

**The University of Portland
Donald P. Shiley School of Engineering**

**EGR361
Analysis of Engineering Data**

HOMEWORK 3—Random Variables and Probability

Assigned: Monday, January 29, 2018
Due: Monday, February 5, 2018
Text: 3-1, 3-2, 3-3
Midterm Exam: Friday, March 2, 2018 (closed-book, 1 crib-sheet, calculator)

Problems:

- 1) Text, 3-12 (page 65) 2) Text, 3-16 (page 65)
- 3) Text, 3-19 (page 65)
- 4) A survey involving 1000 random customers at a fast-food restaurant indicates that 718 customers ordered hamburgers, 585 ordered soft drinks, and 448 ordered both. Let event A be a customer ordering hamburger and event B be a customer ordering soft drink. Construct a Venn Diagram and calculate the following:
 - a) Find $P(A)$ and $P(B)$
 - b) Find $P(A^c)$ and $P(B^c)$
 - c) Find $P(A \cap B)$ and $P(A \cup B)$
 - d) Find $P(A|B)$ and $P(B|A)$
 - e) Are the events A and B mutually exclusive?
 - f) Are the events A and B independent?
- 5) Consider rolling two fair dice simultaneously and let A be the event of getting a prime-number sum, B be the event of getting of a Fibonacci-number sum, and C be the event of a square-number sum. Construct a Venn Diagram and calculate the following:
 - a) Find $P(A)$, $P(B)$, and $P(C)$
 - b) Find $P(A^c)$, $P(B^c)$, and $P(C^c)$
 - c) Find $P(A \cup B)$, $P(A \cup C)$, and $P(B \cup C)$
 - d) Find $P(A \cap B)$, $P(A \cap C)$, and $P(B \cap C)$
 - e) Find $P(A \cup B \cup C)$ and $P(A \cap B \cap C)$
 - f) Find $P(A|B)$, $P(B|A)$, and $P(C|B)$
 - g) Find $P(A|(B \cap C))$ and $P(A|(B \cup C))$
 - h) Are the events A, B and C mutually exclusive? If no, are any two of the three events mutually exclusive?
 - i) Are the events A, B and C independent? Are any two of the three events independent?
- 6) If three cards are randomly drawn from a standard card deck, find the probability of drawing:
 - a) Three face cards (i.e., any combination of Jack, Queen, and King)
 - b) Three same face-value cards (e.g., three 7's or three Aces)
 - c) Three same suit cards (e.g., three hearts)
- 7) A bag contains 10 identical balls labeled with letters A to J.
 - a) If two balls are drawn randomly, what is the probability that they both have vowel letters?

- b) If the two balls are drawn randomly, what is the probability that they both have consonant letters?
- c) If the two balls are drawn randomly, what is the probability that one has a vowel letter and the other has a consonant letter?
- 8) What is the probability that any two of the three randomly selected people are not born on the same day of the year? (Assume all three births to be independent events and neglect leap years.)
- 9) At a high school, 117 students play basketball, 124 play soccer, 76 students play volleyball, 26 students play both basketball and soccer, 41 students play both basketball and volleyball, 34 students play both soccer and volleyball, 5 students play all three sports, and 59 students are not involved in any of these three sports. Construct a Venn diagram and calculate the following: a) The probability that a student who plays soccer also plays volleyball. b) The probability that a student who plays volleyball also plays basketball. c) The probability that a student who plays basketball and volleyball also plays soccer.
- 10) A survey at a fitness club shows that 85% of the members use the treadmill and 35% of the members use the treadmill and weightlifting equipment. What percentage of those who use treadmill also use weightlifting equipment?
- 11) Six couples (6 men and 6 women) order hot drinks at a coffee shop. Five men each order coffee and the sixth man orders tea. Four of the six women order tea and the other two women order coffee. Find the following:
- a) The probability that a man orders tea.
- b) Find the probability that a person who orders tea is a woman.
- c) Find the probability that a woman orders tea.
- 12) Due to economic downturn, a high-tech company lays off some of their employees. The following table summarizes their layoffs:

| Employee | Laid off | Not laid off | Total |
|-----------|----------|--------------|-------|
| Engineers | 412 | 925 | 1337 |
| Managers | 133 | 188 | 321 |
| Total | 545 | 1113 | 1658 |

- a) Find the probability that an engineer gets laid off.
- b) Find the probability that a manager doesn't get laid off.

Resources for further reading:

<https://www.mathsisfun.com/data/random-variables.html>

<https://www.mathsisfun.com/data/probability-events-mutually-exclusive.html>