

Last Name:

First Name:

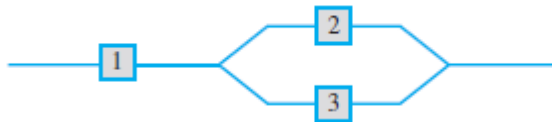
SCIPER:

Practice Problems: Exercise 4 – Microengineering 110

Spring 2025

Prof. Vivek Subramanian

1. Three components are connected to form a system as shown in the accompanying diagram. Because the components in the 2–3 subsystem are connected in parallel, that subsystem will function if at least one of the two individual components functions. For the entire system to function, component 1 must function and so must the 2–3 subsystem.



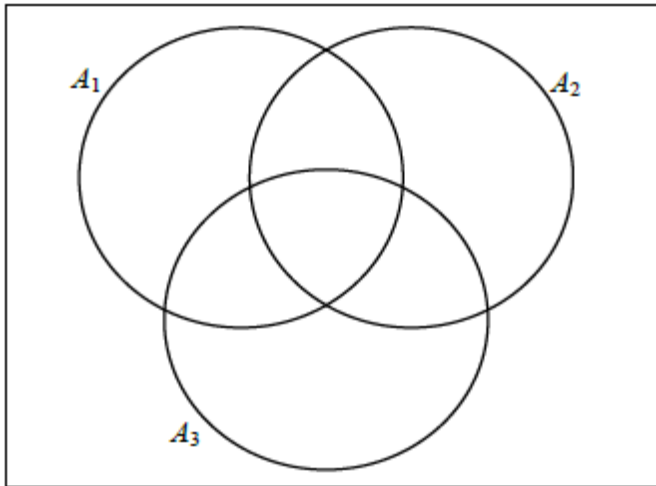
The experiment consists of determining the condition of each component [S (success) for a functioning component and F (failure) for a nonfunctioning component].

- a. Which outcomes are contained in the event A that exactly two out of the three components function?
- b. Which outcomes are contained in the event B that at least two of the components function?
- c. Which outcomes are contained in the event C that the system functions?
- d. List outcomes in C' , $A \cup C$, $A \cap C$, $B \cup C$, and $B \cap C$.

2. A certain system can experience three different types of defects. Let A_i ($i = 1, 2, 3$) denote the event that the system has a defect of type i . Suppose that

$$\begin{aligned}P(A_1) &= .12 & P(A_2) &= .07 & P(A_3) &= .05 \\P(A_1 \cup A_2) &= .13 & P(A_1 \cup A_3) &= .14 \\P(A_2 \cup A_3) &= .10 & P(A_1 \cap A_2 \cap A_3) &= .01\end{aligned}$$

To proceed, it is recommended that you populate the Venn diagram below.



- What is the probability that the system does not have a type 1 defect?
- What is the probability that the system has both type 1 and type 2 defects?
- What is the probability that the system has both type 1 and type 2 defects but not a type 3 defect?
- What is the probability that the system has at most two of these defects?

3. The composer Beethoven wrote 9 symphonies, 5 piano concertos (music for piano and orchestra), and 32 piano sonatas (music for solo piano).
 - a. How many ways are there to play first a Beethoven symphony and then a Beethoven piano concerto?
 - b. The manager of a radio station decides that on each successive evening (7 days per week), a Beethoven symphony will be played followed by a Beethoven piano concerto followed by a Beethoven piano sonata. For how many years could this policy be continued before exactly the same program would have to be repeated?
4. Computer keyboard failures can be attributed to electrical defects or mechanical defects. A repair facility currently has 25 failed keyboards, 6 of which have electrical defects and 19 of which have mechanical defects.
 - a. How many ways are there to randomly select 5 of these keyboards for a thorough inspection (without regard to order)?
 - b. In how many ways can a sample of 5 keyboards be selected so that exactly two have an electrical defect?
 - c. If a sample of 5 keyboards is randomly selected, what is the probability that at least 4 of these will have a mechanical defect?