THE 2022 YOUNG MATHEMATICAL STORY AUTHOR (YMSA) COMPETITION

THE CINDY NEUSCHWANDER AWARD

(THE 12-15 YEARS OLD CATEGORY)

SHORTLISTED

‘The Probable End of the Island’ by Virginia Marzia Massone (12 years old)

at Marymount International School Rome (Italy)

You can read the author’s inspiration for the story and the judges’ comments on:

www.mathsthroughstories.org/ymsa2022

#YMSAMaths

THE PROBABLE End OF the Island

By Virginia Marzia Massone
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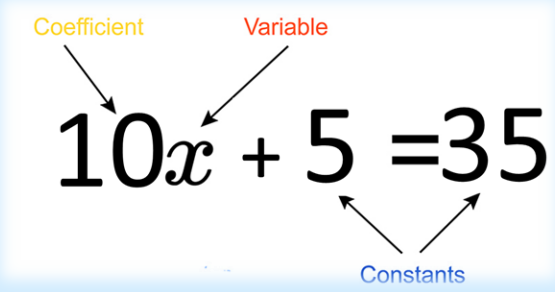
Co and Vid were siblings who lived on a small peaceful island. Co was twelve years old, and Vid was eight when rumours of an imminent virus bound to strike the island were received. Co remembers the day that the news of the virus reached his family. It was on a fine Monday during the Christmas holiday. Festivities have been ongoing, and Co and Vid were very excited and looking forward to the New Year.

During a family dinner, each recounted their most interesting experiences and lessons in the year. As Co and Vid reflected on the lessons for the year, the major thoughts were on whether the virus marked the end of the island.

Co had always been the family scientist and a very odd kid, a bit of a "bookish". Being bored on an island, he had taken an interest in statistics and, from an early age, enjoyed making predictions on natural disasters. Co's analysis on situations was, however, always exaggerated.

He had received the nickname "Co" from his mother from "coefficient" due to his multiplying catastrophic predictions. In fact, a coefficient is a multiplicative factor of a variable. Whatever Co was predicting, it had at least a 10-multiplier factor if not 19!

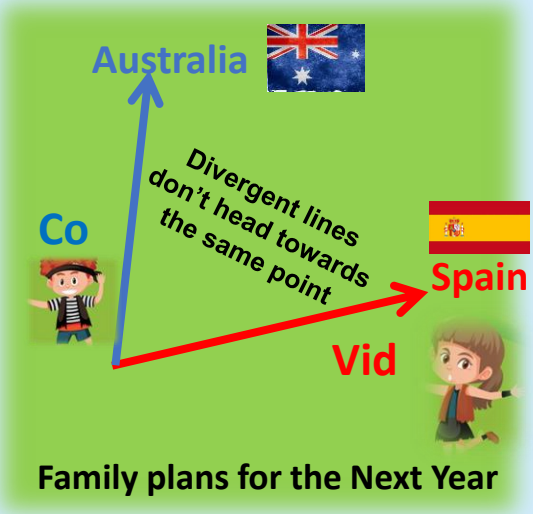


Co had always been obsessed with predictions on floods. He used to draw his forecast in the wet sand.

This time he was expecting a flood 10 times bigger than the one that 100 years earlier destroyed the entire village.

10 (Flood 100 years ago ) = New flood predicted by Co

Vid, Co's sister, on the other hand, was so different. She was the polite, reasonable, and fun person in the family, which often raised conflicts between her and Co. They were like two divergent lines. Since she was always arguing with her brother, her mom inverted Div(ergences) into Vid and made it more feminine. It was not a surprise that at the Christmas dinner, Co and Vid were separated in terms of what were the family travelling plans for the New Year.



Despite their differences, the rumours of the virus demanded the two to work together to save the island. Difficult choices had to be made. What is the probability that the virus will hit our island? What is the probability that the island is not going to be destroyed by the virus?

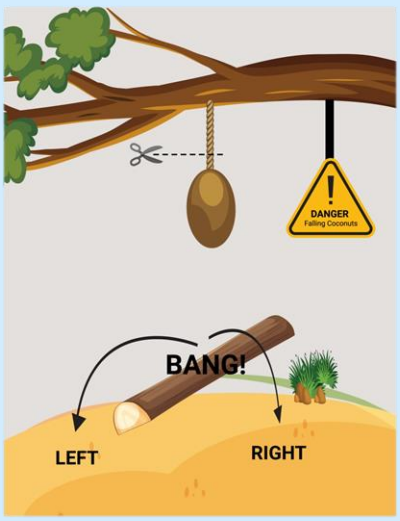
Vid was wondering what was the meaning of this weird thing Co called pro pro …oh, yes, probability. 'Probability means how likely it is for something to happen.!' Co clarified.

