MATHEMATICS AND STATISTICS

MASTER OF SCIENCE IN MATHEMATICS

In the Department of Mathematics and Statistics, College of Science
www.csupomona.edu/~math

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There are four emphases for the Master of Science in Mathematics. The Pure Mathematics emphasis is for individuals whose principal interest is in pure mathematics. It is intended for students who are interested in further graduate study. The Applied Mathematics emphasis is intended for students who wish to learn the applications of mathematics, in particular with a goal of working in industry. This program is also appropriate for the individual seeking the community college teaching credential. The Statistics emphasis is for students interested in working in the statistics field. The Mathematics Education emphasis is intended for students interested in teaching at the secondary and post-secondary level, particularly those interested in mathematics education as a profession.

ADMISSION TO THE PROGRAM

An applicant for admission should have completed a baccalaureate degree program in mathematics comparable to that offered at this university or a baccalaureate degree in a related field with at least 20 quarter units of upper-division courses in mathematics. Students whose undergraduate degree is in a field other than mathematics will generally find it necessary to follow a program of additional preparation before undertaking graduate work in mathematics. Applicants for the Pure Mathematics emphasis must have course work which includes MAT 314, MAT 315, MAT 417, MAT 418 and MAT 428 (or their equivalent). Applicants for the Applied and Statistics emphases must have course work which includes MAT 314, MAT 315, MAT 417 and MAT 428 (or their equivalent). Work experience, as well as undergraduate course work, may be taken into account by the Graduate Committee for credit towards the admission of an applicant.

An upper-division grade point average of at least 3.0 is required for admission as an unconditional graduate student in mathematics. Each applicant will be considered by the departmental graduate committee and recommended for admission on the basis of all evidence applicable to the student's admission. An applicant not meeting the minimum standards of the department may be admitted as a conditional student, if space is available. The student must comply with the conditions of admittance within the time stipulated.

Student Program

The student's program will be based upon his/her undergraduate preparation, current interests in mathematics, occupational and professional goals. During the first quarter of residence, each unconditional graduate student will prepare a contract in consultation with the graduate coordinator. This will define all courses and requirements which the student must fulfill to earn the degree. Once approved by the College of Science and verified by the Graduate Studies Office, the study list may be amended only by petition, as outlined in the appropriate sections of this catalog.

Advancement to Candidacy

Advancement to candidacy is required of all students who register for MAT 696 (thesis) or 697 (comprehensive exam). In order to advance to candidacy, a student must:

1. Have an overall GPA of at least B (3.0);
2. Satisfy the GWT requirement;
3. Satisfy all requirements stipulated by the graduate coordinator at the time of admission;
4. Have a contract approved by the graduate coordinator and the Associate Vice President for Graduate Studies;
5. Complete at least 6 courses which appear on the student's contract, 4 of which must be at the 500 level; and
6. Have at least a B (3.0) average on contract courses taken.

REQUIREMENTS

1. Pure Mathematics Emphasis: Either a thesis (three units) and directed readings (two units), or a comprehensive exam (one unit) is required. Those students who take the comprehensive exam must complete at least 45 units of acceptable graduate work in the master's degree program. At least 36 of these units shall be in courses at the graduate level. Those students who write a thesis must complete at least 45 units (which includes the five units of thesis and directed reading) of acceptable graduate work in the master's degree program. At least 33 of these units shall be in courses at the graduate level.
2. Applied Mathematics Emphasis: At least 45 units of acceptable graduate work must be completed in the master's degree program. At least 33 of these units shall be in courses at the graduate level. A thesis (three units) and directed readings (two units) are required.
3. Statistics Emphasis: At least 45 units of acceptable graduate work must be completed in the master's degree program. At least 33 of these units shall be in courses at the graduate level. A thesis (three units) and directed readings (two units) are required.
4. Mathematics Education Emphasis: At least 45 units of acceptable graduate work must be completed in the master's degree program. At least 33 of these units shall be courses at the graduate level. A thesis (3 units) and directed readings (2 units) are required.
5. No more than 13 units of acceptable graduate credit may be transferred from another graduate institution. No more than 13 units taken through Extended University (400- level only) may be used on a contract. No more than 13 units of acceptable graduate credit may be petitioned by an undergraduate student. A total limit of 13 transfer, Extended University, or units petitioned for graduate credit may be included on a master's contract. The stipulated time limit of 7 years applies to all of the above.
6. A grade-point average of at least 3.0 shall be maintained in all course work taken to satisfy the degree requirements, as well as in all courses taken at Cal Poly Pomona postbaccalaureate which number 300 or more.
7. The candidate must be enrolled in the university during the quarter of graduation.

