GRADE 12 ESSENTIAL
UNIT I – PROBABILITY
INTRODUCTION TO PROBABILITY

Name: ____________
Date: ______________

PROBABILITY

The **Probability** of an event happening is defined as the number of ways the desired outcome could (or did) happen as a ratio (fraction, percent) with the number of all possible outcomes (or trials).

$$Prob(outcome\ 'A') = \frac{\#\ of\ desired\ outcomes\ 'A'}{Total\ \#\ of\ possible\ outcomes}$$

You draw one of the cards without looking (ie: randomly). Write the probability as a reduced fraction and as a percent.

Cards:

Jared	**Janet**	**Janet**
Juan	**Juan**	**Juan**

Random means no outcome is favoured. They are all equally likely

Other notation to show NOT J:
- $Prob(\overline{J})$
or
- $Prob(\sim J)$

a. Prob(Janet) = ___/___; ____%

b. Prob(Jared) = ___/___; ____%

c. Prob(Juan) = ___/___; ____%

d. Prob(first letter is a **J**) = ___/___; ____%

e. Prob (first letter is **not** a **J**) = ___/___; ____%

Sample Space. A sample space is a *list of all the possible outcomes* or events! (An event is simply a combination of basic outcomes). Example: list the possible events for the flipping of two coins: a **loonie** and a **quarter**; each can come up **H**ead or **T**ail.

The set of all possible outcomes: { (H_l, H_q) , (H_l, T_q), (T_l, H_q) , (T_l, T_q) }

Or since you are only combining two outcomes you *might* do a table:

		Loonie	
		Head	**Tail**
Quarter	**Head**	(H_l, H_q)	(T_l, H_q)
	Tail	(H_l, T_q)	(T_l, T_q)

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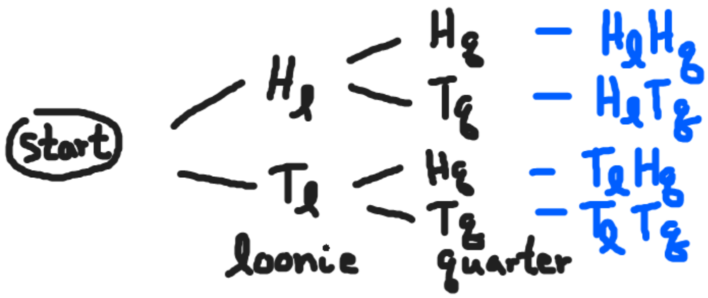
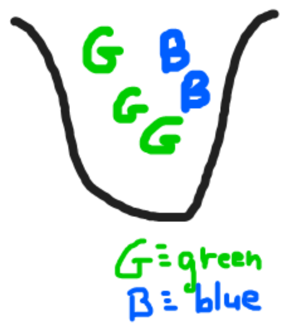
Another useful way to generate a more complicated **sample space** is to use an Outcome Tree



You [randomly] draw one of the coloured marbles from the bag. Calculate:



Prob(B) = — or %

Prob($\overline{B}$) = — or %

Prob(Yellow) = — or %

Complementary. Have you noticed that the probability of something **happening** and the probability of it **not happening** adds up to 100%? They are '*complementary*' events.

$$Prob(A) + Prob(\overline{A}) = 100\% = 1$$

Or you could say: $Prob(\bar{A}) = 1 - Prob(A);$

ie: The probability of something **not** happening is 1 minus the probability it **does** happen! WOW!

Example: If there is a 30% chance of rain today, there is a 70% chance of it **not** raining!

$$Prob(NOT\ Rain) = 100\% - \boldsymbol{Prob(Rain)}$$
$$Prob(NOT\ Rain) = 100\% \quad - \quad \mathbf{30}\% = \mathbf{70}\%$$

Manipulate Probability Formula. A company knows that 1% of the bolts that they make are defective. If they produce 250,000 bolts, how many will [likely] be defective?

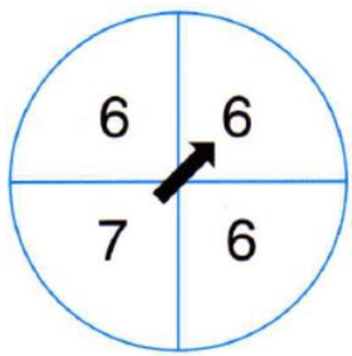
$$Prob(defective) = \frac{\#\ of\ defectives}{Total\ \#\ of\ bolts}$$

$$0.01 = \frac{\#\ of\ defectives}{250{,}000}$$

$$\#\ of\ defectives = 0.01 * 250{,}000 = \mathbf{2,500}$$

There will be an *expectation* of 2,500 defective bolts.
But it may be 2483 or 2532 or somewhere around 2500 plus or minus (±) a few ! You only ***expect*** an average of 2,500 defectives if you select different batches of 250,000 bolts.

You spin the spinner at the right.



a. Calculate the probability it will stop at 'six':
________ or _______% (in theory!)

b. If you spin it 20 times, predict how many times you would '*expect'* it to stop on '6'.

____

c. If you spin it 200 times, predict how many times you would '*expect'* it to stop on '6'.

____

Experimental vs Theoretical Probability.

They are both the same calculation. But sometimes you do not know the probability of something happening (like flipping a coin); sometimes you have to calculate it *yourself* by doing an '*experiment*'. To do a successful experiment you would need to do lots of '*trials*'. Flip a paper cup 50 times (ie: 50 trials) and see how often it lands on: the **rim**, the **bottom**, the **side**.

Outcome	Count (tally)	Prob [%]
Rim	12	24%
Bottom	8	16%
Side	30	60%
Total(s)	50	100%

You do your own experiment. Use 50 trials. Calculate your experimental probabilities for flipping a paper cup. Record your results here. Compare with other students, should they not be close to the same result?

Should your experiment and others' not give the exact same result? Explain:

Outcome	Count (tally)	Prob [%]
Rim		
Bottom		
Side		
Total(s)	50	100%

Permutations, Combination, Combinatorics. Notice that to calculate probabilities you need to be able to **count**! *Counting is not all that easy*! We will learn lots of ways to count in **Applied Math** when we study Permutations and Combinations. So to **whet your appetite**, what is the Probability of being dealt four aces in a five card hand?

How many possible poker hands are there? **Ans**: 2,598,960
(how do I know that!? Wait for Grade 12 Applied!
How many five card poker hands have four aces? **Ans**: 48.

So Prob (4 Aces) = $\frac{48}{2,598,960} = \frac{1}{54,145} = 0.000018468 = \mathbf{0.0018468}\%$

So if you play 54,145 poker hands you *might expect* to win likely once on average. **Or** you could possibly (but improbably) win the very first hand! Heck you could win **twice** in a ***row***! One chance in 2,931,681,025 of that happening! **Good Luck**!

MrF