

## II. Graduate Curricula and Degree Programs

### A. Scope of programs within the department

The department offers the following graduate degree plans. More specific detail concerning each of these programs is available in the Appendix, Sections B and D.

**150-Hour Combined Bachelor's-Master's Degree in Mathematics or Statistics:** The department has recently implemented three combined bachelor's/master's degree programs.

- 150-Hour Combined Bachelor of Science / Master of Science
- 150-Hour Combined Bachelor of Arts / Master of Arts
- 150-Hour Combined Bachelor of Arts / Master of Science

These programs will allow qualified students to obtain a master's degree in Mathematics or Statistics through an additional 12 months of study beyond the bachelor's degree. Students enrolled in one of these programs will follow the standard undergraduate curriculum for course work during their first six semesters. Beginning in their final undergraduate year, they will begin taking graduate courses (one during the first semester and two during the second semester). At the end of this year, the student will receive his/her bachelor's degree in Mathematics. The three graduate courses taken in the final undergraduate year are applied to the student's master's program. The completion of the combined degree program would then typically require an additional year of study. Under the first option, during the additional year five graduate courses are taken along with 6 hours of thesis. Under the other two options, during the additional year six courses additional graduate courses are taken along with 3 hours of report.

**Master of Arts Degree in Mathematics:** The M.A. degree in Mathematics consists of 36 hours of graduate work, including 3 hours of credit for a departmental report. The student must complete three sequences chosen from algebra, analysis, geometry, probability and statistics, modeling and applications, and computer literacy. This degree is offered primarily for those students who wish to teach mathematics at the secondary level or at a junior/community college.

**Master of Science Degree in Mathematics:** The M.S. program is designed to prepare students for one or more of the following areas: pre-college or junior college teaching, industrial employment, or further graduate study. A minimum of specific course requirements allows the student a great deal of freedom in his or her program of study and thereby fulfills the purpose of the program.

The M.S. degree in mathematics consists of 36 hours of graduate work, including 3 hours of credit for a departmental report, or 30 hours of graduate work including 6 hours of credit for the master's thesis. The student must complete at least two of the core sequences listed on the Ph.D. program for the 36-hour plan and at least one of the core sequences for the 30-hour plan. In the 36-hour plan a minor of 9 hours is permitted and in the 30-hour plan a minor of 6 hours is permitted. In each case the graduate advisor must approve the minor.

**Master of Science Degree in Mathematics with an emphasis in Computer Science:** This degree calls for a balance of mathematics courses and computer courses designed for the student with little or no background in computer science. The degree consists of 36 hours with 3 hours of credit

for a departmental report. This plan calls for 18 to 21 hours of graduate course work in mathematics and 12 to 15 hours of graduate course work in computer science. Of the 18 to 21 hours of mathematics course work, at least two sequences from the list in the departmental handbook must be completed. The 12 to 15 hours of computer science course work constitute adjunct requirements and must be approved by the graduate advisor.

