GER Assessment Materials for MA 114

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Course Justification:
Finite mathematics encompasses the major areas of post high school mathematics outside of calculus. The major topics of the course are matrices, linear programming, and probability. These topics have become increasingly important in managerial, behavioral, and biological sciences. Present availability of computers to handle computational aspects of matrix manipulation makes it more feasible than ever before to relate topics of finite mathematics to significant real world applications.

Proposed Revisions:
The proposed revision is the creation of new learning outcomes and means of assessing those outcomes to meet the new GER requirements as set forth by the CUE.

Enrollment For Past Five Years:

Summer 1999	106
Summer 1999	36
Fall 1999	542
Spring 2000	626
Summer 1 2000	85
Summer 2 2000	40
Fall 2000	632
Spring 2001	630
Summer 1 2001	93
Summer 2 2001	28
Fall 2001	637
Spring 2002	547
Summer 2002	78
Summer 2002	50
Fall 2002	691
Spring 2003	568
Summer 1 2003	102
Summer 2 2003	41
Fall 2003	668

Resources Statement:
N/A

Consultation with other Departments:
N/A

Student learning outcomes

1. In MA 114 all students will be able to analyze and mathematically model real world situations involving linear optimization. Students will use geometric and algebraic techniques (simplex method) to produce optimal solutions for linear models (for example, maximizing profit, minimizing cost, minimizing pollution, maximizing crop yield, etc.)

2. In MA 114 all students will understand the basic concept of a Markov chain. This incorporates the understanding of transition probabilities between the various states in the model and the transition matrix as a tool for displaying and manipulating transition probabilities. Students will understand the concept of using a Markov chain to model a variety of real world phenomena, and will solve problems related to steady-state transition probabilities and absorbing states.

3. Students will master elementary combinatorics as a procedure for organizing and classifying data. This will include a knowledge of elementary set theory, Venn diagrams, and tree diagrams. Students will develop an understanding of permutations and combinations as a way of counting sets of outcomes and arrangements.

4. Students will learn to construct simple probability models to represent mathematically a quantitative way of treating uncertainty and chance. Students will learn simple probability distributions such as the binomial distribution and uniform distribution, and will understand their relevance to everyday phenomena. Students will apply the concepts of combinatorics to evaluate probabilities, and will develop an understanding of the concepts of independent trials and expected value.

Method of achieving learning outcomes

These are to be matched with the preceding list, i.e. item #1 below is the method for achieving learning outcome #1 in the preceding list.

1. Students will solve a variety of optimization problems. These problems will be delivered to students via WebAssign and will be individualized for each student. Many of these scenarios will be presented to students via everyday language (what students call "word" problems), and students will construct the mathematical model prior to using geometric or algebraic techniques to find the optimal solution. The problems will be delivered to students via a common set of WebAssignments offered in all sections of the course.

   Sample Problem: A lake is to be stocked with trout and salmon. Two foods, A and B, are available in the lake. Each trout requires 2 units of A and 1 unit of B per day while each salmon requires 1 unit of A and 3 units of B per day. Only 500 units of A and 900 units of B are available daily. If each trout weighs 2 lbs. and each salmon weighs 4 lbs., how should the lake be stocked to maximize the weight of the fish which can be supported by the lake?

2. WebAssign will be used to deliver a variety of individualized Markov chain problems to each student as homework. Many of these will be in the form of word problems where the student constructs the model prior to analyzing it. Many problems will be of a practical nature where the student will find an obvious interest in the answer.

   Sample Problem: A company has stores in Boston and Chicago and sells items to men, women and children. Sometimes items that do not sell well are transferred from one store to another. Each week at the Boston store, 10% of the items are sold to men, 10% are sold to women, 20% are sold to children, 20% are shipped to Chicago, and the remaining 40% are kept in Boston. The Chicago store sells 10% to men, 20% to women, 30% to children, ships 10% to Boston, and keeps the remaining 30%.
   (a) Treat this as a 5-state Markov chain with men, women, and children as absorbing states. Write down the transition matrix.
   (b) What is the probability that an item in the Boston store will eventually be sold to a woman?
   (c) What is the probability that an item in the Chicago store will eventually be sold to a child?

3. Students will have several WebAssignments devoted to combinatoric models and solution of combinatoric problems. These problems will be individualized for students so that no comparison or copying of answers between students is meaningful. All students will solve a variety of problems related to Venn diagram techniques, tree diagrams, combinations, and permutations.

   Sample Problem: There are 5 permanent and 10 non-permanent members of the

United Nations Security Council. A resolution is passed by the Council if it receives at least 9 favorable votes *and* if no permanent member votes against the measure. How many ways can a resolution be passed if

(a) all members vote on the measure and there are no abstentions?
(b) one particular permanent member and 3 particular non-permanent members abstain from voting?

4. Probability is generally considered by students to be the hardest topic of MA 114. Students will have WebAssignments that present them with a wide opportunity to apply the techniques of combinatorics to model uncertainty. These WebAssignments will illustrate use of uniform and binomial probability distributions, conditional probability, probabilities in tree diagrams, independent trials processes, and expected value. These assignments will be required of all students and will draw on diverse problem solving skills. Once again, each student will have a unique version of the problems so that copying work of others is impossible.

   Sample Problem: 5% of the population of a region is thought to have diabetes. A standard diagnostic test will correctly identify 94% of the people who have the disease. However, the test also incorrectly diagnoses 8% of those who do not have the disease as having the disease. A person is tested and his test result comes back "positive," indicating that he has the disease. What is the probability that he actually does have the disease?

Means of assessing GER outcomes

All sections of MA 114 use WebAssign as the mechanism for delivery of assignments to students. These assignments are given on a regular basis, and when the student submits the assignment the student work is immediately graded by WebAssign and the results are available to both student and teacher. Therefore, the teacher has immediate and continual access to up-to-date information regarding the extent to which the student is achieving the desired outcomes.