

PROBABILITIES, RANDOM VARIABLES AND THEIR DISTRIBUTIONS

3.1 Probabilities

In any random experiment (e.g. fertilizer trials on yield), there is always uncertainty on whether a particular event (like desired yield) will or will not occur. We measure this using **probability**. This is the likelihood that an event will occur.

Probabilities range from 0 – 1 or 0 – 100% (in percentage)

If we are certain an event will occur, we say the probability is 1 or 100%. If we are sure the event will not occur, then probability is zero. If our probability is $\frac{1}{4}$ or 0.25, then there is a 25% chance of the event occurring.

If we toss a coin, the probability of getting “heads” i.e. $P(H)$ is $\frac{1}{2}$ or 50% and probability of getting “tails” i.e. $P(T)$ is also $\frac{1}{2}$ or 50%. This is because there are only 2 possible outcomes.

3.2 Random Variables

A random variable is an alphabetical character (a capital letter) which associates each outcome of an event with a real number.

It can take on different numbers because it is a function.

$X = \{1 \text{ if Heads, } 0 \text{ if tails}\}$. In this case, X is the random variable.

Random variables can be associated with discrete (countable) outcomes or continuous (measurable) outcomes.

Simple example:

If $X = \#$ of heads after 2 flips of a coin, what is the probability distribution of the different possible values?

Possible outcomes:

H, H

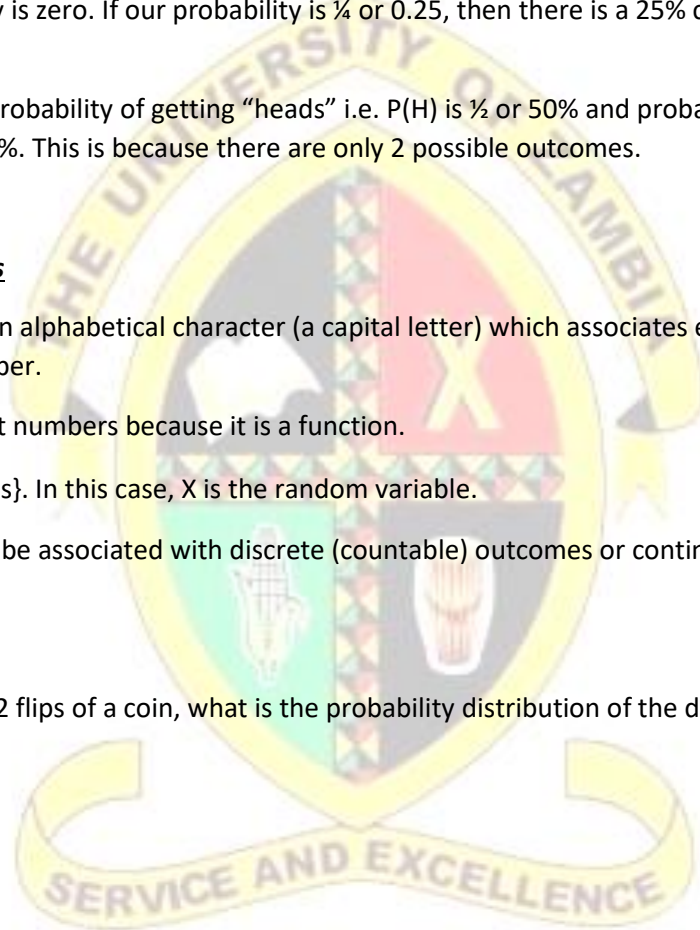
H, T

T, H

T, T

Therefore:

- $P(X = 0) = \frac{1}{4}$ or 25%
- $P(X=1) = \frac{2}{4}$ or 50%
- $P(X =2) = \frac{1}{4} = 25\%$



This is a distribution of probabilities for the random variable X .

There are two important measures of a random variable:

- a) The expected value of a random variable represented by $E(X)$ indicates the average value or mean. $E(X) = \mu$
- b) The variance of a random variable represented by $\text{Var}(X)$ is a measure of the spread of the distribution around its mean.

Basically, we try to find the probability that a random variable (X) will equal a particular value. Example questions:

Toss a coin 7 times, what is the probability you will get 5 heads or 0 heads?

Use 4 fertilizer trials, what is the probability that you will have 2 successes in terms of yield?

3.3 Distributions under Random Variables

There are different distributions under different types of random variables. The most common are:

- a) **Discrete** random variable distributions
 - Bernoulli Distribution
 - Binomial Distribution
 - Poisson Distribution

The above have been tackled in the assignment

- b) **Continuous** random variable distributions
 - Normal Distribution
 - Standard Normal Distribution

