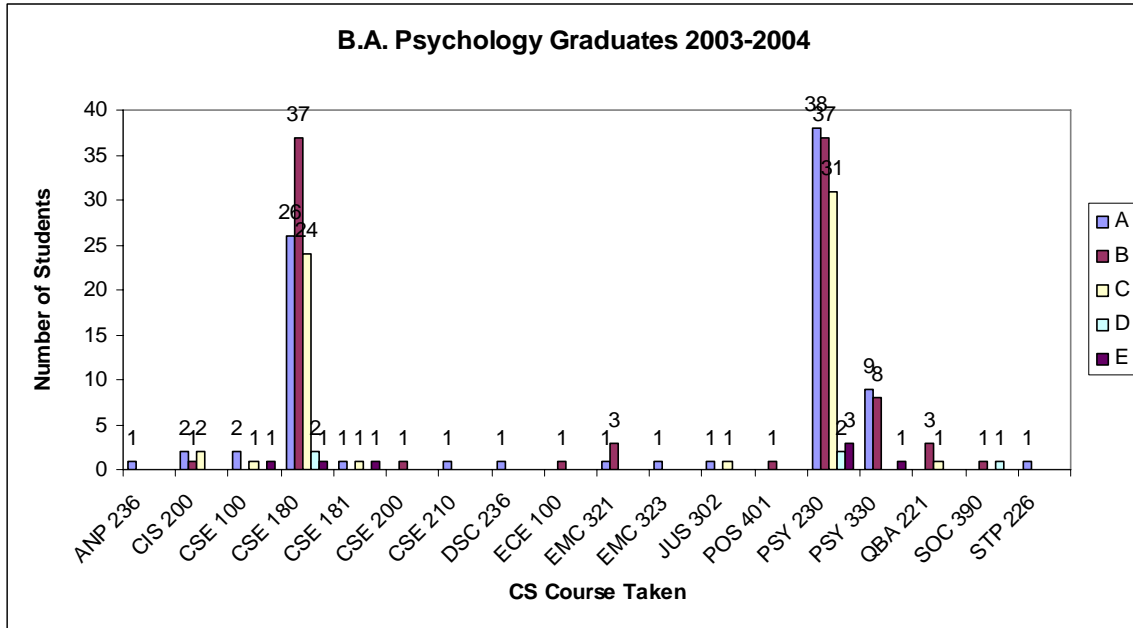


Figure 15. CS courses taken by 158 B.A. Psychology Graduates 2003-2004

Grade/ Course	ANP 236	CIS 200	CSE 100	CSE 180	CSE 181	CSE 200	CSE 210	DSC 236	ECE 100
A	1	2	2	26	1		1	1	
B		1		37		1			1
C		2	1	24	1				
D				2					
E			1	1	1				
Count	1	5	4	90	3	1	1	1	1

Grade/ Course	EMC 321	EMC 323	JUS 302	POS 401	PSY 230	PSY 330	QBA 221	SOC 390	STP 226	Count
A	1	1	1		38	9			1	85
B	3			1	37	8	3	1		93
C			1		31		1			61
D					2			1		5
E					3	1				7
Count	4	1	2	1	111	18	4	2	1	251

Table 15. CS courses taken by 158 B.A. Psychology Graduates 2003-2004

Figure and Table 15 include data for 158 out of 229 students (26 out of 36 minority students). 215 courses met the CS requirement, 21 courses met the N2 requirement, and 15 courses met the N3 requirement.

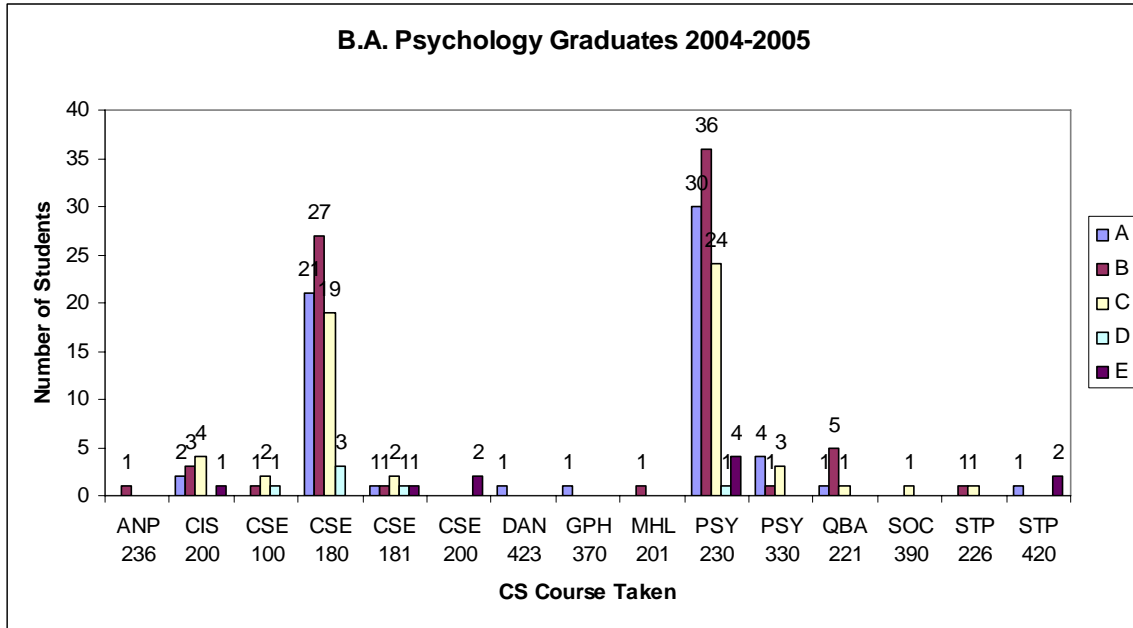


Figure 16. CS courses taken by 128 B.A. Psychology Graduates 2004-2005

Grade/ Course	ANP 236	CIS 200	CSE 100	CSE 180	CSE 181	CSE 200	DAN 423	GPH 370
A		2		21	1		1	1
B	1	3	1	27	1			
C		4	2	19	2			
D			1	3	1			
E		1			1	2		
Count	1	10	4	70	6	2	1	1

Grade/ Course	MHL 201	PSY 230	PSY 330	QBA 221	SOC 390	STP 226	STP 420	Count
A		30	4	1			1	62
B	1	36	1	5		1		77
C		24	3	1	1	1		57
D		1						6
E		4					2	10
Count	1	95	8	7	1	2	3	212

Table 16. CS courses taken by 128 B.A. Psychology Graduates 2004-2005

Figure and Table 16 include data for 128 out of 245 students (22 out of 53 minority students). 190 courses met the CS requirement, 13 courses met the N2 requirement, and 9 courses met the N3 requirement.

The requirement that all students majoring in psychology take PSY230 has been in place for many years. For each of the three academic years represented in the tables above, this is the course taken by the largest number of students. CSE courses were required for students entering the Psychology program prior to the spring of 2004, and thus a significant number of students have taken one of these courses.

Note that many of the students graduating with a B.A. in Psychology are not represented by this data. **For the 2002-2003 and 2003-2004 academic years, approx 70% of the B.A. Psychology students took a course meeting the CS requirement at ASU. For the 2004-2005 academic year, only 52% of the B.A. Psychology students took a course at ASU meeting the CS requirement.** When planning curriculum changes it might be worthwhile to determine how the remaining students are satisfying this ASU requirement. Did the number of transfer students increase, or have students found an “easier” way to satisfy this requirement?

Figures and Tables 17 through 19 demonstrate the number of B.S. Psychology students taking each CS course, along with their performance in each course. The data reflects a subset of the number of students graduating with a B.S. in Psychology.

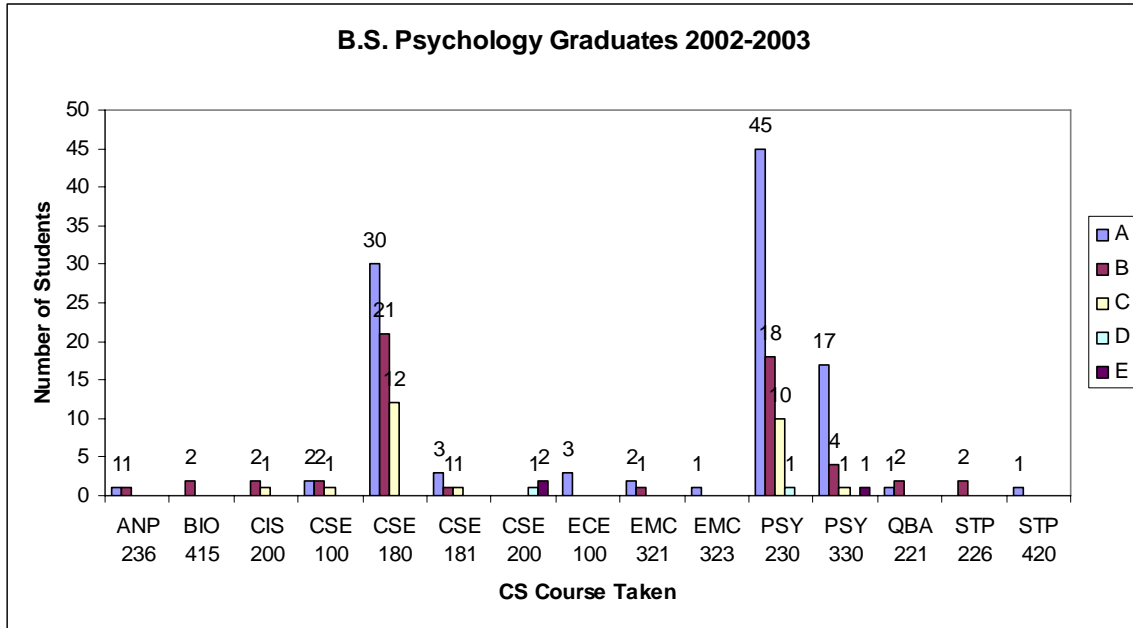


Figure 17. CS courses taken by 102 B.S. Psychology Graduates 2002-2003

Grade/ Course	ANP 236	BIO 415	CIS 200	CSE 100	CSE 180	CSE 181	CSE 200	ECE 100
A	1			2	30	3		3
B	1	2	2	2	21	1		
C			1	1	12	1		
D							1	
E							2	
Count	2	2	3	5	63	5	3	3

Grade/ Course	EMC 321	EMC 323	PSY 230	PSY 330	QBA 221	STP 226	STP 420	Count
A	2	1	45	17	1		1	106
B	1		18	4	2	2		56
C			10	1				26
D			1					2
E				1				3
Count	3	1	74	23	3	2	1	193

Table 17. CS courses taken by 102 B.S. Psychology Graduates 2002-2003

Figure and Table 17 include data for 102 out of 128 students (10 out of 16 minority students). 113 courses met the CS requirement, 38 courses met the N2 requirement, and 42 courses met the N3 requirement.

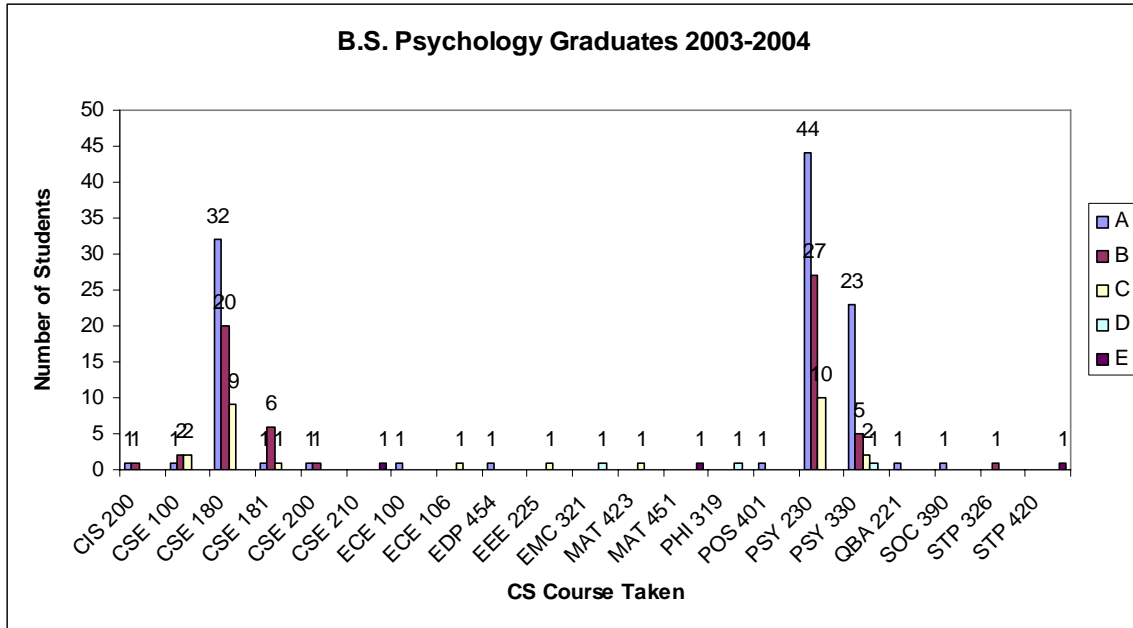


Figure 18. CS courses taken by 113 B.S. Psychology Graduates 2003-2004

Grade/ Course	CIS 200	CSE 100	CSE 180	CSE 181	CSE 200	CSE 210	ECE 100	ECE 106	EDP 454	EEE 225	EMC 321
A	1	1	32	1	1		1		1		
B	1	2	20	6	1						
C		2	9	1				1		1	
D											1
E						1					
Count	2	5	61	8	2	1	1	1	1	1	1

Grade/ Course	MAT 423	MAT 451	PHI 319	POS 401	PSY 230	PSY 330	QBA 221	SOC 390	STP 326	STP 420	Count
A				1	44	23	1	1			108
B					27	5			1		63
C	1				10	2					27
D			1			1					3
E		1								1	3
Count	1	1	1	1	81	31	1	1	1	1	204

Table 18. CS courses taken by 113 B.S. Psychology Graduates 2003-2004

Figure and Table 19 include data for 113 out of 146 students (15 out of 20 minority students). 161 courses met the CS requirement, 20 courses met the N2 requirement, and 23 courses met the N3 requirement.

