

Test _____ /70 points

Take Home _____ 30 points

Show work where necessary in a clear, organized fashion. probabilities and express each as a fraction, a decimal, and a percent Round all answers to three decimal places.

1. (2 pts) Which of the following numbers could be probabilities? Circle all correct answers.

a) 2.051

b) 0

c) 0.325

d) -0.732

e) 1

2. (2 pts) If 28 of 40 people in our class have brown eyes, what is the probability a randomly selected student in the class will not have brown eyes?

$P(\text{not brown}) = \frac{12}{40} = .3 = 30\%$

Alternative approach
 $B = \text{brown}$ $B^c = \text{not brown}$
 $P(B^c) = 1 - P(B) = 1 - \frac{28}{40} = .3$

3. (4 pts) (a) Assuming it is equally likely for a woman to have a boy or a girl baby, what is the probability of her having a boy?

$P(\text{Boy}) = \frac{1}{2} = .5 = 50\%$

What type of probability is this? (circle one)

Empirical

Theoretical

(b) The births in a large city in one year revealed that out of 100 births, 46 of them were boys. According to this result, what is the probability that a woman had a boy in that city?

$P(\text{boy}) = \frac{46}{100} = .46 = 46\%$

What type of probability is this? (circle one)

Empirical

Theoretical

4. (2 pts) Use your knowledge of the world to determine whether the following events are independent or associated:

(a) Being a basketball player in the NBA; being taller than average.

INDEPENDENT

ASSOCIATED

(b) The outcomes (heads or tails) on the flip of two separate coins:

INDEPENDENT

ASSOCIATED

5. (3 pts) Suppose Event A is that a person is taking a statistics exam. Give an example of another event, Event B, that is mutually exclusive to Event A.

Event B = The person is sleeping (answers will vary)

Favorite student answers: Riding a cow, surfing at the Rock, in a coma (!), swimming in a pool, hiking Bishop's Peak, dancing on a stage, playing a guitar...

jet skiing in the Bahamas, climbing the Tetons, giving birth

6. (4 pts) The probability that a fair coin lands heads is 0.5. Therefore, we can be sure that if we toss a coin a large number of times (say, 10,000 times), the proportion of times it lands heads will (circle your answer)

- 2 (a) be close to 0.5 (b) be equal to 0.5 (c) be greater than 0.5 (d) can't tell

What is the name of the Law that supports your answer above?

2 The Law of Large Numbers

7. (12 pts) This year, (2019), Pew Research found that 90% of all U.S. adults use the internet.

3 (a) If two unrelated U.S. adults are randomly selected, what is the probability that both of them use the internet?

$$\begin{aligned} I &= \text{uses internet} \\ P(I) &= .9 \\ P(I_1 \text{ and } I_2) &= P(I_1) \cdot P(I_2) \\ &= (.9)(.9) = .81 = 81\% \end{aligned}$$

3 (b) What is the probability that neither of them use the internet?

$$\begin{aligned} P(I^c) &= .1 \\ I^c &= \text{no internet} \\ P(I_1^c \text{ and } I_2^c) &= P(I_1^c) \cdot P(I_2^c) \\ &= (.1)(.1) = .01 = 1\% \end{aligned}$$

4 (c) What is the probability that exactly one of them use the internet?

$$\begin{aligned} P(I_1 \text{ and } I_2^c \text{ OR } I_1^c \text{ and } I_2) &= (.9)(.1) + (.1)(.9) \\ &= .09 + .09 = .18 = 18\% \end{aligned}$$

2 (d) In the same study, Pew Research found that only 75% of adults in rural areas use the internet. This tells us

that internet use and the area a US adult lives are most likely (circle one) INDEPENDENT ASSOCIATED

8. (6 pts) Let's define "I" to be the event that a person uses Instagram.

1 (a) What does P(I) mean? The probability that a randomly selected person uses Instagram

2 (b) What is the complement for event I?

$I^c =$ the event someone does not use Instagram.

4 (c) If $P(I) = .78$ for college students, what is $P(I^c)$ and what does it mean?

$P(I^c) = 1 - .78 = .22 = 22\%$
This means the probability a college student does not use Instagram is 22%.