Co immediately drew a sketch of his experiment in the sand. He grabbed a nicely shaped coconut and tied it to a lower branch of a cashew tree. Then he placed a log just below the coconut and cut the rope.

What is the probability that the coconut will land by the sand on the left side of the log?

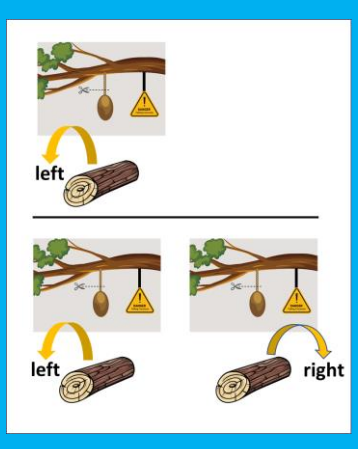
1 in 2, because there are only two possible outcomes: either the coconut falls on the left or on the right hand side of the log.

Vid said, 'I see, 1 over 2 can be also written as a fraction 1 /2 or calculated as a decimal (1:2= 0.5).' Co added, 'Correct! It is equivalent to 50:50 chances because there is an equal chance of one of the two results happening.' Co felt proud like a peacock because his sister got it right. Vid understood that the first and essential step in solving any probability problem was to work out all the possible events that could happen. The number of possible outcomes in any probability problem is called the 'sample space".



Experiment: If the coconut falls, what is the probability that it will fell on the left side of the log?

Probability of Left = $\frac{\text{number of favourable outcomes}}{\text{total number of outcomes}}$

