Math 247: Test 2   Name: _KEY_

In-class test _____ /80 points   Take home test _____ /20 points

On all problems involving probability, use the <u>correct notation</u> for full credit on the problem.

1. (2 pts) Which of the following numbers could NOT be probabilities? Circle your answer(s).

     a) 2.724   b) 0.043   c) −0.125   d) 0   e) 1

2. (4 pts) Which is an Empirical Probability and which is a Theoretical Probability? Circle your answer.

     a.   You flip a fair coin 100 times and get heads 54 times. You calculate $P(Heads) = \dfrac{54}{100} = .54$

          Empirical   Theoretical

     b.   You calculate the probability of getting a heart in a deck of cards as $P(Heart) = \dfrac{13}{52} = .25$

          Empirical   Theoretical

3. (5 pts) Use your knowledge of the world to determine whether the following events are mutually exclusive:

     A = A person currently lives full time in Mexico.
     B = A person currently lives full time in Canada.
     C = A person was born in the U.S.A.

     A and B are mutually exclusive? YES   NO

     A and C are mutually exclusive? YES   NO

     B and C are mutually exclusive? YES   NO

4. (4 pts) Use your knowledge of the world to label the pairs of these events as independent or associated.

     (a) The outcome of each flip when you flip a coin a coin twice _independent_

     (b) Height of a person and shoe size _associated_

5. (3 pts) If you flip a fair coin and roll a six-sided die, what is the probability you will get Tails on the coin <u>and</u> a 5 on the die?

$$P(T \text{ AND } 5) = P(T) \cdot P(5)$$
$$= \frac{1}{2} \cdot \frac{1}{6} = \frac{1}{12} = .083 = 8.3\%$$

6. (3 pts) The Humane Society of the United States reported that 39% of households own dogs and 33% own cats.

Would it be correct to say that 72% of households own a dog or a cat?   YES, correct   NO, not correct

Explain your answer.

$P(D) = .39$
$P(Cat) = .33$

Some people may own a dog AND a cat

⟶ They would have been included in both groups, so adding the probabilities is wrong, since it double counts those people.

1½ OR means add
1½ double counts

7. (15 pts) A survey of randomly selected adults found that 64% of the men and 52% of the women believe there is intelligent life on other planets.

$P(M) = .64$ $P(W) = .52$

3   a. If M = the event that a man believes, what is $P(M^C)$? $P(M^C) = 1 - .64 = .36$

note: $P(W^C) = 1 - .52 = .48$ $= 36\%$

4   b. If a man and a woman from this group meet, what is the probability that they both believe there is intelligent life on other planets? Use proper notation!

$$P(M \text{ and } W) = P(M) \cdot P(W)$$
$$= (.64)(.52)$$
$$= .333$$
$$= 33.3\%$$

4   c. What is the probability that they both do NOT believe there is intelligent life on other planets? Use proper notation!

$$P(M^C \text{ and } W^C) = P(M^C) \cdot P(W^C)$$
$$= (.36)(.48)$$
$$= .173$$
$$= 17.3\%$$

4   d. What is the probability that one of them believes and one does not believe? Use proper notation!

$$P(M \text{ and } W^C \text{ OR } M^C \text{ and } W)$$
$$= P(M \text{ and } W^C) + P(M^C \text{ and } W)$$
$$= (.64)(.48) + (.36)(.52)$$
$$= .307 + .187$$
$$= .494 = 49.4\%$$

8. (20 pts) The Researchers asked students in grades 4 through 6 in three school districts in Michigan about what they thought was the most important thing in school: making good grades, being popular, or being good in sports. There were rural, suburban, and urban schools surveyed. The table shows the results

	Rural	Suburban	Urban	All
Grades	57	87	103	247
Popular	50	42	49	141
Sports	42	22	26	90
All	149	151	178	478

Express each of the following probabilities as a fraction, a decimal to three decimal places, and a percent.

a. What percentage of all the students think sports are the most important thing in school?

$$P(Sports) = \frac{90}{478} = .188 = \boxed{18.8\%}$$

b. What percentage of the Rural students think that sports are the most important thing in school?

$$P(sports \mid Rural) = \frac{42}{149} = .282 = \boxed{28.2\%}$$

c. Based on your answers to (a) and (b), is there an association between being from a rural school, and thinking sports are most important for this group of kids? Explain your answer.
(Note: Do NOT do a Chi-Square Test here. Just examine your answers from (a) and (b).)

