Fall 2012

Advising Newsletter
Department of Mathematics and Statistics

Dear Majors and Minors in the Department of Mathematics and Statistics,

Registration for Spring 2013 classes will take place November 6-16th and advising will begin shortly. Your advisors should be contacting you to arrange a time to meet to discuss your academic plans, progress, and future goals. You may also reach out to your advisor to schedule an appointment. Please discuss specific individual questions with your advisor when you meet. But as there have been a number of changes in the Department this year, we wanted to send out a general informational announcement.

1. *Advising Holds for First-Semester Students*. Beginning this fall, the Department is placing advising holds for all entering first-year students and entering transfer students. First-year and transfer students will need to meet their academic advisor for advising before the hold is lifted. *If you do not meet with your advisor, you will not be able to register for classes.* After meeting with your advisor, the advisor will lift the hold and you will be able to register for classes. The Department has implemented this policy because students who meet with their advisors and get good advising are more successful in college.

2. *Waiting Lists.* This fall, the Department will again have a waiting list for all closed classes. If a class is closed, you should fill out the Google form -- found at the link on our web site, or at http://tinyurl.com/TCNJWaitList -- to be placed on the wait list. As students change courses, and spots open up in closed classes, the Department will fill the spots with students from the wait-list. The wait list should be used only when there is a closed section that you need to enroll in and there is no open section that fits your schedule.

3. *Capstone Courses.* For Senior Liberal Arts Mathematics Majors and Applied Mathematics Majors, the capstone requirement will be satisfied by taking MAT 498 (a 1 course unit/4 credit course) in the Spring. The Applied Mathematics capstone is MAT 498-01 and all Applied Mathematics Seniors will take that section. Its topic will be "Numerical Analysis." Liberal Arts Mathematics Seniors can take either MAT 498-02 or MAT 498-01 (as space permits). The topic of MAT 498-02 will be emailed to seniors this coming week.

   Senior statistics majors will take STA 498 (.5 course units/2 credits) in the spring. Senior statistics majors should already be working with Professor Holmes and Thayer. Senior statistics majors should enroll themselves in STA 498.

4. *Mathematics/Statistics Courses.* In Spring 2013, among the course offerings (the list of regular offerings is at http://mathstat.pages.tcnj.edu/files/2011/06/CourseOfferingsS12revision.xls), there are some courses that are only offered at most every other year. Please take advantage of the opportunity to take them! Descriptions of these courses can be found at the end of this letter. In

addition, there will be a section of MAT 310: Real Analysis offered in the Spring semester. This course is normally only offered during the fall semester.

Spring 2013 Semester:

MAT 315: Topics in Linear Algebra, Prof. Clark
MAT 440: Mathematical Logic, Prof. Alves
MAT 454: Seminar in Applied Mathematics (Topic: Mathematical Modeling), Prof. Harris
STA 304: Sampling and Nonparametric Statistics, Prof. Holmes
STA 314: Statistical Quality Control, Prof. Navard
STA 318: Operations Research, Prof. Thayer

5. *Sections of Courses.* Here are the currently anticipated number of sections to be offered for the upper level courses in the major:

MAT 301: Number Theory (2)
MAT 305: Abstract Algebra (1)
MAT 310: Real Analysis (1)
MAT 315: Topics in Linear Algebra (1)
MAT 316: Probability (1)
MAT 320: Complex Analysis (1)
MAT 326: Differential Equations (1)
MAT 351: Geometry (1)
MAT 440: Mathematical Logic (1)
MAT 454: Seminar in Applied Mathematics (Topic: Mathematical Modeling) (1)
MAT 498: Capstone (2)
MTT 390: Methods of Teaching Mathematics II (2)
MTT 490: Student Teaching (7)
STA 304: Sampling and Nonparametric Statistics (1)
STA 314: Statistical Quality Control (1)
STA 318: Operations Research (1)
STA 498: Capstone (1)

We wish you a successful registration session. Please write or see us if you have any questions!

Sincerely,

Professors Hagedorn and Liebars
Co-Chairs of the Department of Mathematics and Statistics

Course Descriptions:

1. MAT 315: Topics in Linear Algebra
Instructor: Karen Clark Prerequisite: MAT 205:Linear Algebra.
The MAT 315 course will build upon the material covered in the MAT 205 course, and will serve to expose students to concepts in Linear Algebra that were beyond the scope of the first course. For instance in Math 205 students learned about diagonalizing square matrices – in this course we'll extend this concept to cases where the matrix is not diagonalizable, or where the matrix is not square. This decomposition is important in image processing (storing pictures taken by a digital camera). We'll spend some time investigating numerical techniques for estimating solutions to systems of equations, and numerical techniques for estimating eigenvalues. Topics to be covered may include the following: Spectral Theorem for Symmetric Matrices, Quadratic Forms, Conic Sections and Constrained Optimization, Positive Definite Matrices, Singular Value Decomposition and PseudoInverse, QR Factorization and Least Squares, Jordan Canonical Form and application to systems of Differential Equations, Gershgorin Theorem, Iterative Methods for Solving Linear Systems, the Power Method, QR method, and Markov Chains. The semester will conclude with students working through a paper analyzing how linear algebra is used in Google's PageRank algorithm. **Students registering for this course must be comfortable with the topics covered in the MAT 205 course, particularly eigenvalues and orthogonality.** The text for this course will be David Lay's "Linear Algebra", supplemented by typed notes.