Curriculum for Pure Mathematics

The student is required to complete six of the following seven courses: MAT 511, MAT 512, MAT 517, MAT 518, MAT 521, MAT 528, MAT 529. In addition, either a thesis or comprehensive examination is required.

Electives can be graduate or senior level mathematics courses other than MAT 417, MAT 418, MAT 428, MAT 429, and MAT 400 or MAT 499 by petition.

Curriculum for Applied Mathematics

Required courses are MAT 508, 511, 512, 545 and the completion of two courses from each of the following three categories: Category I: MAT 509, MAT 546, MAT 540. Category II: MAT 480, MAT 570, MAT 580. Category III: STA 430, STA 432, STA 530, STA 584, STA 533, STA 534.

Curriculum for Statistics

Required courses are MAT 511, STA 590, and MAT 512 or MAT 508. The student is required to take at least two courses from Category I, at least two courses from Category II, and a minimum of seven courses from all three of Categories I, II, and III. Category I: STA 432, STA 435, STA 533, STA 534, STA 560. Category II: STA 425, STA 430, STA 525, STA 530, MAT 540, STA 584. Category III: STA 440, STA 441, MAT 545, MAT 546, STA 565. In addition, a thesis is required. Electives can be graduate or senior level courses other than MAT 417, MAT 418, MAT 428, and MAT 400 or MAT 499.

Curriculum for Mathematics Education

The student is required to complete the following courses: MAE 590, MAE 591, MAE 593, MAT 511, MAT 517, and MAT 512 OR MAT 518. Also, one of the following courses must be selected: MAE 550, MAE 592, MAE 560, MAT 535. In addition, three of the following courses must be selected with at least one 500 level course from each category. Category I: MAT 512 (if not taken to satisfy the previous requirement), MAT 518 (if not taken to satisfy the previous requirement), MAT 521, MAT 528, MAT 413, MAT 415, MAT 416, MAT 419, MAT 420. Category II: MAT 540, MAT 545, MAT 570, MAT 580, STA 530, STA 533, MAT 401, MAT 431, MAT 470. Finally, a thesis is required.

GRADUATE COURSE DESCRIPTIONS

MAE 560 Problem Solving as a Mathematical Endeavor (4) (even years)

Heuristics and strategies to solve mathematical problems, impact of technology in solving problems and in teaching problem solving, reformulation of problems and problem posing techniques, presentation of outcomes. Introduction to mathematical problem solving literature. 4 lecture/problem. Prerequisite: C or better in MAT 511 or MAT 517.

MAE 590 Acquiring Mathematical Knowledge: Cognitive Dimension (4) F (odd years)

Theoretical foundations of cognitive aspects of mathematics learning including knowledge acquisition construction of knowledge, thinking processes, and forms of communication. Trends in cognitive development and learning strategies. Critical examination of the current research literature concerning cognitive issues related to mathematics education. 4 lectures/problem-solving. Prerequisite: Consent of instructor

MAE 591 Acquiring Mathematical Knowledge: Non-cognitive Dimension (4) W (odd years)

Theoretical foundations of non-cognitive aspects of mathematics learning including personal, classroom, public issues affecting mathematics learning. Incorporation of non-cognitive components into instructional decisions. Critical examination of the current research literature related to issues and policies in mathematics education. 4 lectures/problem-solving. Prerequisites: Consent of instructor, C or better in MAT 590.

MAE 592 Technology in Mathematics Education (4) F (even years)

A study of various technology tools for teaching mathematics. An examination of criteria for evaluation of technical tools, methods of incorporating technology into educational practices, and educational as well as sociopolitical issues related to the use of technology in mathematics education. 4 lectures/problem-solving. Prerequisite: C or better in MAT 492

MAE 593 Research Methods in Mathematics Education (4) Sp (odd years)

Quantitative and qualitative methods of research in mathematics education. An introduction to the research literature. Issues such as analysis of protocols, problems of measurement in evaluation of learning. 4 lectures/problem. Prerequisite: C or better in MAE 590 or consent of instructor.

MAE 594 Topics for Math Educators(4)

Topics related to purpose, method, and scope of assessment in the mathematics education classroom, and to method of instructional design in secondary and post-secondary settings. Exploration of the relationship between assessment and instructional design. 4 lectures/problem-solving. Prerequisite: consent of instructor.