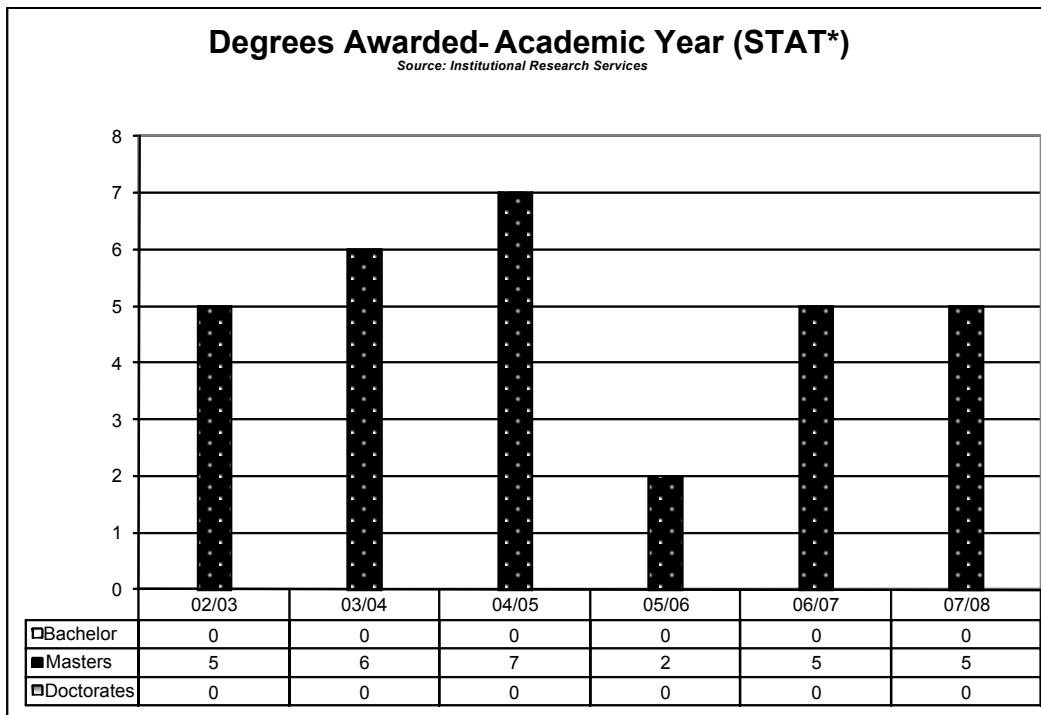
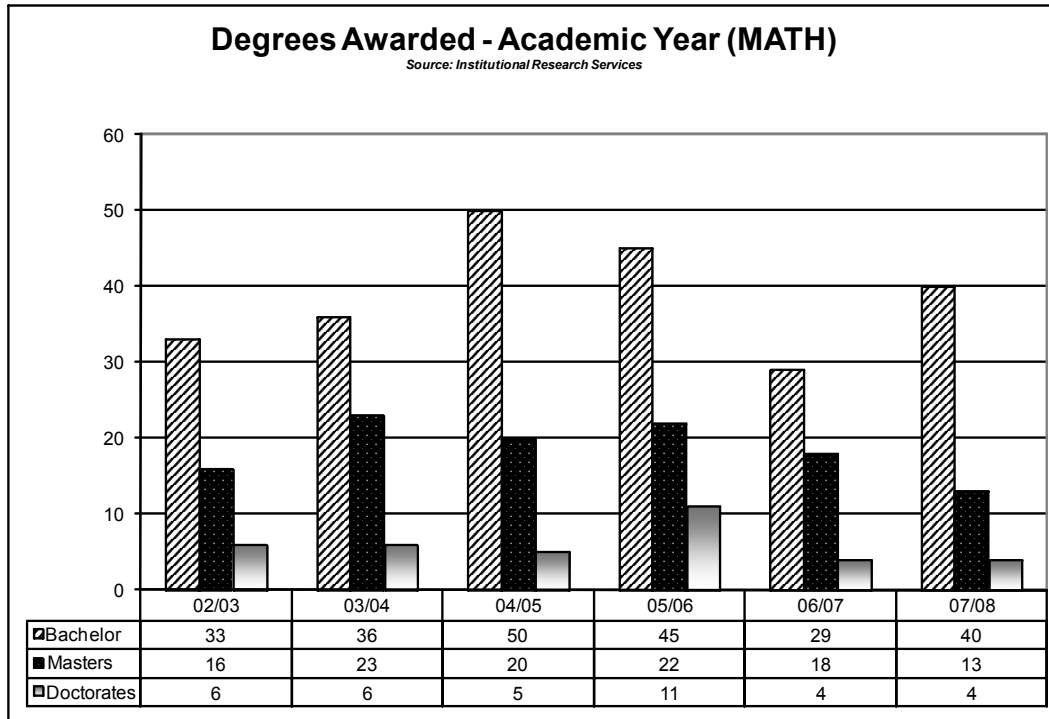
**Master of Science in Statistics:** This program is a concentrated study in statistics. The M.S. degree in statistics consists of 36 hours of graduate work including 3 hours of credit for a departmental report or 6 hours of credit for the master's thesis. Up to 3 hours of graduate work are permitted in other areas such as agriculture, biology, business, economics, engineering, psychology, sociology, or fields as approved by the graduate advisor.

**The Ph.D. Degree:** The principal goal of the Ph.D. program is to train research oriented mathematicians for college and university teaching or for governmental and industrial employment. Each doctorate in Mathematics at Texas Tech University is based on the doctoral candidate's choice of an area of specialization from the following three broad specialty areas: Applied Mathematics, Pure Mathematics and Statistics. Minimum course requirements have been established in each of these areas to ensure that the student obtains a broad background in mathematics and, in addition, attains depth in his or her specialty area.

The Doctoral Preliminary Examinations are administered twice each year (in May and in August) and are offered in the seven areas corresponding to the following graduate core courses: (1) Algebra, (2) Complex Analysis, (3) Ordinary Differential Equations and Partial Differential Equations, (4) Numerical Analysis, (5) Real Analysis, (6) Probability and Statistics, and (7) Topology. Each examination is four hours long with content based on important fundamental concepts in the area. Each examination is developed by a committee of faculty in the respective core area in consultation with the Graduate Committee. The topics over which a student can be tested are listed in the Preliminary Examination Topics List, which is available from the Graduate Advisor. Examples of Doctoral Preliminary Examinations are available on the departmental web page.

Each doctoral student is required to pass a Qualifying Examination on advanced topics beyond those covered in the Preliminary Examinations. Doctoral candidates are expected to present a departmental colloquium prior to graduation. Any foreign language requirements are at the discretion of the student's dissertation advisor.

