

Stat 3011 Practice Problems for Second Midterm Exam

July, 2006

Name: _____

Student ID: _____

- You have 1 hour and 55 minutes to complete the exam.
- The exam is out of **165 points total**.
- The exam is closed book. You may use a calculator and one sheet of paper with formulas or other notes on both sides. No sharing of calculators or formula sheets is allowed.
- **Table A** will be provided to you with the exam.
- **Show all of your work** (use the back if necessary) in questions 2 through 9.
- This exam must be your own work entirely. You can not talk to or share information with anyone.
- Ask questions if anything is unclear or if you get stuck.
- **Problem 9 (10 points) is Extra Credit.**

Problem 1 [40 points total, 4 points each]:

Circle **one** of the listed three choices for each question (no explanation is needed).

1. Which of the following is not one of the three principles of experimental design?
 - (a) control
 - (b) randomization
 - (c) blinding
2. Of 2500 questionnaires send out to high school principals randomly chosen from across the U.S., 250 were filled out and returned. The results of the survey far overestimated the proportion of principals that were under medication for stress. This bias is an example of:
 - (a) bias due to voluntary response sampling
 - (b) response bias
 - (c) bias due to question wording effects
3. Which of the following is true for *all* events A and B ?
 - (a) $P(A \text{ and } B) = P(A) \times P(B)$
 - (b) $P(A \text{ and } B) = P(A|B) \times P(B)$
 - (c) $P(A \text{ and } B) = P(A|B) \times P(B|A)$
4. In a certain town, 50% of households own a cell phone, 40% own a pager, and 20% own both a cell phone and pager. The probability that a randomly selected household owns *neither* a cell phone or pager is:
 - (a) .10
 - (b) .30
 - (c) .70

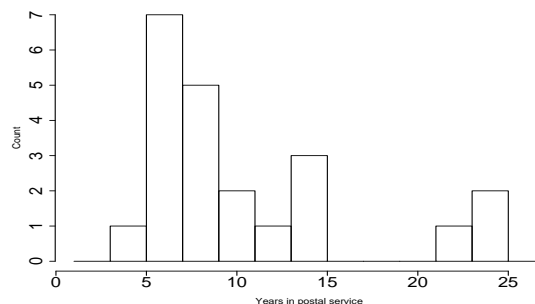
5. The two-way table of counts below describes pizza topping preferences of 1,120 students at a certain small college:

	Likes Pepperoni	Doesn't like Pepperoni
Likes Sausage	598	74
Doesn't like Sausage	241	207

Suppose we randomly select a student. Given that the student likes sausage, what is the probability that the student doesn't like pepperoni?

- (a) 0.1101
(b) 0.2624
(c) 0.6000
6. The probability that Oscar will marry a blonde is .20. The probability that he will marry an intelligent girl is .40. The probability that he will marry a rich girl is .05. Assuming the 3 characteristics are independent, what is the probability that Oscar will marry a rich, dumb blonde?
- (a) $.20 \times .40 \times .05 = .004$
(b) $.20 \times .60 \times .05 = .006$
(c) $.20 + .40 + .05 = .65$
7. Suppose 75% of all students at a large university own a computer. If 2 students are selected independently of each other, the probability that exactly one of them owns a computer is:
- (a) .8125
(b) .1875
(c) .3750

8. Suppose X has a binomial distribution with $n = 1600$ and $p = .2$. Then X has approximately a
- (a) $Bin(320, .2)$ distribution
 - (b) $N(320, 16)$ distribution
 - (c) $N(1600, .2)$ distribution
9. Which of the following does *not* affect the width of a confidence interval for μ ?
- (a) sample mean, \bar{x}
 - (b) population standard deviation, σ
 - (c) sample size, n
10. Suppose we record the number of years spent in the postal service for a SRS of 22 U.S. postal workers. A histogram of those values is shown below.



A 99% confidence interval for the true mean number of years spent in the postal service is determined to be $(8.22, 13.13)$. Based on the histogram of the sample observations, we would conclude

- (a) the assumption of normality for the sampling distribution of \bar{x} is valid.
- (b) the assumption of normality for the sampling distribution of \bar{x} is not valid.
- (c) the 99% confidence interval is actually a 95% confidence interval.

Problem 2 [15 points, 5 points each]:

Scientists are interested in finding a better mosquito repellent. They have a promising new repellent and they wish to test it against two existing standard repellents, DEET and alphacypermethrin. These three repellents are tested with two different strains of mosquitoes, strain A and strain B. Researchers randomly assign 30 mosquitoes from each strain to each of the repellents. The number of mosquitoes not biting (one measure of the efficacy of the repellent) is recorded for each treatment.

