

Graduate Interdisciplinary Program (GIDP) in Statistics

Graduate Student Handbook

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THE UNIVERSITY OF ARIZONA®

Graduate Interdisciplinary Program (GIDP) in Statistics Graduate Student Handbook

Introduction

The Graduate Interdisciplinary Program (GIDP) in Statistics at the University of Arizona focuses and enhances statistical training and research across the UA campus. It administers both the M.S. and Ph.D. degrees, as well as a Ph.D. Minor and a 12-unit Graduate Certificate, in Statistics. The Program boasts a diverse and distinguished research faculty who hail from a variety of campus units, including departments in the Colleges of Agriculture & Life Sciences, Education, Management, Public Health, Medicine, Science, Social & Behavioral Sciences, the BIO5 Institute, and the Arizona Research Laboratories. This diversity fuels an intellectually stimulating atmosphere in which modern statistical research is developed and put directly into practice.

The educational goal of the GIDP in Statistics is to produce active and creative researchers and practitioners who will work at the forefronts of modern scientific study, and who will develop statistical techniques and practical innovations to advance the subject matter in those areas. Such an interdisciplinary focus requires strong analytical and computational skills, in addition to a deep knowledge of the discipline from which the new research problems arise. Developing this level of expertise is a challenging goal, and requires honest dedication on the part of our students.

The Program receives enthusiastic support from all departments and colleges with which it interacts. In addition, the Program sponsors a variety of seminars, colloquia featuring distinguished invited speakers, special lecture series, workshops, and conferences. Faculty in the Program receive grant and contract support from numerous Federal agencies, including the National Science Foundation (NSF), the National Institutes of Health (NIH), the Environmental Protection Agency (EPA), the Department of Agriculture (USDA), and several other private foundations and companies. This grant and contract support provides many opportunities for students to secure research assistantships as well as funds for special Program activities.

The University of Arizona is renowned for its atmosphere of flourishing interdisciplinary research. As the list of faculty research interests reflects (see Appendix 1), the GIDP in Statistics fits naturally into this environment, encompassing a wide range of transdisciplinary studies in both theoretical and applied statistics. It is from this list that students can select an advisor and begin developing their graduate research directions.

This handbook describes the Program's current regulations and procedures as well as the various requirements that must be met for the Doctor of Philosophy (Ph.D.) or the Master of Science (M.S.) degrees. It also details the Ph.D. Minor and Graduate Certificate in Statistics. Since every student's graduate experience will be different, however, it is important to discuss any questions about the Program requirements with the Program director.

Courses of Study

As outlined below, the Program offers courses of study leading to either the Doctor of Philosophy (Ph.D.) degree in Statistics or the Master of Science (M.S.) degree in Statistics. A Ph.D. Minor in Statistics and a Graduate Certificate in Statistics is also available to students majoring in fields external to the Statistics GIDP.

1. The Ph.D. in Statistics

The following guidelines identify the basic structure of the Ph.D. in Statistics at the University of Arizona. At the core of the program is a fundamental grounding in both statistical theory and methodology; however, extensive flexibility via course electives allows students to tailor their final programs of study to their own interdisciplinary interests. The student's advisor, along with the Program director, are available to discuss individual selection of these electives. *It is GIDP policy that the student holds final responsibility for being aware of and responding to all GIDP and Graduate College policies, requirements, formats, and deadlines as they pertain to progression towards and completion of the Ph.D.*

The basic requirements for entrance into the Ph.D. program are:

- (a) An M.S. in Statistics, Biostatistics, Mathematics, or Applied Mathematics, or an advanced degree in a field that makes significant use of quantitative methods. A student who wishes to apply to the Ph.D. program without an M.S. and with only a Baccalaureate degree may do so, but is required to meet all other M.S. and Ph.D. entrance requirements. If her/his application is successful, the student must earn the M.S. in the GIDP "en route" to her/his Ph.D.
- (b) Scores on the Graduate Record Examination (GRE -- general test only) that exceed 75th percentile Quantitative and 50th percentile Verbal.
- (c) For students applying from non-English-speaking countries and who do not have a degree from a U.S. institution of higher learning, scores on the Test of English as a Foreign Language (TOEFL): pBT score above 640 and a pBT Section 1 score above 64, or iBT score above 106 and an iBT Speaking score above 28. The International English Language Testing System (IELTS) examination can be submitted in lieu of the TOEFL. The minimum IELTS score requirement for admissions consideration is a score of 8, with a score of no less than 7 on any individual module.

A. Coursework

A minimum of 71 units of coursework past the Bachelor's Degree is required, made up as follows:

1. Core Ph.D. Courses; minimum 32 units as follows:

15 units from the set of Core M.S. Statistics courses:

Theory of Probability (STAT 564/MATH 564)
Theory of Statistics (STAT 566/MATH 566)
Advanced Statistical Regression Analysis (STAT 571A/MATH 571A)
Design of Experiments (STAT 571B/MATH 571B), or
Research Design & Analysis of Variance (PSY 507C)
Statistical Consulting (CPH 685/EPID 685)

along with an additional set of 17 units of Core Ph.D. Statistics courses:

Real Analysis (MATH 523A)
Probability Theory (MATH 563/STAT 563)
Theoretical Statistics (STAT 567A/MATH 567A)
Theory of Linear Models (CPH 687/EPID 687/STAT 687)

cont'd

Simulation Modeling and Analysis (SIE 531), or
Statistical Computing (STAT 675)
Scientific Writing Strategies, Skills & Ethics (PHCL 595B)

Students entering with an M.S. in Statistics or an M.S. from a comparable field may petition for waiver of and/or credit for any of the units from the Core M.S. course list, up to a maximum of 12 units. These credits are referred to by the Graduate College as *Transfer Coursework*. Transfer coursework must be approved in advance by the Program director and by the Graduate College, via the College's [Transfer Credit Form](#). Approved transfer coursework must be listed as such on the student's [Doctoral Plan of Study](#) (DPOS; see below).

2. *Additional Elective Courses; minimum 12 units from any of the following (a maximum of 6 units may come from STAT 599 and/or STAT 900):*

Advanced Data Analysis: Structural Equation Modeling (FSHD 617A)
Advanced Data Analysis: Dyadic Data Analysis (FSHD 617B)
Advanced Data Analysis: Multilevel Modeling (FSHD 617C)
Advanced Geographic Information Systems (RNR 520/GEOG 520)
Advanced Quality Engineering (SIE 606)
Advanced Statistical Natural Language Processing (LING 582)
Analysis of High Dimensional Data (CPH 648/EPID 648)
Applied Biostatistics Analysis (CPH 576C/EPID 576C), or
Advanced Topics in Biological Statistics (ECOL 581), or
Applied Biostatistics (RNR 613/ENTO 613/INSC 613)
Applied Econometric Analysis (ECON 549/AREC 549)
Applied Time Series Analysis (GEOS 585A)
Bayesian Statistical Theory and Applications (STAT 574B/ECON 574B)
Biostatistics for Research (CPH 576B/EPID 576B)
Categorical data analysis (STAT 574C/SOC 574C)
Clinical Trials and Intervention Studies (CPH 675/EPID 675)
Data Management and the SAS Programming Language (CPH 576D/EPID 576D)
Detection and Estimation in Engineering Systems (ECE 639)
Econometrics (ECON 522A), or
Advanced Applied Econometrics (AREC 559)
Econometrics (ECON 522B)
Engineering Decision Making Under Uncertainty (SIE 522)
Environmental Statistics (STAT 574E/MATH 574E/CPH 574E)
Fundamentals of Optimization (SIE 545)
Game Theory and Mathematical Programming (MATH 579), or
Game Theory (SIE 543)
General Linear and Mixed Effects Models (CPH 684/EPID 684)
Graphical Exploratory Data Analysis (PSY 597G)
Independent Study (STAT 599)
Information and Noise in Quantum Optics and Photonics (OPTI 528)
Introduction to Geostatistics (GEOG 574G/MATH 574G/STAT 574G)
Litigating with Experts (LAW 611C)/Law and Economics (ECON 538)
Multivariate Analysis in Management (MGMT 582D)
Multivariate Methods in Educational Research (EDP 646A)
Neural Networks (ECE 631)
Numerical Analysis (MATH 575A/C SC 575A)
Principles of Image Science (OPTI 637)
Queuing Theory (SIE 525)

cont'd

Reliability and Quality Analysis (A ME 574)
Research (STAT 900)
Social Statistics (SOC 570B)
Spatial Statistics and Spatial Econometrics (GEOG 577)
Spatio-Temporal Ecology (ECOL 518)
Statistical Bioinformatics and Genomic Analysis (MCB 516A/ABE 516A)
Statistical Genetics for Quantitative Measures (ANS 513/EPID 513/GENE 513)
Statistical Mechanics (PHYS 528)
Statistical Methods in Psychological Research (PSY 507B), or
Educational Tests and Measurements (EDP 558)
Statistical Natural Language Processing (LING 539)
Statistical Packages in Research (EDP 548)
Stochastic Differential Equations (MATH 565C)
Stochastic Methods in Surface Hydrology (HWR 655/C E 655), or
Applied Stochastic Processes (MATH 568)
Stochastic Modeling I (SIE 520)
Stochastic Processes (MATH 565A)
Stochastic Processes (MATH 565B)
Survey Sampling (STAT 574S)
Survival Analysis (CPH 686/EPID 686)
Theoretical Statistics (STAT 567B/MATH 567B)
Theory of Measurement (EDP 658A)
Theory of Measurement (EDP 658B)
Time Series Analysis (STAT 574T/MATH 574T)

Students must meet all prerequisites for any elective courses they wish to undertake, or must secure instructor permission prior to registering for the course. Courses may be added to or removed from this list by action of the GIDP Curriculum Committee, after approval by the GIDP Executive Committee.

Where needed to suit a particular or specialized need in an individual student's program of study, petition may be made to the GIDP Executive Committee for approval of a course not listed above for use as an elective. The student must be in good standing and be enrolled in the Statistics GIDP. The burden of proof for admitting such a course rests with student, and the decision of the committee will be final. Note that introductory, elementary-methods courses that do not expand the statistical frontier are not generally approved for credit towards the Ph.D. in Statistics.

3. A minimum of 9 additional units for the Ph.D. minor.

Graduate College requirements stipulate that a minimum of 9 units be applied for the Ph.D. minor. Minor requirements are fixed by the minor department or program; some Minor programs require upwards of 12 or even 15 units for completion. (A Ph.D. Minor in Statistics cannot be counted towards a Ph.D. in Statistics.) The selection of the Ph.D. Minor field is to be made by the student in consultation with her/his advisor and the Program director. The Minor should reflect the student's transdisciplinary interests, and wherever possible should be coordinated with the student's additional Statistics electives. A non-exhaustive list of potential Ph.D. Minors, and their requirements, is given in Appendix 4.

4. Dissertation credit: minimum 18 units of STAT 920

As per Graduate College requirements, a minimum of 18 units in the Ph.D. program of study must include dissertation credits. These are used to undertake the Ph.D. research. Registration for any units of STAT 920 is restricted to students who have passed the Ph.D. Comprehensive Examination (see below). Students who wish to undertake research coursework prior to passing the Comprehensive Examination may consider STAT 599

and/or STAT 900 as possible alternatives; however, a maximum of only 6 units from STAT 599 and/or STAT 900 may be applied to the Ph.D. curriculum.

5. *Language requirement*

The GIDP in Statistics has no formal, non-English, language requirement.

* course under development

B. The Doctoral Plan of Study (DPOS)

The [Doctoral Plan of Study](#), or DPOS, represents a tailored guideline for the courses that will satisfy the student's Ph.D. degree requirements; it may be amended if circumstances so require. The DPOS should be formulated and submitted during the student's third semester in residence in the GIDP: by the end of the second semester in residence, the student should choose an *advisor* from among the Regular faculty of the GIDP in Statistics (see Appendix 1). [Until such time as the student has chosen an advisor, the chair of the GIDP Recruiting & Admissions (R&A) Committee, or another GIDP faculty member designated by the GIDP Chair, serves as the student's temporary advisor.] After consultation with the chosen advisor and the GIDP Chair, the student determines an expected list of courses to be taken toward the Ph.D. degree, and submits these on the DPOS to the Graduate College. The DPOS *must* be on file before the student can sit for the Ph.D. Oral Comprehensive Examination (see below.)