## B. Number and types of degrees awarded



\* There are no bachelor's or doctoral degrees in Statistics

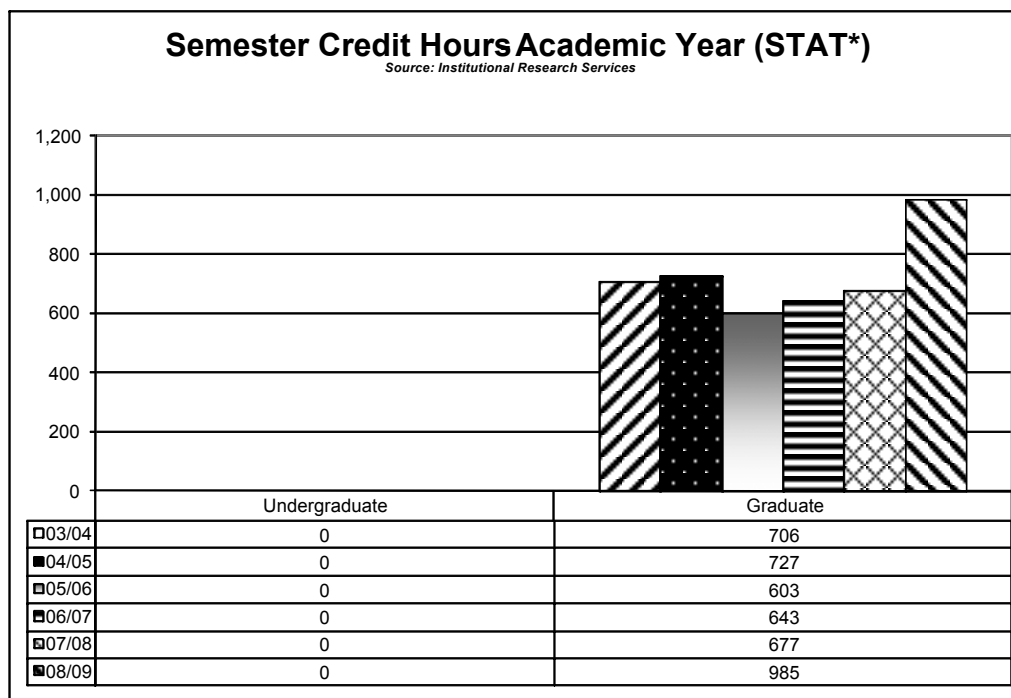
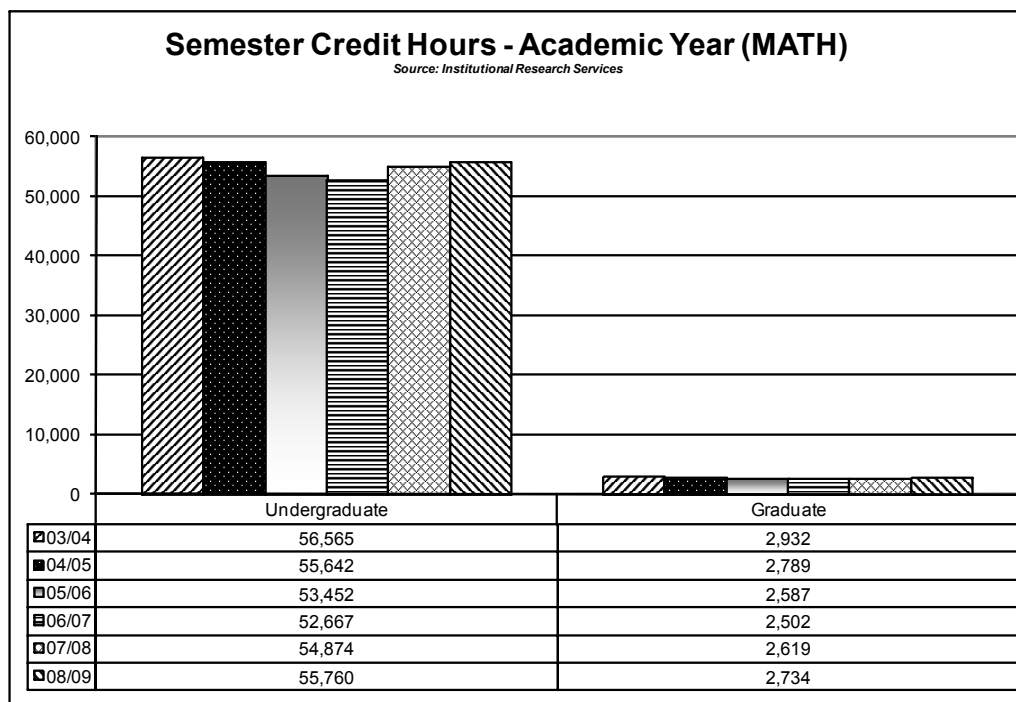
## Graduate Program Degrees Awarded

*Source: Institutional Research Services*

Name of Program	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008
Mathematics	22	29	25	33	22	17
Statistics	5	6	7	2	5	5

Comparison of Degrees Awarded - Fall Data	03/04	04/05	05/06	06/07	07/08	08/09
<b>Oklahoma State</b>						
Bachelor	18	9	18	17	16	
Master	7	12	11	10	4	
Doctoral	0	1	1	1	0	
<b>University of Kansas (AY)</b>						
Bachelor	41	34	30	37	26	
Master	13	18	12	21	18	
Doctoral	3	2	4	2	3	
<b>University of Oklahoma</b>						
Bachelor	29	30	44	43	38	
Master	3	12	9	12	16	
Doctoral	1	4	2	5	3	
<b>Texas Tech - Mathematics</b>						
Bachelor	36	50	45	29	40	
Master	23	20	22	18	13	
Doctoral	6	5	11	4	4	
<b>Texas Tech - Statistics</b>						
Bachelor	0	0	0	0	0	
Master	6	7	2	5	5	
Doctoral	0	0	0	0	0	
<b>Semester Credit Hours (MATHS &amp; STATS Dept) - Academic Year (Fall + Spring + SS1 + SS2)</b>						
	03/04	04/05	05/06	06/07	07/08	08/09
Undergraduate	56,565	55,642	53,452	52,667	54,874	55,760
Graduate	2,932	2,789	2,587	2,502	2,619	2,734
Operating Cost	\$408,035	\$182,039	\$167,213	\$197,423	\$208,228	\$0

