ENRE 447 Homework 1

Problems are very similar to the book problems from Modarres & Groth 2023 (problem number in brackets). In some cases I have modified the problem slightly. In case of differences, solve the problem as written on this assignment. Approved software ok, open everything. All policies of course syllabus and grading rubric apply.

1. Select a system and application that you are familiar with (e.g., I might select a hydrogen fueling station). In 2-3 paragraphs, please:
    a. Briefly describe the system & define its mission
    b. List 3 potential benefits / value of formally analyzing reliability.

2. [1.2] Discuss the relationship between reliability and failure, both in words and mathematically.

3. Let $A = \{-2,0,1\}$, $B = \{0, \pi, \sqrt{2}, 3\}$, and $C = \{\pi, \sqrt{2}, 3\}$. Find
    a. $A \cap C$
    b. $\overline{A} \cup B$
    c. $\overline{A \cap B}$

4. [2.1] Simplify the following Boolean expressions.
    a. $\overline{\overline{(A \cap B)} \cup C \cap \overline{B}}$
    b. $((A \cup B) \cap \overline{A}) \cup \overline{B} \cap \overline{A}$

5. Determine the probability p for each of the following events:
    a. A king, ace, jack of clubs, or queen of diamonds appears in drawing a single card from a well-shuffled ordinary deck of cards.
    b. The sum 8 appears in a single toss of a pair of fair dice.
    c. A non-defective bolt will be found, if out of 600 bolts already examined, 12 were shown to be defective.
    d. A 7 or 11 comes up in a single toss of a pair of fair dice.

6. If A and B are independent, prove that
    a. A and $\overline{B}$ are independent.
    b. $\overline{A}$ and B are independent.
    c. $\overline{A}$ and $\overline{B}$ are independent.

7. [2.7] Use both Equations (2.26) and (2.29) to find the $\Pr(s)$ for the union of three events, $\Pr(s) = \Pr(E_1 \cup E_2 \cup E_3)$, with probabilities: $\Pr(E_1) = 0.8$; $\Pr(E_2) = 0.9$; $\Pr(E_3) = 0.95$. Which equation is preferred for numerical solution?

8. [2.10] An electronic assembly consists of two subsystems, A and B. Each assembly is given one preliminary checkout test. Records on 100 preliminary checkout tests show that subsystem A failed 17 times. Subsystem B alone failed 13 times. Both subsystems A and B failed together seven times.
    a. What is the probability of A failing, given that B has failed?
    b. What is the probability that A alone fails?