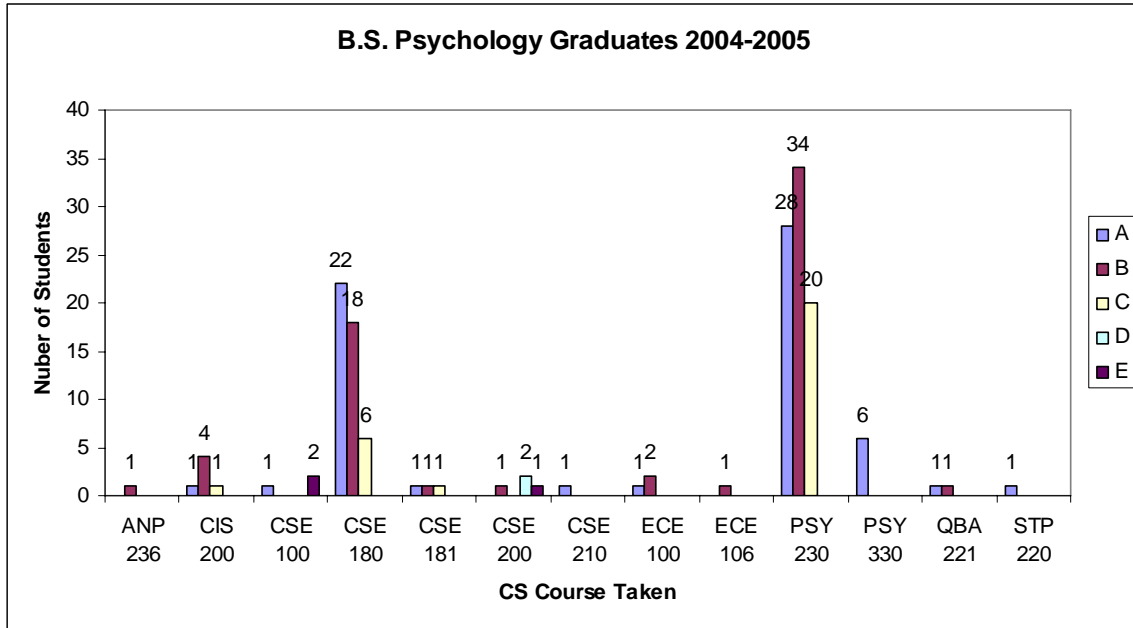


Figure 19. CS courses taken by 101 B.S. Psychology Graduates 2004-2005

Grade /Course	ANP 236	CIS 200	CSE 100	CSE 180	CSE 181	CSE 200	CSE 210
A		1	1	22	1		1
B	1	4		18	1	1	
C		1		6	1		
D						2	
E			2			1	
Count	1	6	3	46	3	4	1

Grade /Course	ECE 100	ECE 106	PSY 230	PSY 330	QBA 221	STP 220	Count
A	1		28	6	1	1	63
B	2	1	34		1		63
C			20				28
D							2
E							3
Count	3	1	82	6	2	1	159

Table 19. CS courses taken by 101 B.S. Psychology Graduates 2004-2005

Figure and Table 19 include data for 101 out of 159 students (25 out of 37 minority students). 143 courses met the CS requirement, 6 courses met the N2 requirement, and 10 courses met the N3 requirement.

The CS requirement for students obtaining a B.S. in Psychology is the same as that for the B.A. in Psychology. Thus the CS courses taken the most often are PSY230 and CSE180. Note CSE180 continues to be offered, however some of the other 100 level CSE courses meeting the CS requirement have changed.

The data in tables 17 through 19 represents a larger percentage of the graduates than was seen for the B.S. Psychology graduates. **For the 2002-2003 academic year, approx. 80% of the B.S. Psychology students took a CS course. For the 2003-2004 academic year, approx 77% of the B.S. Psychology students took a CS course. For the 2004-2005 academic year, only 64% of the B.S. Psychology students took a course at ASU meeting the CS requirement.** Once again the percentage was lower in the most recent year.

Figures and Tables 20 through 22 demonstrate the number of B.S. in Biological Sciences students taking each CS course, along with their performance in each course. The data reflects a subset of the number of students graduating with a B.S. in Biological Sciences.

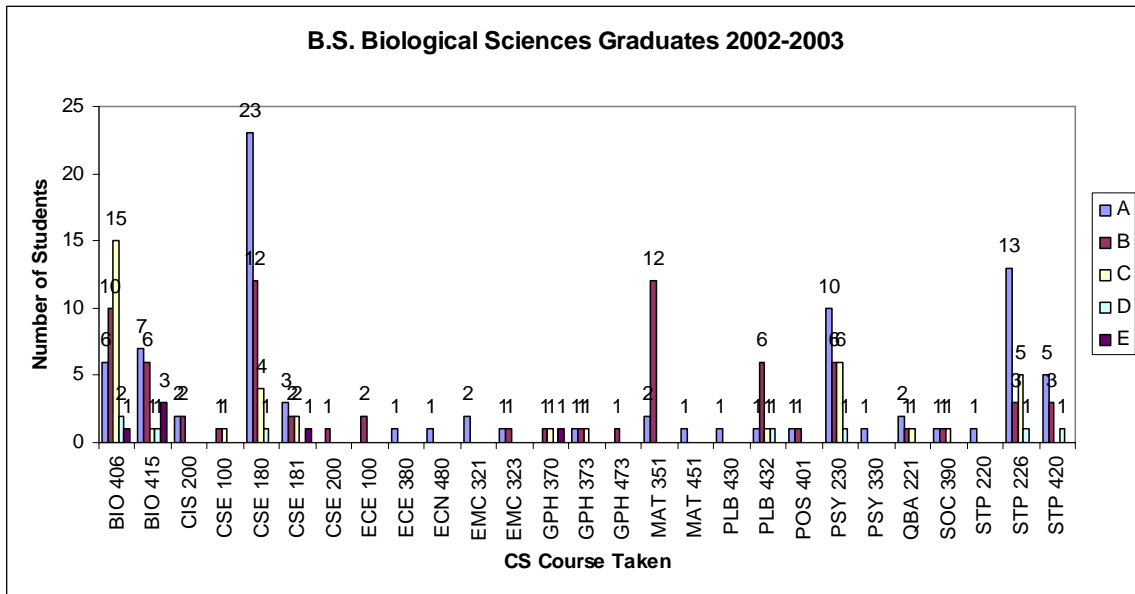


Figure 20. CS courses taken by 176 B.S. Biological Sciences Graduates 2002-2003

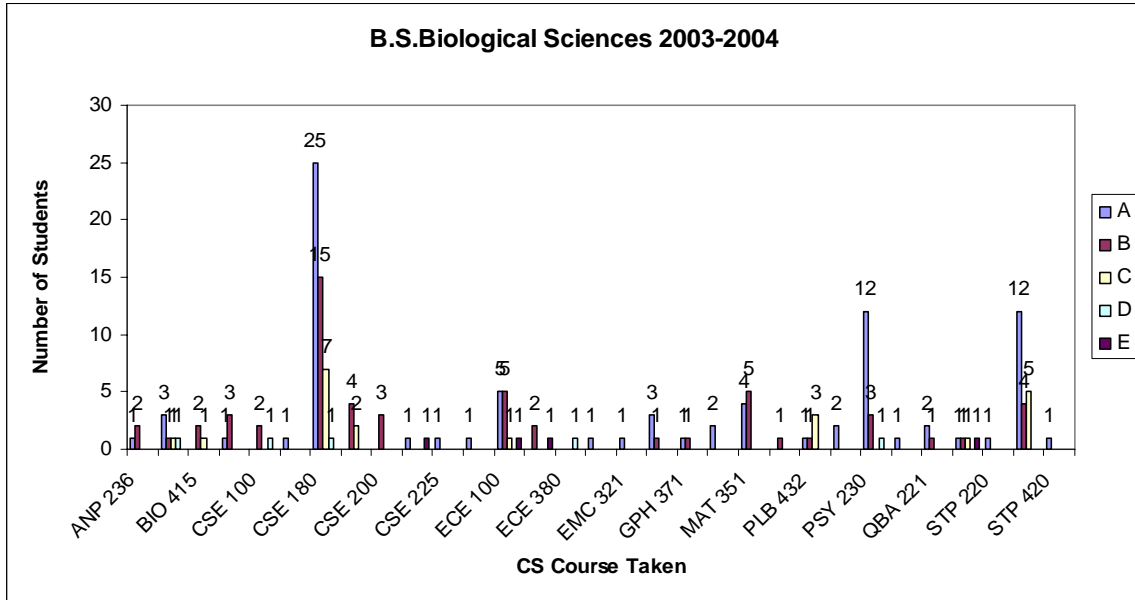
<b>Grade /Course</b>	<b>BIO 406</b>	<b>BIO 415</b>	<b>CIS 200</b>	<b>CSE 100</b>	<b>CSE 180</b>	<b>CSE 181</b>	<b>CSE 200</b>	<b>ECE 100</b>	<b>ECE 380</b>
A	6	7	2		23	3			1
B	10	6	2	1	12	2	1	2	
C	15	1		1	4	2			
D	2	1			1				
E	1	3				1			
Count	34	18	4	2	40	8	1	2	1

<b>Grade /Course</b>	<b>ECN 480</b>	<b>EMC 321</b>	<b>EMC 323</b>	<b>GPH 370</b>	<b>GPH 373</b>	<b>GPH 473</b>	<b>MAT 351</b>	<b>MAT 451</b>	<b>PLB 430</b>
A	1	2	1		1		2	1	1
B			1	1	1	1	12		
C				1	1				
D									
E				1					
Count	1	2	2	3	3	1	14	1	1

<b>Grade /Course</b>	<b>PLB 432</b>	<b>POS 401</b>	<b>PSY 230</b>	<b>PSY 330</b>	<b>QBA 221</b>	<b>SOC 390</b>	<b>STP 220</b>	<b>STP 226</b>	<b>STP 420</b>	<b>Count</b>
A	1	1	10	1	2	1	1	13	5	86
B	6	1	6		1	1		3	3	73
C	1		6		1	1		5		39
D	1		1					1	1	8
E										6
Count	9	2	23	1	4	3	1	22	9	212

**Table 20. CS courses taken by 176 B.S. Biological Sciences Graduates 2002-2003**

Figure and Table 20 includes data for 176 out of 247 students (12 out of 17 minority students). 161 courses met the CS requirement, 17 courses met the N2 requirement, and 34 courses met the N3 requirement.



**Figure 21. CS courses taken by 139 B.S. Biological Sciences Graduates 2003-2004**

Note: based on size limitation, all of the course labels are not shown. Refer to Table 22 for details.

Grade /Course	ANP 236	BIO 406	BIO 415	CIS 200	CSE 100	CSE 101	CSE 180	CSE 181	CSE 200	CSE 210	CSE 225
A	1	3		1		1	25			1	1
B	2	1	2	3	2		15	4	3		
C		1	1				7	2			
D		1			1		1				
E										1	
Count	3	6	3	4	3	1	48	6	3	2	1

Grade /Course	DAN 423	ECE 100	ECE 106	ECE 380	ECE 383	EMC 321	GPH 370	GPH 371	GPH 373	MAT 351	MAT 464
A	1	5			1	1	3	1	2	4	
B		5	2				1	1		5	1
C		1									
D				1							
E		1	1								
Count	1	12	3	1	1	1	4	2	2	9	1

Grade /Course	PLB 432	POS 401	PSY 230	PSY 330	QBA 221	SOC 390	STP 220	STP 226	STP 420	Count
A	1	2	12	1	2	1	1	12	1	84
B	1		3		1	1		4		57
C	3					1		5		21
D			1							5
E						1				4
Count	5	2	16	1	3	4	1	21	1	171

**Table 21. CS courses taken by 139 B.S. Biological Sciences Graduates 2003-2004**

Figure and Table 21 include data for 139 out of 244 students (16 out of 29 minority students). 128 courses met the CS requirement, 5 courses met the N2 requirement, and 38 courses met the N3 requirement.

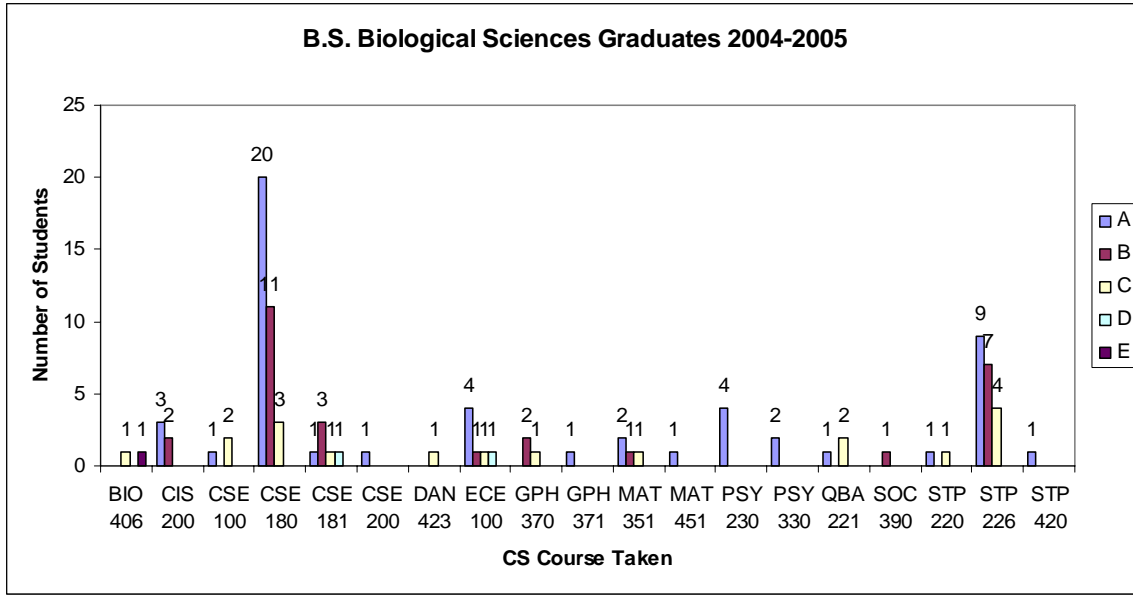


Figure 22. CS courses taken by 91 B.S. Biological Sciences Graduates 2004-2005

Grade /Course	BIO 406	CIS 200	CSE 100	CSE 180	CSE 181	CSE 200	DAN 423	ECE 100	GPH 370	GPH 371
A		3	1	20	1	1		4		1
B		2		11	3			1	2	
C	1		2	3	1		1	1	1	
D					1			1		
E	1									
Count	2	5	3	34	6	1	1	7	3	1

Grade /Course	MAT 351	MAT 451	PSY 230	PSY 330	QBA 221	SOC 390	STP 220	STP 226	STP 420	Count
A	2	1	4	2	1		1	9	1	52
B	1					1		7		28
C	1				2		1	4		18
D										2
E										1
Count	4	1	4	2	3	1	2	20	1	101

Table 22. CS courses taken by 91 B.S. Biological Sciences Graduates 2004-2005

Figure and Table 22 include data for 91 out of 252 students (15 out of 35 minority students). 81 courses met the CS requirement, 2 courses met the N2 requirement, and 18 courses met the N3 requirement.

**The CS requirement for students obtaining a B.S. in Biological Sciences is as varied as the programs themselves. Tables 20-23 show a wide variety of courses being used to satisfy this requirement. CSE180, Computer Literacy appears to be the most popular course taken**

A closer look was taken at the students taking MAT351, as the program requirements list this course for Molecular Biosciences and Biotechnology majors. From the spring of 2000 through the spring of 2005, 120 undergraduate students completed MAT351. Of these 120 students, 60 were Molecular Biosciences and Biotechnology majors. Of these 60 students, 51 obtained a B or better in the course.

