

# Exam 1 Review

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# Exam 1

1. Friday, February 28 – 9:55am-10:45am (50 min) in Social Sciences 5208 (regular lecture room)
2. Counts for 25% of your final grade
3. Bring your formula sheet – double-sided 8.5”x11” paper of hand-written (no photocopies) formulas/equations/definitions
4. Bring a scientific or graphing calculator

# Format of Exam

## Section 1. Sampling and Descriptive Statistics

- Problem 1
- Problem 2
- ...

## Section 2. Probability and Propagation of Error

- Problem 1
- Problem 2
- ...

## Section 3. Common Probability Distributions

- Problem 1
- Problem 2
- ...

# Question Format

- A few fill in the blank and/or multiple choice
- Mostly calculation and short answer
- Around 8-12 problems total, many with subparts

# Review Topics

1. Sampling and Descriptive Statistics
2. Basic probability
3. Error propagation
4. Distributions

# 1. Sampling and Descriptive Stats

- Section 1.1
  - populations vs samples, parameters vs statistics
  - simple random samples vs samples of convenience
  - data types (numerical/quantitative vs categorical/qualitative)
- Section 1.2
  - measures of center: the sample mean, median, and mode
  - measures of spread: the sample variance, standard deviation, range, and IQR
  - other measures: quartiles and percentiles

# 1. Sampling and Descriptive Stats

- Section 1.3
  - histograms and boxplots for numerical data (how to construct and interpret)
  - bar charts and pie charts for categorical data
- Examples:
  - Homework 1
  - Practice Exam 1, Problems 1-4

## 2. Basic Probability

- Section 2.1
  - events and the sample space (in set notation, i.e.  $S=\{O_1, O_2, \dots, O_n\}$ )
  - union, intersection and complement of events
  - mutually exclusive events
  - axioms of probability and additional properties that follow
- Section 2.2
  - fundamental principle of counting
  - permutations and combinations (how to calculate, when to use)
- Section 2.3
  - definition of conditional probability
  - independent events and the multiplication rule
  - law of total probability and Bayes' rule



# 2. Basic Probability

- Section 2.4
  - types of random variables (discrete vs continuous)
  - properties of the PMF, PDF, and CDF
  - calculation of population mean, variance and standard deviation from the PMF or PDF
- Section 2.5
  - calculation of the mean and variance of an independent linear combination of RVs
- Section 2.6
  - joint PMF/PDF of two random variables
  - calculation of marginal PMF/PDF from joint
- Examples
  - Homeworks 1, 2, and 3
  - Practice Exam 1, problems 5-8

# 3. Error Propagation

- Section 3.1
  - bias vs random error
  - accuracy vs precision
- Section 3.2
  - uncertainty of a linear combination of measurements (estimate when independent, upper bound when dependent)
- Section 3.3
  - uncertainty of a (nonlinear) function of one measurement
- Section 3.4
  - uncertainty of a (nonlinear) function of several measurements (estimate when independent, upper bound when dependent)
- Examples
  - Homework 3
  - Practice Exam 1, Problem 7c

# 4. Common Distributions

- Sections 4.1-4.4:  
Discrete
  - Bernoulli
  - Binomial
  - Poisson
  - Geometric
- Sections 4.5, 4.7, 4.8:  
Continuous
  - Normal
  - Exponential
  - Uniform
- For each, you should know
  - typical examples to help you recognize when to apply it
  - probability calculations using PMF/PDF (or normal table in the case of normal RVs)
  - mean and variance/standard deviation in terms of parameters
  - how to estimate parameters and their uncertainty when unknown
  - relationships with other distributions and special properties (see next slide)
- Examples
  - Homework 4
  - Practice Exam 1, Problems 9-10

# Distributional Relationships & Properties

- Binomial models multiple independent Bernoulli trials
- Geometric models the number of independent Bernoulli trials up to and including the first success
- Poisson approximation to the binomial under certain conditions (large  $n$  and small  $p$ )
- Exponential models the waiting time between events in Poisson process
- Lack of Memory Property of the Exponential
- Linear combination of normal RVs is normal
- Normal approximation of the Binomial and Poisson (by the CLT) not covered – will be on Exam 2

# Reminders

- Complete solutions to the practice exam and homework problems have been posted to Learn@UW
- Remember to bring your calculator and formula sheet to the exam
- Try to arrive a few minutes early on Friday so we can get started on time

Good Luck!