Exam 2 Study Guide and Review Problems

Exam 2 covers chapters 3 and 4.

I will NOT give you any formulas for this exam; instead you are allowed to bring one 3x5 note card, front and back, with your own handwritten notes.

Don't forget to bring your graphing calculator and know how to use it (I will not answer calculator questions during the exam).

Study tips:

- Do the review problems below. This is just a sample of the kinds of problems you might expect on the exam. But there will also be multiple choice questions with mainly conceptual problems. You will not receive points for doing these problems; they are just to help you study for the exam.

- Read through your in-class lecture notes. They will contain the key concepts and the kinds of problems that I find important.

- Make sure you learn to recognize when to use what method. For instance, how do you know when a random variable follows a binomial distribution (I will probably not state on the exam when a random variable follow a binomial distribution, so you need to recognize this on your own)? When do you add and when do you multiply probabilities? When do you use Combinations vs. Permutations?

- Last, but not least, make sure you know how to operate your calculator. You need to know how to access all your programs (such as the binomial program), how to calculate permutations and combinations, how to enter lists and calculate mean and standard deviations, etc. I will not answer calculator questions during the exam. Make sure to bring your calculator!

Review Problems for Chapters 3 and 4

1. In a recent year, 389 of the 281,421,906 people in the United States were struck by lightning.

(a) Estimate the probability that a randomly selected person in the United States will be struck by lightning this year.

(b) Estimate the probability that a randomly selected person in the United States will not be struck by lightning this year.

(c) Estimate the probability that a randomly selected person in the United States will be struck by lightning twice. Assume that the first and second time the person is struck by lightning are independent events. (Do you think that those events are independent in real life?)
2. The following table summarizes results from 985 pedestrian deaths that were caused by accidents.

<table>
<thead>
<tr>
<th></th>
<th>Pedestrian Intoxicated</th>
<th>Pedestrian Not Intoxicated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver Intoxicated</td>
<td>59</td>
<td>79</td>
</tr>
<tr>
<td>Driver Not Intoxicated</td>
<td>266</td>
<td>581</td>
</tr>
</tbody>
</table>

(a) Are the events "Driver intoxicated" and "Driver Not Intoxicated" mutually exclusive?

(b) If one of the pedestrian deaths is randomly selected, find the probability that the pedestrian was intoxicated and the driver was intoxicated.

(c) If one of the pedestrian deaths is randomly selected, find the probability that the pedestrian was intoxicated or the driver was intoxicated.

(d) If one of the pedestrian deaths is randomly selected, find the probability that the driver was intoxicated, given that the selected pedestrian was not intoxicated.

(e) Are the events "Driver Intoxicated" and "Pedestrian Intoxicated" independent?

3. The student affairs committee has 3 faculty, 2 administration members, and 5 students on it.

(a) In how many ways can a subcommittee of 4 people from student affairs committee be formed?

(b) In how many ways can a subcommittee of 1 faculty, 1 administrator and 2 students be formed?

4. For each of the following, state whether or not it is a probability distribution. If it is not, tell the reason why. If it is, find its mean and standard deviation (you should be able to do this by hand and with calculator).

<table>
<thead>
<tr>
<th>x</th>
<th>P(x)</th>
<th>x</th>
<th>P(x)</th>
<th>x</th>
<th>P(x)</th>
<th>x</th>
<th>P(x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.2</td>
<td>1</td>
<td>0.4</td>
<td>1</td>
<td>0.5</td>
<td>0</td>
<td>1/8</td>
</tr>
<tr>
<td>2</td>
<td>0.3</td>
<td>2</td>
<td>0.3</td>
<td>2</td>
<td>-0.3</td>
<td>1</td>
<td>3/8</td>
</tr>
<tr>
<td>3</td>
<td>0.3</td>
<td>3</td>
<td>0.2</td>
<td>3</td>
<td>0.6</td>
<td>2</td>
<td>3/8</td>
</tr>
<tr>
<td>4</td>
<td>0.1</td>
<td>4</td>
<td>0.1</td>
<td>4</td>
<td>0.2</td>
<td>3</td>
<td>1/8</td>
</tr>
</tbody>
</table>

5. The probability that any given person is allergic to a drug is 0.03.

(a) Let x be the number of persons who are allergic to this drug. Draw a tree diagram for this problem. Then write the probability distribution for x if three persons are selected at random.

(b) What is the probability that at least one out of three randomly selected persons is allergic to this drug?

(c) Now, suppose we randomly select 200 persons instead. How many of these persons do we expect to be allergic to the drug?
(d) What is the probability that more than 12 of 200 randomly selected persons are allergic to the drug?