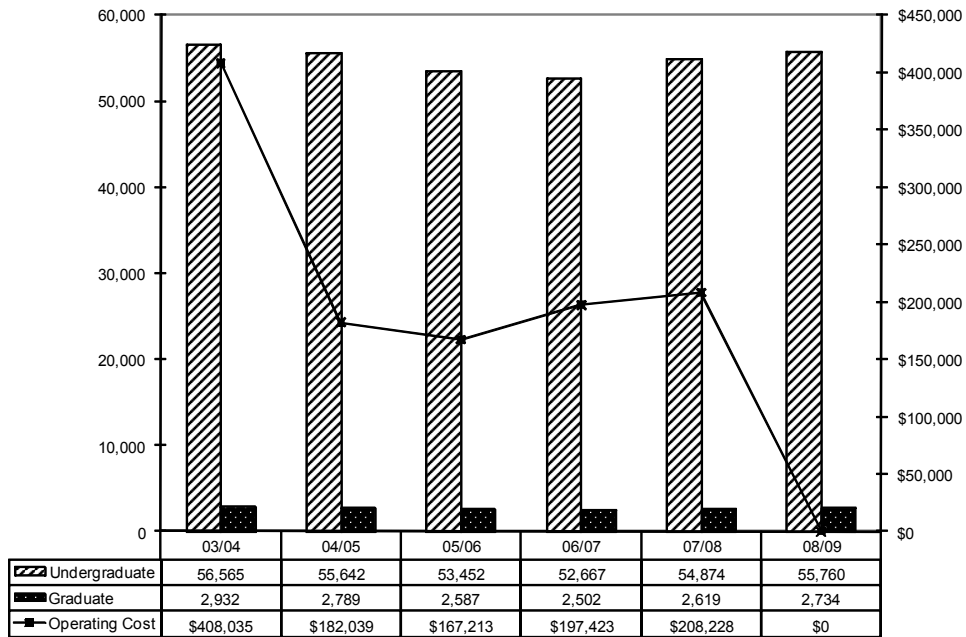
## C. Undergraduate and graduate semester credit hours



\* There are no undergraduate courses in Statistics

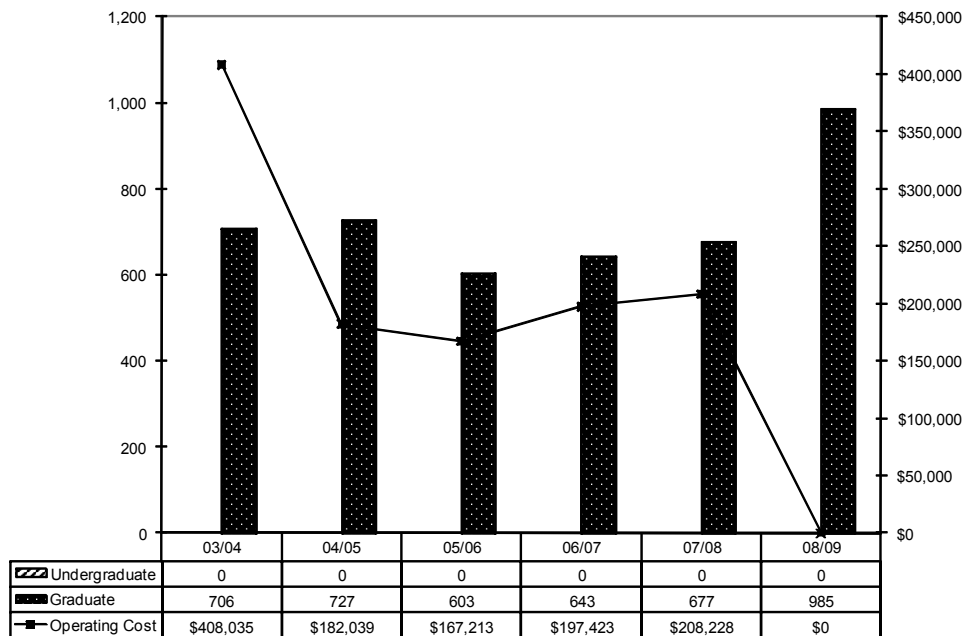
### AY SCH compared to Budget (MATH)

