Typos: #14 "Humphrey" = "Dallas"
#16(e) "part (d)"

Math 247: Test 2 (Spring, 2019) **Name:** KEY

_____/100 **Class Time:** _____

Show work where necessary in a clear, organized fashion. Breath…you've got this!

1. (3 pts) Which of the following numbers could be probabilities? Circle all correct answers.

[a) 0.724] b) 1.043 [c) 0.125] d) -0.432 [e) 1]

2. (4 pts) (a) Assuming it is equally likely for a woman to have a boy or a girl baby, what is the probability 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 1000 births, 510 of them were boys. **According to this result**, what is the probability that a woman had a boy in that city?

$P(\text{boy}) = \frac{510}{1000} = .51 = 51\%$

What type of probability is this? (circle one) (Empirical) Theoretical

3. (3 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)

(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?

The Law of Large Numbers

4. (4 pts) What is the complement for each of the following events? Write a sentence for each.

(a) R = It will rain tomorrow.

R^C = It will not rain tomorrow

(b) A = At least one of a group children (in a study) will develop a disease.

A^C = None of the children will develop the disease.

5. (2 pts) Determine which of the following variables is continuous and which is discrete (circle the answer):

veces - instances

X = the number of times a student takes the bus to Cuesta per week. (DISCRETE) CONTINUOUS

tiempo - clock time

X = the time a student takes to finish an exam DISCRETE (CONTINUOUS)

6. (3 pts) Suppose Event A is that a person is sleeping. Give an example of another event, Event B, that is **mutually exclusive** to Event A. ANSWERS WILL VARY...

(see back of test)

Event B = A person is taking a Stats exam!

Note: Complements are always mutually exclusive!

7. (4 pts) Let S be the event that a Cuesta student has taken a Statistics course, and let V be the event that a Cuesta student is a veteran. Suppose 32% of all Cuesta students have taken a Statistics course, 4% of all Cuesta students are veterans, and 2% of Cuesta students are veterans and have taken a Statistics course.

Find the probability that a randomly selected Cuesta student has taken Statistics OR is a veteran.

$P(S \text{ OR } V) = P(S) + P(V) - P(S \text{ and } V)$

$= .32 + .04 - .02$

$= .34 = 34\%$

2 pts

$P(S) = .32$

$P(V) = .04$

$P(S \text{ and } V) = .02$

8. (12 pts) Suppose you have a bag with 2 yellow marbles, 5 red marbles, and 3 blue marbles. Find the following probabilities and express each as a fraction, a decimal, and a percent.

6 (a) If you choose one marble,

i. what is the probability it will be blue? $P(\text{blue}) = \frac{3}{10} = .3 = 30\%$

ii. What is the probability it will be red? $P(\text{red}) = \frac{5}{10} = .5 = 50\%$

iii. What is the probability it will be red or yellow? $P(\text{red OR yellow})$

$= P(\text{red}) + P(\text{yellow}) = .5 + .2 = .70$

$= 70\%$

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

$P(Y_1 \text{ and } Y_2) = \frac{2}{10} \cdot \frac{2}{10} = \frac{4}{100} = .04 = 4\%$

and + mult - 4pts

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

$P(Y_1 \text{ and } Y_2) = \frac{2}{10} \cdot \frac{1}{9} = \frac{2}{90} = .022 = 2.2\%$

9. (3 pts) Use your knowledge of the world to determine whether the following events are independent:

A = a person is a good swimmer B = a person plays water polo C = a person drives a white car

Which of the following is reasonable to conclude? (Circle all correct answers)

A and B are independent A and C are independent B and C are independent

10. (12 pts) A student doing a report on study habits, gave a survey to 100 college students, majoring either in science or something other than science were asked whether they listen to music while studying. The results of the survey are summarized in the table:

	Listen	Do Not Listen	Total
Science	12	39	51
Not Science (Science^C)	20	29	49
Total	32	68	100

a) What percentage of students in this sample listen to music while studying?

$P(\text{listen}) = \frac{32}{100} = .32 = 32\%$

b) What is the probability that student listens to music, given that they are a science major?

$P(\text{listen} \mid \text{science}) = \frac{12}{51} = .235 = 23.5\%$

decimals in (b) (c) = 2 points

c) What is the probability that student listens to music, given that they are a not science major?

$P(\text{listen} \mid \text{science}^C) = \frac{20}{49} = .408 = 40.8\%$

A good follow-up - this is not a causal link!

d) Is there an association between major and music-study preference in this sample of students? For full credit, explain your answer *using the numbers you found in a, b, and c*.

Yes, there is an association! A lower percentage of science majors (23.5%) listen to music as compared to the overall percentage (32%). As well, the higher percentage of non-science majors listen to music (40.8%) as compared to the overall percentage. This tells us that major matters when it comes to music-study preference.

11. (2 pts) Explain why the following is not a probability distribution:

X	0	1	2	3
P(X)	.20	.25	.15	.10

$\Rightarrow \Sigma P(x) = .70 \neq 1$

The probabilities don't add up to 1!

12. (12 pts) If you roll a fair, six-sided die,

(a) What is the sample space? $\{1, 2, 3, 4, 5, 6\}$ (sample space = all possible equally likely outcomes)

(b) What is the probability of rolling a five?

$P(\text{five}) = \frac{1}{6} = .167 = 16.7\%$

(c) What is the probability of rolling an eight?

