







## J.8. Probability Template

Topics	Activity	Deadline (tick off checklist)
Master the fundamentals of probability and random variables and apply to a wide array of scenarios.	 JOURNAL	<input type="checkbox"/> <a href="#">Upload Journal completed in OneNote</a> Due Monday 21st March 5pm  <input type="checkbox"/> <a href="#">Accuracy Check Quiz :</a> Due Monday 21st March 5pm
	 QUIZ	<input type="checkbox"/> <a href="#">Mastery Quiz (Due 26/03/21)</a>

## A. Counting, Permutations & Combinations

<b>need to know</b>	Counting 	When n is the total number of things to choose from and we choose r of them, choices are independent of each other, then the number is <b><math>n^r</math></b>	 Factorial
	Permutations and Combinations	$\binom{n}{r} {}^nC_r = \frac{n!}{r!(n-r)!}$ 	${}^nP_r = \frac{n!}{(n-r)!}$ 

### Question 1

a) The password for a mobile consists of 2 digits from numbers [0,1,2,3,4,5,6,7,8,9]



How many passwords are possible

Answer:

100

Show calculations

$10 \times 10 = 100$

b) How many unique ways are there to arrange the word MATHS

Answer:

120

Show calculations

MATHS = 5 WORDS

$5! = 120$

$5 \times 4 \times 3 \times 2 \times 1 = 120$

c) How many unique ways are there to arrange the word CLASS

Answer:

60

Show calculations

CLASS = 5 words 2s = 2 words

$5! / 2! = 60$

$5*4*3*2*1 / 2*1 = 60$

- d) Dylan uses a password formed from **one letter** of his name followed by **four of the digits from 1 - 9**. He does **not use any digit more than once**. How many of the passwords **begin with D**?

Answer:

3024

Show calculations

$1P1 * 9P4 = 3024$

- e) There are 13 hockey players on GMIT panel, including the captain.  
The manager has to choose a team of 11. How many different teams could she possibly pick?

- (i) The manager has to choose 11 players out of 13

Answer:

78

Show calculations

$$\binom{n}{r} {}^nC_r = \frac{n!}{r!(n-r)!}$$

$$\binom{13}{11} {}^{13}C_{11} = \frac{13!}{11!(13-11)!}$$
$$= 78$$

- (ii) The captain must be included; the manager has to pick the remaining 10 players from the remaining 12 panel members.

Answer:

66

Show calculations

$$\binom{n}{r} {}^nC_r = \frac{n!}{r!(n-r)!}$$

$$\binom{12}{10} {}^{12}C_{10} = \frac{12!}{10!(12-10)!}$$
$$= 66$$

## B. Calculate Simple Probability

needto  
know

Basic Probability

P(A)=

## Question 2

a) what is the probability of **rolling an even number** on a fair, six sided die?

Answer:

1/2

Show calculations

Number of outcome = 3 (2,4,6)

Total outcomes = 6 (1,2,3,4,5,6)

Probability =  $3/6 = 1/2 = 0.5$

b) A card is drawn from a standard pack at random.  
What is the probability that the card drawn is a **Heart**?

Sample Space for Choosing a Card from a Deck

Ace	2	3	4	5	6	7	8	9	10	Jack	Queen	King
♥	♥	♥	♥	♥	♥	♥	♥	♥	♥	♥	♥	♥
Ace	2	3	4	5	6	7	8	9	10	Jack	Queen	King
♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
Ace	2	3	4	5	6	7	8	9	10	Jack	Queen	King
♠	♠	♠	♠	♠	♠	♠	♠	♠	♠	♠	♠	♠
Ace	2	3	4	5	6	7	8	9	10	Jack	Queen	King
♣	♣	♣	♣	♣	♣	♣	♣	♣	♣	♣	♣	♣

Answer:

P(HEART) = 1/4

Show calculations

P(HEART) =  $13/52 = 1/4 = 0.25$

## C. 2-Way Frequency Table

needto  
know

Basic Probability

P(A)=

## Question 3

The table represents survey data collected from GMIT students in 2021.  
Students are classified by their age profile and use of WhatsApp social media tool

Age Profile	16 - 22	23 - 29	30 and over	TOTAL
Use of WhatsApp	117	78	35	230
Do not use WhatsApp	33	42	55	130
TOTAL	150	120	90	360

If an individual is selected at random calculate **the probability**, (correct to four decimal places), that s/he:

(i) **Does not use WhatsApp**

Answer:

0.3611

Show calculations

$$P(\text{DONT USE WHATSAPP}) = 130/360 = 13/36 = 0.3611$$

(ii) Is a 23 – 29-year-old user

Answer:

0.2167

Show calculations

$$P(23 - 29\text{-year-old user}) = 78/360 = 0.2167$$

(iii) Is over 30 years old or does not use WhatsApp

Answer:

0.4583

Show calculations

$$130/360 + 90/360 - 55/360 = 0.4583$$

## D. Probability Rules

needto  
know

Probability  
Rules (AND)

$$P(A \text{ and } B) = P(A) * P(B) \text{ (Independent)}$$

$$P(A \text{ and } B) = P(A) * P(B|A)$$

Probability  
Rules (OR)

$$P(A \text{ or } B) = P(A) + P(B) \text{ (mutually exclusive)}$$

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

Complement  
(At Least)