Components on the DPOS will include the 33 units of core Ph.D. courses and the minimum $12 + 9 = 21$ units of additional electives and Ph.D. minor coursework that comprise the student's own interdisciplinary specialization. The Ph.D. Minor must be officially recognized and correctly listed on the DPOS form. No more than half of the total units listed on the DPOS (including transfer units; see below) can be in courses graded with an S or P grade. The 18 units of dissertation research (STAT 920) are tracked separately and should not appear on the DPOS.

Up to 12 units on the DPOS may be from courses taken outside a UA graduate degree program, including courses taken in non-degree seeking status and/or as transfer coursework. (Note: The GIDP does not recognize coursework at or below the 400-level for credit towards the Ph.D. in Statistics.) Transfer coursework must be approved in advance by the Program director and by the Graduate College, via the College's [Transfer Credit Form](#). (Consult the Graduate College's degree certification staff for more details on transfer coursework requirements.) Approved transfer coursework must be listed as such on the DPOS.

Sample Program (71-72 units):

(Initial matriculation in the Fall is strongly encouraged, since many core courses are taught in a Fall-then-Spring sequence.)

Fall Semester #1 (9 units)

MATH 564 -- Theory of Probability
STAT 571A--Adv. Statist. Regression Analysis
MATH 523A -- Real Analysis

Spring Semester #1 (9 units)

STAT 566 -- Theory of Statistics
STAT 571B -- Design of Experiments
Elective Course

End of semester (May): Ph.D. Qualifying Exam

Fall Semester #2 (9 units)

CPH 685 -- Statistical Consulting
CPH 687 -- Theory of Linear Models
MATH 563 -- Probability Theory

Spring Semester #2 (9 units)

STAT 567A -- Theoretical Statistics
STAT 675 -- Statistical Computing
Minor Course

cont'd

Fall Semester #3 (9 units)

Elective Course
Elective Course
Minor Course

Spring Semester #3 (8-9 units)

PHCL 595B
Elective Course(s)
Minor Course

End of semester (May-Aug.): Comprehensive Exam

Fall Semester #4 (9 units)

STAT 920 -- Dissertation

Spring Semester #4 (9 units)

STAT 920 -- Dissertation

End of semester (May-Aug.): Final Oral Defense

* course under development

C. The Ph.D. Qualifying Examination

To proceed towards Ph.D. candidacy in the GIDP, a student must pass a written Ph.D. Qualifying Examination by the beginning of her/his fourth semester of study. The examination may be retaken only once. Offered during May and January of each year, the Qualifying Examination is used to assess the student's potential to successfully complete a Ph.D. dissertation in modern interdisciplinary statistics. It tests the student's ability to integrate material from the following core Ph.D. courses, and to use this knowledge in solving pertinent, challenging statistical problems commensurate with Ph.D. status at the level of this material:

Theory of Probability (STAT 564/MATH 564)

Theory of Statistics (STAT 566/MATH 566)

Advanced Statistical Regression Analysis (STAT 571A/MATH 571A)

Design of Experiments (STAT 571B/MATH 571B), or

Research Design & Analysis of Variance (PSY 507C)

Each specific examination is constructed and graded by a committee of GIDP faculty appointed annually by the GIDP Chair. Where possible, this will include the instructors of the pertinent core courses. A minimum of two examiners grade every question independently.

The exam is administered in two parts over two consecutive days; the first day centers on the more theoretical material from STAT 564-566/MATH 564-566, and the second day centers on the more methodological material in STAT 571A and STAT 571B (or PSY 507C). With prior agreement of the GIDP Examination Committee, this order may be reversed on an exam-by-exam basis, but must be the same for all students who sit for that exam. Note, however, that concepts from all four course areas will be addressed freely in either or both parts of any examination, at the discretion of the Examination Committee.

Students have 4 hours on each day to complete the exam questions given on that day. If a student is present for only one of the two days, s/he will be viewed as having attempted the entire exam and graded accordingly.

Replicas of previous exams are available from the GIDP's Graduate Coordinator for students who wish to make copies for study purposes.

Students must register in advance for each examination; deadlines will be set by the GIDP Examination Committee prior to each offering. (Students who register for an examination but do not sit for it at the designated time and place will be viewed as having received a failing grade on that examination, unless prior authorization and approval are acquired from the Program director.)

There are three possible outcomes to the exam:

- PhD Pass: Students may continue towards candidacy in the Program.
- MS Pass: Students interested in pursuing a Ph.D. will be required to retake the exam the next time it is offered and improve to a grade of PhD Pass. Students who wish to complete only the M.S. degree in Statistics (see below) may use this result to stand for their M.S. exit examination.
- Fail: Students must retake the exam at the next opportunity in order to remain in the Program and be eligible to pursue a Ph.D. degree in Statistics. Failure, or a score of MS Pass, on a second attempt on the exam results in the student's dismissal from the Ph.D. program.

After receiving written notice of the Qualifying Exam results, each student will meet individually with the Program director to discuss his/her performance and options for the coming year. Students may request a consultation with a designated member of the Examination Committee to review their exam results.

Note that a Qualifying Examination result of MS Pass on a first attempt indicates that the student has made good progress, but also identifies areas of weakness that must be resolved in order to pursue more advanced studies. Although students are often initially disappointed at not having achieved a PhD Pass on their first attempt, they should recognize that an MS Pass demonstrates development in their studies. It is not uncommon for students who retake and pass the exam, after the benefit of further study, to later produce excellent Ph.D. dissertations.

D. The Ph.D. Comprehensive Examination

Before advancement to Ph.D. candidacy, a student must pass a written and an oral [Ph.D. Comprehensive Examination](#) in both the major area of Statistics and the chosen minor(s). This examination is intended to test the student's comprehensive knowledge of Statistics and of the minor field(s) of study, both in breadth across the general field of Statistics and in depth within the area of interdisciplinary specialization. The Comprehensive Examination is considered a single examination, although it consists of separate written and oral components.

A student must pass the written portion of the exam before sitting for the oral portion. The written portion is determined and graded by a comprehensive examination committee, which by Graduate College regulations must consist of a minimum of four members. The student's advisor serves as chair of the committee. The advisor and two additional members must be tenured, or tenure-track, members of the graduate faculty. (Advisors who do not hold such status must receive special approval from the Dean of the Graduate College to serve in this capacity.) The fourth member may be tenured or tenure-track, or a special approved member. (If the advisor is already specially approved due to non-tenure-eligible status, the fourth member of the committee must be tenured or tenure-track.) All special members must be pre-approved by the Dean of the Graduate College. Any members beyond the fourth can also be tenured or tenure-track, or special approved members. It is expected, but not required, that the examining committee will overlap with the student's graduate dissertation committee (see below), in order to foster continuity in the student's research program.

The typical format for the written portion of the examination is a series of technical and conceptual questions put forth by the committee concerning the student's expected dissertation research. If the research theme is not yet sufficiently developed, these questions can address broader areas of interdisciplinary statistics. The student is given the questions in a single examination packet, and allowed a maximum of 24 hours to answer the questions in writing. Deviations from this format are permitted at the discretion of the examining committee and with prior agreement of the student.

During the 24-hour examination period, all questions and interactions on the examination material, on allied material, and/or on larger issues related to scholarship in statistics or in the minor field(s) of study must be transmitted to the examining committee chair. Interaction with *any* other individuals, without prior approval from the GIDP Chair, is considered a breach of the UA [Code of Academic Integrity](#) and will be treated accordingly.

The written portion of the exam will be graded by the examining committee, and results transmitted to the student within 14 calendar days of receipt of the student's answers. A student who fails her/his written portion may sit for a second attempt; an entirely new set of questions may be drawn up and graded by the committee. This second sitting must be scheduled within 4 months of the original sitting. Failure on a second written portion will lead to a student's dismissal from the Program.

Upon successful completion of the written portion of the Comprehensive Examination, a student must sit for the oral portion of the exam. The oral portion is again conducted by the student's examining committee, and must occur no earlier than 1 calendar week and no later than 4 months after successful completion of the written portion. An approved [DPOS](#) must be on file before the student can sit for the oral portion of the Comprehensive Examination. Before the exam, the student is responsible for retrieving the *Results of Oral Comprehensive Exam for Doctoral Candidacy* form [online](#) and completing the form. Prior to the actual oral exam session, s/he must take the form to the GIDP office to have the section on 'Results of Written Examination' prepared. The student must then bring the form along to the oral exam, where the committee will record the results and provide the necessary signatures. A representative of the committee must submit the form in person to the Graduate College (Admin. Bldg room 316) within 24 business hours of the exam's completion.

The faculty committee conducting the oral portion of the examination has both the opportunity and obligation to require the student to exhibit knowledge of

- (i) the specific questions/material posed during the written portion,
- (ii) general comprehension of the minor field(s) of study as it pertains to the student's research interests, and
- (iii) sufficient depth of understanding in the area(s) of the student's statistical specialization.

Discussion of proposed dissertation research may be included. The examining committee must attest that the student has demonstrated the professional level of knowledge necessary to successfully undertake a Ph.D.-level career in interdisciplinary statistics.

As with the written portion of the examination, a student who fails her/his oral portion may sit for a second attempt. This second sitting must be scheduled within 4 months of the original oral sitting, but also no later than 4 months after successful completion of the written portion. Failure on a second oral portion will lead to a student's dismissal from the Program.

The written and oral portions of the comprehensive examination must be completed successfully no later than 3 months prior to the Final Oral Defense Examination (see below).

E. Advancement to Candidacy and the Ph.D. Dissertation

Once a student has an approved DPOS on file, has satisfied all required coursework and residence requirements, and has passed the written and oral portions of the Comprehensive Examination, s/he must file an *Application to Advance to Candidacy*. This application must be submitted to the Graduate Degree Certification Office as soon as requirements are met but no later than 6 months before the Final Oral Defense Examination is scheduled (see below). The Office is located on the 3rd floor of the University's [Administration building](#). Deadlines for the submission of paperwork pertaining to doctoral programs are available in the Graduate Degree Certification Office, or [online](#). Forms for "Application to Advance to Candidacy" are available [online](#) and from the Graduate Degree Certification Office.

At the time a student submits her/his Application for Advancement to Candidacy, her/his bursar account will be billed a single composite [fee](#) for candidacy, dissertation processing, and archiving. This is a one-time fee and is not reassessed if the anticipated graduation date changes. Copyrighting of the dissertation is optional and carries an additional fee.

By the time of advancement to candidacy, the candidate must form a [Dissertation Committee](#). Graduate College regulations require the committee to consist of at least three faculty, all tenured, tenure-track, or approved by the Dean of the Graduate College as equivalent. The candidate's advisor, who must be a Regular member of the GIDP in Statistics, serves as the committee chair. At least one of the other two committee faculty must be from the GIDP in Statistics; s/he may hold Affiliate or Regular status. One committee member must represent the student's minor field(s) of study. A fourth or fifth member from the GIDP in Statistics or from the Minor area(s) may be added to the committee, at the discretion of the candidate and with approval of the committee chair. Such members can be tenured or tenure-track, or a special approved member. As above, special members must be pre-approved by the Dean of the Graduate College. Individual faculty members may decline to serve on committees for academic reasons. It is encouraged, but not required, that the dissertation committee include as many members as possible from the candidate's comprehensive examination committee, in order to foster continuity in the student's research.

If a dissertation committee has only three members, all must approve the dissertation prior to or at the final oral defense (see below). For committees consisting of four or five members, there may be at most one dissenting vote. All dissertation committee members are expected to attend the oral defense.