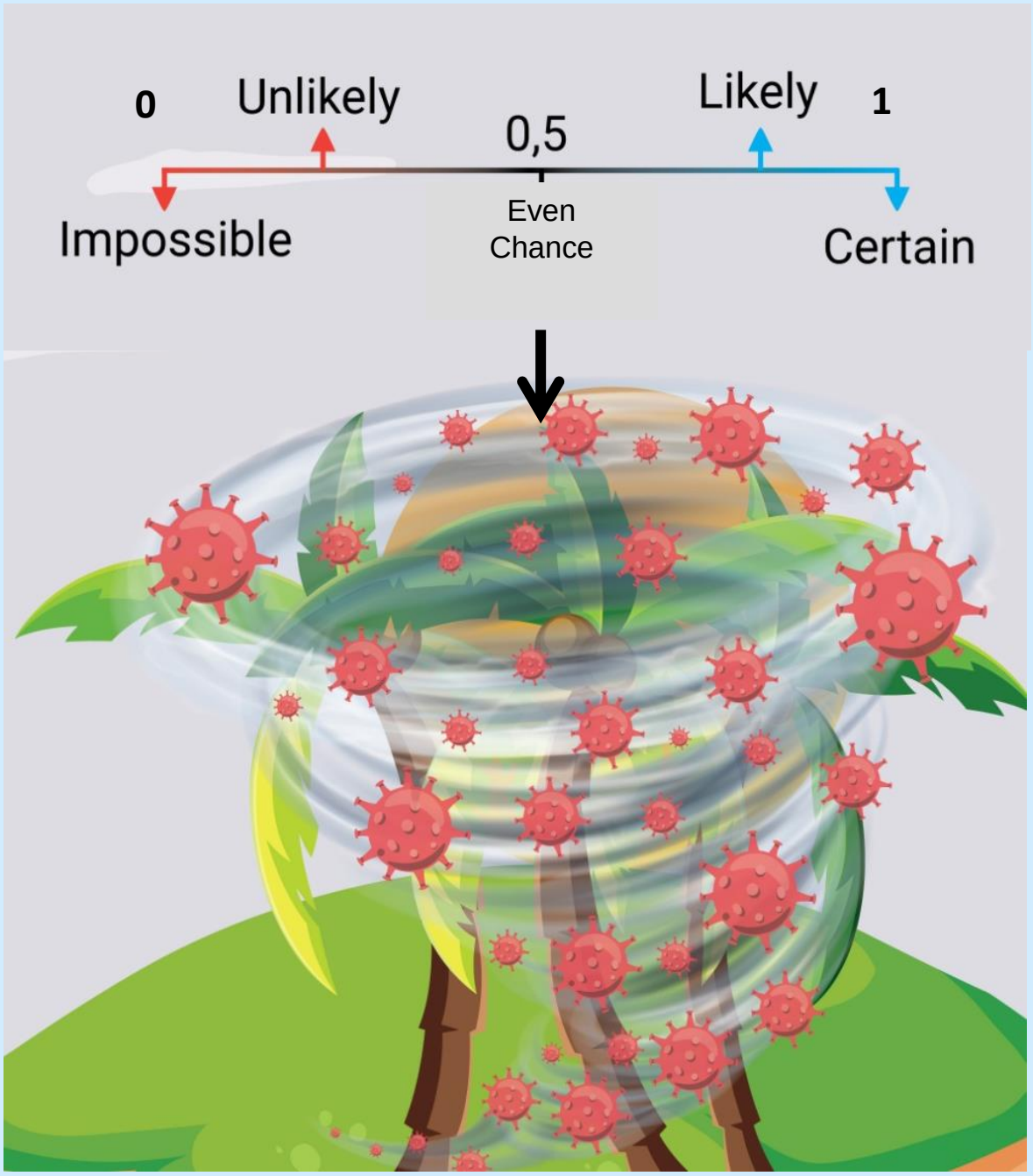
P (LEFT) = $\frac{1}{2}$ = 

= 0.5 = 50%

The experiment taught Vid that probability is a quantity and can be expressed as decimals, as fractions or as a percentage:

- a ratio $\frac{1}{2}$
- dividing the numerator by the denominator gives the decimal (0.5)
- multiplying the decimal times 100 gives the percentage 0.5 x 100 = 50%.

Co's catastrophic personality jumped in and he began to run his stats stories. 'Do you know that 150 people a year die because they are hit by falling coconuts? Do you know that coconuts are 10 times more likely to kill you than sharks?' Co was claiming. The poor Vid was now frightened of being struck on her head by a falling coconut and swore to never seek shelter again under palm trees. 'You shall ask for a safety helmet as a Christmas present for next year' Co snickered.



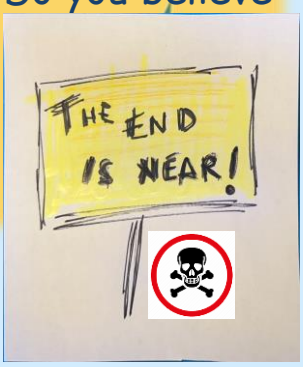
Despite his brother's night time elucubrations, Vid understood that probability would always be a number between 0 and 1, with 0 meaning that the event will never happen (impossible event) while 1 that it is sure that it will occur (certain event).

The following day Vid heard from the news that there was a 50:50 chance that the virus would have stroke their island (equal to 0.5 probability, a 'likely' to happen event).

Vid and Co went to the mall for their afternoon activities. Co headed directly to the Mall library (where else would he ever go?) as Vid entered the game store.

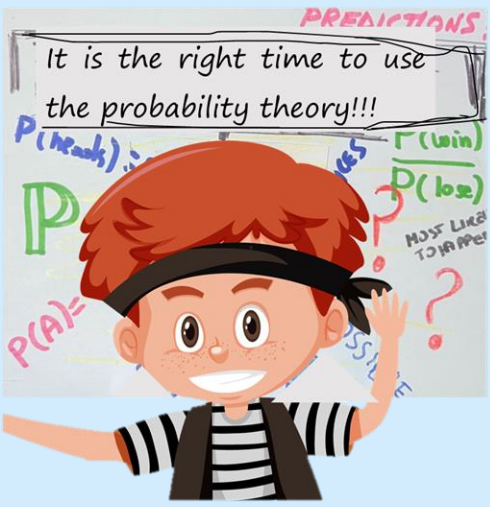
In the store, Vid was shocked to see a sticker on the wall, 'Take whatever you can for free; it's only for a while.'

The virus is here, and WE ARE ALL GONNA DIE!' Vid was shaken. She hurriedly left the store to get Co. The sign said that we are all going to die?' Co asked impatiently. 'Die yes.' said Vid. 'Do you believe it?' Of course, I do,' replied Co. Why would they give things away if it wasn't true? I guess this is really the end for us!' Vid said. 'It can't be. Hurry, we must do something about this.' Co replied.



Probability theory is a way in which we can study scientifically things that happen by chance.
For example:
Is it going to rain tomorrow?
What are the chances of winning a raffle in which 479 people have bought a ticket?