MAE 599/A/L Special Topics in Mathematics Education (4) (odd years)

Group study of a selected topic, the title to be specified in advance. Total credit limited to 8 units with a maximum of 4 units per quarter. Lecture/activity/laboratory or combination of these. Prerequisite: consent of instructor.

MAT 508 Numerical Linear Algebra (4) W (even years)

Topics will include numerical methods for determinants, systems of linear equations (direct and iterative methods), matrix inversions, eigenvalues, eigenvectors, techniques to minimize error propagation, splittings, rate of convergence of methods. 4 lectures/problem-solving. Prerequisites: a grade of C or better in MAT 208, MAT 315 and MAT 401 or consent of instructor.

MAT 509 Error Analysis (4) Sp (even years)

Topics will include sources of error, types of error, error propagation, techniques for minimizing error, backward error analysis, approximation of functions, error analysis of iterative methods for non-linear equations. 4 lectures/problem-solving. Prerequisites: a grade of C or better in MAT 401 and 402 or consent of instructor.

MAT 511, 512 Real Analysis (4) (4) F, W

Properties of Lebesgue measure and integration, Borel Sets, monotone functions and functions of bounded variation, classical Banach spaces, metric spaces, measure spaces and measurable functions, the Radon-Nikodym theorem, the Fubini theorems, Daniel integrals, applications. 4 lecture/discussions. Prerequisite: a grade of C or better in MAT 315 or consent of instructor.

MAT 517, 518 Abstract Algebra (4) (4) W, Sp (odd years)

Groups, Sylow theorems, rings and modules, chain conditions, morphism theorems, principal ideal domains, field extensions and finite fields, Galois theory. 4 lecture/discussions. Prerequisite: a grade of C or better in MAT 418 or consent of instructor.

MAT 521 Topology (4) F (even years)

Topological spaces, connectedness, compactness, continuity, separation and countability axioms, metric spaces, product spaces, function spaces and quotient spaces, uniform spaces, paracompactness. 4 lecture discussions. Prerequisite: consent of instructor.

MAT 528, 529 Complex analysis (4) (4) F (odd years) W (even years)

General form of Cauchy's theorem, conformal mappings, normal families.

Riemann mapping theorem, theorems of Mittag-Leffler and Weierstrass, analytic continuation. Picard's theorem. Selected topics such as Dirichlet's problem, generalization of Picard's theorem, gamma and zeta functions. 4 lecture/discussions. Prerequisite: MAT 314 or 428 or consent of instructor.

MAT 535 History of Mathematics (4)

Historical development of selected mathematical topics drawn generally from the body of 18th century and later mathematics. Topics to be covered announced by the professor prior to registration. 4 lecture discussions. Prerequisite: consent of instructor.

MAT 540 Kalman Filter (4) F (odd years)

Discrete- and continuous-time Kalman Filter. Design, simulation, and implementation; the extended Kalman Filter. Applications to radar, tracking, communication networks, space navigation, social and environmental systems. 4 lectures/problem-solving. Prerequisites: CS 128 or CS 125, MAT 208, MAT 216, STA 241 or STA 326 or consent of instructor.

MAT 545, 546 Modeling (4) (4) W, Sp (odd years)

Modeling of deterministic systems and random processes using ordinary and partial differential equations. Fourier methods, general modeling principles and techniques, perturbation theory and sensitivity analysis, applications. 4 lectures/problem-solving. Prerequisite: consent of instructor.

MAT 550 Seminar in Mathematics (1–4)

Topics in advanced mathematics chosen according to the interests and needs of the students enrolled. Each seminar will have a subtitle according to the nature of the content. May be repeated for a maximum of 8 units. 1-4 seminars. Prerequisite: consent of instructor.

MAT 570 Graphs and Network Flows (4) Sp (even years)

Matching theory in graphs and network flows in capacity-constrained networks. Major topics include the Konig-Egervary Theorem for bipartite graphs and the Maximal Flow Algorithm for networks, along with a wide variety of applications. 4 lectures/problem-solving. Prerequisite: MAT 370 or consent of the instructor.

MAT 580 Optimization Theory and Applications (4) F (odd years)

Topics will include convex sets, extrema of functions, convex functions, non-linear convex, quadratic and dynamic programming, applications, primal-dual methods for solving constrained problems, applications to large scale mathematical programming problems. 4 lectures/problem-solving. Prerequisite: a grade of C or better in MAT 480 or consent of instructor.