To relate this information to the total number of students completing a B.S. degree in Molecular Biosciences and Biotechnology (MBB) a closer look was taken at the 2004-2005 graduates. In 2004-2005 there were 17 MBB graduates. 16 of these students took a course meeting the CS requirement at ASU. Of these, 11 took MAT351. **Across the three academic years for which data was collected, 40 out of 63 MBB students took MAT351. It appears that currently approx one-third of the MBB students are getting permission to satisfy their CS requirement with a course other than the course that is documented as required.**

The data in tables 20 through 22 represents a decreasing percentage of the Biological Sciences. For the 2002-2003 academic year, approx. 71% of the students took a CS course. For the 2003-2004 academic year, approx 57% of the students took a CS course. For the 2004-2005 academic year, only 36% of the students took a course at ASU meeting the CS requirement. **As program changes, focused on freshman and sophomore level courses, are evaluated, it may be important to determine whether the fact that fewer students are taking their CS classes at ASU is the result of higher levels of transfer students. If the decrease indicates that students are avoiding these classes, then curriculum changes are truly needed!**

### ***Performance in Mathematics***

The data collected in the previous section of this report demonstrates that a wide variety of courses are being taken to satisfy the General Studies, Mathematical Studies (MA) and

(CS) requirements. In this section of this report the performance of students in their Mathematics courses will be related to their performance overall.

All of the courses which satisfy the (MA) requirement are offered by the Department of Mathematics and Statistics and are prefixed with MAT. The courses that satisfy the (CS) requirement are offered by numerous departments across ASU. Based on the nature/diversity of the courses meeting the (CS) requirement, and the focus of the proposed curriculum changes, the determination of performance in Mathematics courses has been limited to courses starting with the MAT prefix. Using these MAT courses a “MatGPA”<sup>11</sup> will be compared with the student overall ASU GPA as well as their “UpperGPA”<sup>12</sup>.

### **Computing GPAs**

An overall or cumulative GPA is available for each student completing a degree at ASU. For this study we are interested in how each student performs in the coursework associated with the development of quantitative reasoning skills. In addition, we would like to determine how this performance compares to performance in coursework required for the student’s major.

A MatGPA is computed from courses with the MAT prefix. An UpperGPA (major GPA) is computed from courses constituting the upper level electives specific to a student’s major. The queries detailed in Appendix B of this report describe the courses included, and the computations performed to obtain the each GPA.

The computation of a MatGPA is limited to the number of student that took a course prefixed by MAT at ASU. The UpperGPA is computed for every student receiving a degree in the behavioral or life sciences. The course prefixes representing the students upper level electives resulted in a GPA which was based on an average of 10 to 12 courses per student. The students’ ASU GPA is the cumulative GPA computed by ASU, at the time the student’s degree was awarded.

---

<sup>11</sup> MatGPA is defined in Appendix A of this report. Appendices B, C, and D contain additional details with respect to the details of this GPA.

<sup>12</sup> UpperGPA is defined in Appendix A of this report. Appendices B, C, and D contain additional details with respect to the details of this GPA.

## **When are Mathematics Courses Taken?**

ASU has requirements in place that are designed to assure some level of competency in Mathematics early in a student's academic career (within the first 30 credits taken at ASU). Continuous enrollment in mathematics is required until the student has reached the level of the University's mathematics requirement (previously College Algebra, now Precalculus). The perception from this would be that students get their mathematical reasoning skills in place before they tackle their upper level courses.

These requirements do not assure that students requiring calculus as part of their major satisfy this major requirement at any particular time. **None of the upper level electives in psychology require calculus as a prerequisite. In the Life Sciences, Biometry (BIO 415) and Statistical Analyses in Environmental Science (PLB 430) list Brief Calculus (MAT 210) or its equivalent as a prerequisite.** Tables 20 through 22 show that across three academic years, 22 out of 662 Life Sciences students took ones of these courses to satisfy their Mathematical Studies (CS) requirement. The remaining students had no courses in their major that required their calculus requirement as a prerequisite. **It should also be noted that when calculus is required as a prerequisite, it is Brief Calculus (MAT 210), not Calculus for Life Sciences (MAT 251) that is noted in the ASU General Catalog.**

To assess the impact of the mathematics courses required by each major, on the students' performance in their major, it is important to know when the mathematics courses were taken. If the Mathematics courses are taken "late" in the student's academic career, they can not be credited as "preparing" the student for their upper level courses. By looking at when the mathematics course are taken, we hope to determine the importance of when the courses are taken, as well as the relationship between performance in mathematics and performance in the major.

For this study we collected data for students graduating over a period of three academic years. The students took a varying length of time to complete their degrees. In addition, students transferred into ASU varying numbers of credits. Some guidelines were established in order to characterize whether a student took their mathematics early or

late<sup>13</sup>. The date associated with their mathematics was the date of the first MAT course taken at ASU. If a student took their first MAT within two years of graduation, they were characterized as late (student must be a junior or senior and already taking upper level electives). If the student took their first MAT course more than two years before graduation, they were characterized as early. If a student did not take MAT courses at ASU, no assumption were made as to whether their mathematics skills were in place early or late.

### **Minority Information**

As a part of the Research Proposal for curriculum changes, ASU would like to demonstrate that they are making an effort to make research careers in the behavioral and life sciences available to minority students. The data in the previous sections of this report, as well as the GPA related data presented here has been broken down such the number of minority students participating each program as well as their performance can be ascertained.

The number of minority students in each degree program in this study (B.A. and B.S. in Psychology; B.S. Biological Sciences) has increased across the three academic years for which data was collected. The percentage of minority students in each degree program is shown in Figures 2 through 4 of this report. **The percentage of minority students earning a B.A. in Psychology increased from 15% to 22%, while the number of students graduating increased by 21% in the same time frame. The percentage of minority students earning a B.S. in Psychology increased from 13% to 23%, while the number of students graduating increased by 24% in the same time frame. The percentage of minority students earning a B.S. in one of the Biological Sciences increased from 7% to 14%, while the number of students graduating remained steady (overall increase of 2%).**

### **GPA Data Obtained**

The mean GPA's for all behavioral science and life sciences graduates have been tabulated in Appendix C. The data is organized first by degree program and then by academic year.

---

<sup>13</sup> See Appendix A for terms associated with when mathematics course are taken.

## **B.A. Psychology**

Appendix C.1 summarizes the mean GPA for students earning a B.A. in Psychology. During all three academic years the group of students within this degree program which had the highest overall GPA (ASU GPA) and the highest GPA in their upper level electives, were the students that did not take any MAT courses at ASU. It may be that these students are students that were better prepared for college, and had already satisfied their Mathematics requirements while in High School. They could also be transfer students, whom had a couple of years of experience at studying for college level courses, before accumulating a GPA at ASU. Regardless of the reason for this trend, it is the students that do take courses to satisfy Mathematical Studies requirements at ASU that would be impacted by the proposed curriculum changes.

**When looking at all of the B.A. Psychology students for each academic year, the mean Math GPA is higher when the MAT course is taken late. This may be the result of students having overlapping information from other courses, or being more experienced at studying when taking their MAT course.**

The major GPA for all students, when the MAT course is taken “early” of “late” fluctuates between which group is higher or lower, with the overall difference being between 0.08 and 0.16 grade points. **When all of the B.A. Psychology students for all three years are combined, students taking MAT “early” have a mean Upper GPA that is 0.07 grade points higher. Statistical analysis is required to determine if this is significant.**

The Upper GPA is computed for all 300+ level courses prefixed with PSY or PGS. In general, the overall ASU GPA and the Upper Level GPA are comparable.

### **Minority B.A. Psychology Students**

The mean GPA for “minority only” students shows more variability than the values across all students. The overall ASU GPA for minority students versus non-minority students is an average of 0.15 to 0.25 grade points lower.

The mean Math GPA includes a number of students with failing Math Grades. To graduate from ASU’s College of Liberal Arts and Science, a student must satisfy their

Mathematical Studies (MA) requirement with a 2.0 or higher. For a student to have a Math GPA less than 2.0, they either have a failed course averaged with a passing course, or they failed a course at ASU and then transferred credits in for a passing course. The transferred credits would not increase the GPA within ASU.

**In 2002-2003, the 9 minority B.A. Psychology students taking math late performed better than the 18 students taking math early. In 2003-2004 and 2004-2005 the trend was reversed, with students performing better in their major and overall, when math was taken early.**

### **B.S. Psychology**

Appendix C.2 summarizes the mean GPA for students earning a B.S. in Psychology. This is a degree program that requires Calculus, unlike the students just described in the previous section.

During all three academic years the number of student taking math late rather than early, appears to be lower than for B.A. Students. **Approximately 1/5 of the B.S. Psychology students that take Math at ASU take it late. During all three years the percentage of students not taking their Math at ASU appears to be higher than within the B.A. Psychology students. Approximately 1/3 of the B.S. Psychology students satisfy their mathematics requirement outside ASU.**

In the 2002-2003 academic year the average overall GPA of a student earning a B.A. in Psychology was slightly higher than that of a student earning a B.S. in Psychology. The overall ASU GPA and the Major GPA of B.A. Psychology students has decreased, while that of B.S. Psychology students has increased each year, such that in 2004-2005 the overall ASU GPA of a B.S. Psychology student was 0.27 grade points higher and the major GPA was 0.32 grade point higher.

### **Minority B.S. Psychology Students**

**For minority students earning a B.S. in Psychology, performance in their upper level electives is higher when math is taken early, regardless of whether their MAT GPA was higher or lower as a result of “early” versus “late”.**

In many cases the MAT GPA is significantly lower than the overall ASU GPA and the Major GPA. In some cases this is the result of a course failed at ASU bringing the Math GPA down, and the repeated course being taken elsewhere, such that the better grade is not reflected in the GPA calculated here.

### **B.S. Biological Sciences**

Appendix C.3 summarizes the mean GPA for students earning a B.S. in Psychology. For reference, Appendix C.4 provides a breakdown of students within each individual major within the School of Life Sciences. These degree programs all require Calculus.

During all three academic years the number of student taking Math at ASU appears to be similar to that of B.S. Psychology students. **Approximately 1/3 of the B.S. Biological Sciences students satisfy their mathematics requirement outside ASU. Of the remaining students, 16-19% take their calculus late in the degree program.**

**In 2002-2003, the B.S. Biological Sciences students that took their math early had a higher Math GPA, but there was no difference in their major GPA as a result. In 2003-2004 the students taking Math early performed better overall by 0.2 grade points. In 2004-2005, the difference in performance when Math is taken early or late is much less (0.04-0.05).** The mean overall ASU GPA for all Biological Sciences majors across all three academic years has a range from 3.17 to 3.19.

### **Minority B.S. Biological Sciences Students**

The overall ASU GPA for minority student in the Biological Sciences is between 0.2 and 0.4 grade points lower than non-minority students. **Minority B.S. Psychology students taking math early appear to do better or the same in their major, than those taking it late.** The major GPA for these students tends to run slightly lower than their overall ASU GPA.

### **Statistical view of GPA data**

One of the goals of this research was to assess performance in Mathematics courses. An effort was made to include all of the Mathematics courses a student has taken at ASU, in the computation of a Math GPA. After stepping through the data collected, it is not clear whether the Math GPA calculated here is the best representation. Perhaps if a student

takes a class and fails it, then takes it again and passes it, we want to compare the passing grade only against performance in subsequent upper level electives.

### Statistical Analyses

I started out trying to perform a linear regression between the Math GPA and the overall ASU GPA or Math GPA and Upper Level/Major GPA. After looking closer at the Math GPA, based on a couple of courses versus the other GPAs based on many more courses, I did not feel that this was a legitimate comparison/correlation. I chose to use the “When” values used to infer “late” and “early” as post-test control versus treatment values<sup>14</sup>. The “When” values were set to 0, if Math was taken late. This was viewed as the control group. The “When” values were set to 1, if Math was taken early. This was viewed as the treatment group. When linear regression is performed, the “When” values of 0 and 1 are the X values. The GPAs are the Y values. The predicted Y value at X=0, the intercept, is the mean when Math is taken late. The slope represents the improvement/increase or decline when Math is taken early.

To perform this analysis, data from all three academic years was combined. Datasets for all students in each degree program and datasets for minority students in each degree program were assessed. The number of students represented is as follows:

	Minority Students			All Students		
Math When	Late =0	Early =1	Total	Late =0	Early =1	Total
B.A. Psychology	26	64	90	119	384	503
B.S. Psychology	10	41	51	55	224	279
B.S. Biological Sciences	10	47	57	85	404	489

**Table 23. Data Points for Statistical Analysis**

#### Minority Students B.A. Psychology:

Y = Math GPA and X = When       $Y = 2.46808 - 0.17605X$  (GPA lower for early)  
 mean GPA for Math Late = 2.4681; 95% confidence interval 2.1212 to 2.8149  
 mean GPA for Math Early = 2.292; 95% confidence interval 2.0710 to 2.5131

Y = Upper GPA and X = When       $Y = 2.79654 + 0.17096X$  (GPA higher for early)

<sup>14</sup> Posttest Analysis: <http://www.socialresearchmethods.net/kb/statsimp.htm>

mean GPA for Math Late = 2.7965; 95% confidence interval 2.5671 to 3.0259  
mean GPA for Math Early = 2.9675; 95% confidence interval 2.8213 to 3.1137

Y = ASU GPA and X = When  $Y = 2.89115 + 0.07853X$  (GPA higher of early)  
mean GPA for Math Late = 2.8912; 95% confidence interval 2.6981 to 3.0842  
mean GPA for Math Early = 2.9697; 95% confidence interval 2.8466 to 3.0927

**For minority students earning a B.A. in Psychology, the performance in Math is slightly higher when taken later; taking it early has some impact on the performance in the Upper Level electives. The impact on the overall GPA is negligible.**

#### **Minority Students B.S. Psychology:**

Y = Math GPA and X = When  $Y = 2.4000 - 0.00561X$  (no difference)  
mean GPA for Math Late = 2.4000; 95% confidence interval 1.8566 to 2.9434  
mean GPA for Math Early = 2.3944; 95% confidence interval 2.1260 to 2.6628

Y = Upper GPA and X = When  $Y = 2.85000 + 0.33878X$  (GPA higher for early)  
mean GPA for Math Late = 2.8500; 95% confidence interval 2.5071 to 3.1929  
mean GPA for Math Early = 3.1888; 95% confidence interval 3.0194 to 3.3581

Y = ASU GPA and X = When  $Y = 2.80300 + 0.31871X$  (GPA higher of early)  
mean GPA for Math Late = 2.8030; 95% confidence interval 2.5250 to 3.0810  
mean GPA for Math Early = 3.1217; 95% confidence interval 2.9844 to 3.2590

**For minority students earning a B.S. in Psychology, the performance in Math is no different when taken later; taking it early has some impact on the performance in the Upper Level electives and overall GPA.**

#### **Minority Students B.S. Biological Sciences:**

Y = Math GPA and X = When  $Y = 2.3000 + 0.24340X$  (GPA higher for early)  
mean GPA for Math Late = 2.3000; 95% confidence interval 1.7396 to 2.8604  
mean GPA for Math Early = 2.5434; 95% confidence interval 2.2849 to 2.8019

Y = Upper GPA and X = When  $Y = 2.59000 + 0.16660X$  (GPA higher for early)  
mean GPA for Math Late = 2.5900; 95% confidence interval 2.1434 to 3.0366  
mean GPA for Math Early = 2.7566; 95% confidence interval 2.5506 to 2.9626

Y = ASU GPA and X = When  $Y = 2.65800 + 0.20200X$  (GPA higher of early)  
mean GPA for Math Late = 2.6580; 95% confidence interval 2.3542 to 2.9618  
mean GPA for Math Early = 2.8600; 95% confidence interval 2.7199 to 3.0001

For minority students earning a B.S. in Psychology, the performance in Math is higher but within the variability; the variability in the values is so high that one confidence interval cannot be distinguished from the other; i.e. it can not be determined whether the timing of taking Math has an impact on Upper GPA or overall ASU GPA.

