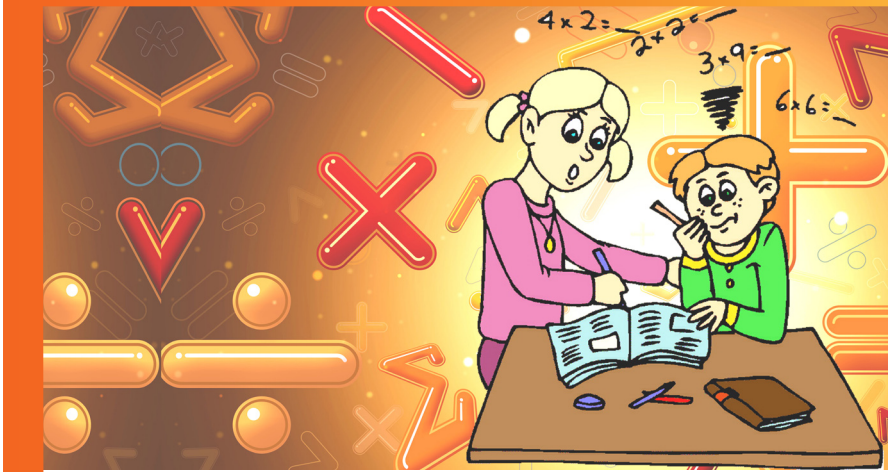


## Mathematics in day to day life

Anuradha Mahasinghe



Even the physical is neither absolute nor independent of conditions. It is a physical body composed of matter and energy, and always subject to change. Therefore, why should we expect the sun to rise tomorrow without doubt?

It is seven 'o clock on the dot. After a short while, I would fasten the door and then I am supposed to be engulfed by the tensive morning road traffic. Yet I have forgotten something. Still I am on bathroom slippers, not my office shoes. I stare at the doorway. Shoes are right here. Still I need to look for a pair of socks in the clothes cabinet. It is not an easy task, as the socks of different types are mingled with all types of garments inside. This hardness is often expected in this sort of untidy environment.

After a few unsuccessful trials, I become tired and then get mad. The worst possibility is ending up with no single pair of socks. No other incident is better than this type of simple misfortune, if you want to lose your temper over something. I get mad over my failure; because I believe that finding a pair of socks is quite natural, though it did not happen so. In other words, why did I end up with the worst, or the least probable; while I could have ended up with something better, and seemingly more probable? If you allow cultural beliefs to mingle up with thoughts, I would call it fate.

Occurrence of the less probable always reminds us of fate. When an airplane crashes in the air and disappears into the sea, it is explainable in terms of the fate of the pilots, the cabin crew and the passengers, yet we would consider it as a natural phenomenon, if it landed at the destination safely. Though we suppose the probability of being disappeared is very low for an airplane, because not a single airplane has disappeared in history. That implies, irrelevance of its probability to become true, an incident with a non-zero probability could somehow become true one day. After being true, the fact that it had a low probability does not make sense to us anymore.

On the other hand, is it fair at all to conclude that something has zero probability merely by past information? Can you say the sun will rise tomorrow, just because every day you observed that it did? According to a Russian fairy tale, once upon a time the bear swallowed the sun. The other animals were looking for the bear in each and every corner of the blacked-out world! Thus, the non-physical entity of sun could easily be endangered even by a storyteller.

In a practical perspective, this questions the validity of the applied form of probability. In this sense, if something can happen at all, the possibility is primary; while the probability becomes secondary. (This is somewhat analogous to existence and uniqueness theorems in mathematics.) So, the worst possible outcome could become true someday. One of these days, if followed by an unusual energy transition, the sun may not rise. The most sophisticated aircraft will undergo technical faults in the air and may disappear. Finally, I would end up with singles, no matching pair of socks.

Murphy's Law, the epigram with the meaning that if anything could go wrong, then it will enter into the diction of the English language, neither will it be for mathematics nor for the probability theory. Absence of tomorrow's sun, disappearance of a modern aircraft and ending up with no pair of socks are a few applications of this so-called law. This law is attributed to Edward Murphy, an American aerospace engineer who passed away about twenty five years ago. It is said that Murphy uttered the following words, referring to a

reckless worker at his laboratory: “If there is some way to do it wrong, he will”. However, the most popular version of Murphy’s Law is the saying “if something could go wrong, then it will”. This addresses the primary-secondary issue of possibility and probability of an incident.