Source: Institutional Research Services

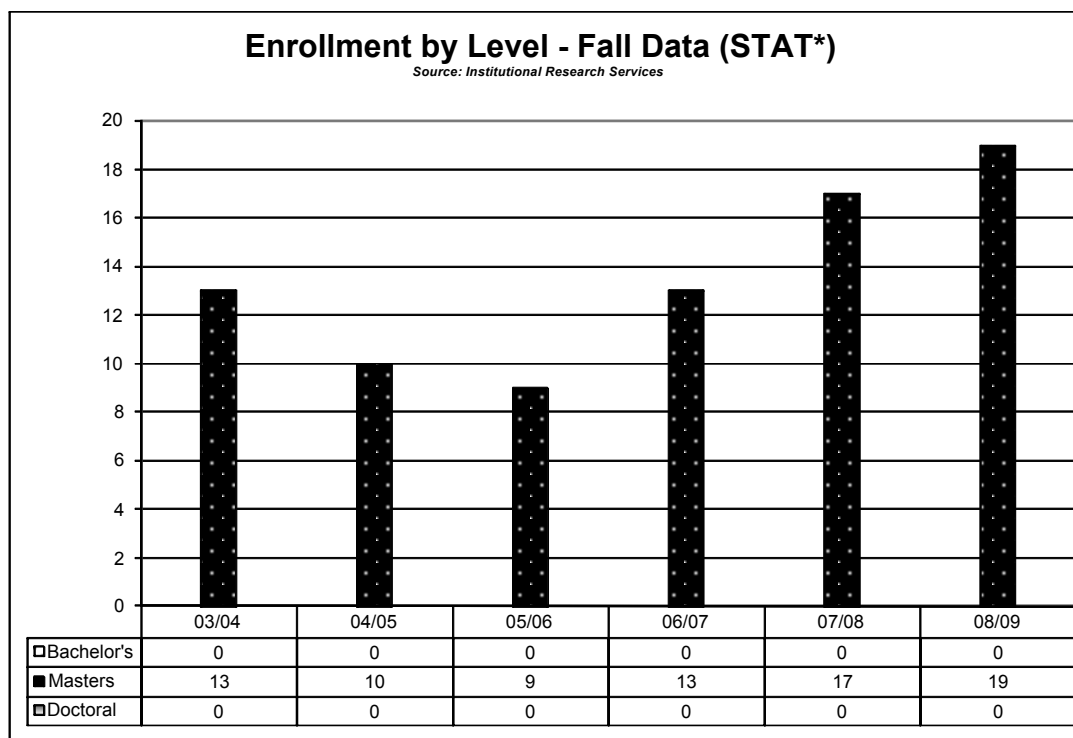
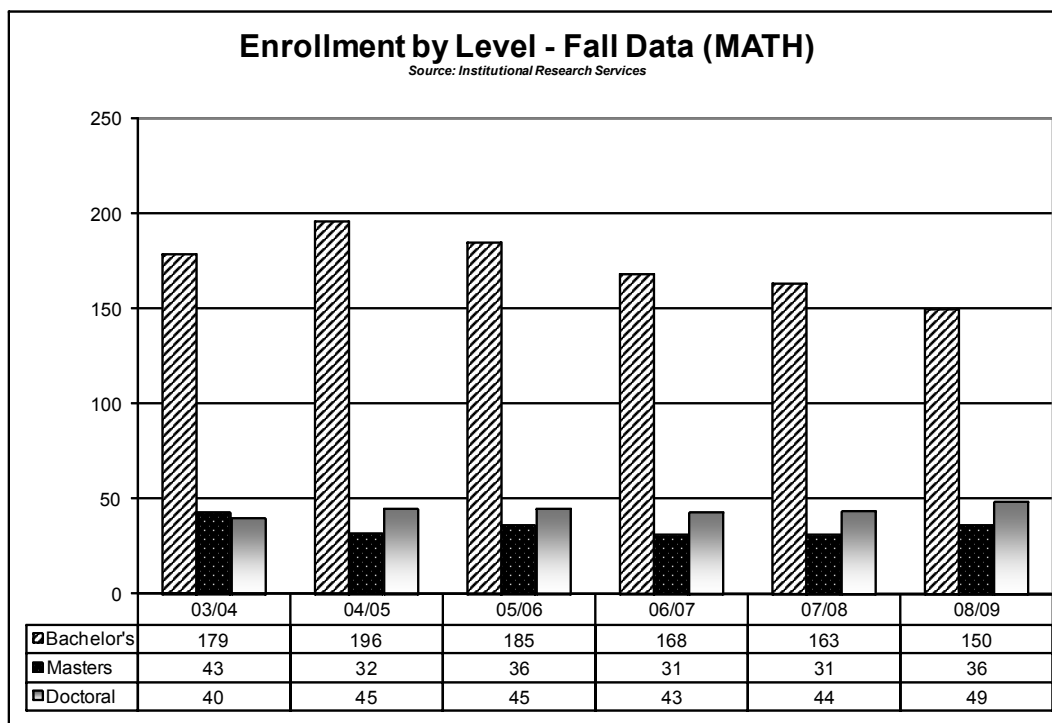