**All Students B.A. Psychology:**

Y = Math GPA and X = When  $Y = 2.80261 - 0.268335X$  (GPA lower for early)  
mean GPA for Math Late = 2.8026; 95% confidence interval 2.6444 to 2.9608  
mean GPA for Math Early = 2.5343; 95% confidence interval 2.4462 to 2.6224

Y = Upper GPA and X = When  $Y = 2.99538 + 0.06954X$  (no difference)  
mean GPA for Math Late = 2.9954; 95% confidence interval 2.8852 to 3.1055  
mean GPA for Math Early = 3.0649; 95% confidence interval 3.0036 to 3.1262

Y = ASU GPA and X = When  $Y = 3.08328 - 0.02070X$  (no difference)  
mean GPA for Math Late = 3.0833; 95% confidence interval 2.9921 to 3.1745  
mean GPA for Math Early = 3.0626; 95% confidence interval 3.0118 to 3.1134

**For all students earning a B.A. in Psychology, the performance in Math is discernibly higher when taken later; it can not be determined whether the timing of taking Math has an impact on Upper GPA or overall ASU GPA.**

**All Students B.S. Psychology:**

Y = Math GPA and X = When  $Y = 2.88473 - 0.21633X$  (GPA lower for early)  
mean GPA for Math Late = 2.8847; 95% confidence interval 2.6345 to 3.1349  
mean GPA for Math Early = 2.6684; 95% confidence interval 2.5444 to 2.7924

Y = Upper GPA and X = When  $Y = 3.20145 + 0.03832X$  (no difference)  
mean GPA for Math Late = 3.2015; 95% confidence interval 3.0432 to 3.3597  
mean GPA for Math Early = 3.2398; 95% confidence interval 3.1614 to 3.3182

Y = ASU GPA and X = When  $Y = 3.21200 - 0.07392X$  (no difference)  
mean GPA for Math Late = 3.2120; 95% confidence interval 3.0816 to 3.3424  
mean GPA for Math Early = 3.1809; 95% confidence interval 3.1163 to 3.3182

**For all students earning a B.S. in Psychology, the performance in Math is discernibly higher when taken later; it cannot be determined whether the timing of taking Math has an impact on Upper GPA or overall ASU GPA.**

**All Students B.S. Biological Sciences:**

Y = Math GPA and X = When  $Y = 2.76071 + 0.10954X$  (GPA higher for early)

mean GPA for Math Late = 2.7607; 95% confidence interval 2.5573 to 2.9641  
mean GPA for Math Early = 2.8702; 95% confidence interval 2.7770 to 2.9635

Y = Upper GPA and X = When  $Y = 3.05765 + 0.03985X$  (no difference)  
mean GPA for Math Late = 3.0576; 95% confidence interval 2.9213 to 3.1940  
mean GPA for Math Early = 3.0975; 95% confidence interval 3.0350 to 3.1600

Y = ASU GPA and X = When  $Y = 3.10624 + 0.0591X$  (no difference)  
mean GPA for Math Late = 3.1062; 95% confidence interval 2.9973 to 3.2152  
mean GPA for Math Early = 3.1655; 95% confidence interval 3.1156 to 3.2155

For all students earning a B.S. in Psychology, the performance in Math is higher but within the variability; the variability in the values is so high that one confidence interval cannot be distinguished from the other; i.e. it can not be determined whether the timing of taking Math has an impact on Upper GPA or overall ASU GPA.

## Conclusion / Remarks

The number of students not taking their general studies requirements at ASU, is quite surprising. This study focused on the students that have been successful, i.e. the students that have graduated. As curriculum changes are made, it may also be important to also look at the students that start out in these programs, and perhaps face stumbling block along the way.

The classes that students are taking to meet the general studies, mathematical studies courses have been presented. **It is surprising, based on a reading of all the self-advising and curriculum check sheets for the various degree programs, that students are not taking Calculus for the Life Sciences (MAT 251). It is also surprising that many student requiring calculus are waiting until way late in their degree programs to take it all. For students to benefit from the curriculum changes proposed, students taking Math at ASU will need to be directed toward these classes including the changes.**

Calculus for the Life Sciences is being made a program requirement for students earning a B.S. in Psychology; with this in mind it is surprising to find that no Psychology course lists calculus as a prerequisite.

It is also surprising that many students take their basic computer literacy course from the computer science department, when numerous courses that are more specific to these

degree programs are available. When making such courses available it is, and will be, important to make it known which general studies requirement they meet.

Performance in Mathematics is hard to gauge. Do we want to look at the highest grade a student got or an average of all their attempts? How do we adjust for a student failing a class and then taking it again outside ASU? Including just the attempts at ASU, lead to a high variability in the Math GPAs calculated, and made it hard to determine whether there is a strong correlation between performance in math and performance in the behavioral and life sciences.

Quantitative reasoning skills are important to the success of students in the behavioral and life sciences. When students take Math later in their degree programs, they may perform better in it, if for no other reason than that they have more experience at studying and testing at a college level. However, performing better in a single Math course does not offset the benefit of having these skills in place prior to tackling the many courses required by the students major. If a student takes their Math earlier, they may find their upper level electives a little bit easier, and perhaps even perform better in them.

The performance of minority students appears to run a bit lower across all of the degree programs. Thus there is more room for improvement in the GPAs of these students. The benefits of taking Math earlier are clearly demonstrated in the performance analysis of minority students.

## ***Appendix A: Glossary of Terms***

**Academic Year:** denotes students graduating in the fall, spring, or summer. For example the academic year 2002-2003 includes students graduating in the fall of 2002, spring of 2003, or the summer of 2003.

**ASU:** Arizona State University. The programs offered at main campus of ASU provide the academic basis of this research.

**ASU Data Warehouse:** warehouse of read-only data maintained by the University. The Data Warehouse includes databases contains student and course information.

**ASU GPA:** denotes the cumulative GPA computed by the ASU registrar for all coursework.

**Behavioral Sciences:** degree programs offered by the Psychology Department at ASU. The focus in this research is undergraduate degree programs. The Psychology Department at ASU offers both Bachelor of Arts (B.A.) and Bachelor of Science (B.S.) degree programs in Psychology.

**Biological Sciences / Life Sciences:** degree programs offered by the School of Life Sciences at ASU. The focus in this research is undergraduate degree programs. The School of Life Sciences at ASU offers programs leading to Bachelor of Science degrees. The degree programs offered are as follows:

B.S. in Biology

B.S. in Biology with a Concentration in  
Biology and Society

B.S. in Plant Biology

B.S. in Plant Biology with concentration in  
Environmental Science and Ecology

B.S. in Plant Biology with concentration in  
Plant Biochemistry and Molecular Biology

B.S. in Molecular Biosciences and Biotechnology

B.S. in Microbiology

B.S. in Conservation Biology

B.S. in Clinical Laboratory Sciences

**College of Liberal Arts and Sciences (CLAS):** college within the ASU main campus.

The entities within CLAS which are of interest in this study are the Psychology Department, the School of Life Sciences (SoLS), and the Mathematics and Statistics Department.

**General Studies:** program at ASU that applies to all students earning a bachelors degree. The programs goal is to assure that all students have a broad basis in their education and develop general intellectual skill needed to continue learning. The general studies program requirement of interest to this study is the mathematical studies requirement. This component has two categories: mathematics (MA) and computer/statistics/quantitative applications (CS). The 3 credits required in each category are expected to be satisfied within the first 30 credits at ASU.

**Major GPA (UpperGPA):** denotes a GPA computed for upper level courses required by the major. For psychology majors this would be courses with a prefix of PSY or PGS, and a numeric suffix greater than or equal to 300. For biosciences majors this would be course with a numeric suffix greater than or equal to 300. The course prefixes for a biosciences major's upper level course requirements is much more varied than that for a psychology major. See Appendix B for details. The value is based on data extracted from the ASU Data Warehouse.

**Math GPA (MatGPA):** denotes a GPA computed for courses prefixed by MAT. The value is based on data extracted from the ASU Data Warehouse.

**Math When? :** denotes when a student took their first course with the MAT prefix at ASU.

**Late:** indicates that the first MAT course was taken within two years of the semester in which the student's degree was awarded.

**Early:** indicates that the first MAT course was taken more then two years prior to the semester in which their degree was awarded.

**Not at ASU:** indicates that the student never took a course with an MAT prefix at ASU. All students are required to satisfy a mathematics requirement. If they never took an MAT course at ASU, then their mathematics requirement was either satisfied during high school or taken at another institution, and the credits transferred in

**Mathematical Studies (MA):** general studies requirement (3 credits) which is intended to ensure that students have the basic skills necessary to perform mathematical analysis within their chosen field. This requirement was established in the fall of 2000, replacing the Numeracy requirement (N1).

**Mathematical Studies (CS):** general studies requirement (3 credits) which is intended to ensure that students have skills in real world problem solving and analysis. . This requirement was established in the fall of 2000, replacing the Numeracy requirements (N2) and (N3).

**Mathematics and Statistics Department:** department within the College of Liberal Arts and Sciences at the ASU main campus which provides all of the courses satisfying the Mathematical Studies (MA) requirement and many of the courses satisfying the Mathematical Studies (CS) requirement.

**Minority:** denotes students with U.S. Citizenship and a Minority status code of African American/Black (B), Native American/Alaskan (N), or Hispanic (H).

**School of Life Sciences (SoLS):** school created within the College of Liberal Arts and Sciences in 2003. SoLS encompasses all of the degree programs offered in the biosciences. These degree programs were previously offered through multiple departments within the College of Liberal Arts and Sciences.

**Upper Level Courses:** courses typically taken during the Junior and Senior year of an undergraduate degree program. These courses have a course number of 300 or higher.

## Appendix B: Sample Queries

### B.1: B.S. Degrees in Behavioral and Life Sciences (Ever)

This query displays information (degree, description, semesters offered) for the all of the Bachelor of Science degrees that the College of Liberal Arts and Sciences, ASU main campus has offered in the behavioral and life sciences. The list of degree codes used as a limit was established by querying for ranges of degree codes, and determining those that apply.

For the behavioral sciences, the degree programs offered has remained steady for many years. The degree programs offered in the life sciences have changed; just as the departments offering them have changed. The School of Life Sciences itself came into existence within the past five years. Familiarity with the degree programs that have been offered within the past decade has been useful in determining course prefixes associated with life Sciences majors.

### Query Section of Brio Intelligence

Table:

**Code Degree Major Lookup** – list of major/degree combinations with semesters they are valid and departments offering them

Limits:

Academic Program Campus Code = M

College Or Division Code = LA

Degree Code = 31

Major Code= 0399, 0400, 0401, 0402, 0403, 0404, 0405,  
0406, 0407, 0408, 0409, 0411, 0420, 0421,  
0422, 0499, 1223, 1225, 1296, 1299, 2001

Fields Displayed:

Major Code

Degree Code

Semester Begin

Semester Expires

Semester Previous Began

Semester Previous Expired

Table:

**Code Degree** – description of each degree code

Join:

**Code Degree Major Lookup.Degree Code** = - - **Code Degree.Degree Code**

Fields Displayed:

**Description** (change properties such that label = Degree Description)

Table:

**Code Major** – description of each major code

Join:

**Code Degree Major Lookup.Major Code** = - - **Code Major.Major Code**

Fields Displayed:

[Description](#) (change properties such that label = Major Description)

Table:

[Code Curriculum Department](#) – description of each department code

Join:

[Code Degree Major Lookup](#).[Curriculum Department Code](#) - = - [Code Curriculum Department](#).[Curriculum Department Code](#)

Fields Displayed:

[Description](#) (change properties such that label = Curr Dept Description)

## Results Section of Brio Intelligence

A list (21) of life science and behavioral science degrees ever offered. 11 of these still exist today and are denoted by [Semester Expires](#) = 99999. Examples of degree programs that no longer exist include:

- 0407 Zoology (expired fall 1998)
- 0402 Botany (expired fall 1997)
- 0421 Entomology (expired Spring 1984)
- 0499 Wildlife Biology (expired Spring 1991)

### ***B.2: B.S. Degrees in Behavioral and Life Sciences (Current)***

This query displays information (degree, description) for the all of the Bachelor of Science degrees that the College of Liberal Arts and Sciences, ASU main campus currently offers in the behavioral and life sciences. The list of degree code used as a limit was established by querying for ranges of degree codes, and determining those that apply.

ASU does not offer Bachelor of Arts degrees in the life sciences. There is however a Bachelor of Arts degree in Psychology, available from the Psychology Department. To display this degree, modify the degree code to include a value of 21 in the query below. ([Degree Code](#) = 21, 31)

## Query Section of Brio Intelligence

Table:

[Code Degree Major Lookup](#) – list of major degree combos with semesters they are valid and departments offering them

Limits:

[Academic Program Campus Code](#) = M  
[College Or Division Code](#) = LA  
[Degree Code](#) = 31  
[Major Code](#)= 0399, 0400, 0401, 0402, 0403, 0404, 0405,  
0406, 0407, 0408, 0409, 0411, 0420, 0421,  
0422, 0499, 1223, 1225, 1296, 1299, 2001  
[Semester Expires](#) = 99999

Fields Displayed:

Major Code	Degree Code
Semester Begin	Semester Expires
Semester Previous Began	Semester Previous Expired

Table:  
Code Degree – description of each degree code

Join:  
Code Degree Major Lookup.Degree Code - = - Code Degree.Degree Code

Fields Displayed:  
Description (change properties such that label = Degree Description)

Table:  
Code Major – description of each major code

Join:  
Code Degree Major Lookup.Major Code - = - Code Major.Major Code

Fields Displayed:  
Description (change properties such that label = Major Description)

Table:  
Code Curriculum Department – description of each department code

Join:  
Code Degree Major Lookup.Curriculum Department Code - = - Code Curriculum Department.Curriculum Department Code

Fields Displayed:  
Description (change properties such that label = Curr Dept Description)

## Results Section of Brio Intelligence

A list (11) of the Bachelor of Science degrees currently offered in the life science and behavioral sciences is displayed. These programs are denoted by Semester Expires = 99999.

