DEPARTMENT OF MATHEMATICS AND STATISTICS

Dr. Shane Redmond, Chair
Dr. Jeff Neugebauer, Graduate Coordinator
www.math.eku.edu (http://www.math.eku.edu)
(859) 622-5942

The Department of Mathematics and Statistics offers the Master of Arts degree in Applied Mathematics. The student may elect courses from mathematics or statistics to fulfill the degree requirements.

Master's

- Applied Mathematics, Master of Arts with a Concentration in Applied Mathematics and Statistics (M.A.) (http://catalogs.eku.edu/graduate/science-technology-engineering-mathematics/mathematics-statistics/applied-mathematics-concentration-statistics-ma/)
- Applied Mathematics, Master of Arts with a Concentration in Data Science (M.A.) (http://catalogs.eku.edu/graduate/science-technology-engineering-mathematics/mathematics-statistics/applied-mathematics-concentration-data-science-ma/)
- Applied Mathematics, Master of Arts with a Concentration in Secondary Mathematics (M.A.) (http://catalogs.eku.edu/graduate/science-technology-engineering-mathematics/mathematics-statistics/applied-mathematics-concentration-secondary-ma/)

Courses

Mathematics

MAT 701. Applicat of Math for P-9. (3 Credits)
A. Topics in the application of mathematical models appropriate for teachers of grades P-9.

MAT 702. Geo with Tech for P-9 Teachers. (3 Credits)
A. Topics in geometry appropriate for teachers of grades P-9.

MAT 705. Foundations of Math. (3 Credits)
A. The nature of mathematical thought; logical systems, axiomatic concepts and methods; consideration of the work of Hilbert, Peano, Whitehead, Russell, and others. It is strongly recommended that students have completed an abstract algebra course.

MAT 706. Number Theory. (3 Credits)
A. Fundamental properties of integers, linear Diophantine equations, linear and quadratic congruences, famous problems of number theory. It is strongly recommended that students have completed a course requiring proof-writing skills.

MAT 707. Seminar in Mathematics:_____. (1-3 Credits)
A. Topics vary with offering. May be retaken with advisor approval, provided the topics are different. Credit towards degree requirements will depend on the course content.

MAT 720. Mathematical Statistics I. (3 Credits)
I. Cross-listed as STA 720. Descriptive statistics, discrete and continuous probability distributions for one and two variables, functions of random variables, sampling distributions, expectations and generating functions. Credit will not be awarded to students who have credit for STA 720. It is strongly recommended that students have completed eight hours of calculus.

MAT 725. Vector Analysis with Applicati. (3 Credits)
A. Algebra and geometry of vectors; vector functions of a single variable; line, surface, and volume integrals; divergence Theorem, Stokes¿ Theorem, Green¿s Theorem; generalized orthogonal coordinates; Fourier Series; solutions to boundary value problems. It is strongly recommended that students have completed twelve hours of calculus.

MAT 727. Cryptology. (3 Credits)
(3) A. Classical cryptosystems, basic number theory, DES, Advanced Encryption Standard, RSA, discrete logs, digital signatures, elliptic curve cryptosystem, lattice methods. It is strongly recommended that students have completed a course in proof writing.

MAT 735. Principles of Geometry. (3 Credits)
A. Two- and three-dimentional analytical Euclidean geometry, alternative geometries, hyperbolic, Riemannian, taxicab, and affine. It is strongly recommended that students have completed a geometry course and a linear algebra course.

MAT 740. Applic of Partial Diff Equatio. (3 Credits)
A. Wave, heat/diffusion and potential/Laplace equations, seperation of variables, orthogonal sets of functions. Fourier series, boundry value problems, Fourier integrals, maximum principles, the Cauchy problem. It is strongly recommended that students have completed a course in differential equations.

MAT 750. Appl of Complex Analysis. (3 Credits)
A. Continuity, differentiation, integration, series, residues, and applications to the evaluation of real integrals. Applications of conformal mappings to boundary value problems in heat, electrostatic potential, and fluid flow. Emphasis throughout on computational techniques and applications. Credit will not be awarded to students who have credit for MAT 850. It is strongly recommended that students have completed twelve hours of calculus or eight hours of calculus plus a differential equations course.