### AY SCH compared to Budget (STAT)

Source: Institutional Research Services



## D. Number of majors in the department for the fall semesters



\* There are no bachelor's or doctoral courses in Statistics

\* There are no bachelor's or doctoral degrees in Statistics



## E. Course enrollments over the past six years (enrollment trends by course)

- Figures are totals – classes may be offered more than once a year

**Course Enrollments by Academic Year***Source: Institutional Research Services*

Department	Subject	Course	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	TOTAL
MATH	MATH	5101	24	22	21	11	12	5	95
MATH	MATH	5102	35	30	39	53	40	25	222
MATH	MATH	5103	9	4	9	5	6	0	33
MATH	MATH	5104	32	33	21	7	18	5	116
MATH	MATH	5105	10	7	9	9	11	5	51
MATH	MATH	5106	21	39	24	37	41	20	182
MATH	MATH	5107	22	14	18	10	12	10	86
MATH	MATH	5310	23	18	14	22	19	15	111
MATH	MATH	5311	14	15	6	17	15	0	67
MATH	MATH	5312	12	10	17	8	7	13	67
MATH	MATH	5313	4	8	7	6	5	0	30
MATH	MATH	5316	12	12	15	24	10	0	73
MATH	MATH	5318	28	29	17	33	34	25	166
MATH	MATH	5319	11	12	13	25	27	0	88
MATH	MATH	5320	0	29	13	12	16	18	88
MATH	MATH	5321	0	19	11	5	15	0	50
MATH	MATH	5322	24	17	18	6	13	10	88
MATH	MATH	5323	18	12	14	5	12	0	61
MATH	MATH	5324	0	10	0	0	0	10	20
MATH	MATH	5325	0	7	0	0	0	0	7
MATH	MATH	5326	16	0	15	0	17	0	48
MATH	MATH	5327	11	0	9	0	18	0	38
MATH	MATH	5330	21	6	19	6	14	13	79
MATH	MATH	5331	0	0	0	0	13	0	13
MATH	MATH	5332	16	6	17	7	6	0	52
MATH	MATH	5333	0	11	0	0	0	0	11
MATH	MATH	5334	47	47	41	42	31	19	227
MATH	MATH	5335	23	15	20	23	22	0	103
MATH	MATH	5340	5	0	0	0	0	7	12
MATH	MATH	5341	6	0	0	0	0	0	6
MATH	MATH	5342	7	13	39	10	11	0	80
MATH	MATH	5343	5	7	0	0	0	0	12
MATH	MATH	5344	23	0	0	0	0	15	38
MATH	MATH	5345	0	14	0	44	5	0	63

MATH	MATH	5346	64	49	23	6	8	0	150
MATH	MATH	5354	0	15	0	0	0	10	25
MATH	MATH	5355	0	10	0	0	0	0	10
MATH	MATH	5356	0	0	0	0	0	0	0
MATH	MATH	5360	51	42	42	43	18	36	232
MATH	MATH	5361	33	38	12	12	24	0	119
MATH	MATH	5362	12	0	0	0	16	0	28
MATH	MATH	5364	14	0	0	13	28	0	55
MATH	MATH	5365	29	27	22	32	47	0	157
MATH	MATH	5382	16	0	9	0	13	0	38
MATH	MATH	5383	0	13	0	0	8	0	21
MATH	MATH	5399	39	23	41	33	52	16	204
MATH	MATH	6000	65	56	46	45	44	20	276
MATH	MATH	6310	9	3	10	13	9	0	44
MATH	MATH	7000	125	126	126	118	120	39	654
MATH	MATH	8000	31	40	47	24	38	13	193
MATH	STAT	5302	9	6	18	0	10	10	53
MATH	STAT	5303	11	4	0	0	10	0	25
MATH	STAT	5326	8	0	0	0	0	0	8
MATH	STAT	5328	22	28	22	30	20	37	159
MATH	STAT	5329	25	22	13	23	15	0	98
MATH	STAT	5370	6	9	0	7	7	0	29
MATH	STAT	5371	5	0	7	0	8	0	20
MATH	STAT	5372	13	0	6	0	0	0	19
MATH	STAT	5373	9	10	0	0	0	0	19
MATH	STAT	5374	16	11	10	9	15	6	67
MATH	STAT	5375	12	8	8	15	15	0	58
MATH	STAT	5376	5	15	5	0	0	0	25
MATH	STAT	5377	0	9	0	0	0	0	9
MATH	STAT	5378	0	17	0	0	0	21	38
MATH	STAT	5379	0	11	0	0	0	22	33
MATH	STAT	5380	0	7	6	0	6	0	19
MATH	STAT	5381	0	10	0	0	0	0	10
MATH	STAT	5384	7	7	17	12	12	25	80
MATH	STAT	5385	8	4	7	8	12	0	39
MATH	STAT	5386	0	0	14	0	18	0	32
MATH	STAT	6000	27	14	11	11	15	3	81
MATH	STAT	6310	0	0	1	0	2	1	4
MATH	STAT	7000	24	28	31	33	41	6	163
<b>Totals</b>			1174	1128	1000	914	1081	480	5777

## F. Courses cross listed

<b>Spring 2004</b>	<b>Math 4000-004 / Math 5399-001</b>	<b>Neusel</b>
<b>Spring 2008</b>	<b>Math 4330-001 / Math 5399-003</b>	<b>Lee</b>
<b>Spring 2008</b>	<b>Math 4351-001 / Math 5399-002</b>	<b>Iyer</b>

**MATH 5399 and 4000/04**  
**Invariant Theory of Finite Groups**

Spring Term 2004  
Neusel PD

Dr. Mara D.

TEXT: M.D. Neusel, *Introduction to Invariant Theory*, World Scientific, to appear.  
(I will hand out copies of the manuscript. )

TIME: MWF 12-12.50pm in MA 115.

OFFICE HOURS: MWF 2-3 pm, room 248, Mathematics Building, or by appointment (mneusel@math.ttu.edu).

HOMEWORK: We will discuss homework problems in class at the end of every chapter.

GRADING: If you attend at least 85% of all classes, you get an automatic B+, i.e., I will check attendance. Furthermore, I expect that you read the manuscript carefully and give me comments, corrections, and suggestions. For any higher grade you need to hand in homework regularly and present homework in class and/or work on a semester project.

LAST DAY TO DROP A COURSE AND GET AN AUTOMATIC W: Feb. 25<sup>th</sup> , 2004.

ADA: Any student who, because of a disability, may require some special arrangements in order to meet course requirements should contact me as soon as possible to make such accommodations as may be necessary.

