GER1000 2018 Sem 1
Quiz 8 solutions

1. When a die is rolled, the top side can show 1, 2, 3, 4, 5 or 6 dots. Suppose you toss a die five times and in exactly three times, the top side shows 4 dots. You wish to test the null hypothesis that the die is fair, against the alternative hypothesis that it is more likely to show 4 dots than any other outcome. In order to calculate the p-value, which of the following events should be used?

   a. Getting “4 dots” 1, 2 or 3 times

   b. Getting “4 dots” 0, 1, 2, or 3 times

   c. Getting “4 dots” 3 times

   d. Getting “4 dots” 3, 4 or 5 times

   e. Getting “4 dots” 4 or 5 times

   Explanation: Answer is d. To compute the p-value, we use outcomes that are equally or more extreme than the observed event, based on the assumption that the null hypothesis is true. For this case, the observed event is “4 dots exactly 3 times”. More extreme events are getting "4 dots" either 4 or 5 times. See Chapter 6 unit 4 slide 4.

2. Refer to Chapter 6 unit 4 slide 9. Suppose that now 6 patients took the new drugs and 1 of them dies of the disease. What is the p value in this case?

   a. 0.0778

   b. 0.0467

   c. 0.2333

   d. 0.1866

   Explanation: Answer is c. The p-value is the probability of the outcomes equivalent to (5 out of the 6 patients survived) and more extreme than the observed (6 out of the 6 patients survived). The probability that 5 out of 6 patients survived is 6 x (0.6 x 0.6 x 0.6 x 0.6 x 0.6 x 0.4) = 0.1866. (Note that we need to multiply by 6 as there are 6 equivalent cases: the patient that did not survive can be any one of the 6.) The probability that 6 out of 6 patients survived is 0.6 x 0.6 x 0.6 x 0.6 x 0.6 x 0.6 = 0.0467.

   So the p-value is 0.1866 + 0.0467 = 0.2333.

3. After an exam, a teacher observed that among the 100 students who failed the exam, 35 of them did not have tuition. Which of the following interpretations is correct?

    a. A student who did not have tuition has a 35% chance of failing the exam

    b. A student who did not have tuition has a 65% chance of passing the exam

    c. A student who had some tuition has a higher chance of failing the exam than a student who did not have any tuition.

    d. A student who failed the exam has a 65% chance of having had some tuition.

    Explanation: Answer is d.
    We can interpret the observation as P(no tuition | fail exam) = 35%. Therefore, P(tuition | fail exam) = 100% - 35% = 65%.
    The observation does not mean P(fail exam | no tuition) = 35%, which is “A student who did not have tuition has a 35% chance of failing the exam”, and also P(pass exam | no tuition) = 65%, which is the other statement starting with “A student who did not …”.
    The remaining option translates to “P(fail exam | tuition) > P(fail exam | no tuition)”, but we have no information about either probability.

4. This question uses the following contingency table:

	Smoker	Non-smoker	Row Total
Female	800	650	1450
Male	1000	550	1550
Column Total	1800	1200	3000

    What is the probability that a randomly selected person is male, given that the person smokes?

    a. 0.645
    b. 0.556
    c. 0.458
    d. 0.444

    Explanation: Answer is b. We can obtain this conditional probability by calculating “rate”. That is, since rate(male | smoker) = 1000/1800 x 100% = 55.6%, we have P(male | smoker) = 0.556. See Chapter 6 unit 5 slide 13.

5. The disease Pompe affects 2 in every 1000 children in a certain town. Recently every child in the town underwent a new test for this disease. The sensitivity of the test is 95%. Among those children who does not have the disease, 90% are tested negative. What is the probability that a child in this town does not have Pompe, given that he/she is tested negative?

   a. 0.9000

   b. 0.9999

   c. 0.0001

   d. 0.1000

   Explanation: Answer is b. We are given that the base rate = 0.002, sensitivity = 0.95 and specificity = 0.9. Let us suppose the town has 10,000 children. We can form the contingency table below (see Chapter 6 unit 6 slide 8):

	Tested positive	Tested negative	Row Total
Pompe	19	1	20
No Pompe	998	8982	9980
Column Total	1017	8983	10000

   Thus P(no Pompe | tested negative) = 8982/8983 = 0.9999.