# Probability and Uncertainty

# Vocabulary

**Event** - A collection of outcomes of a procedure.

**Simple Event** - A single outcome.

**Compound Event** – A combination of simple event.

**Sample Space** – All simple events (all possible outcomes).

**Example**

| Procedure | Event | Sample Space |
|---|---|---|
| Flip a coin once | H | { H, T} |
| Flip a coin 3 times | 1 Head & 2 Tails | {HHH, HHT, HTH,HTT, TTT, TTH, THT, THH} |
| | | |

# Probability

Def: The likelihood of an event occurring.

Probability : P

Event : A, B, C, …. Etc

P(A) = the probability of event ‘A’ occurring

# 3 types of probability

**Observed probability** – its estimated probability based on observations.

$$P(A) = \frac{\#\ of\ times\ A\ occurred}{\#\ of\ times\ procedure\ was\ repeated}$$

**Classical Probability -** Its based on the chance of an event occurring (each simple event must have an equal chance of occurring)

$$P(A) = \frac{\#\ of\ ways\ A\ could\ occur}{\#\ of\ simple\ events\ (outcomes)}$$

**Subjective Probability (educative guess)-** based on past experience and education

# Examples

**Q1.** Find the probability of selecting a Heart ❤️ from a deck of cards.

P ( ❤️ ) = $\frac{13}{52}$ = 0.25 = 25%

**Q2**. If you flip a coin 100 times, and you get 64 Tails.

P(T) = $\frac{64}{100}$ = 0.64 = 64%

**Q3**. Find the probability that if a couple has 3 kids, two will be boys (Assuming equal chance of Boy/Girl).

Procedure : Having 3 children

Event : 2 boys, 1 girl

Sample space: {BBB, BBG, BGB, BGG, GGG, GGB, GBG, GBB}

P(2B,1G) = $\frac{3}{8}$

= 0.375

= 37,5%

# Rules of Probability

P(E) : The probability that event E occurs.

$0 \leq P(E) \leq 1$ or 0% ≤ P(E) ≤ 100%

# Complementary Events

Events which are mutually exclusive (can't happen at the same time).

For example: When you roll a 6 sided dice once can you get both

a 2 and a 5 at the same time ? No because they cannot happen

at the same time.

# Complement

The complement of an event A is denoted by $A^c$ (or A′)

If we have an event A, then $A^c$ (or A′) is all the outcomes that do not accomplish event A or all the outcomes when event A does not occur.

Example

Event: Rolling a 5

Complement: not rolling a 5

**Q1.** What is the probability of getting a 5 after rolling a dice once

**Q2**. What is the probability of not getting a 5 after rolling a dice once

$P(5) = \frac{1}{6}$

$P(5^c) = \frac{5}{6}$

Note: The probability of an event + the probability of the complement must equal to 1

$$P(A) + P(A^c) = 1$$

# Exercises on simple probability

1. When you roll a 6 sided die, which number are you most likely to get?
2. If you roll a die 600 times, how many sixes would you expect to get?
3. Use the following to describe the statements bellow: certain, very likely, likely, unlikely, very unlikely, impossible. [Zimbabwean events]

a) It will snow tomorrow

b) It will rain tomorrow

c) The sun will not rise tomorrow

d) Jesus will come next week

e) You will win a car in a competition today

f) You will pass all part one courses at NUST

# cont

4. In February 1995 it rained on 18 days. Calculate the probability that it will rain on a day in February. [Relative frequency of rain]
5. A six-sided die and a coin are tossed. List all the possible outcomes.
6. In a class of 30 Computer Science students at NUST, 16 are ladies, 4 wear glasses and 3 are left – handed. A student is chosen at random from the class. What is the probability that this student is:

a) A lady
b) A gentleman
c) Right – handed
d) Left - handed
e) Wearing glasses
f) Not wearing glasses

7. A card is taken at random from a full pack of playing cards with no jockers. What is the probability that the card:

a) Is an ace b) is Black c) is a heart d) has an even number on it