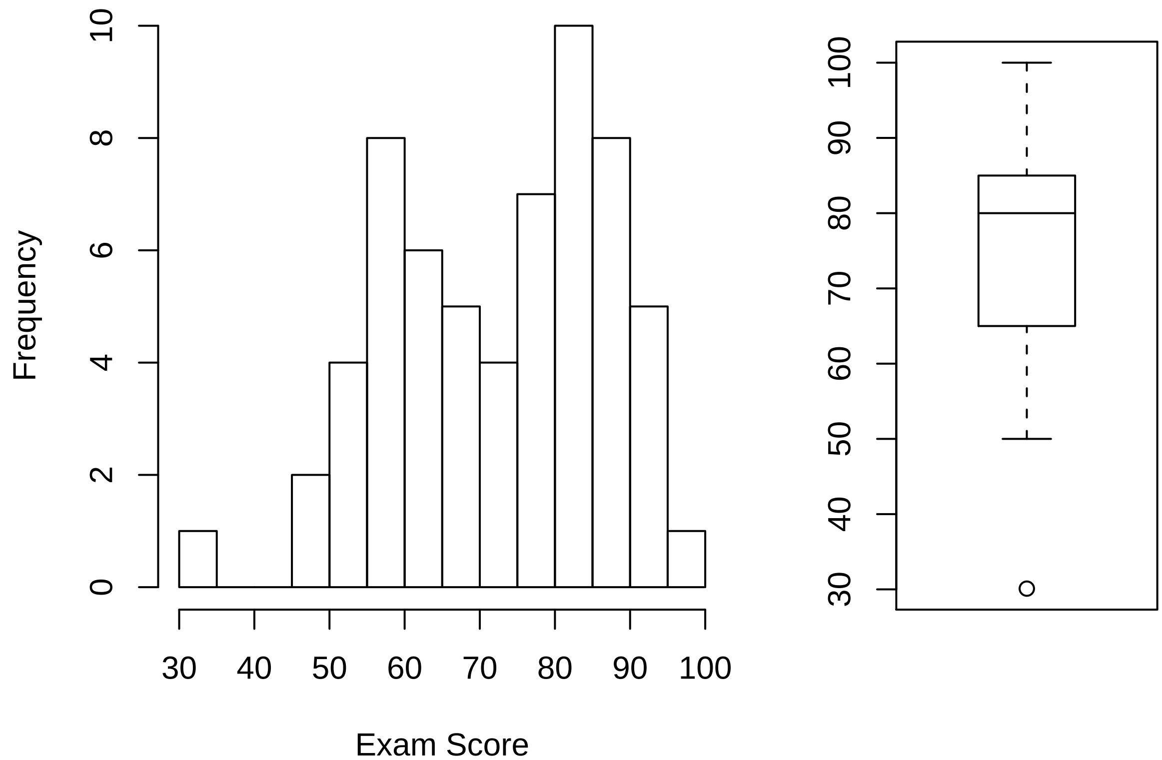
Midterm Exam 1 Review — Chapters 1, 2, 4 and 5

1. The histogram and boxplot of the exam scores for 60 students are given below.



   (a) What is the overall shape of the distribution of the exam scores?

   (b) What proportion of students scored more than 90? ________________

   (c) 25% of students scored more than ________________ .

   (d) What was the lowest score? ________________

   (e) **Based on the boxplot only**, can you tell that the mean exam score was larger or less than the median score? Explain why.

2. A marketing research firm conducted a survey of companies in its state. They mailed a questionnaire to 300 small companies, 300 medium-sized companies, and 300 large companies. The rate of nonresponse is important in deciding how reliable survey results are. Here are the data on response to this survey:

	Response		
Size of Company	Yes	No	Total
Small	175	125	300
Medium	145	155	300
Large	120	180	300

(a) Draw a bar graph to compare the nonresponse rates for the three size categories. Label both axes clearly.

(b) What is the overall nonresponse rate?

(c) Given that a randomly selected company does not response to the survey, what is the probability that this is a large company?

(d) Are the variables "response" and "size of company" independent? You must fully explain your answer for full credit.

3. A basketball player has made about 70% of his free throws over several years. Suppose that his free throws are independent trials with probability 0.7 of a success on each trial.

   (a) What is the probability that he makes none in 6 attempts?

   (b) What is the probability that he makes at least one in 6 attempts?

4. A manufacturing process produces compact discs (CDs). It is known that 10% of the CD's produced are defective. A simple test is used to determine whether a CD is defective, for which 98% of the defective CDs are detected and 5% of the good CDs are declared defective.

   (a) What is the probability that a randomly selected CD will be declared defective by the test? Show all work.

   (b) Given that a randomly selected CD is declared defective by the test, what is the probability that the CD is truly defective? Show all work.

5. Let X be the number of persons living in an American household. Ignoring the few households with more than seven inhabitants, the distribution of X is as follows:

Inhabitants	1	2	3	4	5	6	7
Probability	0.25	0.32	0.17	0.15	0.07	0.03	?

(a) What is the missing probability $P(X = 7)$?

(b) What is $P(2 < X \leq 4)$?

(c) What is $P(X \neq 1)$?

(d) What is $P(X < 4 | X \neq 1)$?

(e) What is the expected (mean) number of persons living in an American household?

(f) What is the standard deviation of the number of persons living in an American household?

Some important concepts for review

Distinction between experiments and observational study.

The basic principles of design of experiments.

Sources of error in surveys

Role of randomization

Measures of centers and spread

Midterm Exam 1

- Time: Monday, October 25, in class (10-10:50)
- Material: Chapters 1, 2, 4 and 5 (including lectures, homework 1-3, labs 1-2)
- It will be a **closed book exam**.
- Bring your calculator, ruler, pen, pencil, eraser, etc.

NOTE: The following formulas will be provided.

Formulas.

Sample Mean and Standard Deviation

mean $\bar{x} = \frac{1}{n}\sum x_i$, standard deviation $s = \sqrt{\frac{1}{n-1}\sum(x_i - \bar{x})^2}$

Probability Rules

Complement Rule: $P(A^c) = 1 - P(A)$.

Addition Rule: $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$.

If A and B are disjoint (mutually exclusive), then $P(A \text{ or } B) = P(A) + P(B)$.

Multiplication Rule: $P(A \text{ and } B) = P(A)P(B \mid A) = P(B)P(A \mid B)$

If A and B are independent then $P(A \text{ and } B) = P(A)P(B)$.

Conditional Probability: $P(A \mid B) = \frac{P(A \text{ and } B)}{P(B)}$

Partition Rule: If $A_1, A_2, ..., A_k$ form a partition,

$P(B) = P(B \mid A_1)P(A_1) + P(B \mid A_2)P(A_2) + ... + P(B \mid A_k)P(A_k)$

Bayes' Rule: $P(A \mid B) = \frac{P(B|A)P(A)}{P(B)} = \frac{P(B|A)P(A)}{P(B|A)P(A)+P(B|A^c)P(A^c)}$.

Random Variables

mean $E(X) = \sum x f(x)$ and variance $\text{var}\,(X) = E[(X - E(X))^2] = E(X^2) - [E(X)]^2$

Rules for expectation: $E[g(X)] = \sum g(x)f(x)$ and $E[g_1(X) + g_2(X)] = E[g_1(X)] + E[g_2(X)]$

Rules for means: $E(a + cX) = a + cE(X)$

Rules for variances: $\text{var}\,(a + cX) = c^2\text{var}\,(X)$