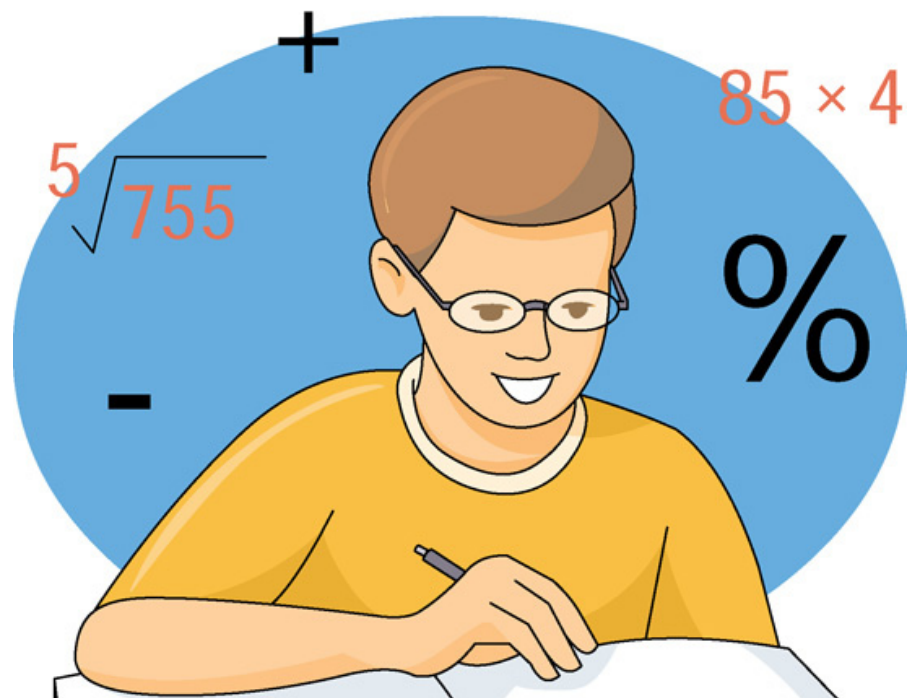
Sufficient evidences prove that the famous mathematician De Morgan (De Morgan’s rules in set theory are named after him.) was aware of this phenomenon, before Murphy or his remarkable employee. De Morgan had cited, “if tested sufficiently, anything would happen”. If we observe for millions of years, then we would find a day the sun does not rise. If we continuously let more and more airplanes fly, one would disappear. If you are going for work in shoes and socks for many years, one day you would miss a pair of socks.

Robert Matthews, a prolific science writer, elaborated Murphy’s Law by using this socks dilemma. Suppose I got ten pairs of socks, and six socks have gone missing. Though I am never pleased to lose my socks, there’s a way I would like most to let that happen: the missing six make three complete pairs. Then I would have seven pairs left with me. What I dislike most is, the missing six belonging to six different pairs. Using the basic counting principles and elementary probability theory, the probabilities of these best and worst outcomes could be calculated. Amazingly, the probability that the missing socks are from three different types is about 0.003, while they have a probability of 0.347 to belong to six different types. So, the worst is about hundred times more probable than the best, supporting the pessimism of Murphy.

Two minutes late than usual. I must

somehow walk to the bus stop as soon as possible. So, let’s not stick to the rule that you always need to put on the same type of socks. Two socks from different colors; it is not so funny after all. Just as I fasten the door, the mother cat appeared before me. She’s a wanderer, and has a litter of three nice kittens. She would like to have something for breakfast. I open the door again, and brought some food for her. Three minutes late now. I rush along the narrow road, listening to the thanksgiving of the cat family. The old lady at the fish-stall once said to me that a cat takes her litter to seven different places. If she is true, I feel mine is the seventh. One day I saw her taking her kids from one place to another. Even after taking the last, she went back and looked for some other kid. Some people say they cannot count. Maybe that is why she did so. (How a cat counts seven is a different problem.)

Though it is not clear if man is the only living being who is capable of counting, it is undoubtedly admitted that counting is the foundation of all creations of mankind in all civilizations. Counting actually comes before literacy in any civilization. You do not need to go to the valley of Nile to find a proof. The fish-stall located about fifty meters would suffice. The fishmonger, the living proof, is an old lady. Now I’m actually very close to her place and hear her voice clearly. Though she is illiterate, nobody could ever cheat her by means of change, coins or wherever basic mathematical operations that would apply in fish-selling. As literacy is not simply that a person knows the alphabet, the mathematical literacy is not simply the capability of adding, subtracting, multiplying or dividing. (Professor John Allen Paulos, a prominent writer on non-textbook mathematics refers to the illiteracy of very basic mathematics as Innumeracy.) Maybe



illiterate, but she is not innumerate, in this Professor's jargon. Mathematical rules are eagerly applied in her fish-stall daily. These include Proportional laws, decimals, interest rates etcetera. If you buy tuna and sprat together, you would get a discount. Two people buying the same amounts of tuna and sprat separately do not get it. Though it seems that the discount is arbitrary, it is not so. She has well-formed formulae that make her business attractive and lucrative.