For the dissertation, candidates must develop a (formal or informal) research proposal of sufficient academic merit and on a topic of sufficient scholarly impact to satisfy their committee. Work proceeds on the research via the dissertation course STAT 920, under the direction of the candidate's advisor and using the skills and knowledge of the larger committee where appropriate. The final, completed dissertation must represent an original, substantive advance in the theory, methodology, and/or practice of statistics, with focus on the candidate's interdisciplinary interests. It is expected that the work will result in one or more published research articles in high-quality, peer-reviewed statistics and subject-matter journals.

F. The Ph.D. Final Oral Defense

To be awarded the Ph.D., a candidate must complete the dissertation and submit to a [Final Oral Defense Examination](#). The examination focuses on the dissertation itself but can include general questions relating to the interdisciplinary study of statistics contained within the scope of the dissertation research.

The exact time and place of this examination must be scheduled with the Graduate Degree Certification Office at least seven working days in advance of the event. The candidate must be in good academic standing in order to schedule the defense with the Graduate College.

The chair of the dissertation committee presides over the examination. The examination is closed to the public, although an initial, open portion may be held during which the candidate presents the dissertation results and entertains questions. (Questions may not be proffered by the dissertation committee during the open period.) During the subsequent closed portion, the dissertation committee brings forward their questions to the candidate. There is no minimum time limit for the Final Oral Examination, but the entire proceedings may not exceed three hours. Members of the dissertation committee must be present for the entire examination. In private session following the examination, the committee votes to pass or fail the candidate based on her/his performance during the oral defense: if the committee is made up of three members, at least two must vote to pass for a successful determination; if the committee is made up of four or five members, at least three must vote to pass. The candidate must make her/himself available to the committee chair within 24 hours of completion of the defense, in order that the results of the examination may be delivered.

Upon successful completion of the Final Oral Defense Examination, the candidate submits the dissertation to the Graduate College [electronically](#) or via paper copies for forwarding to the Library of The University of Arizona and to University Microfilms, Inc. A [processing and microfilming fee](#) also must be paid to the University Bursar. The final, completed dissertation must meet all Graduate College formatting and submission requirements; a bound, printed copy is required for submission to the GIDP Graduate Coordinator. For more

information consult the *Manual for Theses and Dissertations*, available [online](#) or from the Graduate Degree Certification Office. Upon receipt of the finalized dissertation, the Dean of the Graduate College will recommend conferral of the doctoral degree by the Arizona Board of Regents.

G. Enrollment Policy and Time Limitation

In general, continuous enrollment is expected of all students admitted to a Ph.D. program. A student admitted to the Ph.D. program in Statistics must register each Fall and Spring semester for a minimum of 3 graduate units from original matriculation until the completion of all course requirements, written and oral comprehensive exams, and the 18 units of STAT 920. After these requirements are met, doctoral students not on financial assistance and/or needing to maintain appropriate visa status must register for a minimum of 1 unit each semester until final copies of the dissertation are submitted to the Graduate Degree Certification Office. Students receiving funding such as assistantships, fellowships, loans, grants, scholarships or traineeships may be required by their funding source to register for more than 1 unit to meet full-time status requirements, and should check with the GIDP office regarding such requirements to ensure that they remain qualified for funding. Doctoral students utilizing University facilities or faculty time during summer sessions must enroll for a minimum of 1 unit of graduate credit.

If any Ph.D. degree requirements (including the Comprehensive Examination and the Final Oral Defense) are completed during Summer term(s), the student must be registered for a minimum of 1 unit of graduate credit during that term. If any degree requirements are completed during an intersession (Winter session or the Pre-Session), the student must have been registered for a minimum of 1 unit during the preceding semester.

Unless excused by an official Leave of Absence (which may not exceed one year throughout the student's degree program), all graduate students are subject to this Continuous Enrollment Policy and must pay pertinent in-state and/or out-of-state tuition and fees in order to remain in the program. If the student fails to obtain a Leave of Absence or fails to maintain continuous enrollment, he or she will be required to apply for re-admission, to pay the Graduate College application fee, and pay all overdue tuition and fees, including cumulative late penalties. Tuition or registration waivers cannot be applied retroactively.

Graduate College policy states that all requirements for the degree of Doctor of Philosophy must be completed within 5 years of passing the Comprehensive Examination. Should a student fail to complete all the Ph.D. requirements within that time period, s/he may be allowed to sit for another Comprehensive Exam, with permission of the Program, and then proceed to complete any remaining Ph.D. requirements.

2. The M.S. in Statistics

The following guidelines identify the basic structure of the M.S. in Statistics at the University of Arizona. At the core of the program is a fundamental grounding in both statistical theory and methodology; however, extensive flexibility via course electives allows students to tailor their final programs of study to their own interdisciplinary interests. The student's advisor, along with the Program director, are available to discuss individual selection of these electives. *It is GIDP policy that the student holds final responsibility for being aware of and responding to all GIDP and Graduate College policies, requirements, formats, and deadlines as they pertain to progression towards and completion of the M.S. degree.*

The basic requirements for entrance into the M.S. program are:

- (a) A Baccalaureate Degree, either in a mathematical field or a field that makes significant use of quantitative methods.
- (b) At least three semesters of Calculus through multivariable/vector calculus (at the level of MATH 125, MATH 129, MATH 223), and one semester of Linear Algebra (at the level of MATH 215).
- (c) Some exposure to elementary statistics, at least at the level of MATH 263. A semester of upper-division probability is strongly recommended.
- (d) Scores on the Graduate Record Examination (GRE -- general test only) that exceed 75th percentile Quantitative and 50th percentile Verbal.
- (e) For students applying from non-English-speaking countries and who do not have a degree from a U.S. institution of higher learning, scores on the Test of English as a Foreign Language (TOEFL): pBT score above 640 and a pBT Section 1 score above 64, or iBT score above 106 and an iBT Speaking score above 28. The International English Language Testing System (IELTS) examination can be submitted in lieu of the TOEFL. The minimum IELTS score requirement for admissions consideration is a score of 8, with a score of no less than 7 on any individual module.

A. Coursework

A minimum of 30 units of coursework past the Bachelor's Degree is required, made up as follows:

1. Core M.S. Courses; 15 units as follows:

Theory of Probability (STAT 564/MATH 564)
Theory of Statistics (STAT 566/MATH 566)
Advanced Statistical Regression Analysis (STAT 571A/MATH 571A)
Design of Experiments (STAT 571B/MATH 571B), or
Research Design & Analysis of Variance (PSY 507C)
Statistical Consulting (CPH 685/EPID 685)

2. Additional Elective Courses; minimum 12 units from any of the following:

Advanced Data Analysis: Structural Equation Modeling (FSHD 617A)
Advanced Data Analysis: Dyadic Data Analysis (FSHD 617B)
Advanced Data Analysis: Multilevel Modeling (FSHD 617C)
Advanced Geographic Information Systems (RNR 520/GEOG 520)
Advanced Quality Engineering (SIE 606)
Advanced Statistical Natural Language Processing (LING 582)
Analysis of High Dimensional Data (CPH 648/EPID 648)
Applied Biostatistics Analysis (CPH 576C/EPID 576C), or
Advanced Topics in Biological Statistics (ECOL 581), or
Applied Biostatistics (RNR 613/ENTO 613/INSC 613)
Applied Econometric Analysis (ECON 549/AREC 549)
Applied Time Series Analysis (GEOS 585A)
Bayesian Statistical Theory and Applications (STAT 574B/ECON 574B)
Biostatistics for Research (CPH 576B/EPID 576B)
Categorical data analysis (STAT 574C/SOC 574C)

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Clinical Trials and Intervention Studies (CPH 675/EPID 675)
Data Management and the SAS Programming Language (CPH 576D/EPID 576D)
Detection and Estimation in Engineering Systems (ECE 639)
Econometrics (ECON 522A), *or*
 Advanced Applied Econometrics (AREC 559)
Econometrics (ECON 522B)
Engineering Decision Making Under Uncertainty (SIE 522)
Environmental Statistics (STAT 574E/MATH 574E/CPH 574E)
Fundamentals of Optimization (SIE 545)
Game Theory and Mathematical Programming (MATH 579), *or*
 Game Theory (SIE 543)
General Linear and Mixed Effects Models (CPH 684/EPID 684)
Graphical Exploratory Data Analysis (PSY 597G)
Information and Noise in Quantum Optics and Photonics (OPTI 528)
Introduction to Econometrics (ECON 518/AREC 518)
Introduction to Geostatistics (GEOG 574G/MATH 574G/STAT 574G)
Litigating with Experts (LAW 611C)/Law and Economics (ECON 538)
Multivariate Analysis in Management (MGMT 582D)
Multivariate Methods in Educational Research (EDP 646A)
Neural Networks (ECE 631)
Numerical Analysis (MATH 575A/C SC 575A)
Principles of Image Science (OPTI 637)
Probability Theory (MATH 563/STAT 563)
Queuing Theory (SIE 525)
Reliability and Quality Analysis (A ME 574)
Scientific Writing Strategies, Skills & Ethics (PHCL 595B/BME 595B/CBIO 595B/PS 595B)
Simulation Modeling and Analysis (SIE 531), *or*
 Statistical Computing (STAT 675)
Social Statistics (SOC 570B)
Spatial Statistics and Spatial Econometrics (GEOG 577)
Spatio-Temporal Ecology (ECOL 518)
Statistical Bioinformatics and Genomic Analysis (MCB 516A/ABE 516A)
Statistical Genetics for Quantitative Measures (ANS 513/EPID 513/GENE 513)
Statistical Mechanics (PHYS 528)
Statistical Methods in Psychological Research (PSY 507B), *or*
 Educational Tests and Measurements (EDP 558)
Statistical Packages in Research (EDP 548)
Stochastic Differential Equations (MATH 565C)
Stochastic Methods in Surface Hydrology (HWR 655/C E 655), *or*
 Applied Stochastic Processes (MATH 568)
Statistical Natural Language Processing (LING 539)
Stochastic Modeling I (SIE 520)
Stochastic Processes (MATH 565A)
Stochastic Processes (MATH 565B)
Survey Sampling (STAT 574S)
Survival Analysis (CPH 686/EPID 686)
Theoretical Statistics (STAT 567A/MATH 567A)
Theoretical Statistics (STAT 567B/MATH 567B)
Theory of Linear Models (CPH 687/EPID 687/STAT 687)
Theory of Measurement (EDP 658A)
Theory of Measurement (EDP 658B)

cont'd

Time Series Analysis (STAT 574T/MATH 574T)

Students must meet all prerequisites for any elective courses they wish to undertake, or must secure instructor permission prior to registering for the course. Courses may be added to or removed from this list by action of the GIDP Curriculum Committee, after approval by the GIDP Executive Committee.

Where needed to suit a particular or specialized need in an individual student's program of study, petition may be made to the GIDP Executive Committee for approval of a course not listed above for use as an elective. The student must be in good standing and be enrolled in the Statistics GIDP. The burden of proof for admitting such a course rests with student, and the decision of the committee will be final. Note that introductory, elementary-methods courses that do not expand the statistical frontier are not generally approved for credit towards the M.S. in Statistics.

3. *An M.S. Thesis or in lieu of a Thesis, advanced statistical coursework; minimum 3 units as follows:*
Thesis (STAT 910)

or any one of:

Bayesian Statistical Theory and Applications (STAT 574B/ECON 574B)

Categorical data analysis (STAT 574C/SOC 574C)

Environmental Statistics (STAT 574E/MATH 574E/CPH 574E)

General Linear and Mixed Effects Models (CPH 684/EPID 684)

Probability Theory (MATH 563/STAT 563)

Statistical Computing (STAT 675)

Survey Sampling (STAT 574S)

Theoretical Statistics (STAT 567A/MATH 567A)

Theoretical Statistics (STAT 567B/MATH 567B)

Theory of Linear Models (CPH 687/EPID 687/STAT 687)

Time Series Analysis (STAT 574T/MATH 574T)

Courses may be added to or removed from this list by action of the Statistics GIDP Curriculum Committee, after approval by the GIDP Executive Committee.