9. (3 pts) A Gallup Poll from 2009 estimated that 83% of all US adults thought that nurses had high or very high ethical standards. If this rate is still correct and there was a new poll of 5000 people, how many would you expect to say nurses have high or very high ethical standards?

Expect 83% of 5000

$$E = (.83)(5000) = 4150$$

We'd expect about 4150 people to say nurses have high or very high ethics.

10. (7 pts) A deck of cards has 52 cards, 4 suits (heart, diamonds, spades, and clubs) and 13 kinds (2 – 10, jack, queen, king, ace). If you pick one card at random from the deck, find the following:

(a) The probability the card is a queen. $P(\text{queen}) = \frac{4}{52} = .077 = 7.7\%$

(b) The probability the card is a heart. $P(\heartsuit) = \frac{13}{52} = .25 = 25\%$

- (c) The probability the card is a queen or a heart. $Q = \text{queen}$

$$\begin{aligned} P(Q \text{ OR } \heartsuit) &= P(Q) + P(\heartsuit) - P(Q \text{ and } \heartsuit) \\ &= \frac{4}{52} + \frac{13}{52} - \frac{1}{52} \\ &= \frac{16}{52} = .308 = 30.8\% \end{aligned}$$

10. (10 pts) Suppose you have a bag with 5 yellow marbles, 11 red marbles, and 4 blue marbles. Find the following.

$$\text{Total} = 20 \text{ marbles}$$

- (a) If you choose one marble,

- i. what is the probability it will be blue?

$$P(\text{blue}) = \frac{4}{20} = .2 = 20\%$$

- ii. What is the probability it will be blue or red?

$$\begin{aligned} P(\text{blue OR red}) &= \frac{4}{20} + \frac{11}{20} \\ &= P(\text{blue}) + P(\text{red}) = \frac{15}{20} = .75 = 75\% \end{aligned}$$

- (b) If you choose two marbles **with replacement**, what is the probability both will be yellow?

$Y = \text{yellow}$ $P(Y_1 \text{ and } Y_2)$

$$= \frac{5}{20} \cdot \frac{5}{20} = .0625 = 6.25\%$$

- (c) If you choose two marbles **without replacement**, what is the probability both will be yellow?

$$\begin{aligned} P(Y_1 \text{ and } Y_2) \\ = \frac{5}{20} \cdot \frac{4}{19} = .0526 = 5.26\% \end{aligned}$$

11. (15 pts) A 2019 study investigating vaping and sleep disturbance (not sleeping well) used a sample of 274 women who responded to the questions of "Do you vape (yes/no)", and "Do you have sleep disturbances (yes/no)". A summary of their answers is given in the table below:

S = sleep disturb.
 V = vape
 V^c = no vape.

Vape?	Sleep Disturbance?		Total
	No	Yes	
No	104	60	164
Yes	32	78	110
Total	136	138	274

1 (a) What type of study is this (circle one)? OBSERVATIONAL CONTROLLED EXPERIMENT

1 (b) What is the research question for this study?

*Is vaping associated with sleep disturbance?
 (linked to)*

Note: The question is NOT does vaping CAUSE sleep disturbance!

3 (c) What is the probability a randomly chosen person from the study has sleep disturbances?

$$P(S) = \frac{138}{274} = .504 = 50.4\%$$

(so about half the participants had sleep disturbances.)

3 (d) What is the probability a person has sleep disturbances, given that she vapes?

$$P(S | V) = \frac{78}{110} = .709 = 70.9\%$$

(Wow, much higher rate of sleep disturbance in the vaping group!)

3 (e) What is the probability a person has sleep disturbances, given that she doesn't vape?

$$P(S | V^c) = \frac{60}{164} = .366 = 36.6\%$$

3 (f) Are vaping and sleep disturbances associated or independent in this group? Explain, and include the percentages you found in the answers above in your explanation.

YES, Vaping and sleep disturbance are definitely associated!

The percentage of vapers with troubled sleep was much higher than for the overall group (70.9% vs. 50.4%) while the non-vapers had a lower percent of women with sleep disturbance (36.9% vs 50.4%).

Note that anxiety is a major confounder here:

