



**DEPARTMENT OF
MATHEMATICS & STATISTICS**

**HANDBOOK FOR
GRADUATE STUDENTS**

2007 - 2008

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GENERAL INFORMATION FOR GRADUATE STUDENTS IN MATHEMATICS & STATISTICS

REGISTRATION

See Schedule of Classes for instructions.

ADVISORS

Each graduate student will be assigned an advisor from the Department of Mathematics & Statistics and should confer with their advisor at least once a semester. See page 4 for more information.

COLLOQUIUM

The department has a weekly colloquium every Tuesday at 4:00 pm. These are talks covering a broad range of mathematical topics usually given by department faculty and occasionally by visitors. Mark this time on your schedule. *Attendance at the colloquium talks is obligatory for all Flagstaff campus graduate students.* The schedule of talks is available on the department web-site.

SEMINARS

In addition to the colloquium, the department usually runs a few seminars each semester. These weekly seminars go into more depth in a particular area of mathematics or statistics. In the past we have had seminars in Combinatorics, in Applied Mathematics, and in Statistics. You will receive more information on these once the topics, days, and times have been arranged.

COMPUTER RESOURCES

Department: The department operates computer labs in rooms 222 and 225 of the Adel Mathematics Building. Both labs can be scheduled for class-time use by instructors of department courses. Labs are equipped with Dell computers (36 in 222, and 21 in 225), a laser printer, and a projection system. Software available on the machines in both labs includes Windows XP, *Mathematica*, *Matlab* including *SEDUMI*, *DP Graph*, *GAP*, *Geometer's Sketch Pad*, *SAS*, *SAS JMP7*, *Microsoft Office 2007*, *Internet Explorer*, *Firefox*, *TeX*, *LyX*, *TI Interactive* and *SSH*. During the Fall and Spring semesters, the lab in 222 has scheduled open hours of approximately 20 hours per week. Graduate teaching assistant offices are also equipped with PCs.

University: There are numerous student computer labs across campus with both Macintosh and PC computers. Upon admission, students receive a university e-mail account. Students are expected to regularly check this account for official department and university announcements. For more information about university computing, visit the Information Technology Services (ITS) website www5.nau.edu/its/ or call the ITS Solution Center at (928) 523-1511.

DEPARTMENT OF MATHEMATICS & STATISTICS

GRADUATE PROGRAM POLICIES

I. ADMISSION REQUIREMENTS

In addition to completing the application form and submitting transcripts of record to the Northern Arizona University Graduate College, applicants also need to submit to the Department of Mathematics & Statistics (1) at least three letters of recommendation from persons able to assess their likelihood of success in a graduate program in mathematics, mathematics education, or statistics, and (2) a brief description (course title, texts used, and grade) of all mathematics and statistics courses taken at the level of calculus and above.

For regular admission to graduate programs in the Department of Mathematics & Statistics, applicants should have completed a bachelor's degree and the following requirements of the specific graduate degree program:

- For the M.S. program in mathematics, a candidate must have completed at least 27 semester hours of undergraduate mathematics coursework at the level of calculus and above with a grade of *C* or better, and have at least a 3.0 grade point average in these courses. The 27 hours must include coursework in linear algebra, real analysis (advanced calculus), and either abstract algebra or mathematical statistics.
- For the M.S. program in statistics, a candidate must have completed at least 23 semester hours of undergraduate mathematics and statistics coursework at the level of calculus and above with a grade of *C* or better, and have at least a 3.0 grade point average in these courses. The 23 hours must include coursework in multivariable calculus, linear algebra, real analysis (advanced calculus), and mathematical statistics.
- For the M.A.T. program in mathematics, a candidate must have completed at least 23 semester hours of undergraduate mathematics coursework at the level of calculus and above with a grade of *C* or better, and have at least a 3.0 grade point average in these courses. These 23 semester hours cannot include mathematics teaching methods courses, and must include two semesters of calculus, introductory applied statistics, foundations of mathematics (introduction to proof), and at least 9 hours of upper division coursework (including foundations of mathematics). It is recommended that the 23 hours include modern geometry, abstract algebra, and real analysis (advanced calculus).
- For the Certificate in Applied Statistics program, a candidate must have earned a bachelor's degree with a minimum grade point average of 3.0. In addition, you must have successfully completed an undergraduate course in statistics. Letters of recommendation are not required for this program.

Applicants must apply for admission to a specific program (M.S. Mathematics, M.S. Statistics, M.A.T. Mathematics, or Certificate in Applied Statistics), and must reapply to be admitted to another program. If the regular admission requirements are not met, an applicant may still be admitted but on a provisional basis. Such an applicant will then be reevaluated for regular admission following the completion of any additional coursework.

International students whose native language is not English must present a TOEFL (Test of English as a Foreign Language) score before being considered for admission. For admission, the department requires a minimum score of 89 on the internet-based test, 250 on the computer-based test, or 570 on the paper-based test.

II. TRANSFER CREDIT

Graduate students may obtain transfer credit for graduate coursework completed at other colleges and universities. To obtain such credit the Graduate College form “Petition for Transfer Credit (Master’s Programs)” must be filled out (<http://home.nau.edu/gradcol/forms.asp>), signed by the student’s advisor and submitted to the Graduate Operations Committee, along with catalog copy and transcripts for the courses in question. The Graduate Operations Committee must approve this petition before it is forwarded to the Graduate College for the final approval. Note that there are limits on the number of credit hours that may be transferred in and then applied to an NAU graduate program. See the current Academic Catalog for additional details: www4.nau.edu/aio/AcademicCatalog/academiccatalogs.htm.

III. FINANCIAL AID

A number of teaching assistantships are offered each year by the Department of Mathematics & Statistics. This number varies from year to year according to budgetary limitations. Subject to the normally available funding and satisfactory progress toward completing the degree plan, a student who is offered an assistantship may expect four semesters of support as a graduate teaching assistant. In situations where a supported student is required to take provisional courses or begins the program mid-year, a semester of study beyond the normally supported four semesters may be required. In such cases, the student will be considered on a competitive basis for an additional semester of support as a graduate teaching assistant.

Northern Arizona University is committed to providing an excellent education to its undergraduates, and the department strives to have a quality team of graduate teaching assistants working as part of that commitment. The most common graduate teaching assistant appointment is for 20 hours per week (considered half-time). The half-time graduate teaching assistant is typically assigned to teach a load of 6 credit hours per semester, except during the first semester when the teaching load is typically 3 credit hours plus 10 hours of other assigned duties (*e.g.*, grading). The half-time graduate teaching assistant is required to take 9 hours of coursework applicable towards his/her degree program each semester.

In filling teaching assistant positions, first preference is given to continuing students with the necessary skills and commitment required for good teaching, and who are making satisfactory progress toward their degree. For a half-time teaching assistant satisfactory progress means completion of 9 hours of coursework in his/her program each semester with a 3.0 grade point average. Assistantships for incoming students are usually available. Primary consideration is given to applicants who are considered the strongest academically; a secondary consideration is teaching experience. The department may also take into account a balance among its various graduate programs.

The stipend for a half-time graduate teaching assistant in the Department of Mathematics & Statistics for the 2007-2008 academic year is \$14,213. All graduate teaching assistants at the university whose appointment is at least 10 hours per week receive an out-of-state tuition waiver, and a waiver of 50% of resident tuition each semester of their appointment. Graduate assistants who work 20 hours per week also receive a waiver of the student health insurance premium. All graduate assistants are expected to pay

other applicable fees. The schedule of tuition and fees for the Fall 2007 semester is available at http://home.nau.edu/bursar/fees_fall.asp.

