

Center for Talent Development-Northwestern University
2006 Summer Spectrum Program
Session 1

Mathematical Modeling Honors:
Probability, Evolution, Data Mining

Instructor: Devrim Bilgili
Teaching Assistant: Patrick J Crutcher

Course Description:

This course is designed to introduce students to mathematical modeling and a variety of applications in real-world situations.

Some examples of questions the students will learn to answer using mathematical models:

Probability: If two people decide to meet at a particular time what is the “chance” that they will meet at a given time such that each person will wait each other ten minutes?

Evolution: What did Darwin think? How do our gene frequencies change from population to population?

Data Mining: How does Google work? Why do we get junk mail? How does Amazon.com suggest some books that we might be interested?

Pre-Requisites:

The course will assume that students have completed Algebra I.

Any other mathematical techniques required will be taught as part of the course.

Evaluation:

Class participation: 20%

Individual homework: 20%

Individual exams: 20%

Group projects and Presentations: 40%

97-100 = A+

93-96 = A

90-92 = A-

87-99 = B+

83-86 = B

80-83 = B-

77-79 = C+

73-76 = C

70-73 = C-

67-69 = D+

63-66 = D

60-62 = D-

Below 60 = F

Text:

There will be no specific text for this course because of the diverse material being covered. However, Eisenberg’s “The Number Devil” will bring more intuition to class.

Course Schedule:

The first part of the course is a rigorous introduction to probability. Students will learn to logically interpret the concept of probability and also practice a diverse set of techniques for solving problems related to probability.

In the second and the third part of the course, the students will receive an overview of Darwin's Evolution Theory, some basic mathematical models expressing our gene frequency throughout generations, and data mining techniques.

Topics:

Probability
Introduction to probability
Sets and set operations
Permutations and combinations
Random Experiments, sample spaces and events
Probability as a concept
Axioms of probability and some important results
Conditional probability and some important results
Independence events
Bayes Rule
Random variables and distributions

Evolution:

Hardy-Weinberg Equilibrium
Darwin's Theory and mathematics behind
Random Genetic Drift

Data Mining:

Data Mining Concepts
Dimensions of today's data and data reduction
Googling google
Learning from data
Statistical Methods (If time permits)
Decision Trees (If time permits)

Instructor Biography:

Devrim Bilgili is working on his PhD at Northern Illinois University's Mathematical Sciences Department. His research focuses on the use of mathematical models in linkage and association of genes.

As an instructor, he seeks to demonstrate the elegance of mathematical models and to foster the creative use of mathematical tools learnt in class in real world settings.