Co knew from previous lessons that events such as an epidemic could not be predicted with total certainty. The best way to approach it was to determine how likely they were to happen using the Theory of Probability. The theory gives a framework to make decisions when there is a degree of uncertainty, while the practice of analysing events governed by probabilities is called Statistics. Just keep in mind that statistics are guides to be used on the event and not the absolute predictions!'



Let's assume that the probability of the virus hitting our island is 50:50 like the news said. It must be reliable since it was calculated by statisticians!

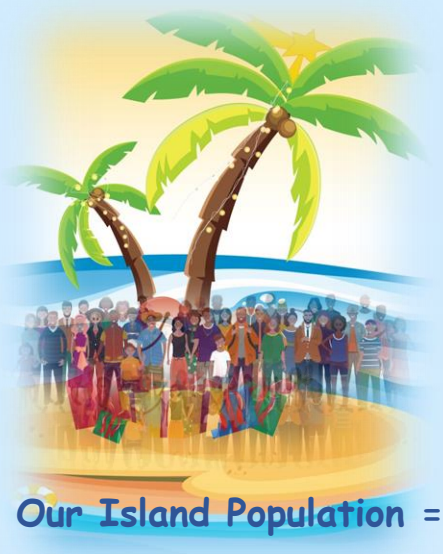
'Our priority now is to establish the probability of whether the virus is the end of the island or not.' The brothers started to argue on the probabilities in infections, expected deaths, probability of a vaccine discovery before the virus spread and wiped out the island, and the future of the island. It was a great time to flush out all the divergences in their opinions!

Co explained to Vid that a cataclysmic storm has a fatality rate of 1:63679, in other words it kills one in 63679 people when it happens. Vid said, 'Did you just guess numbers at the lottery?' 'Of course not, I read it in a book from Torrealba-Rodigrez2020, from the University of...' Vid stopped him before he could also tell her how many hairs Mr Rodriguez had on his head.

Event: cataclysmic storm

'We can assume that the fatality rate of the virus storm will be same as the cataclysmic storm fatality rate. What would be more cataclysmic than a viral infection-storm?' Vid stated.

For the first time, Co and Vid were in alignment using Co statistic madness in predicting the virus impact. Vid quicky calculated the expected deaths by multiplying the virus fatality rate by the total population.



Our Island Population = 100.000 people

Virus fatality rate =
Cataclysmic fatality rate =
0.000015

100.000 people X 0.000015 = 1.5 people
Less than 2 people are expected to die!

Co added 'Well, I am sure that we can be even more optimistic if we incorporate our population age structure (which is very young), our social interactions levels, our outdoor lifestyle, our medical infrastructures including the number of ICUs beds...'

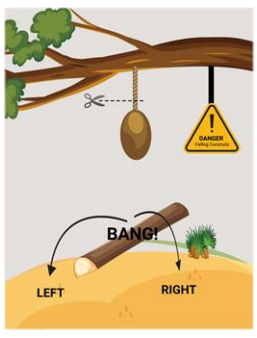
They both got relieved because there was a probability that less than two individuals would have died if the virus hit the island.

Given their outdoor life, it was sufficient to warn the local authorities and put in place few measures to prevent contamination such as social distance and use of masks, washing hands, restriction of movement, and maybe some remote learning for children for a few days in the event of the virus stroke.

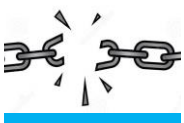
All of a sudden Co was taken back by his 100-year flood obsession. 'What if the flood hits our island along with the virus outbreak?' He knew that the *Virus Outbreak* and the *Flood* were unrelated events, called by statisticians *independent events*. Two events are independent if the occurrence of one does not influence or alter the probability of the other event happening. In other words, knowing that virus outbreak occurred does not give any additional information about whether the flood will or will not hit the island.

Independent events: the occurrence of one event does not affect the probability of another event

Coconut falling



Independent Events



Playing crab or elephant

For example,the probability of the coconut falling on the left of the log does not impact on the probability of getting crab when playing crab or elephant, our favourite hand gestures' game.

Being the flood and the virus outbreak independent events, Co tried to calculate the probability of the two events applying the multiplication rule.

Event V = Virus outbreak

Event F = Flood

$P(V) = 0.5$

$P(F) = 0.01$

$P(V \text{ and } F) = P(V) \cdot P(F) = 0.5 \cdot 0.01 = 0.005$

Co felt relieved when he found out that the probability of both events – the flood and the virus outbreak – occurring was 0.05.

