Workload

	hours per week/ occurence	weeks/number	hours (total)
class meetings	3	13	39
reviewing class	3	13	39
homework	4	13	52
midterms	10	2	20
final	30	1	30
TOTAL			180

Course: AM1655 Statistical Inference I

Instructor: Caroline Klivans

Course Description: AM 1655 begins an integrated first course in mathematical statistics. The first half of AM 1655 covers probability and the last half is statistics, integrated with its probabilistic foundation. Specific topics include probability spaces, discrete and continuous random variables, methods for parameter estimation, confidence intervals, and hypothesis testing.

Prerequisite: MA100

Class Schedule: 2×80 min lectures weekly

Text: Mathematical Statistics with Applications, Seventh Edition, by Wackerly, Mendenhall and Scheaffer, Duxbury Press, 2001. AM1655 covers approximately chapters 1 through 10

Topics:

I. Introduction

A. Inference and statistics

1. Examples

2. Estimation

3. Hypothesis Testing

B. Sampling problem

C. Role of probability theory

II. Probability

A. Probability and statistics

1. Intuitive Notions: relative frequencies

2. Dual roles of probability and statistics

B. The probability space

1. Sample space, sample points, probability, events, set notation

2. Calculating probabilities by counting

3. Conditional probability & independence

4. Bayes' rule

5. Random variables.

C. Discrete Random variables

1. Definitions, discrete probability distribution.

2. Expected values and variance.

3. Special discrete random variables: binomial, geometric, Poisson, hypergeometric

D. Continuous Random Variables

1. Definitions, cumulative distribution functions (cdf), density.

2. Expected values and variance.

3. Special continuous random variables: normal, exponential, uniform.

E. Multivariate probability distributions.

1. Review on multivariate calculus.

2. Joint distributions, marginal distributions, conditional distributions.

3. Independence, correlations, covariance.

4. Conditional expectation.

F. Functions of random variables: the method of distribution functions.

G. Law of Large Numbers and Central Limit Theorem.

III. Statistics

A. Introduction to statistics

1. Goals of statistics

2. Random sampling

3. Examples

B. Estimation

1. Definitions, population parameter vs. estimate, point estimators.

2. Bias, mean square error (MSE).

3. Confidence interval, large sample approximation.

4. Estimation for a single population.

5. Estimation for two populations.

6. Minimal variance unbiased estimator (MVUE), sufficient statistics.

7. Maximum likelihood estimate (MLE).

C. Hypothesis Testing

1. Type I error, Type II error, power.

2. Some standard large sample hypothesis testing and P-value.

3. Neyman-Pearson Lemma -- the most powerful test.

4. Likelihood ratio test.