MAT 755. Graph Theory. (3 Credits)
A. Introduction to the theory and applications of graph theory. Topics will include trees, planarity, connectivity, flows, matching and coloring. It is strongly recommended that students have completed a course in abstract algebra or discrete structures.

MAT 760. Point Set Topology. (3 Credits)
A. An introduction to topology with emphasis on Euclidean and other metric spaces. Mappings, connectivity, compactness, formation of new spaces, relationship to analysis. It is strongly recommended that students have completed a course requiring proof-writing skills.

MAT 765. Math of Structural Bioinformat. (3 Credits)
(3) A. Mathematical and computational approaches to analyze and understand macromolecular structure data. Methods for protein structure determination, refinement, evaluation, comparison, and visualization. Protein surface representation and shape comparison. Structure databases.It is strongly recommended that students have completed courses in linear algebra and multivariable calculus and have experience in computer programming.

MAT 777. Intro to Alg Coding Theory. (3 Credits)
(3) A. Prerequisites: Senior standing; MAT 301, or both MAT 214 and departmental approval. Introduction to basic concepts of coding theory, linear codes, perfect codes, cyclic codes, BCH codes, and Reed Solomon codes. Additional topics as time permits. It is strongly recommended that students have completed a course in linear algebra and a course in proof writing.

MAT 803. Number/Geometric Con/P-5 Tchrs. (3 Credits)
A. Prerequisite: admission to the MAT program or departmental approval. Numeric and geometric concepts; problem solving with numbers, geometry, and data; reasoning; and connections. Credit does not apply toward the M.S. degree offered within this department. Credit will not be awarded to students who have credit for MAT 202.

MAT 806. Advanced Number Theory. (3 Credits)
A. Basic concepts from analytic and algebraic number theory including the Prime Number Theorem, Dirichlet¿s Theorem, the Riemann Hypothesis, algebraic integers, ideals and factorization in algebraic number fields. Additional topics as time permits. It is strongly recommended that students have completed courses in number theory, abstract algebra, and real analysis or differential equations.

MAT 809. Modern Algebra. (3 Credits)
A. Study of groups, including the fundamental isomorphism theorems. Sylow Theorems, and finitely generated abelian groups. It is strongly recommended that students have completed an abstract algebra course.

MAT 810. Modern Algebra. (3 Credits)
A. STudy of rings, integral domains, unique factorization domains, modules, vector spaces, fields and field extensions, including Galois theory. It is strongly recommended that students have completed and abstract algebra course.

MAT 815. Real Analysis. (3 Credits)
A. Further study of the concepts introduced in MAT 315. Theconvergence theorems, Lebesgue measure and measurable functions, the Lebesgue integral, Fourier series, allied topics. It is strongly recommended that students have completed a real analysis course.

MAT 839. Co-op or Appl Lrn: Mathematics. (0.5-3 Credits)
A. Prerequisite: departmental approval. May be retaken with approval to a maximum of three credits. Employment with faculty and field supervision in an area related to the student¿s academic interests. A minimum of eighty hours of employment is required for each academic credit.

MAT 850. Complex Analysis. (3 Credits)
A. The topology of the extended complex plane. The theory of analytic and meromorphic functions including integration, Taylor and Laurent series, Cauchy Integral and Residue Theorems, Argument Principles, Rouche¿s Theorem, Maximum Modulus Theorems, conformal mappings. It is strongly recommended that students have completed a real analysis course.

MAT 853. Ordinary Differential Equation. (3 Credits)
(3) A. Uniqueness and existence of solutions of initial value problems, maximal intervals of existence, continuous dependence, disconjugacy of boundary value problems, Cauchy functions, Green's functions, and fixed point theory. Additional topics as time permits. It is strongly recommended that students have completed a course in analysis.

MAT 856. Applied Mathematics. (3 Credits)
A. Dynamical systems, linear and nonlinear systems theory, transform methods, integral equations, control theory and optimization, calculus of variations, eigenvalue problems, stability theory, bifurcation. It is strongly recommended that students have completed a course in differential equations.

MAT 865. Applied Linear Algebra. (3 Credits)
(3) A. Vector spaces, LU decomposition, singular value decomposition, orthogonality, and related theory, with applications to least squares, Markov chains, combinatorics, differential equations, and other topics. It is strongly recommended that students have completed a course in linear algebra.