2. MAT 440: Mathematical Logic
Instructor: Professor Carlos Alves
Prerequisites: MAT 200 and MAT 305
Modern mathematics deals with abstract objects. Real numbers, functions, algebraic structures, or metric spaces are examples of such objects. Mathematical logic adds to the study of such objects by paying attention to the language used in studying them, how these abstract objects are defined and to the rules of logic we use in studying them. In this mathematics of mathematics approach can we prove that mathematics is consistent, i.e. that we will not get at some point a contradiction of mathematics as we know it? Is every true statement of a theory provable in that theory? Is there a procedure to determine if a statement or its negation is a theorem? In analyzing these topics we will gain deeper insight into mathematical thinking as well as learn about limitations of modern mathematics.

3. MAT 454: Seminar in Applied Mathematics (Topic Mathematical Modeling)
Instructor: Professor Leona Harris Prerequisite: MAT 326 Differential Equations
The purpose of this course will be to provide students with experience in the process of developing and utilizing mathematical models to solve complex real-world problems of current interest in research and industry. During this course, students will be introduced to mathematical models that can be applied to problems in .a wide variety of fields including biology, economics, engineering, finance, and physics. This course will build upon differential equation and modeling concepts learned in MAT 326 and will introduce students to advanced modeling concepts such as nonlinear dynamics, dimensional analysis, sensitivity analysis, bifurcation analysis, and optimization. This course will be a project-based course that will consist of a mixture of formal lectures and computer laboratories. Throughout the semester, students will have an opportunity to work in teams on modeling projects and work on a longer final project that

will involve modeling a natural or physical phenomenon of their choosing, implementing the model using Matlab or Mathematica, writing a paper on the model, and presenting the results of the model to the class.

The purpose of the computer laboratories and computer projects will be to provide students with hand-on experience in developing an initial mathematical model from a stated problem and using software packages to build, test, and analyze the model; create graphical representations of the modeled phenomena over time or space; run numerical simulations to make predictions about how phenomena will behave under certain circumstances; and, when experimental data is available, students will be able to run numerical simulations to determine how well the model fits the data. This will allow students to determine whether they have a "good" working model that can be used to solve the problem or whether they need to change their modeling assumptions in an effort to improve the model.

4. STA 304: Sampling and Nonparametric Statistics
Instructor: David Holmes Prerequisite: STA 215
This course introduces students to the use of sampling theory, the design and analysis of sample surveys, and robust statistical tests that are applicable in a wide range of real-world applications. Topics include: stratified sampling, cluster sampling, quota sampling, questionnaire design, and k-sample tests for paired and unpaired data.

5. STA 314: Statistical Quality Control
Instructor: Sharon Navard Prerequisite: STA 215
An introduction to the theory and application of statistical quality control. Topics include variables control charts (, R, and s), attributes control charts (p, np, c, and u), and non-Shewhart type charts (CUSUM, MA, and EWMA); rational subgrouping, Average Run Length, and O-C curves.

6. STA 318: Introduction to Operations Research
Instructor: Richard Thayer Prerequisite: MAT 316: Probability
Operations Research is a key field in the Mathematical Sciences. The common thread in OR is the concept of Optimization – OR is therefore a set of techniques that are useful in optimization. The field breaks down into a Deterministic Component, which is taught at TCNJ as MAT 317, Linear Programming and a Probabilistic Component which is MAT 318. In Linear Programming one solves problems with an objective function subject to a set of constraints. One example is scheduling airplanes and the associated crew members.

The OR course relies heavily on the Probability Course and, as such, can be thought of as Applied Probability. One major component of the course is Queuing Theory where one builds models to balance the random arrival of customers to the queue with the probability distribution of Service Times for customers. Various steady state statistics are developed. Some time is spent on Inventory Control, now called Supply Chain Theory, where one optimizes the Order Quantity to balance Ordering costs against Service Costs. Also a bit of time is spent on Forecasting.

The major focus of the second half of the course is Simulation. Simulation models are developed for Queuing and Inventory situations. One learns some of the elements of the art of programming – flow charting, coding, debugging a program, interpreting the results, etc. The course requires the student to develop skills in both SAS and EXCEL; both of which are heavily used in the workplace and are an important part of a student's resume.