In addition, the Graduate College offers a limited number of waivers of resident tuition to Arizona residents and waivers of the nonresident portion of tuition available to nonresidents of Arizona. Graduate program coordinators across the university make annual recommendations for these waivers. The department is permitted to make just a few such recommendations, and waivers are given totally at the discretion of the Graduate Dean. Such recommendations are made with the goal of attracting the very best applicants, especially those with undergraduate degrees obtained elsewhere. Typically, students who have had full tuition waivers in their first year and who have made good academic progress are recommended for tuition waivers for their second year.

Recommendations may also be made in cases of financial need.

Teaching assistantships are generally not offered to incoming international students whose native language is not English, although financial support may be available in the form of hourly wages. To be awarded a graduate teaching assistant position, a student whose native language is not English must demonstrate evidence of effective communication skills in English, either through a personal interview or a score on the Test of Spoken English (TSE) of at least 50.

IV. ADVISORS

After admission to a graduate program in the Department of Mathematics & Statistics, the admitted student is expected to write or e-mail the department Graduate Coordinator conveying his/her intent to enroll. At that point, the Graduate Operations Committee will formally assign the student an advisor, with this assignment recorded in the student's department file. Any change of advisor must be approved by the Graduate Operations Committee and so recorded. Such a change will occur, in particular, if the student decides on, and is admitted to the Thesis Option whereupon the student's thesis director will become the student's new advisor.

As well as fulfilling the normal advising duties (providing course and program information, graduation papers, career advice, etc.), the student's advisor also has a role to play in setting up the student's Comprehensive Oral Examination Committee or Research Committee.

V. COURSE SUBSTITUTION

It may be necessary for a graduate student to substitute a course for one that is required in his/her program. The student's advisor and the Graduate Operations Committee must approve all such course substitutions in writing. By Graduate College policy no more than two 400-level courses may be applied toward a master's degree program. Department policy on course substitution varies by program:

M.S. Mathematics: MAT 467, STA 471, and MAT 480 will normally be approved for students selecting the Actuarial and Financial Mathematics block (subject to the two 400-level course limit mentioned above). STA 471 will normally be approved for students taking the Applied Mathematics and Dynamical Systems block. Courses at the 400-level will not usually be permitted to count toward the degree in other circumstances. Graduate courses taken outside of the Department of Mathematics & Statistics may be approved if such courses enhance the student's overall program of study.

M.S. Statistics: Substitutions are evaluated on a case-by-case basis.

M.A.T. Mathematics: Substitutions are evaluated on a case-by-case basis.

VI. RETENTION

Graduate College policy requires that a graduate student maintain a 3.0 grade point average both for all graduate courses taken, and for all courses taken within the degree program. A 3.0 grade point average is also required at the time of graduation. Only two grades of *C* are permitted to count toward the program, and grades below a *C* cannot count at all. If you have more than 6 hours of graduate work with a grade of *C* or below, you cannot continue in your master's program, regardless of your grade point average.

The following are policies of the Department of Mathematics & Statistics:

A student who is admitted provisionally to a Department of Mathematics & Statistics graduate program will be asked to meet certain requirements before their admission status is changed to regular standing. A provisional student who fails to meet such requirements will not be allowed to continue in their graduate program. In these circumstances, a graduate teaching assistantship would be terminated due to unsatisfactory performance.

Students are expected to make continued satisfactory progress toward their degree. Normally, a student who is admitted with regular standing, but whose grade point average falls below a 3.0 because of a single *C* grade will be allowed to continue in the program under probationary status for one semester. In rare circumstances, this probationary period may be extended for a second semester, but only if there is a reasonable expectation that the student will be able to meet the requirements of the degree. In any case, if a student's grade point average falls below a 3.0 to a greater extent than a single *C*, the student will normally not be allowed to continue in their graduate program.

Grade point average requirements are also in place for admission to the thesis option, and also have a bearing on the awarding of graduate teaching assistantships. Furthermore, a graduate teaching assistant may have their assistantship terminated due to unsatisfactory progress toward their degree.