MAT 866. Combinatorial Optimization. (3 Credits)
(3) A. Combinatorial optimization, linear programming, flow and matching theory, traveling salesman problem, and related topics. It is strongly recommended that students have completed a linear algebra course.

MAT 871. Numerical Analysis. (3 Credits)
A. Computer arithmetic. Analysis of errors and stability of well-posed problems. LaGrange, Hermite and spline interpolation. Newton-Cotes, Romberg, and Gaussian quadrature. Consistency, convergence, and stability of numerical integration methods for ordinary initial value problems. Finite difference and shooting methods for two-point boundary value problems. It is strongly recommended that students have completed a real analysis course and have experience with a programming language.

MAT 880. Seminar in:_____. (1-3 Credits)
A. Advanced topics in Mathematics. May be retaken to a maximum of six hours, provided the topics are different. Credit towards degree requirements will depend on the course content.

MAT 890. Independent Study in:_____. (1-3 Credits)
A. Prerequisites: An 800-level course and departmental approval. Independent study on a problem chosen by the student and instructor. Student must have the independent study proposal form approved by faculty supervisor and department chair prior to enrollment. May be retaken to a maximum of nine hours, provided the topics are different.

MAT 898. Applied Mathematics Capstone. (3 Credits)
(3) A. Prerequisite: completion of at least 15 hours toward the M.A. in Applied Mathematics degree. Preparation for mathematical and statistical study. Guided one-on-one study of a mathematical or statistical concept. Use of mathematical typesetting software, presentation software, and research databases.

MAT 899. Thesis in _____. (1-6 Credits)
A.

Math Education

MAE 701. Applicat of Math for P-9. (3 Credits)
A. Topics in the application of mathematical models appropriate for teachers of grades P-9.

MAE 702. Geo with Tech for P-9 Teachers. (3 Credits)
A. Topics in geometry appropriate for teachers of grades P-9.

MAE 704. Tech for Teaching & Research. (3 Credits)
(3) A. Technology for mathematical and statistical teaching and research. Exploration of mathematical and statistical concepts through the use of computer algebra systems, statistical software, geometry software, programming languages, and related technologies.

MAE 707. Seminar in Math Edu:_____. (1-3 Credits)
(1-3) A. Topics vary with offering. May be retaken to a maximum number of nine hours, with advisor approval, provided the topics are different. Credit towards degree requirements will depend on the course content.

MAE 750. Teach Math in Sec School. (3 Credits)
I. Cross-listed as ESE 750. Developmentally appropriate materials and methods for teaching mathematics and computer science in secondary schools. Minimum of 96 field/clinical hours. Credit will not be awarded to students who have credit for ESE 750.

MAE 843. Mathematics Intervention Strat. (3 Credits)
A. Cross-listed as EME 843. In-depth analysis of teaching resources, teaching strategies, and appropriate mathematics curriculum content for intervention. Credit will not be awarded to students who have credit for EME 843.

MAE 850. Trends in Teaching Sec Math. (3 Credits)
A. Cross-listed as ESE 850. Examination of curricular trends, modern programs, appropriate strategies, and innovative materials in secondary mathematics. Credit will not be awarded to students who have credit for ESE 850.

MAE 870. HLM in Educational Research. (3 Credits)
Hierarchical data structures, fixed effects, random effects, hierarchical linear models, null model, partition of variance, intraclass correlation, random intercept models, random coefficient models, growth models, repeated measures, educational research, and use of statistical software. It is strongly recommended that students have completed a course in applied statistics.

MAE 872. Mathematics in the Curriculum. (3 Credits)
A. Exploration of trends, concepts, and issues involved in modern mathematics programs. Research findings are examined and multisensory materials are presented.

MAE 880. Seminar in: _____. (1-3 Credits)
Advanced topics in mathematics education. Topics vary with offering. Credit towards degree requirements will depend on the course content. May be retaken to a maximum of nine hours, provided the topic is different.

