Medical Technology and Critical Decisions

Spring 1988

Instructors: Ted Ducas (Physics) and Alan Shuchat (Mathematics)

Ted Ducas                                                                                 Alan Shuchat
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Office Hours: Wed.  2:00                                                         Office Hours: Mon. 11:30
             Thur. 2:40                                                                 Wed. 1:30; Thurs. 2:40
             and by appointment                                                                    and by appointment


Other readings will be handed out in class or placed on reserve at the Science Library. Several of these readings will be from:

Course Requirements

Medical Technology and Critical Decisions meets twice a week, Tuesdays and Thursdays at 1:30. On Tuesdays we will usually meet from 1:30 to 4:00, and some of this time will be devoted to laboratory and computer work. The course carries one unit of non-laboratory Group C distribution credit.

Reading assignments are listed in the course outline below. You are expected to become informed about the class topic in advance and to contribute to class discussions.

Homework assignments will be based on classes, laboratory and computer work, and readings. There will be 4 or 5 homework assignments, a take-home midterm exam, and a final paper summarizing the semester's work. You are expected to complete your work on time. Late work will only be accepted by prior arrangement, or in case of medical emergency.

The grading scheme for the course is as follows:

Homework assignments 50%
Midterm exam 20%
Final paper 30%
Course Outline

I. INTRODUCTION: Overview of the course

Medical technology, risk, and decision making under uncertain conditions. Focus on personal medical decisions such as amniocentesis. Scientific and mathematical principles underlying the transmission of genetic defects, ultrasound technology, and decision making based on probabilities and personal values.

Reiser, Medicine and the Reign of Technology, Chap. 11.
McKean, "Decisions, Decisions," Discover, June 1985, pp. 22-31. To be read by Feb. 4

II. REPRESENTING DATA: Summarizing Data Numerically and Graphically

Average, median, standard deviation, histograms, and the normal "bell" curve.
Freedman, Statistics, Chaps. 3-5 (1-2 also suggested)
Fuchs, Who Shall Live?, Chap. 2

III. PROBABILITY: Introduction to Probabilistic Reasoning

Elementary concepts and sources of probabilities. Probability trees, conditional probabilities, testing and diagnosis. Lab session on data and probability.
Freedman, Statistics, Chaps. 13-14
Also suggested:

IV. GENETICS: How can we use biology and probability to make predictions about the next generation?

Molecular basis of genetics.
Generational analysis and genetically-linked traits.
Applications of probability to genetics.
Sex-linked traits.
The genetics and statistics of Down's syndrome.
Guest speaker on medical ethics.
Francoeur, Biomedical Ethics, Chap. 1
Singer, Human Genetics, Chaps. 1,2,3
Winchester, Heredity, Chaps. 7, 9 (omit pp 88-91).
V. ULTRASOUND: *What information can be extracted using sound? How does this lessen the risk of amniocentesis and what new risks does it introduce?*

The nature of sound.
Imaging using sound as a non-invasive means of obtaining information.
Other imaging techniques, such as X-rays, MRI, etc.
Ultrasound in amniocentesis and the question of risk.
Lab sessions on characteristics of sound.

Powis, *Ultrasound Physics*.

Also suggested:
Kane and Sternheim, Physics, Chaps. 21, 22

TAKE-HOME MIDTERM EXAM

VI. CHANCE PROCESSES, SAMPLING, AND INFERENCE: *Using the bell curve: samples and surveys.*

A model for chance processes; expected value and standard error.
Probability histograms and approximation by the normal curve.
Sample surveys, errors in sampling, and choosing the sample size.
What model may be generating the given data? Confidence intervals.
Lab session on sampling.


VII. DECISION ANALYSIS: *A model for decision-making that accounts for personal values and how attitudes towards risk influence choices.*

Decision trees and utility.
Threshold probabilities and sensitivity analysis.
Lab sessions on computer software for decision analysis.

Hill et al., *Making Decisions*, 1982, Chap. 9, (Omit Secs. 2,5,7); Chap. 10, Secs. 1,2;

Suggested:
VIII. AMNIOCENTESIS: A Detailed Analysis of the Decision

The amniocentesis procedure and its timing.
A decision analysis for amniocentesis.
The future: the CVS procedure and its effect on genetic counseling.
Guest speaker on genetic counseling.

Hill et al., Making Decisions, Chap. 10. Secs. 3-5
Singer, Human Genetics, Chap. 6

Also suggested:

IX. PUBLIC CHOICE: Setting public policy when resources are scarce.

Valuing costs and benefits.
The value of a life.
Fuchs, Who Shall Live?, Chap. 1

Also suggested:

FINAL PAPER