VII. COMPREHENSIVE ORAL EXAMINATION

To be eligible to take the Comprehensive Examination, a student must:

- a) Have a cumulative grade point average of 3.0 or better for all courses completed in their program;
- b) Have no more than 9 hours of required coursework remaining, and anticipate completing this coursework in the current semester or session; and
- c) Be formally registered in graduate coursework at NAU at the time of the exam.

The Comprehensive Examination Committee shall normally consist of 3 members. The Committee and topics to be covered shall be selected by the student's assigned graduate advisor in the program, and approved by the Graduate Operations Committee. Where possible, the committee membership should be restricted to those faculty members under whom the student has completed or is in the process of completing coursework in their program. The Chair of the Committee shall be the student's assigned graduate advisor or a member designated by the advisor should he/she not be a member of the Committee.

The Comprehensive Examination will take place on the NAU Flagstaff campus and the student being examined must be physically present on campus, and is responsible for any and all costs associated with his/her travel to Flagstaff for the examination.

A student will be tested over three courses, selected with the guidance of the student's advisor and approved by both the advisor and the Graduate Operations Committee. Note: If the oral exam includes courses that are currently in progress, then the exam may not take place until after the 12th week of instruction (after the 4th week of instruction in the summer).

- For the M.S. program in mathematics, the three courses selected should form a coherent group of coursework, and should include at least one course from each of the two blocks completed for the student's program.
- For the M.S. program in statistics, the examination should cover both theoretical and applied coursework.
- For the M.A.T. program in mathematics, the examination should cover at least one “Connections” course.

Each examination typically lasts 2 hours with 30-45 minutes allowed per course. At the end of the exam a discussion of the committee members shall occur, with a vote taken following the discussion. The committee members may vote to pass or fail a student based on their performance on the examination as a whole. If a two-thirds majority is not obtained to pass, then the student fails the examination. The student may retake the oral exam on the same set of course work after a period of one month has passed. Should the student fail the exam a second time, or fail to retake the examination within a six month period, then their enrollment in the program will be terminated.

The Chair of the Comprehensive Exam Committee will promptly convey the result (pass/fail) of the exam to the Chair of the Graduate Operations Committee and the department Chair.

The *Comprehensive Oral Examination Approval* form may be found on the Graduate Forms page at <http://www.cens.nau.edu/Academic/Math/degreePrograms/GraduateForms.shtml>.

VIII. THESIS OPTION

The Thesis Option is available only to students pursuing the M.S. in Mathematics. To be eligible for the Thesis Option, the student should have a minimum grade point average of 3.3 at the time of their initial enrollment in MAT 699: Thesis.

A student interested in pursuing the Thesis Option should first seek a department faculty member willing to serve as the students' thesis director who, together with the student, will decide on a research topic. Once this is done, the student and his/her thesis director must submit a research plan to the Graduate Operations Committee together with the names of the three-member Research Committee (which is to include the thesis director and at least one other faculty member from the Department of Mathematics & Statistics). Before submission to the Graduate Operations Committee, all three members of the Research Committee should approve the research plan. The thesis director will become the student's new advisor and an Advisor Change form will be submitted to the department office.

A student can only enroll for MAT 699 once the Graduate Operations Committee has approved his/her research plan. A student interested in pursuing this option should therefore meet with a faculty member to discuss possible thesis topics in the semester prior to the planned start of the research project, and should submit a research plan to the Graduate Operations Committee for approval at least one week prior to the start of the semester in which the research will begin. At least 6 credit hours of MAT 699 are required to fulfill the requirements of the Thesis Option, and the research is to be carried out over at least two semesters (or one semester and the 10-week summer session).

In the event that a student's research diverges substantially from the initial plan, the student must submit a revised research plan to the Graduate Operations Committee for their approval. This should be done no later than the start of the second semester in which the student enrolls for MAT 699.