MAE 890. Independent Study in:_____. (1-3 Credits)
Prerequisites: An 800-Level course and departmental approval. Studnet must have the independent study proposal approved by faculty supervisor, department graduate committee, and deparmtnet chair prior to enrollment. Independent sutdy on a topic chosen by the student and instructor. May be retaken to a maximum of six hours, provided the topics are different.

Statistics

STA 707. Seminar in Statistics:_____. (1-3 Credits)
A. Topics vary with offering. May be retaken with advisor approval, provided the topics are different. Credit towards degree requirements will depend on the course content.

STA 720. Mathematical Statistics I. (3 Credits)
A. Cross-listed as MAT 720. Descriptive statistics, discrete and continuous probability distributions for one and two variables, functions of random variables, sampling distributions, expectations and generating functions. Credit will not be awarded to students who have credit for MAT 720. It is strongly recommended that students have completed eight hours of calculus.

STA 721. Mathematical Statistics II. (3 Credits)
heA. Prerequisite: MAT 520, 720, STA 520 or STA 720. A continuation of STA 720. Estimation theory, hypothesis testing, linear regression, analysis of variance, and allied topics. It is strongly recommended that students have completed a course in linear algebra.

STA 770. Quality Control & Reliability. (3 Credits)
(3) A. Analysis of six sigma techniques, statistical analysis of process capability, statistical process control using control charts, quality improvement, acceptance sampling, and an introduction to product reliability. It is strongly recommended that students have completed a course in calculus and STA 700, 721, or two courses in applied statistics.

STA 775. Statistics Methods Using SAS. (3 Credits)
(3) A. Data set manipulation, application of statistical techniques in SAS, and statistical programming. It is strongly recommended that students have completed a course in applied statistics.

STA 780. R and Introductory Data Mining. (3 Credits)
A. Cross-listed as DSC 780. Data set manipulation, application, of statistical techniques in R, statistical programming, and data mining skills. It is strongly recommended that students have completed a course in applied statistics and an introductory course in computer programming. Credit will not be awarded to students who have credit for DSC 780.

STA 785. Experimental Design. (3 Credits)
A. Completely randomized designs, factorial experiments, multiple comparisons, model diagnosis, randomized blocks, Latin squares, fixed and random models,nested-factorial experiments, 2f factorial experiments, and split-plot designs. Emphasis on applications and use of statistical software. It is strongly recommended that students have completed a course in applied statistics.

STA 800. Applied Statistical Inference. (3 Credits)
A. Data collection, descriptive statistics, basic probability, confidence intervals, hypothesis testing, linear regression, chi-square tests, analysis of variance, and use of statistical software. Credit does not apply toward the Concentration in Applied Mathematics and Statistics or the Concentration in Data Science and Statistics under the M.A. in Applied Mathematics. Credit will not be awarded for STA 700 and STA 800.

STA 835. Linear Models. (3 Credits)
(3) A. Prerequisite: Use of matrix algebra to develop theory of linear models. General linear models, estimability, multivariate normal distribution, estimation, testing, prediction, restricted models, models with general covariance structure, reparameterization, multi-part model, and random and mixed models. It is strongly recommended that students have completed a course in applied statistics and a course in linear algebra.

STA 839. Co-op or Appl. Lrn: Statistics. (0.5-3 Credits)
A. Prerequisite: departmental approval. May be retaken with approval to a maximum of three credits. Employment with faculty and field supervision in an area related to the student's academic interests. A minimum of eighty hours of employment is required for each academic credit.

STA 840. App Multi Statistical Analysis. (3 Credits)
(3) A. Prerequisite: Analysis of variance and simple linear regression review, multiple linear regression, multivariate analysis of variance, multivariate analysis of covariance, repeated measures ANOVA, discriminant analysis, factor analysis, principal component analysis, and use of statistical software. It is strongly recommended that students have completed courses in applied statistics.

STA 880. Seminar in:_____. (1-3 Credits)
A. Advanced topics in Statistics. May be retaken to a maximum of six hours provided the topics are different. Credit towards degree requirements will depend on the course content.

STA 890. Independent Study in _____. (1-3 Credits)
A. Prerequisite: departmental approval. Independent study on a problem chosen by the student and instructor. Student must have the independent study proposal form and course syllabus approved by faculty supervisor and department chair prior to enrollment. May be retaken to a maximum of nine hours, provided the topics are different.