The 11 valid degree programs (as of Spring 2006) are:

- 0400 Biology (Biology & Society)
- 0401 Biology
- 0403 Plant Biology
- 0404 Plant Bio (Envrnmtl Sci & Ecol)
- 0408 Molecular Bio Sci/Tech
- 0409 Plant Bio (Plnt Biochem/Mol Bio)
- 0411 Microbiology
- 0420 Conservation Biology
- 1296 Clinical Laboratory Science
- 1299 Pre-Medical-No Preference (no student records found for this major)
- 2001 Psychology

### **B.3: Behavioral and Life Sciences Students with Minority Status**

This query determines the number of minority students which were awarded a Psychology or Biology Degree from the College of Liberal Arts and Sciences, ASU main campus during the specified academic year (the limits below represent the 2002-2003 academic year).

The minorities of interest (from a funding perspective) are: United States Citizens of Native American/Alaskan (N), Hispanic (H), or African American/Black (B) descent.

#### **Query Section of Brio Intelligence**

Table:

**Student Degree** – contains record for each degree awarded to a student, includes the semester in which the degree was granted.

Limits:

Semester degree Granted = 20027, 20031, 20033, 20034, 20035

Academic Program Campus Code = M

College Or Division Code = LA

Degree Code = 21, 31

Major Code= 0400, 0401, 0403, 0404, 0408, 0409, 0411, 0420, 1296, 2001

Record On Sis Flag = Y

Fields Displayed:

Semester Degree Granted

Affiliate Id

Asu Id (change properties such that label = Student Degree Asu Id)

Degree Code

Major Code

Cumulative Asu Gpa

Total Asu Hours Earned

Dual Degree Flag

Table:

**Student** – record for each student (per Asu Id)

Join:

**Student Degree.Afiliated Id** - = - **Student.Affiliate Id**

Limits:

Minority Status Code = B, H, N

Citizenship Code = US

Fields Displayed:

Asu Id (change properties such that label = Student Asu Id)

Minority Status Code

Citizenship Code

Record On Sis Flag

#### **Results Section of Brio Intelligence**

A list of all minority students in the behavioral and life sciences who graduated during the 2002-2003 academic year is displayed.

This query can be modified to obtain minority students from specific degree programs or different years. Additional tables can be joined to obtain course information per student.

## Pivot Section of Brio Intelligence

Side Labels:

[Minority Status Code](#) (select column and “Add totals”)

Facts:

[Affiliate Id](#) (select values and set “data function” → “count distinct”)

A count of the number of students per minority code, as well as the total number of students represented is displayed.

## Pivot2 Section of Brio Intelligence

Side Labels:

[Major Code](#), [Degree Code](#), [Citizenship Code](#), [Minority Status Code](#)

Facts:

[Affiliate Id](#) (select values and set “data function → count distinct”)

The number of students per minority code, with respect to each degree program in the behavioral and life sciences are displayed.

### ***B.4: B.S. Psychology Students with Minority Status***

This query determines the number of minority students which were awarded a Bachelor of Science degree in Psychology from the College of Liberal Arts and Sciences, ASU main campus during the specified academic year (the limits below represent the 2002-2003 academic year).

The minorities of interest (from a funding perspective) are: United States Citizens of Native American/Alaskan (N), Hispanic (H), or African American/Black (B) descent.

## Query Section of Brio Intelligence

Table:

[Student Degree](#) – contains record for each degree awarded to a student, includes the semester in which the degree was granted.

Limits:

[Semester degree Granted](#) = 20027, 20031, 20033, 20034, 20035

[Academic Program Campus Code](#) = M

[College Or Division Code](#) = LA

[Degree Code](#) = 31

[Major Code](#)= 2001

[Record On Sis Flag](#) = Y

Fields Displayed:

Semester Degree Granted                      Affiliate Id  
 Asu Id (change properties such that label = Student Degree Asu Id)  
 Degree Code                                      Major Code  
 Cumulative Asu Gpa                            Total Asu Hours Earned  
 Dual Degree Flag

Table:

Student – record for each student (per Asu Id)

Join:

Student Degree.Afiliated Id - = - Student.Affiliate Id

Limits:

Minority Status Code = B, H, N

Citizenship Code = US

Fields Displayed:

Asu Id (change properties such that label = Student Asu Id)

Minority Status Code

Citizenship Code

Record On Sis Flag

## Results Section of Brio Intelligence

A list of all minority students who graduated with a Bachelor of Science degree in Psychology during the 2002-2003 academic years is displayed.

This query can be modified to obtain minority students from other degree programs or different years. Additional tables can be joined to obtain course information per student.

## Pivot Section of Brio Intelligence

Side Labels:

Minority Status Code (select column and “Add totals”)

Facts:

Affiliate Id (select values and set “data function” → “count distinct”)

The number of students per minority code, as well as the total number of students represented is displayed.

Minority Status Code	Affiliate Id
B	3
H	13
Count Distin	16

Figure 23. Pivot displaying 2002-2003 B.S. Psychology Students with Minority Status

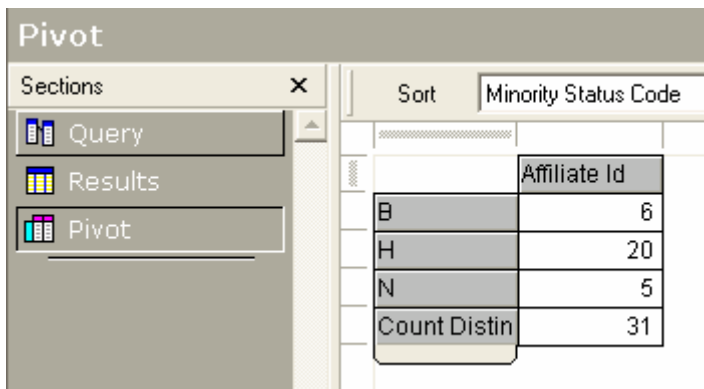
### **B.5: B.A. Psychology Students with Minority Status**

This query determines the number of minority students which were awarded a Bachelor of Arts degree in Psychology from the College of Liberal Arts and Sciences, ASU main campus during the specified academic year.

The minorities of interest (from a funding perspective) are: United States Citizens of Native American/Alaskan (N), Hispanic (H), or African American/Black (B) descent.

This query is identical to the query “B.S. Psychology Students with Minority Status”, with the exception of the limit of the degree code in the Student Degree table.

Degree code = 21.



Minority Status Code	Affiliate Id
B	6
H	20
N	5
Count Distin	31

Figure 24. Pivot displaying 2002-2003 B.A. Psychology Students with Minority Status

### **B.6: B.S. Biology Students with Minority Status**

This query determines the number of minority students which were awarded a Bachelor of Science degree in Biology from the School of Life Sciences, within the College of Liberal Arts and Sciences, ASU main campus during the specified academic.

The minorities of interest (from a funding perspective) are: United States Citizens of Native American/Alaskan (N), Hispanic (H), or African American/Black (B) descent.

This query is identical to the query “B.S. Psychology Students with Minority Status”, with the exception that limit of the major code in the Student Degree table is matched to multiple values.

Major Code = 0400, 0401, 0403, 0404, 0408, 0409, 0411, 0420, 1296

### **Pivot Section of Brio Intelligence**

Side Labels:

Major Code (select column and “Add totals”), Minority Status Code

Facts:

Affiliate Id (select values and set “data function” → “count distinct”)

The number of students per degree program per minority, as well as the total number of students is displayed.

The screenshot shows a Pivot table window titled 'Pivot'. On the left, there is a 'Sections' pane with 'Query', 'Results', and 'Pivot' options. The main window has a 'Sort' dropdown set to 'Major Code' and a 'by' dropdown. The table data is as follows:

Major Code	Minority Status	Affiliate Id
0400	H	1
0401	H	9
	N	1
0403	H	1
0408	H	1
0411	H	4
1296	B	1
Count Distinct		18

Figure 25. Pivot displaying 2002-2003 B.S. Biology Students with Minority Status

### ***B.7: MA courses for All B.A. Psychology Students***

This query determines the courses meeting the Mathematical Studies (MA) requirement, taken by all students which were awarded a Bachelor of Arts degree in Psychology from the College of Liberal Arts and Sciences, ASU main campus during the specified academic year (the limits below represent the 2002-2003 academic year).

A citizenship and minority status code are included for each student, such that information specific to minority students can be determined. The minorities of interest (from a funding perspective) are: United States Citizens of Native American/Alaskan (N), Hispanic (H), or African American/Black (B) descent.

### **Query Section of Brio Intelligence**

Table:

**Student Degree** – contains record for each degree awarded to a student, includes the semester in which the degree was granted.

Limits:

Semester degree Granted = 20027, 20031, 20033, 20034, 20035

Academic Program Campus Code = M

College Or Division Code = LA

Degree Code = 21

Major Code= 2001

Record On Sis Flag = Y

Fields Displayed:

Semester Degree Granted

Affiliate Id

Asu Id

Degree Code



## Results Section of Brio Intelligence

A list of all courses meeting the Mathematical Studies (MA) requirement taken by students who graduated with a Bachelor of Arts degree in Psychology during the 2002-2003 academic year is displayed.

This query can be modified to obtain students from other degree programs or different years. Changing the limit in the **General Studies** table to **General Studies Code = CS, N2, N3** will produce a list of the courses, for the same group of students, taken to meet the Mathematical Studies (CS) requirement.

## Pivot Section of Brio Intelligence

Side Labels:

**Course Id**

Facts:

**Affiliate Id** (select values and set “data function” → “count”)

**Affiliate Id2** (select values and set “data function” → “count distinct”)

A count of the number of students taking each MA course is displayed. The first column contains all of the courses taken while the second column eliminates repeated courses.

## Pivot2 Section of Brio Intelligence

Side Labels:

**Citizenship Code, Minority Status Code**

Facts:

**Affiliate Id** (select values and set “data function” → “count distinct”)

		Affiliate Id
CA	W	1
CA	X	1
CA	Y	1
PE	H	1
SF	X	1
US		9
	A	5
	B	5
	H	16
	N	1
	W	97
Count Distinct		138

Figure 26. Pivot displaying MA courses of minority B.A. Psychology Students

A count of the number of students taking MA courses by citizenship and minority is displayed. Student with US citizenship and a minority status code of B, H, or N are considered minorities. This count of 22 minority students is used in the description of Table 4.

### Pivot3 Section of Brio Intelligence

Side Labels:

[Adjusted Grade Code](#)

Top Labels:

[Course Id, General studies Code](#)

Facts:

[Affiliate Id](#) (select values and set “data function” → “count”)

A table with a count of the number of students taking each MA course, and whether it was taken as a “MA” or “N1”, listed by grade is displayed.

### Pivot4 Section of Brio Intelligence

Side Labels:

[Adjusted Grade Code](#)

Top Labels:

[Course Id](#)

Facts:

[Affiliate Id](#) (select values and set “data function” → “count”)

	MAT 114	MAT 115	MAT 117
	Affiliate Id	Affiliate Id	Affiliate Id
A	2		11
B			22
C	1	1	28
D			2
E			1
Count	3	1	64

Figure 27. Pivot displaying MA courses with grades of B.A. Psychology Students

A table with a count of the number of students taking each MA course, listed by grade is displayed. This pivot is exported to Excel and used to create Table 4.

### ***B.8: Math GPA for B.S. Psychology Students with Minority Status***

This query determines a Math GPA for each minority student earning a Bachelor of Science Degree in Psychology. Each student is required to take a Calculus course (200 level or above). This query looks at courses taken at ASU, 200 level or above, with an MAT prefix. (The limits below represent the 2002-2003 academic year).

The minorities of interest (from a funding perspective) are: United States Citizens of Native American/Alaskan (N), Hispanic (H), or African American/Black (B) descent. Limits on the Student table select the students with these minority statuses.

### **Query Section of Brio Intelligence**

Table:

**Student Degree** – contains record for each degree awarded to a student, includes the semester in which the degree was granted.

Limits:

**Semester degree Granted = 20027, 20031, 20033, 20034, 20035**

**Academic Program Campus Code = M**

**College Or Division Code = LA**

**Degree Code = 31**

**Major Code= 2001**

**Record On Sis Flag = Y**

Fields Displayed:

**Semester Degree Granted**

**Affiliate Id**

**Asu Id (Student Degree Asu Id)**

**Degree Code**

**Major Code**

**Cumulative Asu Gpa**

**Total Asu Hours Earned**

**Dual Degree Flag**

Table:

**Student** – record for each student (per Asu Id)

Join:

**Student Degree.Afiliated Id** - = - **Student.Affiliate Id**

Limits:

**Minority Status Code** = B, H, N

**Citizenship Code** = US

Fields Displayed:

**Asu Id (Student Asu Id)**

**Minority Status Code**

**Citizenship Code**

**Record On Sis Flag (Student Record On Sis Flag)**

Table:

**Student Class** – all classes for every Affiliate ID (actually the ASU ID)

Join:

**Student.Asu Id** - += - **Student Class.Affiliate Id** (a left join, maintaining the rows for each Asu Id, even if the student has not taken an MAT course at ASU)

Limits:

**Course Id Begins With** MAT 2, MAT 3, MAT 4

**Adjusted Grade Code** = A+, A, A-, B+, B, B-,C+, C, D, D@, D @, E, E@, E @

**Adjusted Grade Point Code** != Null

**Record On Sis Flag** = Y

Fields Displayed:

**Semester**

**Course Id**

**Hours**

**Adjusted Grade Code**

**Adjusted Grade Point Grade**

Add Computed Item:

**Student Class.Hours**\***Student Class.Adjusted Grade Point Grade** = MAT Grade Points

## Results Section of Brio Intelligence

Sort Ascending: **Affiliate Id, Semester,**

Suppress Duplicate on: **Affiliate Id, Asu Id, Asu Id2**

## Pivot Section of Brio Intelligence

Side Labels:

**Course Id** (select column and “Add totals”)

Facts:

**Affiliate Id** (select values and set “data function → count distinct”)

A count of the number of students taking each Mathematics course is displayed.

## Pivot2 Section of Brio Intelligence

Side Labels:

Affiliate Id

Facts:

Cumulative Asu Gpa (AsuGPA) . MAT Grade Points . Course Id, Hours, MatGPA, Semester Degree Granted, Semester (select values and set “data function → minimum”)

MatGPA is a computed item = MAT Grade Points/ Hours

Hide all of the Facts except:

AsuGPA, MatGPA, Semester Degree Granted, Semester

When this pivot is exported to Excel there will be a row for each Affiliate ID and columns for the Affiliate ID followed by these 4 Facts. In Excel, the Semester Degree Granted and Semester values will be used to determine whether mathematics courses were taken early, late, or not at ASU.

### ***B.9: Math GPA for B.A. Psychology Students with Minority Status***

This query determines a Math GPA for each minority student earning a Bachelor of Arts Degree in Psychology. Each student is required to take a Math course, however the program does not require a specific course to be taken. University and College of Liberal Arts requirements determine the course to be taken. This query looks at courses taken at ASU, MAT 114 or above.