(a) What are the experimental units and the response variable in the experiment?

(b) List the factors. How many treatments are there?

(c) How many experimental units are required for the treatment?

Problem 3 [15 points, 5 points each]:

The probability that a rifleman hits a target with any single shot is 0.4. Assume each shot hits the target independently of all the other shots. Suppose the rifleman fires five shots at the target.

(a) Find the probability that that he hits the target with all five shots.

(b) Find the probability that he misses the target with all five shots.

(c) Find the probability that he hits the target at least once.

Problem 4 [20 points, 5 points each]:

Suppose we have two pails. Pail A contains four balls numbered 1, 2, 3, and 4; pail B contains three balls numbered 6, 7, and 8. One ball is randomly selected from each pail.

- (a) List all the outcomes in the sample space.
{For example, one outcome might be (1,6), meaning the ball labeled 1 was selected from pail A and the ball labeled 6 was selected from pail B.}
- (b) Let X = sum of the numbers on the two balls. Make a probability distribution table for X .
- (c) What is the probability that the sum of the numbers on the two balls is more than 9?

{*Problem cntd.*}

- (d) Given that the sum of the numbers on the two balls is more than 9, what is the probability that the sum is more than 11?

Problem 5 [12 points, 6 points each]:

Americans' opinions on certain political issues:

63% of Americans believe in the death penalty

40% of Americans believe that the war in Iraq was just

Out of Americans who believe in the death penalty, 80% believe that the war in Iraq was just

Suppose we select an American at random.

- (a) What is the probability that the person chosen believes in the death penalty and believes the war in Iraq was just?
- (b) Are the events “believes in the death penalty” and “believes the war in Iraq was just” independent? **Justify / check your response numerically.**

Problem 6 [15 points, 5 points each]:

According to the U.S. National Institutes of Health, 55% of American adults today are “overweight” (that is, have a Body Mass Index of 25 or more).

For parts (a) and (b), suppose a random sample of $n = 10$ American adults is chosen. (Note: since this is a *random* sample, you can assume the observations are independent, and each adult has probability 0.55 of being “overweight”.)

(a) What is the probability that all 10 of these adults are overweight?

(b) What is the probability that 8 or fewer of these adults are overweight?

For part (c), suppose a random sample of $n = 1000$ American adults is chosen.

(c) What is the (approximate) probability that more than half of these adults are overweight?

Problem 7 [18 points, 6 points each]:

For a particular department store, the management wants to consider the population of customers who have charge accounts with the store. The balances on these customer charge accounts have mean $\mu = \$280$ and standard deviation $\sigma = \$60$.

Suppose a random sample of $n = 225$ customer charge accounts is selected. Let \bar{x} = the sample mean balance on the charge accounts.

(a) What is the sampling distribution of \bar{x} over all possible samples? (give the shape, mean, and standard deviation of the distribution.) **How do you know this?**

(b) What is the probability that \bar{x} is greater than \$290?

(c) What is the probability that the *total* of the balances on these 225 charge accounts is more than \$63,000?

Problem 8 [30 points, 5 points each]:

A medical researcher from the National Institute of Health has collected two random samples to study the life expectancies (in years) of people who are long-time smokers and those who are nonsmokers. The data are summarized in the table below.

Group	Sample Size (n)	Sample Mean (\bar{x})	Population Standard Deviation (σ)
Smokers	100	67.6	5
Nonsmokers	120	74.5	8

(a) Give a 95% confidence interval for the population mean life expectancy for smokers.

(b) Interpret the interval from part (a) in context of the problem.

(c) Fully explain what is meant by “95% confidence”.

{*Problem cntd.*}

(d) Suppose the researcher wants the margin of error for the 95% confidence interval to be ± 0.5 year. What sample size n should the researcher use in his/her next study?

(e) Give a 95% confidence interval for the population mean life expectancy for nonsmokers.

(f) Based on your confidence intervals from parts (a) and (e), do you believe that nonsmokers have a higher life expectancy than smokers, on average? *Explain how the confidence intervals show this.*

[EXTRA CREDIT, 10 points] Problem 9:

A literature professor decides to give a 25-question true-false quiz to determine who has read an assigned novel. She wants to choose the passing grade so that the probability of passing a student who guesses on every question is less than 0.02. What score should she set as the lowest passing grade?