Once the research work is completed, the student must write the thesis according to Graduate College regulations as described in the Format Manual. In particular, the graduate College's format editor should give the thesis an initial format check at least a few weeks in advance of the thesis defense.

Before the thesis defense is scheduled, the student must first give copies of his/her thesis to the members of his/her Research Committee. This committee will verify that the objectives of the student's research plan have been met and that the work is of an appropriate standard. Only once it is agreed that the student is ready to defend, and following an initial format check, may the defense be scheduled.

On the completion of the written thesis, the student is required to give a public presentation of their work on the NAU campus. This presentation must occur within the month prior to the formal thesis defense.

The student's Research Committee must all be present at the thesis defense, and are free to ask questions on any material contained in the student's thesis. The defense is closed to all but the student and the Research Committee.

The *Approval of Research Plan for Thesis* form may be found on the Graduate Forms page at <http://www.cens.nau.edu/Academic/Math/degreePrograms/GraduateForms.shtml>.

IX. GRADUATE CERTIFICATE IN APPLIED STATISTICS

The Department of Mathematics & Statistics offers a 15 credit hour graduate certificate in the area of applied statistics. This certificate is designed to offer graduate students from other disciplines, and non-degree seeking students, the opportunity to obtain a strong foundation in applied statistics with an emphasis on data analysis. This Certificate is not available to students in the M.S. in Statistics program. Upon completion, the successful student will understand the methods that comprise the foundation of applied statistics, be able to apply statistical methodology to problems in their own field, and be able to communicate statistical ideas with researchers in their own discipline.

To be admitted to the certificate program the student must hold an earned baccalaureate degree or equivalent from an accredited college or university with a minimum GPA of 3.0 and have completed an undergraduate course in statistics. To complete the certificate the student must achieve a minimum GPA of 3.0 on the required courses, with no more than 3 credit hours at a grade of C.

The interested student should refer to the Graduate Certificate in Applied Statistics program sheet to obtain the details concerning the 8 statistics courses from which choices must be made. With approval of the coordinator of the graduate certificate in applied statistics, it may be possible to apply up to 3 credit hours of graduate courses from the student's home department. Inquire with a statistics professor within the Department of Mathematics & Statistics for more information.

DEPARTMENT OF MATHEMATICS & STATISTICS
PERMANENT FULL-TIME FACULTY

Chair: Janet M. McShane

Terence R. Blows, Ph.D., (University College of Wales, Aberystwyth) Ordinary differential equations

Brent D. Burch, Ph.D., (Colorado State University) Statistics; mixed linear models, variance components

Terry W. Crites, Ph.D., (University of Missouri) Mathematics education

Michael J. Falk, Ph.D., (University of Wisconsin) Topology; combinatorics

Shannon Guerrero, Ph.D., (University of California-Davis) Mathematics education, technology, teacher development

John W. Hagood, Ph.D., (University of Utah) Measure theory and integration; probability

Jeff Hovermill, Ph.D., (University of Colorado-Boulder) Mathematics education

Guenther P. Huck, Ph.D., (University of Frankfurt) Low dimensional topology; combinatorial group theory

Shafiu Jibrin, Ph.D., (Carleton University) Operations research, semidefinite programming, linear matrix inequalities

Monika Keindl, M.A., M.S. (Arizona State University) Number theory, statistics

Katie E. Louchart, M.S., (Northern Arizona University) Undergraduate mathematics

Janet M. McShane, Ph.D., (University of Arizona) Group theory; invariant theory; commutative algebra

John M. Neuberger, Ph.D., (University of North Texas) Nonlinear differential equations; numerical analysis

Michael I. Ratliff, Ph.D., (University of Colorado) Number theory; actuarial mathematics

Amy L. Rushall, M.M., (University of Tennessee-Knoxville) Undergraduate mathematics

Jeffrey L. Rushall, M.A., (University of Texas-Austin) Number theory; undergraduate education