MAT 599/599A/599L Special Topics for Graduate Students (1–4)

Group study of a selected topic, the title to be specified in advance. Total credit limited to 8 units with a maximum of 4 units per quarter. Lecture/Activity/Laboratory/or combination of these. Prerequisite: consent of Instructor.

MAT 691 Directed Study (1)

Individual reading program in an area chosen by the student under the direction and supervision of the faculty. Students must obtain the written permission of the graduate coordinator in order to register for this course. Unconditional standing required. May be repeated for credit, with a maximum of 4 units applied to degree.

MAT 696 Master's Degree Thesis (1)

Independent research and study under supervision of a faculty advisor. Research results must be reported in an acceptable form. Students must obtain the written permission of the graduate coordinator in order to register for this course. Advancement to Candidacy required. May be repeated for credit, with a maximum of 3 units applied to degree.

MAT 697 Comprehensive Examination (1) Credit/no Credit

Preparation for the comprehensive examination. Students must obtain the written permission of the graduate coordinator in order to register for this course. May be taken no more than twice. Failure to complete exam satisfactorily the second time will result in termination from the program. Only applicable with Pure Math subplan. Advancement to Candidacy required.

MAT 699 Master's Degree Continuation (0)

Enrollment in this course allows candidates that have enrolled in the maximum number of thesis or project units to maintain resident status in order to receive university services. Approval of graduate coordinator is required to register for this class. Advancement to candidacy is required. Mandatory credit/no credit grading basis.

STA 525 Time Series Analysis (4) F (odd year)

Stationary and non-stationary models. Autocorrelation and partial autocorrelation functions. Autoregressive (AR), Moving Average (MA), Autoregressive moving average (ARMA), and Autoregressive integrated moving average (ARIMA) models. Models for seasonal time series. Identification, estimation, diagnostic checking and forecasting. Use of computer package such as SAS or MINITAB. 4 lectures/problem-solving. Prerequisites: C or better in STA 341 or STA 326 or consent or instructor.

STA 530 Random Processes (4) Sp (odd years)

Topics will include second order stationary processes, mean and covariance properties, Gaussian processes, Wiener process and white noise, counting and renewal processes. 4 lectures/problem-solving. Prerequisite: a grade of C or better in STA 241 or STA 326 or consent of instructor.

STA 533 Linear Statistical Models I (4) W (even years)

Introduction to general linear models, distribution of quadratic forms, the Gauss-Markov theorem, estimation, testing the general linear hypothesis. Computer package SAS will be used. 4 lectures/problem-solving. Prerequisite: C or better in STA 432 or consent of instructor.

STA 534 Linear Statistical Models II (4) Sp (even years)

Fixed and random components models, balanced and unbalanced cases, analysis of covariance, components of variance. Computer package SAS will be used. 4 lectures/problem-solving. Prerequisite: C or better in STA 533 or consent of instructor.

STA 560 Advanced Experimental Designs (4)

Incomplete block designs, fractional factorial designs, multifactor experiments with randomization restrictions, response surface methods and designs. 4 lectures/problem-solving. Prerequisite: STA 435 or consent of instructor.

STA 565 Multivariate Analysis (4) W (odd year)

Multivariate distribution. Variance-covariance matrices. Multivariate Normal distribution, Hotelling's T2 distribution. Inference about a mean vector. Discriminant analysis, Principal components, Factor analysis and Clustering. Use of computer package such as SAS or MINITAB. 4

lectures/problem-solving. Prerequisites: C or better in STA 341 or STA 326, and MAT 208 or consent of instructor.

STA 584 Queueing Theory (4) F (even years)

Analysis of queueing systems, discrete and continuous time Markov processes, birth and death processes, equilibrium results for single and multiple server queues, method of stages, priority queues. 4 lectures/problem-solving. Prerequisites: a grade of C or better in STA 430, and STA 341 or STA 441, or consent of instructor.

STA 590 Supervised Statistical Consulting (2)

Use of Statistical Computer Packages and Spreadsheets, Formulation of Statistical/Probabilistic Models, Planning of surveys and experiments, data analysis, report writing and presentation, oral communication with clients, role-playing and group discussions. 2 lecture/problem-solving. Prerequisites: C or better in STA 432 or STA 435 or consent of instructor. May be repeated for a maximum of 4 units of credit.

STA 599/599A/599L Special Topics for Graduate Students (1–4)

Group study of a selected topic, the title to be specified in advance. Total credit limited to 8 units with a maximum of 4 units per quarter. Lecture/Activity/Laboratory or combination of these. Prerequisite: consent of Instructor.