$P(\text{eight}) = \frac{0}{6} = 0 = 0\%$

(d) If X = the number of spots on the die (i.e., what what you rolled), set up a probability distribution for this random variable:

X	1	2	3	4	5	6
P(X)	.167	.167	.167	.167	.167	.167

(e) Graph the probability distribution:

(f) What is the shape of this distribution? (Circle one answer)

Symmetric Skewed Bimodal (Uniform)

13. (10 pts) A survey found that 60% of adults believe there is life on other planets. Suppose two people, Sarahi and Victor, meet. $P(\text{believe}) = .6$ $P(\text{believe}^C) = .4$

3 (a) What is the probability that both Sarahi and Victor believe there is life on other planets.

$P(\text{both}) = P(\text{believe}^{(S)} \text{ AND believe}^{(V)})$

$= (.6)(.6)$

$= .36 = 36\%$

3 (b) What is the probability that neither will believe this?

$P(\text{neither}) = (\text{believe}^{C(S)} \text{ AND believe}^{C(V)})$

$= (.4)(.4)$

$= .16 = 16\%$

4 (c) What is the probability that exactly one (one **or** the other) will believe this?

$P(\text{believe}^{(S)} \text{ AND believe}^{C(V)} \text{ OR believe}^{C(S)} \text{ AND believe}^{(V)})$

$= (.6)(.4) + (.4)(.6)$

$= .24 + .24 = .48 = 48\%$

14. (8 pts) Two tests used for admission to Medical School and to Law School are the MCAT and LSAT, respectively. The scores on these exams are adjusted so they are normally distributed. Suppose Emily, a pre-med major, and Dallas, a pre-law student, took these exams and were comparing their scores.

The mean MCAT score is 25 with a standard deviation of 6.4. Emily scored a 39.

The mean LSAT score is 150, with standard deviation of 11. and ~~Humphrey~~ Dallas scored a 173.

Whose score was highest, relative to their exam? (For credit, you have to show work that supports your answer)

Work:

Emily MCAT

$\mu = 25$ ($\bar{x}$ okay)

$\sigma = 6.4$ (s okay)

$X = 39$

$Z = \frac{39 - 25}{6.4}$

$Z = 2.1875$

Dallas LSAT

$\mu = 150$

$\sigma = 11$

$X = 173$

$Z = \frac{173 - 150}{11}$

$Z = 2.0909$

(Circle the answer): Dallas's score is relatively higher

Emily's score is relatively higher

15. (3 pts) Suppose a patient has a white blood cell count with a z-score of 2.8. What can you deduce from this (just regarding the white blood cell count) and would it be a cause for concern.

This z-score indicates the patient's WBC count is 2.8 S.D.'s above the mean which is very, very unusually high. This is definitely a cause for concern since WBC's are produced because of infection.

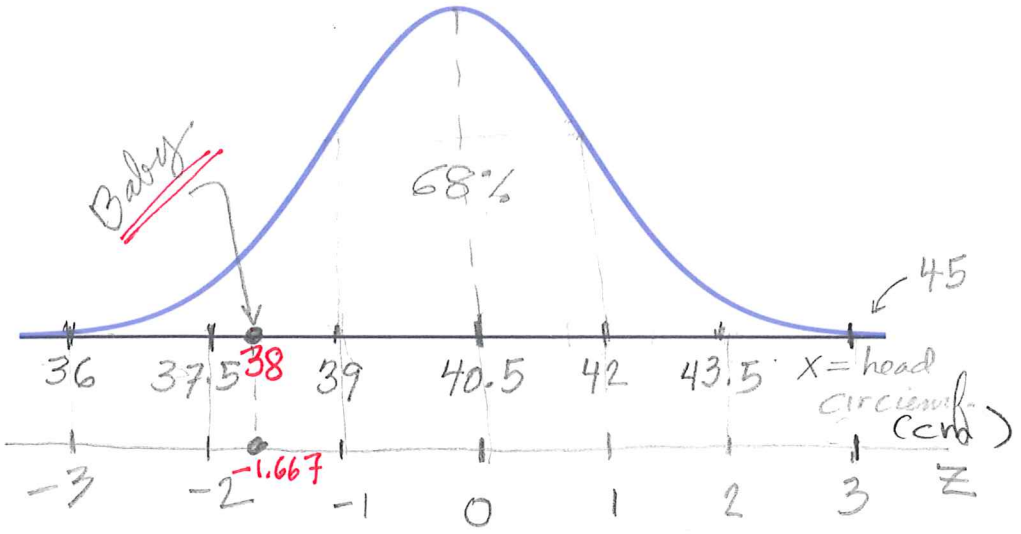
16. (15 pts) The average head circumference of 3-month-old female infants is 40.5 centimeters with a standard deviation is 1.5 centimeters. Assume head circcumferences are symmetrically distributed.

4 (a) Sketch a well-labeled normal distribution curve, with the x-axis labeled, showing the distribution of head circumferences.

$\mu = 40.5$ cm

$\sigma = 1.5$ cm

3 (b) Sketch the z-axis beneath and label it.



3 (c) Between what two values should about 68% of the head circumferences fall?

Between 39cm and 42cm

3 (d) Find the z-score for the baby girl with a head circumference of 38 cm. Interpret the z-score in the context of the situation.

$x = 38$

$$Z = \frac{38 - 40.5}{1.5}$$

$$Z = -1.667$$

The baby girl's head circumference is 1.667 standard deviations below the mean. This is less common but not very unusual.

2 (e) "Microcephaly" is a defined as a baby having a head circumference of more than 2 standard deviations from the mean. Does the baby from part (d) have microcephaly? (Circle the correct answer.)

(a) Yes, based on the z-score, this infant has microcephaly
(b) No, based on the z-score, this infant does not have microcephaly
(c) Can't tell since the z-score doesn't tell us anything about standard deviations.