6. Suppose you randomly pick two marbles out of a bag containing 2 red marbles and 4 green marbles.

(a) List all outcomes for this experiment in a sample space.
(b) What is the probability of picking exactly one red and one green marble? You might want to draw a tree diagram.
(c) What is the probability of picking at least one red marble? Please show two ways of finding this probability.

7. Looking at the Venn diagram below, what can you determine about event A and event B?

(a) Are events A and event B mutually exclusive?
(b) What does mutually exclusive mean?
(c) Shade the area that represents the outcomes for the union of A and B (that is, A or B).
(d) Find P(A and B).
(e) Draw a Venn diagram where event A and event B are not mutually exclusive.

8. The probability that a student graduating from Suburban State University has student loans to pay off after graduation is 0.60. The probability that a student graduating from this university has student loans to pay off after graduation and is a male is 0.24. Find the conditional probability that a randomly selected student from this university is a male given that this student has student loans to pay off after graduation.

9. Calculate the following:

(a) 6!
(b) \(_6C_6\)
(c) \(_6P_6\)
(d) How many ways can I choose a three digit code, if all the numbers have to be different?
(e) How many ways can I choose my 4 digit ATM-machine code if the numbers can be repeated?
(f) What is the probability of someone guessing the right ATM-machine code on the first try?
(g) How many ways can I be dealt four cards from a regular 52 deck of cards? (the order doesn’t matter)
(h) What is the probability of receiving exactly 2 kings in my four card hand? (there are 4 kings in one deck)

10. A lottery ticket costs $2. Out of a total of 100,000 tickets, 10,000 tickets contain a prize of $5 each, 200 tickets have a prize of $100 each, 50 tickets have a prize of $1000 each, and 3 tickets have a prize of $10,000 each.

(a) Let x be a random variable that denotes the net amount a player wins by playing this lottery. Write the probability distribution of x.
(b) Find the mean and standard deviation of x.
(c) Interpret the mean in the context of this problem.
11. How can you tell when a random variable follows a binomial distribution?

**Answers to Review Problems**

1. (a) 1.38226624E-6  (b) 0.9999986177  (c) 1.91065996E-12

2. (a) Yes  (b) 0.0599  (c) 0.410  (d) 0.120  (e) No

3. (a) \( _{10}C_4 = 210 \)  (b) \( \frac{3!}{2!1!} \cdot \frac{2!}{1!1!} \cdot \frac{1!}{1!} = 60 \)

4. Not the first because the probabilities don’t add to one, and not the third because it contains a negative probability. The second table has mean = 2 and SD = 1, the fourth table has mean = 1.5 and SD = 0.8660.

5. (a) (b) 0.0873  (c) 6  (d) 0.0078 (use Binomial83)

<table>
<thead>
<tr>
<th>( x )</th>
<th>( P(x) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.9127</td>
</tr>
<tr>
<td>1</td>
<td>0.0847</td>
</tr>
<tr>
<td>2</td>
<td>0.0026</td>
</tr>
<tr>
<td>3</td>
<td>( 2.7 \times 10^{-5} )</td>
</tr>
</tbody>
</table>

6. (a) \( S = \{RR, RG, GR, GG\} \)  (b) 0.533  (c) 0.6

7. (a) Yes  (b) Both events can’t occur at the same time  (c) Shade circle A and circle B  (d) 0  (e) A and B should overlap

8. 0.4

9. (a) 720  (b) 28  (c) 20,160  (d) 720  (e) 10,000  (f) 0.0001  (g) 270,725  (h) 0.0250

10. (a)

<table>
<thead>
<tr>
<th>( x )</th>
<th>( P(x) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td>0.89747 ( (=89747/100,000) )</td>
</tr>
<tr>
<td>3</td>
<td>0.1 ( (=10,000/100,000) )</td>
</tr>
<tr>
<td>98</td>
<td>0.02 ( (=200/100,000) )</td>
</tr>
<tr>
<td>998</td>
<td>( 5 \times 10^{-4} ) ( (=50/100,000) )</td>
</tr>
<tr>
<td>9,998</td>
<td>( 3 \times 10^{-5} ) ( (=3/100,000) )</td>
</tr>
</tbody>
</table>

(b) mean = -0.50 dollars, SD = 59.33 dollars  (c) On average, the players of this game are expected to lose $0.50 per ticket.

11. There are \( n \) identical trials, each trial has exactly two possible outcomes, the probabilities for these outcomes remain constant, and the trials are independent.