The minorities of interest (from a funding perspective) are: United States Citizens of Native American/Alaskan (N), Hispanic (H), or African American/Black (B) descent. Limits on the Student table select the students with these minority statuses.

This query is identical to the query “B.S. Psychology Students with Minority Status”, with the exception of the limits of the degree code in the Student Degree table and the Course Id in the Student Class table.

Degree code = 21

Course Id Begins With MAT 114, MAT 115, MAT 117, MAT 118, MAT 119, MAT 122, MAT 170, MAT 2, MAT 3, MAT 4

Course Id	Affiliate Id
	5
MAT 117	8
MAT 118	1
MAT 119	12
MAT 122	1
MAT 170	2
MAT 210	11
MAT 274	1
Count Distin	41

Figure 28. Pivot displaying Mathematics courses of minority B.A. Psychology Students

### ***B.10: Math GPA for B.S. Biology Students with Minority Status***

This query determines a Math GPA for each minority student earning a Bachelor of Science Degree in Biology. Each student is required to take a Calculus course (200 level or above). This query looks at courses taken at ASU, 200 level or above, with an MAT prefix.

The minorities of interest (from a funding perspective) are: United States Citizens of Native American/Alaskan (N), Hispanic (H), or African American/Black (B) descent. Limits on the Student table select the students with these minority statuses.

This query is identical to the query “Math GPA for B.S. Psychology Students with Minority Status”, with the exception that limit of the major code in the Student Degree table is matched to multiple values.

**Major Code = 0400, 0401, 0403, 0404, 0408, 0409, 0411, 0420, 1296**

An additional Side Label for the major in the Pivot displays a distribution of courses taken per major.

Major Code	Affiliate Id
0400	1
0401	3
	8
	1
0403	1
	1
0408	1
0411	3
	1
1296	1
Count Distinct	21

Figure 29. Pivot displaying Mathematics courses of minority B.S. Biology Students

### ***B.11: Upper Level GPA for B.S. Psychology Students with Minority Status***

This query determines a GPA for the upper level electives of each minority student earning a Bachelor of Science Degree in Psychology. Courses within the Psychology department are prefixed with PSY and PGS. This query looks at courses taken at ASU, 300 level or above, with an PSY or PGS prefix. (The limits below represent the 2002-2003 academic year).

The minorities of interest (from a funding perspective) are: United States Citizens of Native American/Alaskan (N), Hispanic (H), or African American/Black (B) descent. Limits on the Student table select the students with the minority status.

### **Query Section of Brio Intelligence**

Table:

**Student Degree** – contains record for each degree awarded to a student, includes the semester in which the degree was granted.

Limits:

Semester degree Granted = 20027, 20031, 20033, 20034, 20035  
 Academic Program Campus Code = M  
 College Or Division Code = LA  
 Degree Code = 31  
 Major Code= 2001  
 Record On Sis Flag = Y

Fields Displayed:

Semester Degree Granted                      Affiliate Id  
 Asu Id (Student Degree Asu Id)              Degree Code

Major Code  
Total Asu Hours Earned

Cumulative Asu Gpa  
Dual Degree Flag

Table:

**Student** – record for each student (per Asu Id)

Join:

**Student Degree.Afiliated Id** - = - **Student.Affiliate Id**

Limits:

Minority Status Code = **B, H, N**

Citizenship Code = **US**

Fields Displayed:

Asu Id (Student Asu Id)

Record On Sis Flag (Student Record On Sis Flag)

Table:

**Student Class** – all classes for every Affiliate ID (actually the ASU ID)

Join:

**Student.Asu Id** - += - **Student Class.Affiliate Id** (a left join, maintaining the rows for each Asu Id, even if the student has not taken an MAT course at ASU)

Limits:

Course Id Begins With **PGS 3, PGS 4, PGS 5, PSY 3, PSY 4, PSY 5**

Adjusted Grade Code = **A+, A, A-, B+, B, B-, C+, C, D, D@, D @, E, E@, E @**

Adjusted Grade Point Code != Null

Record On Sis Flag = **Y**

Fields Displayed:

Semester

Course Id

Hours

Adjusted Grade Code

Adjusted Grade Point Grade

Add Computed Item:

**Student Class.Hours**\***Student Class.Adjusted Grade Point Grade** = Grade Points

## Results Section of Brio Intelligence

Sort Ascending: **Affiliate Id, Semester,**

Suppress Duplicate on: **Affiliate Id, Student Degree Asu Id, Student Asu Id**

## Pivot Section of Brio Intelligence

Side Labels:

**Affiliate Id**

Facts: **Cumulative Asu Gpa (AsuGPA),**

**Grade Points** (select values and set “data function” → “sum”),

**Hours** (select values and set “data function” → “sum”),

**UpperGPA** where UpperGPA is a computed item = **Grade Points/ Hours**

When this pivot is exported to Excel there will be a row for each Affiliate ID and columns for the Affiliate ID followed by these 4 Facts.

### ***B.12: Upper Level GPA for B.A. Psychology Students with Minority Status***

This query determines a GPA for the upper level electives of each minority student earning a Bachelor of Arts Degree in Psychology. Courses within the Psychology department are prefixed with PSY and PGS. This query looks at courses taken at ASU, 300 level or above, with an PSY or PGS prefix.

The minorities of interest (from a funding perspective) are: United States Citizens of Native American/Alaskan (N), Hispanic (H), or African American/Black (B) descent. Limits on the Student table select the students with the minority status.

This query is identical to the query “Upper Level GPA for B.S. Psychology Students with Minority Status”, with the exception of the limit of the degree code in the Student Degree table. Degree code = 21.

### ***B.13: Upper Level GPA for B.S. Biology Students with Minority Status***

This query determines a GPA for the upper level electives of each minority student earning a Bachelor of Science Degree in Biology. Courses within the School of Life Science vary from degree to degree. This query looks at courses taken at ASU, 300 level or above, with the prefixes listed below.

The minorities of interest (from a funding perspective) are: United States Citizens of Native American/Alaskan (N), Hispanic (H), or African American/Black (B) descent. Limits on the Student table select the students with the minority status.

This query is identical to the query “Upper Level GPA for B.S. Psychology Students with Minority Status”, with the exception of the limits of the major code in the Student Degree table and the limits of the Course Id in the Student class table.

Major Code = 0400, 0401, 0403, 0404, 0408, 0409, 0411, 0420, 1296  
Course Id Begins With BCH 3, BCH 4 BCH 5, BIO 3, BIO 4 BIO 5,  
BOT 3, BOT 4 BOT 5, CLS 3, CLS 4 CLS 5,  
MBB 3, MBB 4 MBB 5, MIC 3, MIC 4 MIC 5,  
PLB 3, PLB 4, PLB 5, ZOL 3, ZOL 4, ZOL 5

### **B.14: All Behavioral and Life Sciences Students**

This query determines all of the students which were awarded a Psychology or Biology Degree from the College of Liberal Arts and Sciences, ASU main campus during the specified academic year (the limits below represent the 2002-2003 academic year).

#### **Query Section of Brio Intelligence**

Table:

**Student Degree** – contains record for each degree awarded to a student, includes the semester in which the degree was granted.

Limits:

**Semester degree Granted** = 20027, 20031, 20033, 20034, 20035

**Academic Program Campus Code** = M

**College Or Division Code** = LA

**Degree Code** = 21, 31

**Major Code**= 0400, 0401, 0403, 0404, 0408, 0409, 0411, 0420, 1296, 2001

**Record On Sis Flag** = Y

Fields Displayed:

<b>Semester Degree Granted</b>	<b>Affiliate Id</b>
<b>Asu Id (Student Degree Asu Id)</b>	<b>Degree Code</b>
<b>Major Code</b>	<b>Cumulative Asu Gpa</b>
<b>Total Asu Hours Earned</b>	<b>Dual Degree Flag</b>

Table:

**Student** – record for each student (per Asu Id)

Join:

**Student Degree.Afiliated Id** - = - **Student.Affiliate Id**

Fields Displayed:

<b>Asu Id (Student Asu Id)</b>	<b>Record On Sis Flag (Student Record On Sis)</b>
--------------------------------	---

#### **Results Section of Brio Intelligence**

A list of all students in the behavioral and life sciences who graduated during the 2002-2003 academic year is displayed.

This query can be modified to obtain students from specific degree programs or different years. Additional tables can be joined to obtain course information per student.

#### **Pivot Section of Brio Intelligence**

Side Labels:

**Major Code, Degree Code** (select column and “Add totals”)

Facts:

**Affiliate Id** (select values and set “data function → count distinct”)

The number of students per major and degree code, as well as the total number of students is displayed.

Major Code	Count	Affiliate Id
0400	31	16
0401	31	148
0403	31	5
0404	31	5
0408	31	19
0411	31	33
0420	31	21
1296	31	4
2001	21	203
	31	128
Count Distinct		582

Figure 30. Pivot displaying all 2002-2003 Behavioral or Life Sciences Students

### ***B.15: All B.S. Psychology Students***

This query determines the number of students which were awarded a Bachelor of Science degree in Psychology from the College of Liberal Arts and Sciences, ASU main campus during the specified academic year (the limits below represent the 2002-2003 academic year).

A citizenship and minority status code are included for each student, such that the percentage of minority students can be determined. The minorities of interest (from a funding perspective) are: United States Citizens of Native American/Alaskan (N), Hispanic (H), or African American/Black (B) descent.

### **Query Section of Brio Intelligence**

Table:

**Student Degree** – contains record for each degree awarded to a student, includes the semester in which the degree was granted.

Limits:

Semester degree Granted = 20027, 20031, 20033, 20034, 20035  
 Academic Program Campus Code = M  
 College Or Division Code = LA  
 Degree Code = 31  
 Major Code= 2001  
 Record On Sis Flag = Y

Fields Displayed:

Semester Degree Granted	Affiliate Id
Asu Id (Student Degree Asu Id)	Degree Code
Major Code	Cumulative Asu Gpa
Total Asu Hours Earned	Dual Degree Flag

Table:

**Student** – record for each student (per Asu Id)

Join:

**Student Degree.Afiliated Id** - = - **Student.Affiliate Id**

Fields Displayed:

Asu Id (Student Asu Id)	Minority Status Code
Citizenship Code	
Record On Sis Flag (Student Record On Sis Flag)	

## Results Section of Brio Intelligence

A list of all students who graduated with a Bachelor of Science degree in Psychology during the 2002-2003 academic year is displayed.

This query can be modified to obtain students from other degree programs or different years. Additional tables can be joined to obtain course information per student.

## Pivot Section of Brio Intelligence

Side Labels:

**Citizenship Code, Minority Status Code**

Facts:

**Affiliate Id** (select values and set “data function” → “count distinct”)

The number of students per citizenship and minority code is displayed.

Note: From a funding perspective the student with US citizenship and a minority status code of N, H, or B are considered minorities.

### ***B.16: All B.A. Psychology Students***

This query determines the number of students which were awarded a Bachelor of Arts degree in Psychology from the College of Liberal Arts and Sciences, ASU main campus during the specified academic year.

A citizenship and minority status code are included for each student, such that the percentage of minority students can be determined. The minorities of interest (from a funding perspective) are: United States Citizens of Native American/Alaskan (N), Hispanic (H), or African American/Black (B) descent.

This query is identical to the query “All B.S. Psychology Students”, with the exception of the limit of the degree code in the Student Degree table. **Degree code = 21.**

### **B.17: All B.S. Biology Students**

This query determines the number of students which were awarded a Bachelor of Science degree in Biology from the School of Life Sciences, within the College of Liberal Arts and Sciences, ASU main campus during the specified academic.

A citizenship and minority status code are included for each student, such that the percentage of minority students can be determined. The minorities of interest (from a funding perspective) are: United States Citizens of Native American/Alaskan (N), Hispanic (H), or African American/Black (B) descent.

This query is identical to the query “All B.S. Psychology Students”, with the exception that limit of the major code in the Student Degree table is matched to multiple values.

Major Code = 0400, 0401, 0403, 0404, 0408, 0409, 0411, 0420, 1296.

The pivot provides a count of the number of students per degree program within each citizenship/minority, as well as the total number of students.

### **B.18: Math GPA for All B.S. Psychology Students**

This query determines a Math GPA for each student earning a Bachelor of Science Degree in Psychology. Each student is required to take a Calculus course (200 level or above). This query looks at courses taken at ASU, 200 level or above, with an MAT prefix. (The limits below represent the 2002-2003 academic year).

A citizenship and minority status code are included for each student, such that the percentage of minority student can be determined. The minorities of interest (from a funding perspective) are: United States Citizens of Native American/Alaskan (N), Hispanic (H), or African American/Black (B) descent. The pivot data from this query is exported to Excel, where the data is sorted with and without regard to minority status, to obtain the summary data in Appendix B.

### **Query Section of Brio Intelligence**

Table:

Student Degree – contains record for each degree awarded to a student, includes the semester in which the degree was granted.

Limits:

Semester degree Granted = 20027, 20031, 20033, 20034, 20035

Academic Program Campus Code = M

College Or Division Code = LA

Degree Code = 31

Major Code= 2001

Record On Sis Flag = Y

Fields Displayed:

Semester Degree Granted

Asu Id (Student Degree Asu Id)

Major Code

Total Asu Hours Earned

Affiliate Id

Degree Code

Cumulative Asu Gpa

Dual Degree Flag

Table:

**Student** – record for each student (per Asu Id)

Join:

**Student Degree.Afiliated Id** - = - **Student.Affiliate Id**

Limits:

**Minority Status Code** = B, H, N

**Citizenship Code** = US

Fields Displayed:

**Asu Id (Student Asu Id)**

**Minority Status Code**

**Citizenship Code**

**Record On Sis Flag (Student Record On Sis Flag)**

Table:

**Student Class** – all classes for every Affiliate ID (actually the ASU ID)

Join:

**Student.Asu Id** - += - **Student Class.Affiliate Id** (a left join, maintaining the rows for each Asu Id, even if the student has not taken an MAT course at ASU)

Limits:

**Course Id Begins With** MAT 2, MAT 3, MAT 4

**Adjusted Grade Code** = A+, A, A-, B+, B, B-, C+, C, D, D@, D @, E, E@, E @

**Adjusted Grade Point Code** != Null

**Record On Sis Flag** = Y

Fields Displayed:

**Semester**

**Course Id**

**Hours**

**Adjusted Grade Code**

**Adjusted Grade Point Grade**

Add Computed Item:

**Student Class.Hours**\***Student Class.Adjusted Grade Point Grade** = MAT Grade Points

## Results Section of Brio Intelligence

Sort Ascending: **Affiliate Id, Semester,**

Suppress Duplicate on: **Affiliate Id, Asu Id, Asu Id2**

## Pivot Section of Brio Intelligence

Side Labels:

**Course Id** (select column and “Add totals”)

Facts:

**Affiliate Id** (select values and set “data function → count distinct”)

A count of the number of students taking each Mathematics course is displayed.