* course under development

B. The Masters Plan of Study (MPOS)

The [Master's/Specialist Plan of Study](#), or MPOS, represents a tailored guideline for the courses that will satisfy the student's M.S. degree requirements. It is essentially a contract between the student, the GIDP, and the Graduate College specifying which courses the student will take to fulfill the requirements of the M.S. degree.

The MPOS should be formulated and submitted during the student's second semester in residence in the GIDP: by the end of first semester in residence, the student should choose an *advisor* from among the Regular faculty of the GIDP in Statistics (see Appendix 1). [Until such time as the student has chosen an advisor, the chair of the GIDP Recruiting & Admissions (R&A) Committee, or another GIDP faculty member designated by the GIDP Chair, serves as the student's temporary advisor.] After consultation with the chosen advisor and the GIDP Chair, the student determines an expected list of courses to be taken toward the M.S. degree, and submits these on the MPOS to the Graduate College.

Components on the MPOS will include the 18 units of core M.S. courses, the minimum 9 units of additional electives that comprise the student's own interdisciplinary specialization, and the 3 thesis units of STAT 910. If the student elects to apply advanced statistical coursework in lieu of the M.S. Thesis, then these (minimum) 3 units should be listed instead of STAT 910 on the MPOS.

The MPOS may be amended if circumstances so require. Changes to an approved MPOS may be submitted to the Graduate Degree Certification Office in any of three ways: (1) on the Changes in Student Records or Programs of Study form (available [online](#) from the Graduate College); (2) by e-mail directly from the student's advisor to the degree auditor (if acceptable to the degree auditor in the Graduate College Degree Certification Office); or (3) on the Completion of Degree Requirements form submitted when the student finishes the degree program. (The Graduate Degree Certification Office is located on the 3rd floor of the University's [Administration building](#).) The MPOS must still be in compliance with all pertinent Graduate College policies after the changes are made, or the degree auditor will not accept the changes.

No more than half of the total units listed on the MPOS (including transfer units; see below) can be in courses graded with an S or P grade rather than a regular letter grade. This includes the 3 units of thesis research via STAT 910 which, if so elected, should appear on the MPOS (see above).

Coursework completed at other institutions (referred to by the Graduate College as *Transfer Coursework*) may be applied towards credit in the M.S. curriculum. This coursework must be approved in advance by the Program director and by the Graduate College, via the College's [Transfer Credit Form](#). (Consult the Graduate College's degree certification staff for more details on transfer coursework requirements.) Approved transfer coursework must be listed as such on the student's MPOS.

A maximum of 12 units on the MPOS may be from courses taken outside a UA graduate degree program, including courses taken in non-degree seeking status, as transfer coursework, and/or as 400-level courses. (Note: The GIDP does not recognize coursework at or below 300-level for credit towards the M.S. in Statistics.)

The student's bursar account will be billed a candidacy [fee](#) at the time the MPOS is submitted to the Graduate Degree Certification Office. This is a one-time fee and is not reassessed if the anticipated graduation date changes. Other fees may be assessed for degree auditing; details are available from the Graduate College.

C. Language requirement

The GIDP in Statistics has no formal, non-English, language requirement.

D. The Masters Thesis

For students undertaking an M.S. thesis in Statistics, a *thesis committee* must be formed prior to registration for STAT 910. The committee must consist of at least two faculty, both tenured, tenure-track, or approved by the Dean of the Graduate College as equivalent. The student's advisor serves as the committee chair, who must be a Regular member of the GIDP in Statistics. The other committee faculty must be from the GIDP in Statistics; s/he may hold Affiliate or Regular status. A third member from the GIDP in Statistics may also be added to the committee, at the discretion of the candidate and with approval of the committee chair. Such members can be tenured or tenure-track, or a special approved member. Special members must be pre-approved by the Dean of the Graduate College. Individual faculty members may decline to serve on committees for academic reasons.

For the thesis, students must develop a (formal or informal) proposal of sufficient academic merit and on a topic of sufficient scholarly impact to satisfy their committee. Work proceeds on the research via the thesis course STAT 910, under the direction of the candidate's advisor and using the skills and knowledge of the larger committee where appropriate. The final, completed thesis must meet all Graduate College formatting and submission requirements; a bound, printed copy is required for submission to the GIDP Graduate Coordinator. Further submission of the thesis to the Graduate Degree Certification Office, for publication by University Microfilms, Inc. and inclusion in The University of Arizona Library archives, is optional. There is a [fee](#) for microfilming and for copyrighting should a student choose those options. For more information consult the *Manual for Theses and Dissertations*, available [online](#) or from the Graduate Degree Certification Office.

E. The Masters Final Exit Examination

All M.S. students must pass an exit examination in Statistics prior to awarding of the M.S. degree. The examination may take the form of an oral defense of the M.S. thesis, held at the completion of STAT 910. The examination focuses on the thesis itself but can include general questions relating to the interdisciplinary study of statistics contained within the scope of the thesis research.

The exact time and place of this examination must be scheduled with the GIDP Graduate Coordinator at least seven working days in advance of the event. The candidate must be in good academic standing in order to schedule the defense.

The student's advisor presides over the examination. The examination is closed to the public, although an initial, open portion may be held during which the candidate presents the thesis results and entertains questions. (Questions may not be proffered by the thesis committee during the open period.) During the subsequent closed portion, the thesis committee brings forward their questions to the candidate. There is no minimum time limit for the Final Exit Examination, but the entire proceedings may not exceed three hours. If held, all members of the thesis committee must be present for the entire examination. In private session following the examination, the committee votes to pass or fail the candidate based on her/his performance during the oral defense: if the committee is made up of two members, both must vote to pass for a successful determination; if the committee is made up of three members, at least two must vote to pass. The candidate must make her/himself available to the committee chair within 24 hours of completion of the final oral defense, in order that the results may be delivered.

A candidate who fails a final oral defense may, upon the recommendation of the GIDP to the Graduate College, be granted a second oral defense. This second defense must be held within 4 months of the first defense. The results of the second oral defense are considered final.

Students who elect the non-thesis option must pass a written examination regularly offered and assessed by a standing committee of the GIDP faculty. The examination may be retaken only once. Offered during May and January of each year, the examination coincides with the Ph.D. Qualifying Examination. It tests the student's ability to integrate material from the following core M.S. courses, and to use this knowledge in solving pertinent, challenging statistical problems commensurate with M.S. status at the level of these courses:

Theory of Probability (MATH 564)
Theory of Statistics (STAT 566/MATH 566)
Advanced Statistical Regression Analysis (STAT 571A/MATH 571A)
Design of Experiments (STAT 571B/MATH 571B), *or*
Research Design & Analysis of Variance (PSY 507C)

Each specific examination is constructed and graded by a committee of GIDP faculty appointed annually by the GIDP Chair. Where possible, this will include the instructors of the pertinent core courses. A minimum of two examiners grade every question independently.

The exam is administered in two parts over two consecutive days; the first day centers on the more theoretical material from STAT 564-566/MATH 564-566, and the second day centers on the more methodological material in STAT 571A and STAT 571B (or PSY 507C). With prior agreement of the GIDP Examination Committee, this order may be reversed on an exam-by-exam basis, but must be the same for all students who sit for that exam. Note, however, that concepts from all four course areas will be addressed freely in either or both parts of any examination, at the discretion of the Examination Committee.

Students have 4 hours on each day to complete the exam questions given on that day. If a student is present for only one of the two days, s/he will be viewed as having attempted the entire exam and graded accordingly.

Replicas of previous exams are available from the GIDP's Graduate Coordinator for students who wish to make copies for study purposes.

Students must register in advance for each examination; deadlines will be set by the GIDP Examination Committee prior to each offering. (Students who register for an examination but do not sit for it at the designated time and place will be viewed as having received a failing grade on that examination, unless prior authorization and approval are acquired from the Program director.)

There are three possible outcomes to the exam:

- PhD Pass: A student who achieves this score may consider taking further coursework towards candidacy in the Program. This score also counts as an MS Pass; see next item.
- MS Pass: A student who wishes to complete the M.S. degree in Statistics may use this score to stand for their M.S. exit examination. If the student also undertakes and completes an M.S. Thesis via STAT 910, an MS Pass may be enlisted to serve as proxy for acceptable performance on the Oral Thesis defense, if desired.
- Fail: A student who receives this score must retake the exam at the next opportunity in order to remain in the Program and be eligible to pursue a graduate degree in Statistics. Failure on a second attempt invalidates use of the written exam results to stand for an M.S. exit examination, and prevents the student from continuing on to a Ph.D. in the program.

After receiving written notice of the exam results, students may request a consultation with a designated member of the Examination Committee to review their exam results.

When the GIDP determines that the student has completed all degree requirements a [Completion Of Master's Degree Requirements Form](#), signed by all members of the student's committee (two of whom must be tenure-track faculty), must be submitted to the Graduate College. Approval of this form by the Dean of the Graduate College will certify completion of degree requirements. For dates by which requirements must be met to graduate in a particular semester, refer to the Deadline Sheets, available in the Graduate Degree Certification Office, or [online](#). Any modifications in the MPOS may be made on the Completion of Degree Requirement form or on the Changes in Student's Records form. These modifications may consist of changes in coursework, changes in addresses, or changes in names. Name changes also require that an official name change be filed with the Registrar's Office. All outstanding fees must be cleared before the final completion date. Any financial encumbrances will delay mailing of the diploma and transcripts. Contact the Bursar's office, in Room 208, [Administration building](#) or call 520-621-3232. All grades must be submitted for Incompletes and current semester coursework must be received before the degree is considered completed. A student must be in good academic standing at the time of submission of the Completion of Master's Degree Requirements Form.

F. Enrollment Policy and Time Limitation

In general, continuous enrollment is expected of all students admitted to a Master's degree program. Such students must register each fall and spring semester for a minimum of 3 graduate units, from original matriculation until all degree requirements are met. If the degree program requirements are to be completed in the summer, the student must register for a minimum of 1 unit of graduate credit during that term. Master's candidates do not have to register for graduate units during summer sessions unless they plan to make use of University facilities or faculty time. If they do plan to use University facilities or faculty time, they must enroll for a minimum of 1 unit of graduate credit.

Unless excused by an official Leave of Absence (which may not exceed one year throughout the student's degree program), all graduate students are subject to this Continuous Enrollment Policy and must pay pertinent in-state and/or out-of-state tuition and fees in order to remain in the program. If the student fails to obtain a Leave of Absence or fails to maintain continuous enrollment, he or she will be required to apply for re-

admission, to pay the Graduate College application fee, and pay all overdue tuition and fees, including cumulative late penalties. Tuition or registration waivers cannot be applied retroactively.

Graduate College policy states that M.S. students have 6 years to complete the degree from the date of the earliest coursework toward the degree listed on the MPOS. Students with a compelling reason for using older coursework toward the degree may submit a [Graduate Petition](#) to request an extension of time to complete the degree program; the petition should be submitted with the MPOS and will be considered by the Associate Dean of the Graduate College.

3. The Ph.D. Minor in Statistics

The following guidelines identify the basic structure of the Ph.D. Minor in Statistics at the University of Arizona. At the core of the program is a foundation in the theory of statistical inference (via STAT 566/MATH 566); however, extensive flexibility via course electives allows students to tailor their Minor programs of study to their own interdisciplinary interests. Students may design or select a concomitant curriculum pertinent to their own research or professional interests from a list of advanced, statistically-rigorous courses taken from across the campus. Depending on the student's selection of Elective Courses, expertise may be gained in statistical practice, theory, and/or applications in a specialized area such as biometry, bioinformatics, econometrics, environmetrics, psychometrics, etc. Of course, these outcomes will differ depending on the combination of elective courses selected.

