Engineering statistics

PROBABILITY

- ✓ **Basic concepts of probability**
- ✓ **Event and Types of event**
- ✓ **Theoretical probability**

BY
Asst.L: Rawaa Ihmade Obaid

Engineering statistics

❖ Probability

- ✓ Is an action through which specific results (counts, measurements or responses) are obtained .
- ✓ All the probability examples are based on four experiments.

1. Dice or Die
2. Coin
3. Balls box or black box
4. Cards

Engineering statistics

- Rolling a dice, or flipping a coin and observing the results are called a probability experiments.
- The result of a single trial in a probability experiment is the outcome.
- The set of all possible outcomes for an experiment is the sample space. Some sample spaces for various probability experiments are shown here.

Experiment	Sample space
flipping or Toss one coin	**(Head, Tail)**
Roll a dice or die	**(1, 2, 3, 4, 5, 6)**
Answer a true / false question	**(True , False)**

Engineering statistics

Example 1 : Find the sample space for rolling two dice.

Solution

Since each die can land in six different ways, and two dice are rolled, the sample space can be presented as the following :

1. **outcomes** $\longrightarrow$ 6^2 $\longleftarrow$ **The count of times the experiment has been performed**

2. Rectangular array as shown in the figure

Engineering statistics

Die 1	Die 2					
	1	**2**	**3**	**4**	**5**	**6**
1	(1,1)	(2,1)	(3,1)	(4,1)	(5,1)	(6,1)
2	(2,1)	(2,2)	(2,3)	(2,4)	(2,5)	(2,6)
3	(3,1)	(3,2)	(3,3)	(3,4)	(3,5)	(3,6)
4	(4,1)	(4,2)	(4,3)	(4,4)	(4,5)	(4,6)
5	(5,1)	(5,2)	(5,3)	(5,4)	(5,5)	(5,6)
6	(6,1)	(6,2)	(6,3)	(6,4)	(6,5)	(6,6)

Engineering statistics

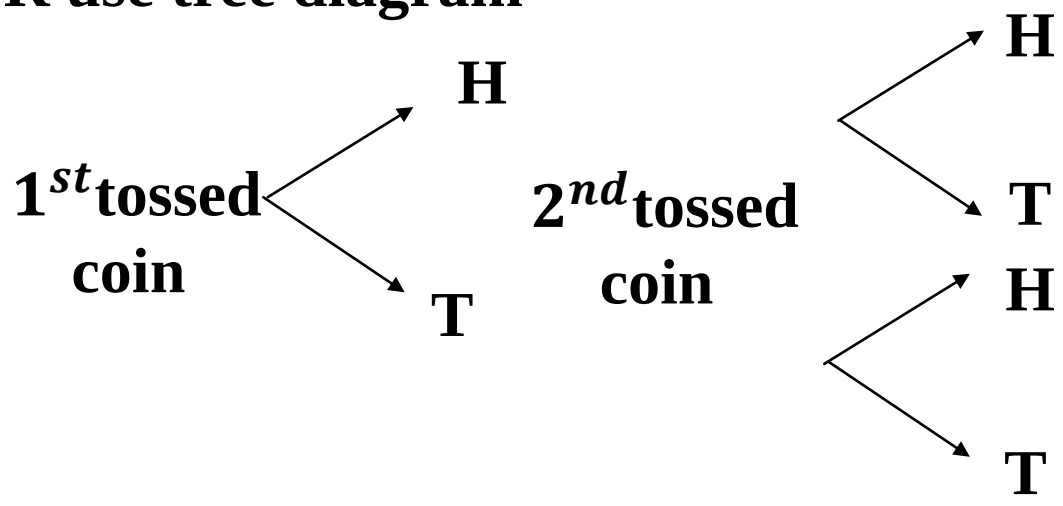
Example 2 : Two coins are flipped. How many different outcomes are there? List the sample space.

Solution

outcomes $\longrightarrow 2^2 \longleftarrow$ **The count of times the experiment has been performed**

There are 4 different outcomes :{HH, HT, TH,TT}

OR use tree diagram



Engineering statistics

Example 3 : find the sample space for the gender of the children if a family has three children. Use B for boy and G for girl.

Solution : to find all possible outcomes of probability experiments use a tree diagram.

Engineering statistics

❖ **A Event :** consists of one or more outcomes and is a subset of the sample space.

➢ **Types of event**

1. A simple event is an event that consists of a single outcome.

2. A compound event that consists from more than one outcome.

Example 4 : A dice is rolled. Event A is rolling an even number. Is the event could be considered as a simple event or isn't ?

Solution

This is not simple event because the outcomes of event A are {2, 4, 6}. The event is compound event

Engineering statistics

3. Mutually Exclusive Events

- The events are said to be mutually exclusive or disjoint when events contain no sample point in common.
- The events, A and B are mutually exclusive if they cannot occur at the same time

Example 5 : Decide if the two events are mutually exclusive

Event A : Roll a number less than 3 on a die.

Event B : Roll a 4 on a die

Solution : these events cannot happen at the same time, so the events are mutually exclusive.

Engineering statistics

4. The complementary Events

- The complement of an event E is the set of outcomes in the sample space that are not include in event E. The complement of is denoted by $\boldsymbol{E^c}$

Example 6 : Find the complement of each event

a. Rolling a die and getting a 4.

b. Selecting a month and getting a month that begins with a J

c. Selecting a day of the week and getting a weekday

Engineering statistics

Solution :

a. **Getting a 1, 2, 3, 5 or 6.**

b. **Getting February, March, April, May, August, September, October, November or December.**

c. **Getting Saturday, Sunday.**

Engineering statistics

❖ Types of probability

1. Theoretical probability

- Is sued when each outcome in a sample space is equal likely to occur.
- The theoretical probability for event E is given by

$$P(E) = \frac{number\ of\ out\ comes\ in\ event}{Total\ number\ of\ outcomes\ in\ sample\ space}$$

Engineering statistics

Example 7 : A dice is rolled. Find the event A , rolling a 5

Solution

There is one outcome is event A :{5}

$$P(A) = \frac{number\ of\ out\ comes\ in\ event}{Total\ number\ of\ outcomes\ in\ sample\ space}$$

$$\mathbf{P(A) = \frac{1}{6}}$$

$$\mathbf{= 0.167}$$

Engineering statistics

2. Statistical or Empirical probability

- Is based on observation obtained from probability experiments.
- $P(E) = \frac{frequency\ of\ event\ E}{Total\ frequency}$
- $P(E) = \frac{f}{n}$

Example 8: A Travel agent determines that every 50 reservations she makes 12 will be for a cruise. What is the probability that the next reservation she makes will be for a cruise

Solution : $P(cruise) = \frac{f}{n} = \frac{12}{50} = 0.24$

Engineering statistics

Example 9: The following frequency distribution table represents the ages of 30 students in a statistics subject. What is the probability that a students is between 26 and 33 years old

Solution

$$P(ages\ 26\ to\ 33) = \frac{f}{n}$$

$$= \frac{8}{30} = 0.267$$

Ages	frequency
18-25	13
26-33	8
34-41	4
42-49	3
50-57	2
	$\sum f = 30$

Engineering statistics

3. Subjective probability

- Is based on intuition, educated, guesses, and estimates. obtained from probability experiments.

Example 10: A business analysis predicts that is probability of a certain union going on strike is 0.15

Rang of probability of an event E is between 0 and 1, inclusive. That is

$$0 \leq P(A) \leq 1$$