## Pivot2 Section of Brio Intelligence

Side Labels:

Affiliate Id

Facts:

Cumulative Asu Gpa (AsuGPA) . MAT Grade Points . Course Id, Hours, MatGPA, Semester Degree Granted, Semester (select values and set “data function” → “minimum”)

MatGPA is a computed item = MAT Grade Points/ Hours

Hide all of the Facts except:

AsuGPA, MatGPA, Semester Degree Granted, Semester

When this pivot is exported to Excel there will be a row for each Affiliate ID and columns for the Citizenship, Minority and Affiliate ID followed by these 4 Facts. In Excel, the Semester Degree Granted and Semester values will be used to determine whether mathematics courses were taken early, late, or not at ASU.

### ***B.19: Math GPA for All B.A. Psychology Students***

This query determines a Math GPA for each student earning a Bachelor of Arts Degree in Psychology. Each student is required to take a Math course, however the program does not require a specific course to be taken. University and College of Liberal Arts requirements determine the course to be taken. This query looks at courses taken at ASU, MAT 114 or above.

A citizenship and minority status code are included for each student, such that the percentage of minority student can be determined. The minorities of interest (from a funding perspective) are: United States Citizens of Native American/Alaskan (N), Hispanic (H), or African American/Black (B) descent. The pivot data from this query is exported to Excel, where the data is sorted with and without regard to minority status, to obtain the summary data in Appendix B.

This query is identical to the query “Math GPA for All B.S. Psychology Students”, with the exception of the limits of the degree code in the Student Degree table and the Course Id in the Student Class table.

Degree code = 21

Course Id Begins With MAT 114, MAT 115, MAT 117, MAT 118, MAT 119,  
MAT 122, MAT 170, MAT 2, MAT 3, MAT 4

### ***B.20: Math GPA for All B.S. Biology Students***

This query determines a Math GPA for each student earning a Bachelor of Science Degree in Biology. Each student is required to take a Calculus course (200 level or above). This query looks at courses taken at ASU, 200 level or above, with an MAT prefix.

A citizenship and minority status code are included for each student, such that the percentage of minority student can be determined. The minorities of interest (from a funding perspective) are: United States Citizens of Native American/Alaskan (N), Hispanic (H), or African American/Black (B) descent. The pivot data from this query is exported to Excel, where the data is sorted with and without regard to minority status, to obtain the summary data in Appendix B.

This query is identical to the query “Math GPA for B.S. Psychology Students with Minority Status”, with the exception that limit of the major code in the Student Degree table is matched to multiple values.

Major Code = 0400, 0401, 0403, 0404, 0408, 0409, 0411, 0420, 1296

An additional Side Label for the major in the Pivot displays a distribution of courses taken per major.

### ***B.21: Upper Level GPA for All B.S. Psychology***

This query determines a GPA for the upper level electives of each student earning a Bachelor of Science Degree in Psychology. Courses within the Psychology department are prefixed with PSY and PGS. This query looks at courses taken at ASU, 300 level or above, with an PSY or PGS prefix. (The limits below represent the 2002-2003 academic year).

The pivot data from this query is exported to Excel and combined with the pivot data from the Math GPA query, which contains the minority status for each student. In Excel the data is sorted with and without regard to minority status, to obtain the summary data in Appendix B.

### **Query Section of Brio Intelligence**

Table:

Student Degree – contains record for each degree awarded to a student, includes the semester in which the degree was granted.

Limits:

Semester degree Granted = 20027, 20031, 20033, 20034, 20035

Academic Program Campus Code = M

College Or Division Code = LA

Degree Code = 31

Major Code= 2001

Record On Sis Flag = Y

Fields Displayed:

Semester Degree Granted

Affiliate Id

Asu Id (Student Degree Asu Id)

Degree Code

Major Code

Cumulative Asu Gpa

Total Asu Hours Earned

Dual Degree Flag

Table:

**Student** – record for each student (per Asu Id)

Join:

**Student Degree.Afiliated Id** = - - **Student.Affiliate Id**

Fields Displayed:

**Asu Id** (Student Asu Id)

**Record On Sis Flag** (Student Record On Sis Flag)

Table:

**Student Class** – all classes for every Affiliate ID (actually the ASU ID)

Join:

**Student.Asu Id** - += - **Student Class.Affiliate Id**(a left join, maintaining the rows for each Asu Id, even if the student has not taken an course using the Asu Id)

Limits:

**Course Id Begins With** **PGS 3, PGS 4, PGS 5, PSY 3, PSY 4, PSY 5**

**Adjusted Grade Code = A+, A, A-, B+, B, B-,C+, C, D, D@, D @, E, E@, E @**

**Adjusted Grade Point Code != Null**

**Record On Sis Flag = Y**

Fields Displayed:

**Semester** **Course Id**

**Adjusted Grade Code** **Hours**

**Adjusted Grade Point Grade**

Add Computed Item:

**Student Class.Hours\*Student Class.Adjusted Grade Point Grade** = Grade Points

## Results Section of Brio Intelligence

Sort Ascending: **Affiliate Id, Semester,**

Suppress Duplicate on: **Affiliate Id, Student Degree Asu Id, Student Asu Id**

## Pivot Section of Brio Intelligence

Side Labels:

**Affiliate Id**

Facts: **Cumulative Asu Gpa (AsuGPA),**

**Grade Points** (select values and set “data function → sum”),

**Hours** (select values and set “data function → sum”),

**UpperGPA** where UpperGPA is a computed item = **Grade Points/ Hours**

Hide all of the Facts except:

**AsuGPA, UpperGPA**

When this pivot is exported to Excel there will be a row for each Affiliate ID and columns for the Affiliate ID followed by these 2 Facts.

### ***B.22: Upper Level GPA for All B.A. Psychology Students***

This query determines a GPA for the upper level electives of each student earning a Bachelor of Arts Degree in Psychology. Courses within the Psychology department are prefixed with PSY and PGS. This query looks at courses taken at ASU, 300 level or above, with an PSY or PGS prefix.

The pivot data from this query is exported to Excel and combined with the pivot data from the Math GPA query, which contains the minority status for each student. In Excel the data is sorted with and without regard to minority status, to obtain the summary data in Appendix B.

This query is identical to the query “Upper Level GPA for All B.S. Psychology Students”, with the exception of the limit of the degree code in the Student Degree table. Degree code = 21.

### ***B.23: Upper Level GPA for All B.S. Biology Students***

This query determines a GPA for the upper level electives of each student earning a Bachelor of Science Degree in Biology. Courses within the School of Life Science vary from degree to degree. This query looks at courses taken at ASU, 300 level or above, with the prefixes listed below.

The pivot data from this query is exported to Excel and combined with the pivot data from the Math GPA query, which contains the minority status for each student. In Excel the data is sorted with and without regard to minority status, to obtain the summary data in Appendix B.

This query is identical to the query “Upper Level GPA for All B.S. Psychology Students”, with the exception of the limits of the major code in the Student Degree table and the limits of the Course Id in the Student class table.

Major Code = 0400, 0401, 0403, 0404, 0408, 0409, 0411, 0420, 1296  
Course Id Begins With BCH 3, BCH 4 BCH 5, BIO 3, BIO 4 BIO 5,  
BOT 3, BOT 4 BOT 5, CLS 3, CLS 4 CLS 5,  
MBB 3, MBB 4 MBB 5, MIC 3, MIC 4 MIC 5,  
PLB 3, PLB 4, PLB 5, ZOL 3, ZOL 4, ZOL 5

## ***Appendix C: GPA Summary Data***

The tables in this appendix contain GPA summary data per degree/major. Within each degree/major, the data is collected for a given academic year (students may complete their degree in the fall, spring or summer).

The GPA values in the tables represent mean values. Mean GPA were computed first for all of the students (per major per year), and then for students of minority versus not minority. Minorities in the context of this data analysis are students with U.S. Citizenship and an Ethnicity of African American, Native American/Alaskan, or Hispanic.

The “ASU GPA” is the cumulative GPA reported by ASU for the semester that the student’s degree was completed. The “Major GPA” is GPA computed across all of the upper level electives (prefix of 300 or above) pertaining to the students major. The Math GPA is computed across all of the Math classes the student took at ASU to satisfy their degree requirements. (See appendix A for additional descriptions of these terms and appendix B for sample queries used to extract this information from ASU’s Data Warehouse.)

The GPA’s per individual programs within the School of Life Sciences are listed in section C.4 for reference. This data shows how the students are distributed across the individual degree programs within the School of Life Sciences. The number of students per degree program is small, and varies from year to year. The summary data across all Biology majors, as shown in section C.3 is used in the data analysis.

### C.1: B.A. Psychology Majors

#### Academic Year: 2002-2003

	# Students	Math When?	# Students	ASU GPA	Major GPA	Math GPA
<b>All students</b>	203	Late	35	3.12	3.06	2.89
		Early	118	3.00	2.98	2.48
		Not at ASU	50	3.39	3.35	NA
			203	3.12	3.08	2.57
<b>Minority Only</b> 15.27%	31	Late	9	3.08	3.06	2.89
		Early	18	2.80	2.66	2.09
		Not at ASU	4	2.95	2.97	NA
			31	2.90	2.82	2.36
<b>Not Minority</b> 84.73%	172	Late	26	3.14	3.06	2.88
		Early	100	3.03	3.03	2.55
		Not at ASU	46	3.43	3.38	NA
			172	3.15	3.13	2.62

#### Academic Year: 2003-2004

<b>All students</b>	229	Late	39	3.08	3.01	2.90
		Early	126	3.11	3.11	2.51
		Not at ASU	64	3.24	3.17	NA
			229	3.14	3.11	2.60
<b>Minority Only</b> 15.72%	36	Late	6	2.76	2.65	2.67
		Early	23	3.04	3.08	2.41
		Not at ASU	7	3.12	3.12	NA
			36	3.01	3.02	2.46
<b>Not Minority</b> 84.28%	193	Late	33	3.14	3.08	2.94
		Early	103	3.12	3.11	2.53
		Not at ASU	57	3.26	3.18	NA
			193	3.16	3.13	2.63

#### Academic Year: 2004-2005

<b>All students</b>	245	Late	45	3.05	2.94	2.66
		Early	140	3.08	3.10	2.60
		Not at ASU	60	3.24	3.16	NA
			245	3.11	3.09	2.61
<b>Minority Only</b> 21.63%	53	Late	11	2.81	2.66	2.02
		Early	23	3.03	3.09	2.33
		Not at ASU	19	3.01	2.76	NA
			53	2.98	2.88	2.23
<b>Not Minority</b> 78.37%	192	Late	34	3.13	3.02	2.86
		Early	117	3.09	3.10	2.66
		Not at ASU	41	3.35	3.35	NA
			192	3.15	3.14	2.71

## C.2: B.S. Psychology Majors

### Academic Year: 2002-2003

	# Students	Math When?	# Students	ASU GPA	Major GPA	Math GPA
<b>All students</b>	128	Late	16	3.07	3.01	2.50
		Early	66	3.17	3.18	2.69
		Not at ASU	46	3.35	3.33	NA
			128	3.22	3.21	2.65
<b>Minority Only</b> 12.50%	16	Late	2	2.50	2.51	2.00
		Early	7	3.20	3.12	2.64
		Not at ASU	7	2.86	2.84	NA
			16	2.96	2.92	2.50
<b>Not Minority</b> 87.50%	112	Late	14	3.15	3.08	2.57
		Early	59	3.16	3.19	2.70
		Not at ASU	39	3.43	3.42	NA
			112	3.25	3.26	2.68

### Academic Year: 2003-2004

<b>All students</b>	146	Late	19	3.22	3.30	3.16
		Early	77	3.24	3.32	2.80
		Not at ASU	50	3.49	3.56	NA
			146	3.32	3.40	2.87
<b>Minority Only</b> 13.70%	20	Late	5	2.73	2.93	2.40
		Early	13	3.24	3.29	2.58
		Not at ASU	2	3.26	3.28	NA
			20	3.11	3.20	2.53
<b>Not Minority</b> 86.30%	126	Late	14	3.40	3.43	3.43
		Early	64	3.25	3.32	2.85
		Not at ASU	48	3.50	3.58	NA
			126	3.36	3.43	2.95

### Academic Year: 2004-2005

<b>All students</b>	159	Late	20	3.32	3.26	2.93
		Early	81	3.13	3.21	2.52
		Not at ASU	58	3.29	3.27	NA
			159	3.21	3.24	2.60
<b>Minority Only</b> 23.27%	37	Late	3	3.13	2.95	2.67
		Early	22	3.07	3.19	2.28
		Not at ASU	12	3.18	3.40	NA
			37	3.11	3.24	2.33
<b>Not Minority</b> 76.73%	122	Late	17	3.35	3.32	2.98
		Early	59	3.15	3.22	2.61
		Not at ASU	46	3.32	3.23	NA
			122	3.24	3.24	2.69

### C.3: B.S. Biological Sciences (excluding CLS)

#### Academic Year: 2002-2003

	# Students	Math When?	# Students	ASU GPA	Major GPA	Math GPA
<b>All students</b>	247	Late	31	3.14	3.10	2.71
		Early	130	3.17	3.08	2.94
		Not at ASU	86	3.24	3.14	NA
			247	3.19	3.10	2.90
<b>Minority Only</b> 6.88%	17	Late	2	2.76	2.56	2.50
		Early	10	2.94	2.80	2.79
		Not at ASU	5	2.89	2.75	NA
			17	2.90	2.76	2.74
<b>Not Minority</b> 93.12%	230	Late	29	3.16	3.14	2.72
		Early	120	3.19	3.10	2.96
		Not at ASU	81	3.26	3.16	NA
			230	3.21	3.13	2.91

#### Academic Year: 2003-2004

<b>All students</b>	244	Late	26	2.99	2.93	2.73
		Early	134	3.18	3.14	2.78
		Not at ASU	84	3.24	3.19	NA
			244	3.18	3.13	2.77
<b>Minority Only</b> 11.89%	29	Late	6	2.68	2.61	2.50
		Early	14	2.68	2.54	2.25
		Not at ASU	9	2.91	2.90	NA
			29	2.75	2.67	2.33
<b>Not Minority</b> 88.11%	215	Late	20	3.08	3.02	2.80
		Early	121	3.24	3.21	2.83
		Not at ASU	74	3.26	3.21	NA
			215	3.23	3.19	2.83

#### Academic Year: 2004-2005

<b>All students</b>	252	Late	28	3.18	3.13	2.85
		Early	140	3.14	3.08	2.89
		Not at ASU	84	3.21	3.12	NA
			252	3.17	3.10	2.88
<b>Minority Only</b> 13.89%	35	Late	2	2.51	2.55	1.50
		Early	23	2.94	2.87	2.61
		Not at ASU	10	3.15	2.92	NA
			35	2.98	2.87	2.52
<b>Not Minority</b> 86.11%	217	Late	26	3.23	3.18	2.95
		Early	117	3.18	3.12	2.95
		Not at ASU	74	3.22	3.15	NA
			217	3.20	3.14	2.95