The student's advisor, along with the GIDP Chair, should be consulted to plan the individual selection of Elective Courses. *It is GIDP policy that the student holds final responsibility for being aware of and responding to all GIDP and Graduate College policies, requirements, formats, and deadlines as they pertain to progression towards and completion of her/his graduate degree.*

A. Coursework

A minimum of 12 units of coursework (graded B or better) is required for the Minor, made up as follows:

1. *Core Statistical Theory Course; 3 units as follows:*

Theory of Statistics (STAT 566/MATH 566)

2. *Additional Elective Courses; minimum 9 units from any of the following:*

Advanced Data Analysis: Structural Equation Modeling (FSHD 617A)

Advanced Data Analysis: Dyadic Data Analysis (FSHD 617B)

Advanced Data Analysis: Multilevel Modeling (FSHD 617C), *or*

General Linear and Mixed Effects Models (CPH 684/EPID 684)

Advanced Statistical Regression Analysis (STAT 571A/MATH 571A)

Analysis of High Dimensional Data (CPH 648/EPID 648)

Applied Biostatistics Analysis (CPH 576C/EPID 576C), *or*

Advanced Topics in Biological Statistics (ECOL 581), *or*

Applied Biostatistics (RNR 613)

Applied Econometric Analysis (ECON 549/AREC 549)

Applied Time Series Analysis (GEOS 585A), *or*

Time Series Analysis (STAT 574T/MATH 574T)

Bayesian Statistical Theory and Applications (STAT 574B/ECON 574B)

Categorical data analysis (STAT 574C/SOC 574C)

Data Management and the SAS Programming Language (CPH 576D/EPID 576D)

Design of Experiments (STAT 571B/MATH 571B), *or*

Research Design & Analysis of Variance (PSY 507C)

Econometrics (ECON 522A), *or*

Advanced Applied Econometrics (AREC 559)

Engineering Decision Making Under Uncertainty (SIE 522)

Environmental Statistics (STAT 574E/MATH 574E/CPH 574E)

Introduction to Econometrics (ECON 518/AREC 518)

Introduction to Geostatistics (GEOG 574G/MATH 574G/STAT 574G)

Introductory Mathematical Statistics for Economists (AREC 517/ECON 517)

Litigating with Experts (LAW 611C)/Law and Economics (ECON 538)

Probability Theory (MATH 563/STAT 563)

cont'd

Spatial Statistics and Spatial Econometrics (GEOG 577)
Spatio-Temporal Ecology (ECOL 518)
Statistical Computing (STAT 675)
Statistical Consulting (CPH 685/EPID 685)
Statistical Genetics for Quantitative Measures (ANS 513/EPID 513/GENE 513)
Survey Sampling (STAT 574S)
Survival Analysis (CPH 686/EPID 686)
Theoretical Statistics (STAT 567A/MATH 567A)
Theoretical Statistics (STAT 567B/MATH 567B)
Theory of Linear Models (CPH 687/EPID 687/STAT 687)
Theory of Measurement (EDP 658B)
Theory of Probability (MATH 564)
Theory of Quantitative Methods in Economics (ECON 520), *or*
Engineering Statistics (SIE 530)

* course under development

B. Prerequisite Courses

Prerequisite courses necessary to undertake a course chosen for the Minor are the responsibility of the student and may only count towards the Minor if they are already listed as a Core Course or as Elective Courses. Students may, however, consult each individual course instructor to determine if special permission can be secured to register for a Core or Elective Course when a prerequisite course requirement has not been met. Decisions of the course instructors are considered final.

C. Changes to the Ph.D. Minor in Statistics

Courses may be added to or removed from this list by action of the Statistics GIDP Curriculum Committee, after approval by the GIDP Executive Committee.

Where needed to suit a particular or specialized need in an individual student's curriculum plan, petition may be made to the GIDP Executive Committee through the GIDP Chair for approval of a course not listed above for use as an Elective Course. The decision of the committee will be final. In no case, however, will a prerequisite course for any Elective Course be considered for such special approval if it is not already listed as an approved course, nor may a course be used to satisfy both a major degree requirement *and* a requirement for the Ph.D. Minor in Statistics.

4. The Graduate Certificate in Statistics

The following guidelines identify the basic structure of the Graduate Certificate in Statistics at the University of Arizona. The Certificate expands existing opportunities for potential or current University of Arizona graduate students wishing to obtain a deeper understanding of statistical methodology, inference, and practice, and offers greater depth of focus to their data-analytic training. The Certificate's program of study provides a prescribed format for such learning, while also allowing for a flexible curriculum that addresses this need over a wide variety of disciplines.

Students may design or select a course curriculum pertinent to their own research or professional interests from a list of advanced, statistically-rigorous courses taken from across the campus. Depending on the student's selection of Elective Courses, expertise may be gained in statistical practice, theory, and/or applications in a specialized area such as biometry, bioinformatics, econometrics, environmetrics, psychometrics, etc. Of course, these outcomes will differ depending on the combination of elective courses selected.

To be eligible for the Certificate Program, a student must have earned at least a bachelor's degree from an accredited U.S. institution of higher learning. No standardized tests are required. Concurrent enrollment in another University degree program outside of the GIDP in Statistics is allowed, but not required. Graduate College [regulations](#) allow for a maximum of 6 units of graduate credit earned as an undergraduate senior at the University, or in graduate non-degree status (NDS), to be applied for credit toward a Graduate Certificate. Those same regulations allow up to 6 units from a University of Arizona Master's degree to count toward the Graduate Certificate. In no cases may coursework taken more than two years prior to admission to the Certificate program be transferred for credit towards the Certificate.

To apply to the Graduate Certificate in Statistics, see the Graduate College's website for online applications: http://grad.arizona.edu/Prospective_Students/Apply_Now/. An application fee is required, except for students already enrolled in the Statistics GIDP.

Once accepted into the program, students meet with the Chair of the GIDP in Statistics or an alternate advisor from the GIDP designated by the Chair to develop a [Plan of Study](#) suited to their professional needs. *It is GIDP policy that the student holds final responsibility for being aware of and responding to all GIDP and Graduate College policies, requirements, formats, and deadlines as they pertain to progression towards and completion of their graduate certificate.*

A. Coursework

A minimum of 12 units of coursework is required for the Graduate Certificate, made up as follows:

i. *Core Statistical Theory Course; 3 units taken for a letter grade as follows:*

STAT 566/MATH 566 -- Theory of Statistics

ii. *Additional Elective Courses; minimum 9 units taken for a letter grade from any of the following 30 options (no course may be taken more than once):*

1. ANS 513/EPID 513/GENE 513 -- Statistical Genetics for Quantitative Measures
2. AREC 517/ECON 517 -- Introductory Mathematical Statistics for Economists
3. AREC 559 -- Advanced Applied Econometrics, *or*
ECON 522A -- Econometrics
4. CPH 648/EPID 648 -- Analysis of High Dimensional Data
5. CPH 684/EPID 684 -- General Linear and Mixed Effects Models, *or*
FSHD 617C -- Advanced Data Analysis: Multilevel Modeling
6. CPH 685/EPID 685 -- Statistical Consulting
7. CPH 686/EPID 686 -- Survival Analysis
8. CPH 687/EPID 687/STAT 687 -- Theory of Linear Models

9. ECOL 518 -- Spatio-temporal Ecology
10. ECON 518/AREC 518 -- Introduction to Econometrics
11. ECON 520 -- Quantitative Methods in Economics, *or*
SIE 530 -- Engineering Statistics
12. ECON 549/AREC 549 -- Applied Econometric Analysis
13. EDP 658B -- Theory of Measurement
14. FSHD 617A -- Advanced Data Analysis: Structural Equation Modeling
15. FSHD 617B -- Advanced Data Analysis: Dyadic Data Analysis
16. GEOG 574G/ MATH 574G/STAT 574G -- Introduction to Geostatistics
17. GEOS 585A -- Applied Time Series Analysis, *or*
STAT 574T/MATH 574T -- Time Series Analysis
18. MATH 563/STAT 563 -- Probability Theory
19. RNR 613 -- Applied Biostatistics
20. SIE 522 -- Engineering Decision Making Under Uncertainty
21. SIE 531 -- Simulation Modeling and Analysis, *or*
STAT 675 -- Statistical Computing
22. STAT 564/MATH 564 -- Theory of Probability
23. STAT 567A/MATH 567A -- Theoretical Statistics
24. STAT 567B/MATH 567B -- Theoretical Statistics
25. STAT 571A/MATH 571A -- Advanced Statistical Regression Analysis
26. STAT 571B/MATH 571B -- Design of Experiments, *or*
PSY 507C -- Research Design & Analysis of Variance
27. STAT 574B/ECON 574B-- Bayesian Statistical Theory and Applications
28. STAT 574C/SOC 574C -- Categorical Data Analysis
29. STAT 574E/MATH 574E/CPH 574E -- Environmental Statistics
30. STAT 574S -- Survey Sampling

* course under development

B. Prerequisite Courses

Prerequisite courses necessary to undertake a course chosen for the Graduate Certificate are the responsibility of the student and may only count towards the Certificate if they are already listed as a Core Course or as Elective Courses.

C. Transfer of Credit

No transfer of credit from outside of the University is allowed; however, coursework taken previously at another institution may be used to satisfy prerequisites for any of the courses in the Graduate Certificate, at the discretion of the course instructor or offering department. Based on their experience with the Graduate Certificate program of study, students who wish to pursue an M.S. or Ph.D. in Statistics must meet all existing requirements for admission to those programs at the time admission is requested.

D. Changes to the Graduate Certificate in Statistics

Individual students cannot make changes to the Graduate Certificate course requirements. Such action must initiate with the Statistics GIDP Curriculum Committee, for approval first by the GIDP Executive Committee, and then by the Graduate College. This process can take a number of months to complete.

E. Enrollment Policy and Time Limitation

Students studying for a Graduate Certificate in Statistics have at their discretion a flexible schedule for completion of the program. As per Graduate College [guidelines](#), however, the maximum time to completion of the Certificate curriculum may not exceed four (4) calendar years.

Financial Support Options

1. Eligibility

Many graduate students in the Program receive financial assistance in the form of fellowships, teaching assistantships, and/or research assistantships. Students should recognize that financial support from the GIDP is a privilege and is not guaranteed. In order to receive financial aid, it is necessary to be considered a full-time graduate student, which requires registration for a minimum of 9 units each semester. Students are encouraged to seek out funding from a variety of sources; the Graduate College has [online resources](#) which can facilitate this effort. Students are also strongly encouraged to apply for Research Assistantship support through faculty and fellowship awards from local and national agencies.

2. Teaching Assistantships (TAs)

Teaching Assistantships carry teaching assignments in various departments and programs across the campus. When you are awarded a teaching (or research; see below) assistantship, you essentially become a student employee of the University and must sign an employment contract, called the *Notice of Appointment* (NOA). A copy of the NOA is given to the student to sign, and it should be read carefully. Some of the key points for the student mentioned in the NOA include:

- Must be enrolled for a minimum of 6 graduate level units, or the minimum required by your department or program. (The Statistics GIDP requires registration for a minimum of 9 units.)
- Maintain a cumulative GPA of 3.0 or higher.
- Limit hours per pay period (two calendar weeks) to the required guidelines of your FTE (0.50 or 0.25; see Item #5, below); if you are on a 0.50 assistantship the maximum number of hours worked *per pay period* is 40; if on a .25 assistantship the maximum number of hours worked *per pay period* is 20. Students on F-1 or J-1 visas are limited to a maximum total of 40 hours *per pay period*.
- Perform duties—whether teaching or research—to the best of your abilities. You may be subject to termination before the end of your appointment if your performance is not at acceptable levels.
- Understand that assistantship appointments are not automatically renewable and may be subject to funding availability. There should be no expectation of employment beyond the dates listed on the current NOA.

Your hiring department may establish conditions of employment over and above mentioned in the NOA.

All students awarded Graduate Teaching Assistantships are required to attend a [Graduate Assistant Training Orientation](#) (GATO) at the beginning of their graduate enrollment. The GATO is designed to acquaint first-time TAs at the University of Arizona with Arizona Board of Regents' teaching requirements. Failure to attend the GATO results in release from a student's hiring agreement. GATO sessions are scheduled at the beginning of each semester and attendance is free. If a Graduate Teaching Assistant fails to attend their GATO, a second orientation is available; however, the cost for attending the second GATO is charged to the student.