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

## Question 4

a) 70% of their students turn up for their first lecture on Monday mornings. If a random sample of 4 students from this population were interviewed, evaluate the following probabilities:

(i) All 4 turned up for last Monday's first lecture;

Answer:

0.2401

Show calculations

$$P(\text{TURNING UP}) = 0.70$$

$$P(\text{TURNING UP}) \text{ AND } P(\text{TURNING UP})$$

$$0.70 * 0.70 * 0.70 * 0.70 = 0.2401$$

$$(0.70)^4 = 0.2401$$

(ii) none of them turned up for it;

Answer:

0.0081

Show calculations

$$P(\text{TURNING UP}) = 0.70$$

$$P(\text{NOT TURNING UP}) = 1 - 0.70 = 0.3$$

$$P(\text{NOT TURNING UP}) = 0.3$$

$$P(\text{NOT TURNING UP}) \text{ AND } P(\text{NOT TURNING UP})$$

$$(0.3)^4 = 0.0081$$

(iii) the first 2 **attended** it and the second 2 **did not**;

Answer:

0.0441

Show calculations

$$P(\text{TURNING UP}) = 0.70$$

$$P(\text{NOT TURNING UP}) = 0.3$$

$$P(\text{TURNING UP}) \text{ AND } P(\text{NOT TURNING UP})$$

$$(0.70)^2 * (0.30)^2 = 0.0441$$

(iv) **at least one** of them turned up for it.

Answer:

0.9919

Show calculations

$$P(\text{AT LEAST ONE TURNED UP}) = 1 - P(\text{NOT TURNING UP})$$

$$= 1 - (0.3)^4$$

$$1 - 0.0081 = 0.9919$$

b) 11% of Irish people have blood group O. What is the probability (%) that 2 unrelated Irish people in a GP's surgery have blood group O? (% round to 2 decimal places)

N.B this question has % in it

Answer:

1.21%

Show calculations

$$P(\text{BLOOD GROUP O}) = 0.11$$

$$P(\text{BLOOD GROUP O}) \text{ AND } P(\text{BLOOD GROUP O})$$

$$(0.11)^2 = 0.0121$$

$$0.0121 * 100 = 1.21 \%$$

## E. Binomial Experiments

need to know

If the same experiment is conducted  $n$  times – each with two possible outcomes, which we will call ‘success’ and ‘failure’.

The probability of getting  $r$  successes (where  $r \leq n$ ) will be:

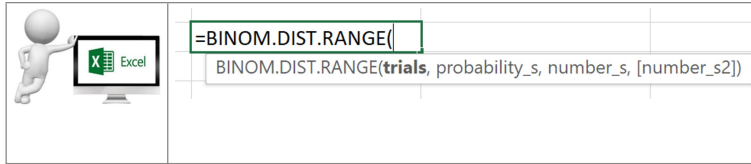
$$P(r) = {}^n C_r p^r q^{n-r}$$

Where

$n$  = number of trials,  $r$  = no of successes,  $n - r$  = no of failures

$p$  = probability of success in 1 trial     $q = 1 - p$  = probability of failure in 1 trial

Alternatively



**=BINOM.DIST.RANGE ( trials, probability \_s, range)**

**Mean (expected):  $\mu = n \cdot p$**

**Standard deviation:  $\sigma = \sqrt{npq}$**

## Question 5

The internet worm 'KLEZ' is ranked high in the number of top malicious software instances. A recent survey reported KLEZ accounted for **53%** of reported malicious instances.

Suppose **7 malicious** software instances are reported, assuming that the malicious instances can be assumed to be independent, calculate the probability, correct to four decimal places, that

a) **Exactly three** were the internet worm 'KLEZ';

Answer:

0.2543

Show calculations

**=BINOM.DIST.RANGE ( 7, 0.53 , 3)**



b) **At least one** was the worm 'KLEZ'

Answer:

0.0400

Show calculations

**=BINOM.DIST.RANGE ( 7, 0.53 , 1)**



And among random sample of 160 reported malicious instances, correct to two decimal places.

c) Find the **mean** (expected value)

Answer:

84.8

Show calculations

$p = 0.53$

$q = 1 - 0.53 = 0.47$

$n = 160$

$\mu = n \cdot p$

$160 \cdot 0.53 = 84.8$

d) **Standard deviation** of the number of KLEZ instance

Answer:

6.31

Show calculations

$p = 0.53$

$q = 1 - 0.53 = 0.47$

$n = 160$

$\sigma = \sqrt{npq}$

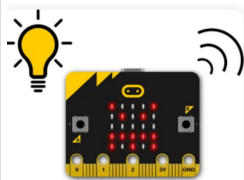
$\sqrt{160 \cdot 0.53 \cdot 0.47}$

6.31

## F. Microbits

### Question 6 (Optional)

Code a probability scenario



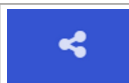
Light alarm

Step 1. Choose one of the following projects

- ☐ Rock Paper Scissors
- ☐ Make a dice

Step 2. Publish your Code

Use share function and publish project



Publish project



You can then copy and paste the url into OneNote!

## Share Project



Your project is ready! Use the address below to share your projects.

[https://makecode.microbit.org/\\_gK0UCwCwxboP](https://makecode.microbit.org/_gK0UCwCwxboP)

Copy



> Embed

### Step 3: Paste Make code project here