Roy T. St. Laurent, Ph.D., (University of Minnesota) Statistics; regression diagnostics; linear models

William C. Schulz, Ph.D., (University of California-Berkeley) Number theory; Grassman algebra; complex variables

Nándor Sieben, Ph.D., (Arizona State University) Operator algebras; combinatorics; game theory

James W. Swift, Ph.D., (University of California-Berkeley) Dynamical systems

Richard J. Turek, Ph.D., (University of New Mexico) Statistics

Phil Turk, Ph.D., (Montana State University) Statistics

Wang, Jin, Ph.D., (University of Texas-Dallas), Statistics

Stephen E. Wilson, Ph.D., (University of Washington) Combinatorial geometry

DEPARTMENT OF MATHEMATICS & STATISTICS SCHEDULE OF GRADUATE COURSES

We have established a two-year rotation schedule for graduate courses in the Department of Mathematics & Statistics (MAT and STA prefixes). What this means is that not every course is offered every year. Because of this, you should carefully plan your schedule of coursework in consultation with your adviser.

The Master of Science programs in Mathematics and Statistics are typically four-semester programs (no summer courses are available), while the Master of Arts in Teaching Mathematics program is year-round.

Rotation Schedule for M.S. Mathematics & Statistics Degree Courses

MAT Prefix

| | | |
|-----|----------------------------------|--------------|
| 511 | Abstract Algebra I | Fall Odd |
| 516 | Linear Algebra | Spring Odd |
| 526 | Topics in Combinatorics | Fall Even |
| 531 | Real Analysis | Fall Even |
| 535 | Complex Analysis | Fall Odd |
| 541 | Topology | Fall Odd |
| 542 | Wildlife Population Modeling | Spring Even |
| 543 | Population Ecology Lab | Spring Even |
| 562 | Interest Theory | Fall Even |
| 563 | Numerical Analysis | Fall Even |
| 565 | Actuarial Mathematics | Spring Odd |
| 567 | Risk Theory | Fall Odd |
| 587 | Professional Development Seminar | Fall |
| 612 | Abstract Algebra II | Spring Even |
| 618 | Theory of Numbers | Occasionally |
| 632 | Measure and Integration | Spring Odd |
| 661 | Applied Mathematics | Spring Even |
| 665 | ODE | Fall Odd |
| 667 | Dynamical Systems | Fall Even |
| 690 | Advanced Topics | Spring |

STA Prefix

| | | |
|-----|----------------------------------|--------------|
| 570 | Statistical Methods | Fall, Spring |
| 571 | Statistical Methods | Spring |
| 572 | Multivariate Statistical Methods | Fall Even |
| 574 | Categorical Data Analysis | Spring Odd |
| 575 | Applied Sampling | Fall Even |
| 585 | Statistical Consulting Practicum | Spring |
| 587 | Professional Development Seminar | Fall |
| 673 | Mathematical Statistics I | Fall Odd |
| 674 | Mathematical Statistics II | Spring Even |
| 675 | Theory of Linear Models | Spring Even |
| 676 | Experimental Design | Spring Odd |

Rotation Schedule for M.A.T. Degree Courses

MAT Prefix

| | | |
|-----|-----------------------------------------------|-------------|
| 500 | Reflections On/In Mathematics Education | Fall Even |
| 501 | History & Philosophy of Mathematics Education | Spring Even |
| 502 | Problem Solving: Theory and Practice | Summer Even |
| 504 | Connections – Algebra & Number Theory | Spring Odd |
| 505 | Connections – Calculus | Fall Odd |
| 506 | Connections – Geometry | Fall Even |
| 507 | Connections – Probability & Statistics | Spring Even |
| 508 | Technology in Mathematics Education | Fall Odd |
| 601 | Seminar in Mathematics Education | Summer Odd |
| 602 | Research in Mathematics Education | Spring Odd |