The Graduate College also requires that all Graduate Teaching Assistants engaged in direct student contact whose native language is not English and who are not U.S. Citizens or Permanent Residents provide verification of [proficiency in spoken English](#). Current regulations view this as either a passing score on the [Test of Spoken English](#) (TSE) administered by the [Educational Testing Service](#) (ETS), or the [T-BEST](#) test administered by the University. Verification of a successful test result is required before a Graduate Teaching Assistant's hiring documents may be processed.

In addition to the key points established by the Graduate College, above, the GIDP in Statistics has an additional set of guidelines which must be followed by students on Teaching Assistantships. These are:

- Students working as Teaching Assistants are classified by the University as student workers; therefore there is no provision for sick or medical leave time. If a TA becomes ill and cannot teach or meet her/his class responsibilities, s/he must inform the course supervisor and the TA

coordinator *immediately*, and s/he must make the necessary arrangements for coverage of the class/responsibilities. In the extreme circumstance of being incapacitated to the extent that a TA cannot teach for an indefinite or extended period of time, the University will require the student to resign from the Teaching Assistantship.

- There is *no* vacation time for Teaching Assistants. Time off during the semester is only allowed for the most exceptional family situations (e.g. death, serious illness) and must be kept to the minimum number of days possible. Obviously, the TA must inform the course supervisor and the TA coordinator if such a situation arises.
- TAs will *not* be paid for time taken off during the semester and for payroll purposes must report any time away to the business office of the sponsoring department or program.
- Graduate Assistants classified as employees of the GIDP must complete an Electronic Time Record (ETR) every pay period. The ETR is then approved by the Supervising Instructor or Professor. Failure to submit the ETR or receive Supervisor approval will prevent the Graduate Assistant from receiving her/his paycheck.

GIDP students may at times be confused about their status when they are Teaching Assistants in another University department or program. The GIDP recommends that students view the teaching and services they provide as a form of “contract” between the student and the department or program. (A similar sort of arrangement often occurs with employees of consulting companies in the commercial sector). While you have a TA contract with another University department or program, you must follow their (and the University’s) rules and procedures with regard to your teaching performance. We call, however, for GIDP students to always conduct themselves as citizens of, and ambassadors for, the GIDP in Statistics, since they are governed by all the GIDP’s academic policies and requirements, irrespective of the source of their financial support.

3. Research Assistantships (RAs)

Research assistantships can come from grants and contracts to faculty members and generally require research related to the grant or contract. Individual faculty or campus training programs administering the research position(s) may have specific requirements that students must meet in order to be eligible for funding. *The nature of financial support for graduate students can vary year to year.* Continuation of research assistantships from non-GIDP sources is always at the discretion of the Principal Investigator of the grant, regardless of the number of years of prior funding. All other aspects and responsibilities for Research Assistants are similar to those discussed above for Teaching Assistants, including the stipulations of an NOA.

4. Fellowships and Research Grants

University Fellowships, for which competition is heavy, are available mainly to first year students; these carry no explicit teaching or research obligations. All support is contingent upon meeting Graduate College requirements, which include maintaining at least a 3.0 grade point average.

There are opportunities for students to obtain external fellowships of various kinds from funding agencies such as the U.S. National Science Foundation (NSF), other various Federal Depts. and Agencies, and private foundations. See <http://grad.arizona.edu/financial-resources>. These fellowships are prestigious, financially advantageous, and can speed up time to graduation. Students are strongly encouraged to apply for these awards. Ms. [Georgia Ehlers](#), Coordinator of Internships & Community Engagement at the Graduate College, will be pleased to assist you.

5. Multiple Means of Support

The University has strict regulations governing academic year employment limits. These are described in the University’s *Graduate Assistantship Hiring Manual*, available on the Graduate College [website](#) or from the GIDP office. A “full-time” TA or RA position is designated as 0.5 FTE (FTE stands for *Full-Time Equivalent*

employee or student). That is, one-half of a 40-hour work week. The term “full time” TA is perhaps confusing, since it designates only 20 hours of work/week. The University and the GIDP view this as comprising only half of the graduate student’s weekly effort, because students are expected to spend the “other” half of their time on coursework and attendant scholarly pursuits as part of their graduate education and training. Indeed, graduate students given “half-time” TA or RA status with reduced duties are usually designated as 0.25 FTE.

The [*Graduate Assistantship Hiring Manual*](#) states that to maintain student employee status, graduate students are limited to no more than 30 hours per week *total* employment; this includes their Graduate Assistantship (either TA or RA) position, and any additional *on-campus* employment during periods of enrollment. But note: “full-time” (0.5 FTE) TAs or RAs cannot seek or accept additional on-campus employment opportunities, since for a graduate student 0.5 FTE status is viewed as working full time (despite the confusing use of the “0.5 FTE” terminology). Such a student could not, e.g., accept an additional 0.25 FTE position as a TA or RA that brings their total contracted workload up to a 30 hour work-week, even though the Graduate College maximum allows for up to 30 hours of service. (To reemphasize, 0.5 FTE status is viewed as working full time; indeed, no responsible professor or sensible department will take on a student with external 0.5 FTE status as a part-time TA or RA.)

It is possible, however, for a graduate student to have partial support from one source, e.g., a half-time TA (0.25 FTE), and to acquire further support from another source. The 30 hour-maximum could then become pertinent, if, say, the GIDP were to approve extra hours—usually termed *supplementary compensation*—for performing special tutoring assignments. In this case, the employment contracts become a little more complex, and students in such situations should endeavor to work closely with the GIDP’s Graduate Coordinator, in order to make sure that all University regulations are satisfied.

6. Professional Conduct

The guidelines reviewed above all center on how a GIDP student should conduct herself or himself, i.e., one’s *professional conduct*. Professional conduct not only involves a commitment to follow the letter of an assistantship contract’s requirements, but also implies that proper respect be given to the spirit behind these requirements. Award of a TA or RA is a privilege, not a right. Irresponsible actions exhibited while serving the GIDP and the University not only damage the student’s own reputation (who will want to hire you as TA in the future if you are known to disrespect rules?), but ultimately damage the reputation of the GIDP. TA and RA positions are exciting opportunities for graduate students to develop professional skills that will carry through the rest of their careers. Enjoy them and benefit from them, but on no account abuse them!

Appendix 1. GIDP Faculty & Research Interests

1. Regular Members

Regular Members of the GDIP in Statistics are those University faculty and staff involved in teaching core Statistics courses, directing M.S. and Ph.D. students in the GIDP, and/or others who have agreed to be significantly active in the Program.

Mark S. Aldenderfer, Ph.D. (Pennsylvania State University), Professor of Anthropology.
Applied multivariate analysis; Spatial statistics; Cluster analysis.

Lingling An, Ph.D. (Purdue University), Assistant Professor of Biometry.
Statistical genetics/genomics; Bioinformatics; Data mining and pattern recognition.

Jacobus J. (Kobus) Barnard, Ph.D. (Simon Fraser University), Associate Professor of Computing Science;
Associate Professor of Electrical and Computer Engineering.
Machine learning; Mathematical modeling of geometric form; Multi-modal data; Statistical applications in computer vision.

Katherine Y. (Kathie) Barnes, Ph.D. (University of Minnesota), J.D. (University of Michigan), Associate
Professor of Law; Director, Rogers Program on Law and Society.
Bayesian statistics; Causation and selection models; Empirical methods in law; Discrimination; Expert
witnesses.

Rabi N. Bhattacharya, Ph.D. (University of Chicago), Professor of Mathematics.
Markov processes; Large sample theory; Statistical shape analysis; Economic theory of growth under
uncertainty.

D. Dean Billheimer, Ph.D. (University of Washington), Associate Professor of Biometry; Director, Arizona
Statistics Laboratory.
Measurement and normalization, Quantitative proteomics, Statistical methods for compositional data.

Zhao Chen, Ph.D. (University of Arizona), Associate Professor of Public Health; Director, Division of
Epidemiology & Biostatistics.
Research study design; Longitudinal data analysis; Risk assessment.

Peter Chesson, Ph.D. (University of Adelaide, Australia), Professor of Ecology & Evolutionary Biology.
Mathematical ecology; Ecological statistics; Stochastic processes; Biodiversity.

Melinda F. (Mende) Davis, Ph.D. (University of Arizona), Research Assistant Professor of Pediatrics; Assistant
Professor of Public Health.
Latent variable modeling; Measurement of change; Item response theory; Health outcomes research; Statistical
consulting.

Scott R. Eliason, Ph.D. (Pennsylvania State University), Associate Professor of Sociology.
Categorical data analysis; Maximum likelihood estimation; Causal inference; Social statistics; Mathematical
demography.

William G. Faris, Ph.D. (Princeton University), Professor of Mathematics.
Stochastic processes; Mathematical statistics.

Keisuke Hirano, Ph.D. (Harvard University), Associate Professor of Economics.
Econometrics; Causal inference.

Chiu-Hsieh (Paul) Hsu, Ph.D. (University of Michigan), Assistant Professor of Public Health.
Survival analysis; Missing data; Statistical modeling.

Chengcheng Hu, Ph.D. (University of Washington), Assistant Professor of Public Health.
High-dimensional data; Survival analysis; Longitudinal data; Missing data; Measurement error.

Christopher S. Johnson, Ph.D. (University of Michigan), Assistant Professor of Educational Psychology.
Hierarchical generalized linear models; Repeated measures analysis; Item response theory.

Alan P. Ker, Ph.D. (North Carolina State University), Professor of Agricultural Resource Economics; Professor of Economics.
Nonparametric regression; Empirical Bayes methods; Nonparametric kernel density estimation.

Bonnie J. LaFleur, Ph.D. (University of Colorado Health Sciences Center), Associate Professor of Public Health.
Biostatistics; Exact tests/permutation tests; Cancer biology; Genomics.

Nirav Merchant, M.S. (University of Arizona), Director of Information Technology, Arizona Research Labs.
Data mining; Classification; Quality control.

Yue (Selena) Niu, Ph.D. (Princeton University), Assistant Professor of Mathematics.
Nonparametric statistics; Semiparametric modeling; Statistical genetics.

Walter W. Piegorsch, Ph.D. (Cornell University), Professor of Mathematics; Professor of Public Health; *Chair*, GIDP in Statistics.
Environmental statistics; Quantitative risk assessment; Statistical toxicology; Biometry; History of statistics.

Denise J. Roe, Dr.P.H. (University of California at Los Angeles), Professor of Public Health.
Clinical trials; Epidemiological studies; Pharmacokinetics.

Moshe Shaked, Ph.D. (University of Rochester), Professor of Mathematics.
Reliability theory; Stochastic modeling; Stochastic orders.

Duane L. Sherrill, Ph.D. (University of Colorado Health Sciences Center), Professor of Public Health; Associate Dean of Research, Mel and Enid Zuckerman College of Public Health.
Longitudinal analyses; Respiratory disease assessment; Applied data analyses; Biometry.

Robert J. Steidl, Ph.D. (Oregon State University), Associate Professor of Natural Resources.
Quantitative ecology; Dynamics of animal populations; Conservation biology.

Michael Tabor, Ph.D. (Imperial College), Professor of Applied Mathematics; Professor of Physics; Professor of Mathematics; Head, GIDP in Applied Mathematics.
Nonlinear growth dynamics; Chaotic dynamical systems; Biomechanical models; Biomathematics.

Daoqin Tong, Ph.D. (Ohio State University), Assistant Professor of Geography & Regional Development.
Spatial statistics; Optimization; Geographic information systems (GIS).

Bruce Walsh, Ph.D. (University of Washington), Professor of Ecology & Evolutionary Biology; Professor of Public Health; Adjunct Professor of Animal Science; Adjunct Professor of Plant Science.
Biostatistics; Statistical genetics/genomics; Mixed models; Bayesian analysis; Resampling and MCMC methods.

Joseph C. Watkins, Ph.D. (University of Wisconsin), Professor of Mathematics.
Stochastic processes; Limit theorems; Statistical applications in the life sciences.