Yes. There is an association! If "Rural" and "Sports" were independent then the percentages of kids who think sports are most important would not change between all kids and just rural kids.

d. What is the probability a student chosen from the entire group is either from a Suburban school _or_ thinks that Grades are most important?

Subtract the overlap

$$P(Sub \ OR \ Grades)$$
$$= P(Sub) + P(Grades) - P(Sub \ AND \ Grades)$$
$$= \frac{151}{478} + \frac{247}{478} - \frac{87}{478} = \frac{311}{478} = .651 = \boxed{65.1\%}$$

e. What is the probability a student is from an Urban school, given that he/she thinks being Popular is most important?

$$P(Urban \mid Popular) = \frac{49}{141} = .348 = \boxed{34.8\%}$$

1 pt numerator

9. (24 points) The data table compares men who chose to regularly view television violence with those who did not, in order to study the difference in physical abuse of spouses. Using the data in the table, do a Chi-Square Hypothesis Test to see whether watching TV violence is associated with spousal abuse. **Use a significance level of .05.**

	High TV Violence	Low TV Violence	Total
Yes, Physical Abuse	$O = 13$ $E = 8.10$	$O = 27$ $E = 31.90$	40
No, Physical Abuse	$O = 18$ $E = 22.90$	$O = 95$ $E = 90.10$	113
Total	31	122	153

$$\hat{E}_{11} = \frac{40 \times 31}{153} = 8.10$$

$$E_{21} = \frac{113 \times 31}{153} = 22.90$$

Others found by subtraction

$$E_{12} = 40 - 8.10 = 31.90$$

$$E_{22} = 113 - 22.90 = 90.10$$

4 (a) Write the Null and Alternative Hypotheses

H_o: There is no association between men watching TV violence and spousal abuse.

H_a: There is an association

3 (b) Find and fill in the expected counts. Show work!

6 (c) Find χ^2 and df by hand. Show work!

$$\chi^2 = \sum \frac{(O-E)^2}{E} = \frac{(13-8.1)^2}{8.1} + \frac{(27-31.9)^2}{31.9} + \frac{(18-22.9)^2}{22.9} + \frac{(95-90.1)^2}{90.1}$$

(4)   (2)

$$\boxed{\chi^2 = 5.03} \quad \boxed{df = 1}$$

$$df = (2-1)(2-1) = 1 \cdot 1 = 1$$

6 (d) The P-value for the Test is .025. Write the conclusion to the hypothesis test.

Conclusion: p-value = .025 < α = .05

(3) Reject H_o, accept H_a

(9) There is statistically significant evidence that there is an association between TV violence and Spousal Abuse.

(You could also say "there is a significant association")

9. (continued)

4 (e) Does this study show that watching TV violence _causes_ men to abuse their spouses? Explain.

No. This was not a controlled experiment **3**
So we cannot conclude cause-and-effect.
(Note: Such an experiment would be completely unethical!)

In a controlled experiment, men would be
randomly placed in the High and Low TV violence
groups, then required to watch such programs.

1pt (f) What is a possible confounder for this study?

A confounder would be anything that connected
to both being drawn to watch violent programs and being
physically abusive.

Possibilities:
Childhood abuse/trauma
~~Genetics - too general~~
Mental illness
Sociopathic tendencies
Etc.
How he was raised (Brad's comment)