RELIGIOUS HOLIDAYS: A student who is absent from classes for the observance of a religious holy day shall be allowed to take an examination or complete an assignment scheduled for that day within a reasonable time after the absence.

You find the syllabus and all other information about this course, like, e.g., current homework, on my webpage

<http://www.math.ttu.edu/~mneusel/math5399.html>

## Course: Mathematics 4330 (and 5399)

Time: 1:00 MWF

**Instructor: Jeffrey M. Lee Ph.D.**

Email: [jeffrey.lee@ttu.edu](mailto:jeffrey.lee@ttu.edu)

**Office Hours:** 11:00\_12:00 PM weekdays in my office; MA 239. Office hours are subject to possible change once the semester starts so check with the instructor.

**Course Number: Mathematics 4330**

**Descriptive Title: Mathematics Computing**

**Prerequisites: Mathematics 1352**

*About the Course:* This course is intended to introduce mathematics majors to special topics in mathematics and programming. In this case the topic is **differential geometry** and the computational aspect is **Mathematica**. While the students may be assumed to be advanced mathematics students, the instructor will assume they are beginning programming students. This class will be somewhat self paced and open ended.

**Learning Outcomes:** The students will learn how computers can be used to study concepts, or solve problems related to the special topic chosen by the department for the particular semester. Concepts and skills to be mastered by the students include but are not limited to the following: Basic theorems and definitions of curve and surface theory. These include: Mean curvature, Gauss curvature, geodesics, basic operations and principles of programming in Mathematica. Emphasis will be place on production of 3D graphics demonstrating surface theory.

**Text:** Modern Differential Geometry of Curves and Surfaces  
By Alfred Gray

**Assessment:** I will assess student progress by collecting electronically saved Mathematica workbooks and via verbal feedback, in class discussions, and examinations etc. The grading itself will be based solely on examinations, attendance and electronically saved Mathematica notebooks.

**Examinations, and Class\_work, Homework:** There will be 2 midterm examinations each worth 100 points. Class\_work consists of going through the text in order and reproducing the Mathematica graphical programming examples therein. The student is strongly encouraged to tweek and modify these programs as a form of experimentation. **The student should save his/her work electronically to be collected later by the instructor.**

### Weighting:

**Attendance 30%**

**Electronically saved work 40%** (This will be judged by content, quality, and content. Make plenty of comments in your Mathematica workbooks. Please listen to my inclass instructions

**Midterm exams 30%**

**Grading:** Grading is based on the percent of possible points accumulated (distributed as above).

**Class Attendance and makeup:** Class attendance required and will be checked. You may miss 4 class periods without an effect on your grade. Each missed day will result in a fraction of attendance points being subtracted. A roll is passed around the class each class period.

**Academic Integrity:** Cheating on any exam will result in the student receiving 0% credit for the exam and the student will be reported to the department chairperson or college dean. Text messaging during an examination will automatically be considered cheating as will using a calculator in inappropriate ways.

**Civility in the Classroom:** Please turn your cell phones off or to silent BEFORE entering the classroom and keep them out of sight at all times. I expect your full attention as I will give you mine when you are speaking. **Do not read the newspaper in class.**

**Students with Disabilities:** Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office at 335 West Hall or 806\_742\_2405.

## **MATH 4351 (5399): Advanced Calculus II (Advanced Problems)**

**Prof. Ram Iyer**

*Office:* Rm 224, Mathematics and Statistics

*Phone:* 742\_2580 ext 239

*Office hours:* TR \_11:00 am \_12:30 pm

*Class Room:* MA 012

*Class Hours:* TR 9.30 \_10.50 am

*Email:* [ram.iyer@ttu.edu](mailto:ram.iyer@ttu.edu)

*Course Website:* <http://www.webct.ttu.edu> (I would prefer it that you contact me through the WebCT email. Otherwise your email might get lost in spam!)

**Prerequisite:** Math 4350

**Required Texts:** *Lebesgue Measure and Integration: An Introduction* \_ Frank Burk;  
*A Friendly Introduction to Analysis*, 2nd Edition \_ Kosmala

**Supplements:** *An Introduction to Lebesgue Integration and Fourier Series* \_ Wilcox and Myers

**Course Description:** The students are expected to present proofs. This course covers measure theory and the theory of integration, Riemann and Lebesgue.

**Learning Outcomes:** Students learn how to think and reason abstractly in the context of analysis of the real line, and learn how to write correct and clear mathematical arguments in this context. Concepts and skills to be mastered by the students include but are not limited to the following:

- II Proof techniques;
- II Understanding the concept of Riemann integration, and the properties of the Riemann integral. Understanding the Improper integral, and Integration in relation to Differentiation.
- II Understanding the basics of measure theory including such concepts as measure, measurable functions and the Lebesgue integral.
- II Understanding limits of sequences of functions, and properties of the Riemann and Lebesgue integrals when applied to sequences of functions.

### **Topics and Tentative Course Organization:**

Chapter 6 (Kosmala) _Sections	1_5	3.5 days
Chapter 7 (Kosmala) _Sections	1_4	1.5 days
Chapter 8 (Kosmala) _Sections	1_4	4 days
Chapter 3 (Burk) _ Sections	1_6	6 days
Chapter 4 (Burk) _ Sections	1_4	5 days
Chapter 5 (Burk) _ Sections	1_5	7 days
		27 days

**Learning Assessment:** The learning outcomes outlined earlier can be continually assessed throughout the semester in both graded and non-graded ways by both the instructor and students.