2. Affiliate Members

Affiliate Members of the GDIP in Statistics are those with a general interest in statistical issues who wish to be fully informed of the Program's operation, and who wish to engage in a limited subset of Program activities. Affiliate members often rotate to Regular status at pertinent intervals, and *vice versa*.

Ronald L. Breiger, Ph.D. (Harvard University), Professor of Sociology.
Statistical models for social network analysis; Log-linear models; Log-multiplicative models for contingency tables.

Emily A. Butler, Ph.D. (Stanford University), Assistant Professor of Family Studies & Human Development.
Multivariate time-series analysis; Multilevel modeling; Dyadic models; Social-relations modeling.

Noel A. Card, Ph.D. (St. John's University), Assistant Professor of Family Studies & Human Development.
Latent variable modeling; Structural equation modeling; Meta-analysis; Dyadic data analysis.

Andrew C. Comrie, Ph.D. (Pennsylvania State University), Professor of Geography & Regional Development; Associate Vice President for Research; Dean of the Graduate College and Director of Graduate Interdisciplinary Programs.
Statistics of climate data; Data reduction; Spatial modeling.

Sandy Dall'erba, Ph.D. (University of Pau, France), Assistant Professor of Geography & Regional Development.
Spatial statistics; Spatial econometrics.

Michael N. Evans, Ph.D. (Columbia University), Adjunct Associate Professor of Dendrochronology.
Paleoclimatology; Spatiotemporal data analysis; Forward and inverse modeling.

Jonah B. Gelbach, Ph.D. (Massachusetts Institute of Technology), Associate Professor of Economics.
Applied microeconometrics; Bootstrap-based inference; Public economics; Law and economics.

Gautam Gowrisankaran, Ph.D. (Yale University), Associate Professor of Economics.
Structural econometric modeling; Applied Bayesian econometrics; Estimation of dynamic models.

James T. (Jake) Harwood, Ph.D. (University of California at Santa Barbara), Professor of Communication.
Applied statistics in the social sciences; Hypothesis testing; Moderator and mediator effects.

Thomas G. (Tom) Kennedy, Ph.D. (University of Virginia), Professor of Mathematics; Professor of Physics; Interim Head, Department of Mathematics.
Monte Carlo simulations; Random walks.

Robert S. Maier, Ph.D. (Rutgers University), Professor of Mathematics.
Applied probability; Mathematical statistics; Limit laws and large deviation theory; Bioinformatics.

Joanna Masel, D.Phil. (Oxford University), Assistant Professor of Ecology & Evolutionary Biology. Stochastic processes; Bayesian learning models; Theoretical population genetics; Stochasticity in gene expression.

Brian J. McGill, Ph.D. (University of Arizona), Associate Professor of Natural Resources. Habitat models; Advanced regression & data mining; Spatial & temporal analysis; Philosophy of science and statistics.

David M. Meko, Ph.D. (University of Arizona), Associate Research Professor of Dendrochronology. Spectral analysis; ARMA modeling; Time series filtering; Regression.

Chris Segrin, Ph.D. (University of Wisconsin), Professor of Communication; Professor of Psychology; Professor of Family Studies; Head, Department of Communication. Meta-analysis; Longitudinal data analysis; Regression analysis; Dyadic data analysis.

Appendix 2. Independent Study Enrollment Form

Independent study via STAT 599 (1-3 units) is considered by the University as an *individual studies course*, and must be approved in advance with the responsible faculty member who has agreed to supervise the work. STAT 599 may be repeated for credit up to a maximum of 6 units. An Independent Study Proposal Form must be submitted to the GIDP Office. The form, reproduced below, allows students and instructors to document expectations for independent study or directed research credit. The form is also available [online](#) from the University, or from the GIDP office.



INDEPENDENT STUDY PROPOSAL FORM

Please complete this form and obtain signatures of approval BEFORE registering. Return the form to the main office of the department that is administering the independent study. This form is for department records and is used to assign a grade at the end of the semester. Some academic departments will register you for Independent Study. If not, you must complete a Registration/Change of Schedule Form and submit it to the Office of the Registrar, Administration Building, Room 210, to be officially enrolled. **Reminder: The last day to register for courses without a late charge in the Fall/Spring Semesters** is the 21st day of the semester; for **Winter/Summer Sessions** (to avoid a late charge) register by the day before the last day to drop with deletion from the record.

Student Name _____ Student ID # _____

Student Phone # _____ Student E-mail _____

Course Number (circle one) 199 199H 299 299H 399 399H 499 499H

599 699 799 Other _____

Number of Units _____ [Note: The University and Board of Regents have set a standard of 45 hours of course work for each unit of credit awarded.]

Semester _____ Year _____

Project Advisor _____

Department/Program _____ STAT _____

Title of Project _____

Estimated hours per week Student will spend on project _____

Estimated Project Advisor/Student contact hours per week _____

Brief description of project, including anticipated product: (attach additional page if necessary) _____

SIGNATURES:

Required:

STUDENT _____ DATE _____

PROJECT ADVISOR _____ DATE _____

Suggested:

DEGREE ADVISOR _____ DATE _____

DEPT. HEAD _____ DATE _____



GUIDELINES FOR INDEPENDENT STUDY

199, 299, 399, 499, 599, 699, 799* Independent Study:

(Credit varies) Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grades Available: S/P, C, D, E, I, W

199H, 299H, 399H, 499H Independent Study - Honors:

(Credit varies) Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grades Available: A, B C, D, E, I, W

* Graduate students doing independent work that cannot be classified as actual research will register for credit under course number 599, 699, or 799.

- **Determination of credit:** The University and Board of Regents require a minimum of 45 hours of course work for each unit of credit awarded.
- **The number of credits** of Independent Study must lie within the approved credit range listed in the catalog course description.
- **The registration fee** for Independent Study credit is calculated at the same rate as for other credit courses.
- **The student should have a specific proposal** in mind when requesting Independent Study.
- **The content** of an Independent Study course must not significantly duplicate material offered in a regularly scheduled course in the department in the current semester, except with the College Dean's approval.

- **The last day to register** for Independent Study without incurring a late charge is:
Fall and Spring Semesters: 21st calendar day after the first day of classes (last day to increase units without a late charge).
Winter and Summer Sessions: Day before the last day to drop with deletion from the record (last day to increase units without a late charge).
- **In the case that a grade of Incomplete is awarded** in an Independent Study course, and the Project Advisor is no longer available, another Project Advisor must be identified who agrees to evaluate the student's work.

Appendix 3. Material Covered in the Ph.D. Qualifying Examination

To proceed towards Ph.D. candidacy in the GIDP, a student must pass a written Ph.D. Qualifying Examination by the beginning of her/his fourth semester of study. The examination may be retaken only once. Offered during May and January of each year, the Qualifying Examination is used to assess the student's potential to successfully complete a Ph.D. dissertation in modern interdisciplinary statistics. It tests the student's ability to integrate material from the following core Ph.D. courses, and to use this knowledge in solving pertinent, challenging statistical problems commensurate with Ph.D. status at the level of these courses:

STAT 564/MATH 564 -- Theory of Probability (3 units)

Description: Probability spaces, random variables, weak law of large numbers, central limit theorem, various discrete and continuous probability distributions. Graduate-level requirements include more extensive problem sets or advanced projects.

STAT 566/MATH 566 -- Theory of Statistics (3 units)

Description: Sampling theory. Point estimation. Limiting distributions. Testing Hypotheses. Confidence intervals. Large sample methods. Graduate-level requirements include more extensive problem sets or advanced projects.

STAT 571A/MATH 571A -- Advanced Statistical Regression Analysis (3 units)

Description: Regression analysis including simple linear regression and multiple linear regression. Matrix formulation and analysis of variance for regression models. Residual analysis, transformations, regression diagnostics, multicollinearity, variable selection techniques, and response surfaces. Students will be expected to utilize standard statistical software packages for computational purposes.

STAT 571B/MATH 571B -- Design of Experiments (3 units)

Description: Principles of designing experiments. Randomization, block designs, factorial experiments, analysis of contrasts, multiple comparisons, analysis of variance and covariance, repeated measures, variance components analysis. Students will be expected to utilize standard statistical software packages for computational purposes.

--OR--

PSY 507C -- Research Design & Analysis of Variance (3 units)

Description: This course provides an overview of research design and statistical analysis with a special focus on Analysis of Variance. Various designs including between subjects, repeated measures, mixed, hierarchical and Latin Square designs are covered. Other topics addressed are contrasts among means and trends analysis.

Each specific Qualifying Examination is constructed and graded by a committee of GIDP faculty appointed annually by the GIDP Chair. Where possible, this will include the instructors of the pertinent core courses. A minimum of two examiners grade every question independently.

Appendix 4. Potential Ph.D. Minors

Possible Ph.D. Minors for students in the Statistics GIDP include the following. This list is *not* considered exhaustive, and students should study the Graduate College Catalog for other possible Minor areas that can meet their individual interdisciplinary interests.

Agricultural Resource Economics

The Ph.D. Minor in [Agricultural Resource Economics](#) (AREC) requires a total of 12 units in AREC courses.

Two of the following Core Courses are required (6 units total):

- Production Economics (AREC 504) [3 units]
- Consumption Economics and Price Analysis (AREC 513) [3 units]
- Introduction to Econometrics (ECON 518) [3 units]
- Applied Econometric Analysis (ECON 549) [3 units]

One of the two Core Courses must be either AREC 504 or AREC 513. The Ph.D. core courses ECON 501A, ECON 501B, and ECON 522A can be substituted for AREC 504, AREC513, and AREC 549, respectively.

Next, 6 units should be chosen from the following AREC Specialty Courses (and/or from the remaining core courses):

- Economic Policy in Developing Countries (AREC 521) [3 units]
- Cost-Benefit Analysis (AREC 514) [3 units]
- Operations Research in Applied Economics (AREC 515) [3 units]
- Agricultural Development (AREC 516) [3 units]
- Introductory Mathematical Statistics for Economists (AREC 517) [3 units]
- Financial Management for Agribusiness (AREC 550) [3 units]
- Advanced Applied Econometrics (AREC559) [4 units]
- Economics of Natural Resource Policy (AREC 575) [3 units]
- Advanced Natural Resource Economics (AREC576) [3 units]
- Advanced Topics in the Economics of Environmental Regulation (AREC 577) [3 units]
- Mathematics for Economists (AREC 580) [2 units]

In no case may a student receive credit for the Ph.D. Minor in Agricultural and Resource Economics based on coursework used to satisfy requirements for an M.S. degree in Agricultural and Resource Economics or an M.S. or Ph.D. degree in Statistics.

Anthropology

Doctoral students who elect a Minor in [Anthropology](#) must complete 12 hours of graduate coursework (15 hours for Medical Anthropology). Students interested in the Minor should consult with the Graduate Advisor in Anthropology to develop an appropriate plan of study.

Applied Mathematics

In order to receive an [Applied Mathematics](#) Minor, the student must take four (4) 500-level MATH courses (12 units) and maintain a better than 3.0 GPA for these classes. At least 3 of these units must be from the Applied Mathematics core sequence as listed below:

- MATH 527A, 527B: Principles of Analysis (3 credit hours per semester)
- MATH 575A, 575B: Numerical Analysis (3 credit hours per semester)
- MATH 583A, 583B: Principles & Methods in Applied Mathematics (3 credit hrs per semester)

The other MATH courses should not be cross-listed with a 400-level course. The complete course list chosen must be specified on the Minor [application form](#) and submitted for approval to the Applied Mathematics Office

in room 412 of the [Math building](#). By the student's Oral Comprehensive Exam, a signature is required from the Head of the Program in Applied Mathematics. At that time the GPA is verified. Once the Oral Comprehensive paperwork is submitted to the Graduate College, the minor will be officially listed on the student's transcript. A student may not receive credit for the Ph.D. Minor in Applied Mathematics based on coursework used to satisfy requirements for an M.S. or Ph.D. in Statistics, unless the course is required by both programs.