Co kept asking himself what were the chances of experiencing a flood in a 50 year period, since he was only 12. In fact, while a 1 in a 100 year flood may have 1% chance of occurring in a given year, the chance is much higher when looking at a longer time frame. It was late. Co decided not to add more worries to his sister and go to bed. In the end, the combination of the two events – the flood and the virus outbreak – was a rare event based on his probability calculations.

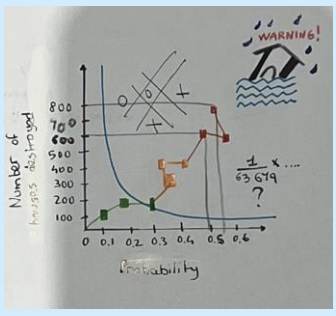
With the government instruction on conduct, Co and Vid were more than certain to say that no one would be killed by the viral storm . Co and Vid were ready to celebrate the good news.

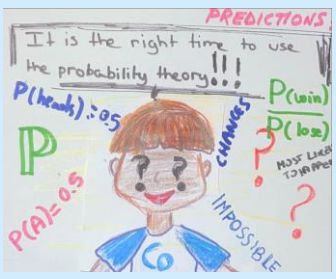
The statistics did not just save the island but, for the first time, created agreement between the two siblings. Vid was not annoyed by Co's statistical madness since she could see how useful it was for them and others. Co and Vid meaningfully incorporated math concepts in their plan of action and saved the island. Her mom was right when she called her Vid instead of Div (divergence): she knew that at some point her children would have been working as a team.

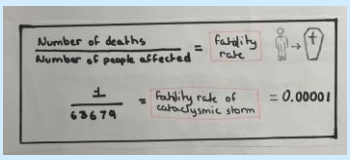
- The end -

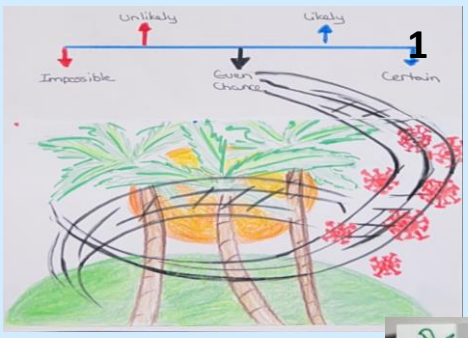
Since then, everyone on the island stopped calling the two children with their nicknames: Co-Vid.
The Co-Vid phase of their life was finally over.

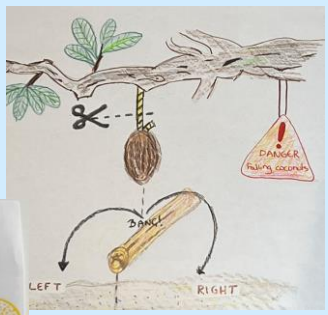
An epidemic strikes the world. There is a 50-50 chance that the epidemic transmitted through a virus will affect urban and remote populations, but the odds are good. It becomes a priority to establish the probable impact.

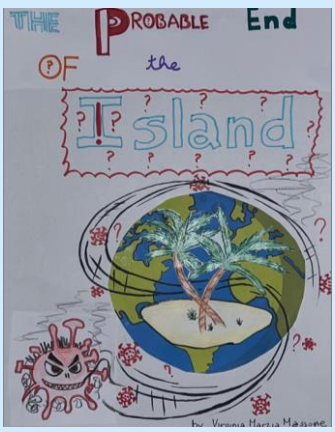


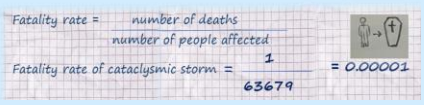












Some preliminary drawings...

My name is Virginia Marzia Massone and I am 12 years old . I live in Rome, Italy. I am a seven grade student at Marymount International School of Rome.

The inspiration for my story comes from a lesson on probability and the recent Covid-19 epidemic. Covid-19 has had a strong impact on our daily life and we have been bombarded every day with epidemic probabilities, death rates, statistics and worldwide comparisons.

I really enjoyed writing my math-story picture book. I realised I was learning so much because I was having fun and doing something practical (and useful). It changed my perspective on math: math is no longer a repetitive exercise of mechanical formulas and calculations to run inside the walls of our classroom. I used math concepts to describe the personality of my characters. I used the probability theory to deal with real-life events and uncertainty. I would encourage everyone to write a story: YMSA it is fun, not just a competition! You can surprise your audience by unveiling a math pattern with the most creative picture story book.

I really hope that probability theory and statistics will help us predict pandemics in future and mitigate their impact.