### C.4: B.S. Biological Sciences by Major

Academic Year: 2002-2003

	# Students	Math When?	# Students	ASU GPA	Major GPA	Math GPA
BS Biology & Society	16	Late	0	NA	NA	NA
		Early	11	3.46	3.43	3.18
		Not at ASU	5	3.46	3.30	NA
			16	3.46	3.39	3.18
BS Biology	148	Late	17	2.99	2.88	2.53
		Early	79	3.15	3.02	3.03
		Not at ASU	52	3.26	3.15	NA
			148	3.17	3.05	2.94
BS Plant Biology	5	Late	2	3.33	3.44	2.50
		Early	2	3.15	3.29	1.50
		Not at ASU	1	2.19	2.66	NA
			5	3.03	3.22	2.00
BS Plant Biology & Ecology	5	Late	1	3.59	3.70	3.00
		Early	2	3.16	3.54	1.00
		Not at ASU	2	3.49	3.56	NA
			5	3.38	3.58	1.67
BS Mol Biology & Biotech	19	Late	7	3.38	3.40	3.00
		Early	10	3.23	3.26	3.00
		Not at ASU	2	3.49	3.59	NA
			19	3.31	3.35	3.00
BS Plant Biology & Biochem	0	Late	0	0.00	0.00	0.00
		Early	0	0.00	0.00	0.00
		Not at ASU	0	0.00	0.00	NA
			0	0.00	0.00	0.00
BS Microbiology	33	Late	2	3.01	3.15	3.50
		Early	17	3.11	3.06	2.80
		Not at ASU	14	3.25	3.17	NA
			33	3.16	3.11	2.87
BS Conservation Biology	21	Late	2	3.20	3.23	2.50
		Early	9	3.03	2.82	2.89
		Not at ASU	10	2.96	2.84	NA
			21	3.01	2.87	2.82
BS Clinical Lab Sciences Uniquely Structured Program Calculus Not Required	4	Late				
		Early				
		Not at ASU				
Success early to remain			4	3.44	3.46	NA

**B.S. Biological Sciences by Major (cont.)**

**Academic Year: 2003-2004**

Degree	# Students	Math When?	# Students	ASU GPA	Major GPA	Math GPA
BS Biology & Society	13	Late	1	3.62	3.90	4.00
		Early	4	3.35	3.36	2.86
		Not at ASU	8	3.62	3.60	NA
			13	3.54	3.55	3.09
BS Biology	148	Late	14	2.69	2.54	2.50
		Early	82	3.15	3.07	2.81
		Not at ASU	52	3.14	3.06	NA
			148	3.10	3.02	2.76
BS Plant Biology	0	Late	0	NA	NA	NA
		Early	0	NA	NA	NA
		Not at ASU	0	NA	NA	NA
			0	NA	NA	NA
BS Plant Biology & Ecology	6	Late	3	3.51	3.57	2.67
		Early	1	3.05	3.43	2.00
		Not at ASU	2	3.23	3.52	NA
			6	3.34	3.53	2.50
BS Mol Biology & Biotech	27	Late	5	3.47	3.50	3.20
		Early	21	3.21	3.33	2.53
		Not at ASU	1	3.91	3.90	NA
			27	3.28	3.38	2.66
BS Plant Biology & Biochem	0	Late	0	NA	NA	NA
		Early	0	NA	NA	NA
		Not at ASU	0	NA	NA	NA
			0	NA	NA	NA
BS Microbiology	34	Late	2	2.94	3.13	3.00
		Early	21	3.29	3.22	2.99
		Not at ASU	11	3.20	3.30	NA
			34	3.24	3.24	2.99
BS Conservation Biology	16	Late	1	2.66	2.20	2.00
		Early	5	3.03	2.86	2.41
		Not at ASU	10	3.38	3.26	NA
			16	3.23	3.07	2.34
BS Clinical Lab Sciences Unique Structured Program Calculus Not Required	9	Late				
		Early				
		Not at ASU				
Success early to remain			9	3.45	3.59	2.50

**B.S. Biological Sciences by Major (cont.)**

**Academic Year: 2004-2005**

	# Students	Math When?	# Students	ASU GPA	Major GPA	Math GPA
BS Biology & Society	19	Late	1	3.63	3.60	4.00
		Early	14	3.54	3.60	3.25
		Not at ASU	4	3.21	3.20	NA
			19	3.48	3.52	3.30
BS Biology	155	Late	16	3.11	3.03	2.58
		Early	84	3.07	2.93	2.90
		Not at ASU	54	3.19	3.05	NA
			154	3.12	2.98	2.85
BS Plant Biology	4	Late	0	NA	NA	NA
		Early	1	3.72	3.84	1.00
		Not at ASU	3	2.82	2.84	NA
			4	3.05	3.09	1.00
BS Plant Biology & Ecology	5	Late	1	3.18	3.36	4.00
		Early	2	3.04	3.17	2.50
		Not at ASU	2	3.39	3.58	NA
			5	3.21	3.37	3.00
BS Mol Biology & Biotech	17	Late	5	3.40	3.56	3.27
		Early	11	3.49	3.68	3.16
		Not at ASU	1	3.28	3.43	NA
			17	3.45	3.63	3.19
BS Plant Biology & Biochem	2	Late	0	NA	NA	NA
		Early	1	3.40	3.25	2.00
		Not at ASU	1	2.97	3.25	NA
			2	3.19	3.25	2.00
BS Microbiology	35	Late	3	3.28	3.07	2.67
		Early	18	2.99	2.96	2.74
		Not at ASU	14	3.37	3.43	NA
			35	3.17	3.16	2.73
BS Conservation Biology	15	Late	2	2.87	2.65	3.00
		Early	9	3.08	3.05	2.65
		Not at ASU	4	3.10	2.83	NA
			15	3.06	2.94	2.71
BS Clinical Lab Sciences Unique Structured Program Calculus Not Required	11	Late Early Not at ASU				
Success early to remain			11	3.66	3.78	3.33

## ***Appendix D: Extracting GPA Data from Database***

The GPA data for each student was collected by combining the results of two separate queries. In the case of students earning a B.S. in Psychology, this would be the queries “Math GPA for All B.S. Psychology Students” and “Upper Level GPA for All B.S. Psychology”, as described in Appendix B. The pivot section from the query “Math GPA for All B.S. Psychology Students” provides the following fields:

1. Affiliate ID – unique identifier for each student
2. Citizenship – Citizenship Code used to determine minority status
3. Minority – Minority Code used to determine minority status
4. AsuGPA – Cumulative ASU GPA at time degree is granted
5. MatGPA – GPA for all MAT courses contributing to degree requirements
6. Semester Degree Granted – semester degree was completed
7. Semester – semester of first MAT course contributing toward Math GPA.

The pivot section from the query “Upper Level GPA for All B.S. Psychology Students” provides the following fields:

1. Affiliate ID - unique identifier for each student
2. AsuGPA – Cumulative ASU GPA at time degree is granted
3. Grade Points – grade points awarded for upper level electives in major
4. Hours – credit hours awarded for upper level electives in major
5. UpperGPA – GPA for upper level electives in major (computed from Grade Points/Hours)

The fields as listed above are extracted from BrioQuery by selecting the “pivot” section to be displayed and then selecting “File → Export → Section” menu the pull down menu. This will invoke a dialog box that allows the section to be saved as an Excel spreadsheet. The goal, starting from these two spreadsheets is to obtain:

1. The data tabulated in Appendix C

- a. separating student by minority status
  - b. separating students by when their math was taken
2. A tab-delimited file that may be imported into SAS, containing data for one student per line as follows: AsuGPA, UpperGPA, MatGPA, When.

The subsequent sections will describe how this data is extracted from the Excel Spreadsheets.

### ***D.1: Computing Mean GPA Values***

This data is extracted from queries representing all of the students earning a particular degree (minority and non-minority).

1. Open the spreadsheets exported from the “Math GPA for All B.S. Psychology Students” and “Upper Level GPA for All B.S. Psychology Students” queries. In Excel, select “Window → Arrange → Vertical”, to visualize the two spread sheets side-by-side.
2. For any column not containing a title, add the title as listed above (Affiliate Id, Citizenship, etc.)
3. Highlight all of the data in each spread sheet and sort ascending by Affiliate Id.
4. Determine whether each spreadsheet contains the same number of rows. Each spreadsheet contains data for the same number of students, however, on occasion the minority status code is not always input when the student changes their ASU ID, causing there to be 2 rows for a single student. If this is the case the data must be combined to obtain a single row of data per student. Once each spreadsheet contains the same number of rows, processing may continue.
5. In the spread sheet containing the “MatGPA”, add a title “When” following the last column “Semester”. In the first cell below this header, compute the difference between “Semester Degree Granted” and “Semester”. (Ex. “Semester Degree Granted” is column F and “Semester” is column G, value in cell H2 is “=F2-G2”). Copy this equation (ctrl-C) and paste it to remaining cells in column

- (ctrl-V). This obtains a value for how long before graduation a student began taking their MAT courses.
6. The spreadsheet containing the “MatGPA” contains all of the fields needed, except for the “UpperGPA”. With the data in each spreadsheet sorted by Affiliate ID, and the same number of rows in each spreadsheet, copy the “UpperGPA”, column and insert it in between the “AsuGPA” and “MatGPA”. When this step is completed, close the spreadsheet that was the source of the “UpperGPA”.
  7. The a copy of the sheet containing all of the GPA data is now duplicated within the remaining file. One tab is labeled “All” and the other is labeled “Minority”.
  8. In the sheet labeled “All”, the columns containing the Affiliate ID, Citizenship, and Minority can all be deleted.
  9. The remaining columns are highlighted and sorted ascending by “When”.
  10. If any “When” value is less than 0, a student took a MAT class after graduation, and not before. Cut this row and move it to the bottom of the data. Change the value to be the same as the “Semester Degree Granted” value
  11. Use the “When” values to categorize when MAT courses were taken.  
  
A value of  $0 \leq x < 20$  is “Late”. A value of  $20 \leq x < \text{“Semester Degree Granted”}$  is “Early. A value of  $x < 0$  or  $x = \text{“semester Degree Granted”}$  is “Not at ASU”.
  12. Within each group, count the number of students (rows), and compute the mean of each GPA.
  13. Calculate the mean GPAs for all students as well. This is the data listed as “All Students” in Appendix C.
  14. In the sheet labeled “Minority”, select all of the data and sort ascending by “Citizenship” and then “Minority”.
  15. Select the rows with a “Citizenship” of “US” and “Minority” of “B”, “N”, or “H”. Cut these rows and move them to the top of the sheet. These rows are the “Minority Only” rows and the remaining rows are the “Not Minority” rows.
  16. Within each group of rows, sort the columns ascending by “When”.

17. Repeat steps 10 to 13 on each set of rows, to obtain the GPA means for “Minority Only” and “Not Minority” as reported in Appendix C.

## ***D.2: Generating Tab-delimited Data Files***

This data is extracted from queries representing all of the students (minority and non-minority). The tab-delimited files will be imported into SAS. The columns to be maintained are: “AsuGPA”, “MatGPA”, “UpperGPA”, and “When”. The “When” column is created in Excel, as described in section D.1, step 5.

The steps for extracting data for Minority student are as follows:

1. Start from the spreadsheet file created in section D.1, “save as” another file, such that the starting spreadsheet is preserved.
2. Delete the “All” sheet, such that just one sheet is present.
3. Delete all rows except those for the “Minority Only” students.
4. Delete all columns except: “AsuGPA”, “MatGPA”, “UpperGPA”, and “When”. The data might look like that in the figure below.
5. Prior to saving the file as a tab-delimited file, the computed column “When” must be converted to numeric values. To do this select the “When” column, then right click → copy, then right click → paste special (paste is to the same location), in dialog box → values, click ok. This replaces each calculation with the value obtained from the calculation.
6. File → Save As, select tab-delimited (.txt) file.

Once the files are in this format rows can be easily deleted or modified to obtain the dataset desired. Files can be easily combined to obtain datasets that span multiple years.

	A	B	C	D
1	AsuGPA	UpperGPA	MatGPA	When
2	2.22	1.88	2	8
3	2.77	3.14	2	18
4	3.6	3.6	3	26
5	2.76	2.29	3	30
6	3.82	3.76	4	36
7	2.73	3	1	40
8	2.68	2.04	1.5	40
9	2.94	3.13	2	40
10	3.85	4	4	44
11	2.06	1.53		20027
12	2.13	2		20027
13	3.58	3.86		20027
14	2.48	1.9		20027
15	3.06	3.29		20027
16	3.6	3.8		20031
17	3.11	3.5		20035

Figure 31. Excel spreadsheet containing GPA data for minority students

### D.3: Example SAS File

The following is an example of a “.sas” file (*all\_51\_psy\_bs\_minority.sas*), as executed on the stats.asu.edu server. The file is executed from Windows using an SSH Secure Shell Client. Files are transferred to and from the server using an SSH Secure File Transfer Client. Both of these clients are available for download from ASU.

The “.sas” files are executed from the UNIX prompt as follows:

```
sas filename.sas -noterminal
```

Since this is a remote execution, the `-noterminal` flag is necessary. Without this flag, the task will hang, and an error in the log file will indicate that it was unable to obtain a window to display the output. Note in the file below, the names of the data fields per row are exactly as described in the creation of the tab-delimited text file.

```

title 'Analysis of Math GPA Data';
* READ IN THE DATA;

proc import datafile="/afs/asu.edu/users/l/g/g/lggoldbe/ra/all_51_psy_bs_minority.txt"
  out=gpadata
  dbms=dml
  replace;
  delimiter='09'x;
  getnames=yes;

label AsuGPA = 'Cummulative ASU GPA';
label UpperGPA = 'Upper Level Major GPA';
label MatGPA = 'Math GPA';
label When = 'Math Early = 1';

* PRINT OUT THE DATA;

options nodate ps=60 ls=80;

proc print data=gpadata;

* PLOT MatGPA vs. When;
proc plot data = gpadata;
* Y=MatGPA X=When;
  plot MatGPA*When;

* PERFORM THE REGRESSION ANALYSIS;
* OBTAIN CONFIDENCE INTERVALS FOR THE MEAN RESPONSE AT EACH X (CLM OPTION);
proc reg data=gpadata lineprinter;
  model MatGPA = When/clm;

* PLOT UpperGPA vs. When;
proc plot data = gpadata;
* Y=UpperGPA X=When;
  plot UpperGPA*When;

* PERFORM THE REGRESSION ANALYSIS;
* OBTAIN CONFIDENCE INTERVALS FOR THE MEAN RESPONSE AT EACH X (CLM OPTION);
proc reg data=gpadata lineprinter;
  model UpperGPA = When/clm;

* PLOT AsuGPA vs. When;
proc plot data = gpadata;
* Y=AsuGPA X=When;
  plot AsuGPA*When;

* PERFORM THE REGRESSION ANALYSIS;
* OBTAIN CONFIDENCE INTERVALS FOR THE MEAN RESPONSE AT EACH X (CLM OPTION);
proc reg data=gpadata lineprinter;
  model AsuGPA = When/clm;

```