Atmospheric Sciences

Ph.D. students who wish to minor in [Atmospheric Sciences](#) must arrange with the Graduate Advisor in Atmospheric Sciences to select a 2-member Minor Committee. Coursework involves at least 12 units of atmospheric sciences (ATMO) at the 500 level or higher. Nine of these units, comprising the core courses, are to be selected from ATMO 541A/541B and ATMO 551A/551B. Students must complete a written Minor exam covering the same 3 core courses. The written examination may be waived by the student's Minor Committee if grades of A or B are obtained in the required 3 core courses.

Biomedical Engineering

The Ph.D. minor in [Biomedical Engineering](#) (BME) consists of 12 units of approved BME courses, including 9 units from BME 510, BME 511, BME 516 or BME 517, and in addition 3 units of BME 597 (not including BME 597X). The student's dissertation committee should contain two faculty members in the BME Program. The minor will be granted upon completion of these courses with a B average for the required units. A Minor Program of Study form must be completed and a signed copy filed with the BME Program Committee.

Biostatistics

The Ph.D. minor in [Biostatistics](#) consists of 12 units of approved courses, as follows: CPH 576C/CPH 576C, CPH 675/CPH 675, CPH 684/CPH 684, CPH 685/CPH 685, and CPH 686/CPH 686. A student may not receive credit for the Ph.D. Minor in Biostatistics based on coursework used to satisfy requirements for an M.S. or Ph.D. in Statistics, unless the course is required by both programs.

Computer Science

Doctoral students seeking a Minor in [Computer Science](#) (CSC) must apply for admission to the minor. The admission process is used to ensure that students are qualified to undertake graduate-level courses in Computer Science. Prospective Minors are required to have undergraduate preparation in computing necessary to attempt first-year graduate courses in the department. A well-prepared applicant should be proficient in a high-level programming language such as C or C++, and have a solid background in the following areas: (1) mathematics, including calculus and discrete mathematics; (2) machine architecture; (3) programming languages, including exposure to high-level languages (e.g., Java, LISP, Icon); (4) data structures; (5) algorithm analysis; (6) theory of computation; and (7) software systems, including compilers and operating systems. Applicants lacking preparation in one or two of these areas may qualify for the minor with the stipulation that they remedy these deficiencies, if such missing background would be prerequisite for courses in their proposed minor program. Deficiencies are normally remedied by auditing undergraduate courses in the department.

The student should consult the Ph.D. minor Faculty Advisor in Computer Science, Dr. [Bongki Moon](#), regarding admissions requirements and a proposed minor program of studies prior to enrolling in courses or applying to the minor. To begin the admission process, complete the form *PhD Minor Application for Admission/Qualification* ([PDF](#), also available in the Computer Science Department Academic Office).

Decisions on admission to the minor are made by the departmental Graduate Admissions Committee. A student who has been admitted and who has completed any deficiency courses designated by the Admissions Committee

is considered to have passed the minor Qualifying Examination in Computer Science, and the Qualifying Examination is waived.

Course Requirements for the Minor consist of 12 units of CSC courses, at least 9 of which must be from courses among the *Comprehensive Examination Core Topics* in systems (CSC 452, 552, 553 and 576), theory (CSC 473, 520, 545 and 573) and applications (CSC 522, 525, 533, and 560). The remaining 3 units are from unrestricted Computer Science electives. More advanced courses can be substituted for courses covering the Comprehensive Exam Core Topics, if the student is adequately prepared for examination in three of the core course areas tested in the Minor Written Comprehensive Exam (see below). The Graduate College permits at most six units of 400-level courses to be part of the degree program in the minor. A letter grade of A or B must be earned in all minor courses.

Minors participate in Computer Science graduate Qualifying, Comprehensive, and Final examinations. The Qualifying Examination in Computer Science is automatically waived provided a student has been admitted to the minor and has removed any admission deficiencies. The Comprehensive Examination has written and oral components in both the major and minor fields of study; it is taken when essentially all course work has been completed. The Minor Written Comprehensive Examination is given as a colloquium requirement (CSC 695B) to be taken during the last semester of minor coursework or the semester immediately following completion of the minor coursework. The student must attend five research colloquia held in the Department of Computer Science to successfully pass this class. CSC 695B must be completed prior to completion of the Oral Comprehensive Exam in both the minor and major subjects. Doctoral Minors are required to successfully answer questions based upon both core and elective courses in their minor program of study. The Oral Comprehensive Examination must take place within two regular terms following completion of the written prelims in the major and minor. It is administered by the student's doctoral committee, consisting of faculty from both the student's major and minor.

Economics

The Ph.D. Minor in [Economics](#) requires 15 units of study, via ECON 501A, ECON 501B, ECON 501C, ECON 520, and ECON 522A. Students must also pass the first year written qualifying examination administered by the Department of Economics faculty.

A student may not receive credit for the Ph.D. Minor in Economics based on coursework used to satisfy requirements for an M.S. or Ph.D. in Statistics, unless the course is required by both programs.

Educational Psychology

A student obtaining a minor in [Educational Psychology](#) (EDP) will take a set of four courses (with a maximum of 3 units allowed in either EDP 599 or EDP 699) as determined by the minor advisor, a tenured or tenure-track faculty member in the Department of Educational Psychology. The Graduate College requires a written examination in the 'subject' that is represented by the set of four courses prior to the student sitting for the Oral Comprehensive Examination, but there is no expectation that the minor advisor or any other from the faculty of the Department of Educational Psychology be a member of that oral examining committee.

There are several options for the written minor in EDP, and the advisor has the freedom to suggest an additional option that better fits a particular situation. The advisor will involve at least one additional department faculty member for assistance in asking questions and grading answers. Options include but are not limited to: (1) answering questions in a 4-hour session, (2) a take-home assignment to substitute for the above, (3) a paper discussing how the minor subject contributes to the student's major field. (Note that the subject of the minor does not need to be totally contained within EDP and thus testing over all the 'courses' taken in the subject is not required.)

Epidemiology

The Ph.D. minor in [Epidemiology](#) is designed for individuals who wish to obtain graduate training in Epidemiology. It requires completion of the first year Epidemiology and Biostatistics courses, 2 additional Epidemiology elective courses, 1 year of Epidemiology Seminar, and completion of the qualifying examination. For more information contact Ms. [Amy Glicken](#), Recruitment and Admissions Coordinator.

Finance

The Ph.D. Minor in [Finance](#) requires 12 units of study, as follows:

- Theory of Finance (FIN 600), *and either*
- Three additional Ph.D. courses, including FIN 602, FIN 695A, and FIN 696E, *or*
- Any two of FIN 602, FIN 695A, and FIN 696E, and one 500-level finance class. The 500-level class may be based on the student's interests, but is dependent on seating availability. The recommended option is FIN 542.

A minimum grade of B is required in all courses taken for the Minor. Students without any background in Finance are required to take FIN 510 before registering for any other Minor courses. Registration for FIN 510 is controlled by the Eller College MBA office; the student and the Department of Finance Graduate Coordinator must request prior approval from the MBA office for the student to register in FIN 510.

Genetics

Ph.D. students minoring in [Genetics](#) (GENE) are required to take 9-10 units as follows:

1. GENE 546/MCB 546, Advanced Genetics (4 units), *or*
PL S 528R, Microbial Genetics (3 units)
2. GENE 568/MCB 568, Nucleic Acids (4 units)
3. GENE 522, History of Genetics (2 units)

In addition, a weekly seminar series (GENE 670, Recent Advances in Genetics) can be used to complement the classroom learning experience. A student may not receive credit for the Ph.D. Minor in Genetics based on coursework used to satisfy requirements for an M.S. or Ph.D. in Statistics, unless the course is required by both programs.

Geography

Students who elect a Ph.D. minor in [Geography](#) must complete a minimum of 12 units of coursework in geography, including one core course (GEOG 500, GEOG 689, or an advanced methods course), with a maximum of 3 units of independent studies (GEOG 599 or GEOG 699). The course work must be pre-approved by the Geography Director of Graduate Studies. Students considering the Minor in geography should consult the Director of Graduate Studies and any potential committee members at an early date.

Global Change

The Ph.D. Minor in [Global Change](#) (GC) provides a broad environmental and earth system science perspective. The Minor requires five courses for a total of 13 units (B grade or better). Seven units come from a required list of core courses: GC 695G -- Global Change Toolkit (1 unit); GC 578 -- Global Change (3 units); and GC 597A -- Global Change Workshop (3 units). The remaining six units are selected from two of the [elective thematic areas](#) (one course per area) with approval of the PhD Minor Faculty member on the student's graduate committee.

Students who have previously taken one or more of the GC core classes to satisfy other Ph.D. requirements must consult a member of their Ph.D. Minor Faculty to identify appropriate substitute courses from the list of electives, and to receive formal approval from the minor representative(s). This arrangement is then formalized by a letter from the minor representative(s) to the GC Executive Committee. A student may not receive credit for the Ph.D. Minor in Global Change based on coursework used to satisfy requirements for an M.S. or Ph.D. in Statistics, unless the course is required by both programs.

Students should identify and contact two [GC faculty members](#) to serve as minor representatives on their preliminary examination and final dissertation defense committees. These faculty should be identified early in the student's program, so they can serve as resources during the student's studies.

Management Information Systems

The Ph.D. Minor in [Management Information Systems](#) (MIS) requires 12 units of MIS graduate courses (500-level or above) that will create a solid foundation in a particular area of MIS. At least two of the courses must be chosen from the following list:

- MIS 507B -- Data Communications
- MIS 531A -- Data Structures and Algorithms
- MIS 531B -- Data Structures and Database Management
- MIS 541A -- Information Systems Analysis and Design
- MIS 696D -- Models for Quantitative Analysis

Students interested in the Minor should contact an MIS faculty member and arrange to meet, in order to (i) obtain the member's approval to serve as the Minor advisor, (ii) use the member's expertise to help select appropriate graduate-level courses and make decisions regarding any additional requirements for the Minor (including the Minor Preliminary Exam in reference to any specific requirements of the GIDP in Statistics), and (iii) obtain the member's signature on the documents required by the GIDP in Statistics.

Mathematics

To minor in [Mathematics](#) a student is required to take four (4) approved graduate level MATH courses and complete a written examination which covers the content of those courses. For more information contact the Mathematics Department.

Optical Sciences

Doctoral students majoring in other disciplines may elect a minor in [Optical Sciences](#). Such students must complete, for the full minor, 12 units of course work with a grade of B or better in optical sciences. No more than 3 of these units may be cross-listed with the student's major department or program. For a split minor, 6 units of course work with a grade of B or better is required. In addition, students wishing to minor in Optical Sciences must complete the Written Comprehensive Exam, which is offered each semester.

Planetary Sciences

Graduate students may obtain credit for a minor in [Planetary Sciences](#) by achieving a grade-point average of 3.0 or higher in a minimum of 12 units of 500-level planetary sciences courses (up to 3 units of which may be independent study supervised by a planetary sciences faculty member). The proposed curriculum of each student must be approved by a minor committee established by the student in consultation with the department Graduate Admissions and Advising Committee, which will also designate a chair. The written comprehensive examination will consist of the final examinations or the equivalent in the individual courses.

Systems and Industrial Engineering

The Ph.D. minor in [Systems and Industrial Engineering](#) (SIE) consists of 12 units of regular SIE graduate [coursework](#). A minor that is split between SIE and another department requires 6 units of regular SIE course work. A student may not receive credit for the Ph.D. Minor in Systems and Industrial Engineering based on coursework used to satisfy requirements for an M.S. or Ph.D. in Statistics, unless the course is required by both programs.

In consultation with the student's advisor, the student forms a "minor" committee consisting of two SIE faculty members. These individuals assist the student and the major advisor in developing and coordinating the student's minor program of study consistent with her/his educational and career goals. The format of the written portion of the preliminary examination is at the discretion of the minor committee members.

Students intending to minor in SIE should contact the Chair of the SIE Graduate Studies Committee at the earliest possible date. Courses taken to satisfy the requirements for a PhD minor in SIE are subject to the approval of the SIE Graduate Studies Committee.

This handbook is dated: 2 November 2009