

Unit 2 Challenge Problems

Module 4

1.	A fair, six-sided die is rolled. Describe the sample space S, identify each of the following events with a subset of S and compute its probability (an outcome is the number of dots that show up). a) Event A = the outcome is two. b) Event B = the outcome is less than four. c) The complement of B. d) A GIVEN B e) B GIVEN A f) A AND B g) A OR B									
2.	The describes the distribution of a random sample S of 100 individuals, organized by gender and whether they are right- or left-handed. <table><tr><td></td><td>Right-handed</td><td>Left-handed</td></tr><tr><td>Males</td><td>43</td><td>9</td></tr><tr><td>Females</td><td>44</td><td>4</td></tr></table> Let's denote the events M = the subject is male, F = the subject is female, R = the subject is right-handed, L = the subject is left-handed. Compute the following probabilities: a) $P(M)$ b) $P(R)$ c) $P(M \text{ and } R)$ d) $P(L \text{ or } F)$ e) $P(R \mid F)$ f) $P(F \mid R)$ g) $P(M \mid L)$		Right-handed	Left-handed	Males	43	9	Females	44	4
	Right-handed	Left-handed								
Males	43	9								
Females	44	4								
3.	A box has two balls, one white and one red. We select one ball, put it back in the box, and select a second ball (sampling with replacement). Find the probability of the following events: a) Let F = the event of getting the white ball twice. b) Let G = the event of getting two balls of different colors. c) Let H = the event of getting white on the first pick. d) Are F and G mutually exclusive?									
4.	Let event G = taking a math class. Let event H = taking a science class. Then, G AND H = taking a math class and a science class. Suppose $P(G) = 0.6$, $P(H) = 0.5$, and $P(G \text{ AND } H) = 0.3$. Are G and H independent? If G and H are independent, then you must show ONE of the following: $P(G H) = P(G)$ $P(H G) = P(H)$ $P(G \text{ AND } H) = P(G)P(H)$									
5.	In a basketball arena, 70% of the fans are rooting for the home team. 25% of the fans are wearing blue. 20% of the fans are wearing blue and are rooting for the away team. Of the fans rooting for the away team, 67% are wearing blue. <i>Let A be the event that a fan is rooting for the away team. Let B be the event that a fan is wearing blue.</i> Are the events of rooting for the away team and wearing blue independent? Are they mutually exclusive?									

6. Suppose a study of speeding violations and drivers who use cell phones produced the following fictional data:

	Speeding violation in the last year	No speeding violation in the last year	Total
Uses cell phone while driving	25	280	305
Does not use cell phone while driving	45	405	450
Total	70	685	755

- Find $P(\text{Driver is a cell phone user})$.
- Find $P(\text{driver had no violation in the last year})$.
- Find $P(\text{Driver had no violation in the last year AND was a cell phone user})$.
- Find $P(\text{Driver is a cell phone user OR driver had no violation in the last year})$.
- Find $P(\text{Driver is a cell phone user GIVEN driver had a violation in the last year})$.

7. The contingency table shows a random sample of 100 hikers and the areas of hiking they prefer. Complete the contingency table and create four different probability problems.

Sex	The Coastline	Near Lakes and Streams	On Mountain Peaks	Total
Female	18	16	—	45
Male	—	—	14	55
Total	—	41	—	—

Module 5

1. Suppose that you are in charge of a raffle for a youth organization in which you are given \$20,000 in prizes.
- a) Decide how many prizes you want to give and how much each prize will be worth. The total should be worth \$20,000.
- b) Create a probability distribution (as a table) to summarize the probability of winning each prize. Assume you will sell 2500 raffle tickets and that you want to charge \$10 per ticket.
- c) Use the table in question 2 to calculate the expected value of each raffle ticket. Based on this answer, does the youth organization make or lose money with the raffle?
- d) If the raffle had the goal of making \$30,000 in profit, how much should each ticket be sold for?

2. Based on your understanding of college students, you will estimate the number of students who work the following number of hours per week while attending college full-time. Assume you randomly survey 100 students, complete the table on the left based on your own estimates of how many students work those amount of hours.

Number of Hours per Week	Number of Students		x	P(x)
0 hours				
1-10 hours				
11-20 hours				
21-30 hours				
Over 30 hours				

Using the table you created, complete the probability distribution for the number of hours a college student works (x) while going to school full time.

Assume I select a student at random:

- a) What is the probability that the student works 0 hours?
- b) What is the probability that the student works any amount of hours?
- c) What is the probability the student works at least 11 hours?
- d) What is the probability that a student works at most 20 hours?
- f) Is it unusual to find a student who works over 30 hours?

Module 6

1.	A study was conducted to determine whether there were significant differences between medical students admitted through special programs (such as retention incentive and guaranteed placement programs) and medical students admitted through the regular admissions criteria. It was found that the graduation rate was 92.9% for the medical students admitted through special programs. a) If 12 of the students from the special programs are randomly selected, find the probability that at least 11 of them graduated. b) If 12 of the students from the special programs are randomly selected, find the probability that exactly 9 of them graduated. c) Would it be unusual to randomly select 12 students from the special programs and get exactly 9 that graduate? Explain. d) If 12 of the students from the special programs are randomly selected, find the probability that at least 3 of them DO NOT GRADUATE. Would this be an unusual event?
2.	<u>Read the short article by Walter Frick, 3 Ways to Improve Your Decision Making.</u> Think of a situation in your life where you want to make a good decision. Now consider a quantitative variable related to your situation where knowing the expected value can help you make a more informed decision. Include the following in your response: 1. Describe the quantitative variable in context. For example, when playing the lottery, one may state that the quantitative variable is the amount of money won, after the cost of the ticket is subtracted. 2. Explain how the ideas of the article and knowing the expected value of this variable can help you make a more informed decision.

Module 7

1.	The scores on a college entrance exam have an approximate normal distribution with mean, $\mu = 52$ points and a standard deviation, $\sigma = 11$ points. a) About 68% of the y values lie between what two values? These values are _____. The z-scores are _____, respectively. b) About 95% of the y values lie between what two values? These values are _____. The z-scores are _____, respectively. c) About 99.7% of the y values lie between what two values? These values are _____. The z-scores are _____, respectively.
2.	In the United States the ages of smartphone users approximately follow a normal distribution with approximate mean and standard deviation of 34.1 years and 12.8 years, respectively. Write answers in probability notation and draw the normal distribution with the given parameters. a) Determine the probability that a random smartphone user is between 13 and 64 years old. b) What is the probability that the age of a randomly selected smartphone user in the range is less than 13 years old OR older than 64? c) Twenty percent of smartphone users are less than what age? (Hint: this is the 20th percentile) d) Based on this distribution, would it be considered unusual to have a smartphone user be more than 65 years old?

Module 8

1.	In a recent study reported on the Flurry Blog, the mean age of Facebook users is 34 years. Suppose the standard deviation is 15 years. Take a sample of size $n = 100$. a) What are the mean(μ_x) and standard deviation (σ_x) for the sample mean ages of Facebook users? b) What does the distribution look like, draw it? c) Find the probability that the sample mean age is more than 30 years (the reported mean age of Facebook users in this particular study). d) Find the 95th percentile for the sample mean age (to one decimal place).
2.	The proportion of students who view class lecture videos is 55%. We randomly take a sample of 60 students. a) What is the mean and standard deviation of the distribution of sample proportions? b) What is the probability that $\hat{p}$ is more than 10% away from the true proportion. c) There is an 80% chance we find between _____ and _____ of the sample who view the lecture videos.