

Math 480 HW 2 2022. Due Wed. Sept. 7. No class Labor Day M Sept. 5. Problems 2) and 3) may be useful for Quiz 1 on Friday, Sept. 2.

DO NOT place solutions side by side. **7 problems 2 pages**

YOU ARE BEING GRADED FOR WORK NOT JUST THE FINAL ANSWER. As a rule of thumb, you should have some idea of what you were doing, even without the book. You are encouraged to form groups to discuss ideas and HW problems, but do not copy.

1) Questionnaires that ask embarrassing questions tend to be answered untruthfully. One strategy to improve the quality of the answers is the following. Suppose the questionnaire asks the person whether they have shop lifted in the past year. The person flips a fair coin. If the coin lands heads, then the person checks “yes”. If the coin lands tail, the person answers truthfully. Suppose that 8% of the people who fill out the questionnaire have shoppedlifted in the past year (event E). Let F = “coin toss was heads.” What is the probability that a randomly selected person checks “yes”? (Hint: events E and F are independent, do not count $P(E \cap F)$ twice.)

2) A personnel director for a company has hired ten new engineers. If three distinctly different positions open at the Cleveland plant, how many ways can she fill the positions? Hint: Distinct positions so this is a permutation.

3) A fleet of nine taxis is to be dispatched to three airports in such a way that three go to airport A, five go to airport B and one goes to airport C. In how many distinct ways can this be done? Hint: Combines the multiplication principle rule with combinations. Let the 1st slot be “A taxis,” the 2nd slot “remaining taxis for B,” and the third slot “remaining taxis for C.”

4) Suppose $P(E) = 0.5$, $P(F) = 0.4$, and $P(E \cup F) = 0.7$.

a) Find $P(E \cap F)$.

b) Find $P(E|F)$.

c) Find $P(\overline{F})$.

d) Are E and F independent? Explain.

5) For a certain population of employees the percentage passing or failing a job competency exam, listed according to sex, were as shown in the table below. That is, of all the people taking the exam, 24% were in the male-pass category, 16% were in the male-fail category, and so forth. An employee is to be selected randomly from this population. Let A be the event that the employee scores a passing grade on the exam, and let M be the event that a male is selected. Are the events A and M independent? Are the events $\overline{A}$ and F independent?

outcome	Male(M)	Female(F)	total
Pass(A)	24	36	60
Fail($\overline{A}$)	16	24	40
total	40	60	100

6) A study of posttreatment behavior of a large number of drug abusers suggests that the likelihood of conviction within a 2-year period after treatment may depend on the offenders education. The proportions of the total number of cases falling in four education-conviction categories is tabled below.

Education	status within 2 years after treatment			totals
	convicted	not convicted		
10 years or more	0.10	0.30		0.40
9 years or less	0.27	0.33		0.60
totals	0.37	0.63		1.00

Suppose a single offender is selected from the treatment program. Define the events A: The offender has 10 or more years of education. B: The offender is convicted within 2 years after treatment.

Find a) $P(A)$ b) $P(AB)$ c) $P(A \cup B)$ d) $P(\overline{A \cup B})$ e) $P(A|B)$

comment: Assume that the person is randomly selected so that the proportions are probabilities. Recall that AB means “A intersect B.” Show work for c), d), and e).

7) Suppose that only one in 100 adults is afflicted with a rare disease for which a diagnostic test has been developed. If the individual actually has the disease, a positive test result will occur 97% of the time. If the individual does not have the disease, a positive result will occur only 4% of the time. Let A_1 = “individual has the disease.” Let E = “the test result is positive.”

- a) Find the probability that a randomly selected individual does not have the disease.
- b) Find the probability that the test is positive given that the individual does not have the disease.
- c) Find the probability that the individual has the disease given that the test result is positive. Hint: Use Bayes’ rule.

From my webpage, use Some Links for SIU Students:
(<http://parker.ad.siu.edu/Olive/students.htm>).

One link describes the SIU actuarial program: (Here is information about useful math courses for students who want to become actuaries)
(<http://parker.ad.siu.edu/Olive/sactuarial.pdf>).

Another link is for useful texts and links to online texts and notes. (Here is a list of math and statistics texts)
(<http://parker.ad.siu.edu/Olive/sref.pdf>).

Carol Ash’s website (<https://faculty.math.illinois.edu/~ash/>) has good notes for advanced calculus, differential equations, discrete math, and linear algebra. The discrete math notes chapter 1, and chapter 1 solutions are good for combinatorics (counting for probability).