For the instructor, participation in class discussions is a way of assessing the students understanding, and their preparation before class. Such discussions will not be graded. The students can assess their own understanding by solving (non-graded) exercise problems from the book and checking their solutions with the instructor. Continuous ongoing communication between the students and the instructor will help in the learning assessment. Students are encouraged to ask questions in class, and to meet with the instructor during office hours. At other times, students are encouraged to send email regarding their difficulties via WebCT. Other ways of assessing learning is by using the Missouri Club that meets in Room 106. The timings will be announced in class during the first/second week of class and posted on WebCT.

The graded assessment of student performance will be through class attendance, class quizzes, and exams (see the detailed grading policy below). Extra credit homework may be assigned from time to time if the instructor feels that the students need extra work on a particular topic. However, the assignment of such homework is not certain, and the students should not depend on the extra credit homework to improve their grade.

### **Homeworks, Quizzes, Exams and Grading Policy:**

- II Homework will be assigned each week on WebCT. Login with your eraider name and password.
- II You are encouraged to work in groups while solving the homework problems, but the homework you turn in must be your own work and not copied from the others.
- II This is a writing intensive course and you will be developing your portfolio thorough out the course. You will get 50 % of lost credit for turning corrected solutions on the next class day after a homework is returned after grading
- II Free tutoring is available during weekdays in the Missouri Club (MA 106). The morning sessions will be conducted by graduate students.
- II There will be two exams in addition to the final exam. Attendance will be taken in every class.



- II The graduate course MATH 5399 will have additional homework and/or exam problems.

Attendance \_5 %  
 Homework \_20 %  
 Two Exams \_22.5 % each  
 Final Exam \_30 %

There will be no curves. The exams will be graded based on what was written on the exam and not on what was intended. Partial credit for correct steps will be awarded even if the final answer is wrong. However, full credit will be given only if the final answer is correct including the method. Correct final answers with wrong method deserve no credit.

The raw scores to grades conversion will be as follows:

<u>Raw score (including all the homeworks, exams and final)</u>	<u>Grade</u>
90-100	A
80-90	B
70-80	C
60-70	D
Below 60	F

#### Missed homework and exams

If you miss homework for any reason, you can use your score on the *following exam* to make up the missed homework. If you miss an exam, you can use the final exam to make it up. You can also make up a low score in a quiz or exam. *You have to notify me in writing before the exam about the quizzes or exams that you want replaced.* **However, you can only make up one homework with an exam score, and only one exam with the final.**

#### General Policies:

1. Civility in the classroom: You are expected to be courteous to me and your fellow students. This means that your cell\_phone should be turned off during the class; you shall not chat with your friends during class, or cause a distraction in any other way. Please see more information on\_line at [www.studentaffairs.ttu.edu/ypsa/publications/civility.htm](http://www.studentaffairs.ttu.edu/ypsa/publications/civility.htm).
2. Religious holy days: You are allowed to take the time to travel and observe a religious holy day. Prior notice should be given at least 1 day before the absence. Any missed quizzes or exams due to this can be made up according to the policy listed earlier.
3. Officially approved trips: Students are allowed to miss class for officially sanctioned trips by TTU. The student should notify the instructor of upcoming trips and present written authorization for such trips. Any missed quizzes or exams can be made up according to the policy listed earlier.
4. Students with Disabilities: If you have a disability that makes it difficult for you take quizzes or exams in class, then you are strongly encouraged to register with the P.A.S.S. Center. Students should present appropriate verification from AccessTECH for the instructor to make the necessary accommodations. Students should note that no requirement exists that accommodations be made prior to completion of this approved university procedure.
5. Academic Integrity: It is the aim of the faculty of TIU to foster a spirit of complete honesty and a high standard of integrity. The attempt of students to present as their own any work that they have not honestly performed is regarded by faculty and administration as a serious offense and renders the offenders liable to serious consequences, possibly

suspension. Please refer to the Texas Tech University Catalog p 49 for more description of this subject.

6. If you are taking another course with the same final exam time, please contact me at least a week before the final exam.
7. For other policies, please refer to the Operating Policy and Procedure manual: <http://www.depts.ttu.edu/opmanual/> . In case of conflict between the above listed policies and those in the OPP manual, the listed policy is void. If you notice such a conflict, please bring it to the instructor's attention.

**Important Dates:** (Please visit [http://www.depts.ttu.edu/OfficialPublications/calendar/07\\_08calendar/07\\_08detailed.html](http://www.depts.ttu.edu/OfficialPublications/calendar/07_08calendar/07_08detailed.html) for more detailed/recent information)

*January 21, Monday:* Martin Luther King Jr. holiday.

*January 25, Friday:* Last day to drop a course and receive a refund.

*February 6, Wednesday:* Last day to withdraw from the university and receive a partial refund.

*February 14, Thursday:* **First Exam**

*March 12, Wednesday:* Last day to declare pass\_fail intentions. Last day to drop a course. ***You will not be able to withdraw from a course after this date!!***

*March 15 \_24, Saturday\_Monday:* Spring break. No Classes.

*March 27, Thursday:* **Second Exam**

*April 29, Tuesday:* Last day of classes.

*May 1, Thursday, 7.30 am \_10 am:* **Final Exam**