

MTH 3210

Exam I Study Guide

The exam covers Slides 1-5, Homeworks 1-3, and Sections 1.2-1.4 and 2.1-2.5 in the book. Exam problems will be similar to examples done in class and homework problems.

1. **Types of variables:** know the difference between

- Discrete numerical variables
- Continuous numerical variables
- Categorical variables

2. **Frequency distribution tables and histograms**

- Know how to make frequency distribution tables and histograms
- Know how to interpret histograms and what to look for

3. **Descriptive statistics for center:**

- Know how to compute and interpret the sample mean and sample median of a data set.
- Know the properties of the mean and median (resistance to outliers, etc.)
- Mean of a linear transformation $y_i = ax_i + b$.

4. **Descriptive statistics for spread:**

- Know how to compute and interpret the sample variance, sample standard deviation, and interquartile range
- Know the properties of the variance, standard deviation, and interquartile range (resistance to outliers, etc.)
- Variance and standard deviation of a linear transformation $y_i = ax_i + b$.

5. **Other descriptive statistics and plots**

- Know how to determine and interpret the quartiles and five-number summary
- Know how to construct a boxplot
- Know to use boxplots to recognize skewness

6. **Probability introduction**

- Identify the sample space (\mathcal{S}) associated with a random experiment
- Events, unions, intersections, complements, mutually exclusive events (know what these mean)
- Venn diagrams: know how to construct them and use them
- Know the three probability axioms
- Probability rules: know the following and how to use them:
 - $P(A) = 1 - P(A')$ and $P(A') = 1 - P(A)$
 - Inclusion-Exclusion Principle: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
(Also know its extension to three events A , B , and C).

7. **Combinatorics** (counting).

- Know the Product Rule for counting
- Know the difference between permutations and combinations
- Know how to count permutations and combinations

8. **Conditional probability**:

- Know how to compute and interpret conditional probabilities: $P(A|B) = P(A \cap B)/P(B)$.
- Multiplication Rule for the intersection of two (or more) events, not necessarily independent: $P(A \cap B) = P(A)P(B|A)$ and $P(A \cap B \cap C) = P(A)P(B|A)P(C|A \cap B)$.

9. **Independence**:

- Recognize and interpret independence ($P(A|B) = P(A)$).
- Use it to independence compute probabilities, e.g. the Multiplication Rule for the intersection of two (or more) independent events: $P(A \cap B) = P(A)P(B)$ and $P(A \cap B \cap C) = P(A)P(B)P(C)$ (and so on for more than three events)

10. **Law of Total Probability**

- Recognize problems for which the Law of Total Probability is applicable
- Use the Law of Total Probability to solve probability problems: $P(B) = P(A \cap B) + P(A' \cap B) = P(A)P(B|A) + P(A')P(B|A')$
(and similarly for any partition A_1, A_2, \dots, A_n of \mathcal{S})

11. **Bayes' Theorem**

- Recognize problems for which Bayes Rule is applicable
- Use Bayes Rule to solve probability problems: $P(A|B) = [P(A)P(B|A)]/[P(A)P(B|A) + P(A')P(B|A')]$
(and similarly for any partition A_1, A_2, \dots, A_n of \mathcal{S})