We have more evidences to prove that illiteracy is secondary when compared with innumeracy. Kumaratunga, the famous Sri Lankan writer who characterized the typical gullible folk in his work *Hathpana*, focuses on the innumeracy of the guy, instead on illiteracy. On one occasion, this guy Kirihami is given eight *panam* and sent to the market to buy pots. The vendor says a pot costs ten *thuttu*. Getting mad at the vendor, Kirihami says, "You cannot fool me, I got only

eight *panam* and you take it and give the pot to me". What a deal!

When I walk down further, I find the small shop owned by the daughter of that old lady. Still in her thirties, she is courageous as her mother. This small place is being used to sew clothes, and she gets a fair income through the business. Her suppliers are from different places and they had different types of raw materials. So, selection of suppliers along with transportation becomes a major problem for her. Finally, the demand of her customers had to be met. When it comes to transportation, even the weather conditions and road conditions do matter. Thus, finding the optimal possibility would reduce her cost and make her business much beneficial. Though she is used to do this intuitively and naively, one day she may have to adopt the mathematical algorithms or software to make profits, if she expands her business beyond a certain level.

Mathematical and statistical modeling becomes vital in this case. For instance, she has previous records of road conditions, collected through her past visits to the suppliers. These records could be thought as data and statistical tests could be performed of them. Thus, we can get some precise measure on the road conditions. But road conditions make only one restriction. We can gather all such restrictions, and build a general mathematical model. The primary objectives are reducing the cost, and meeting the customer requirements. And in the core of the model is the selection of suppliers. This can be done through assignment algorithms in optimization, a fast developing branch of mathematics.

This depicts the nature of mathematical modeling. You encounter a problem in your real life. Then you take it out from the realistic norms and express in a mathematical realm in a symbolic language. It is

no longer a real-life problem; you have a mathematical problem instead. Mathematical problems are subjected to mathematical treatment, and if a solution exists, you find it. Now this solution has to be transformed back to the domain of real life. Finally, you have solved the real-life problem.

The daughter of the old fishmonger shows signs of becoming a successful



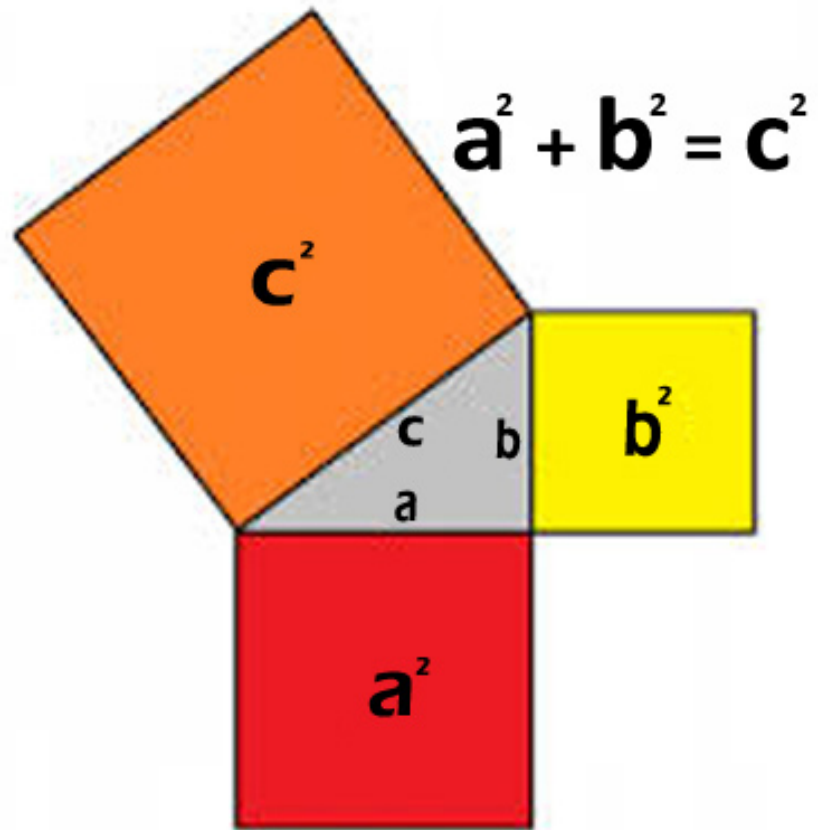
businesswoman in the future. She has already decided to expand her business by adding an annex to the current premises. Probably she is going to recruit more sewing-girls and get more orders. Presence of the mason and his crew at her place in the early morning indicates that the construction work of the annex is going on smoothly. It is somewhat amazing, because normally the mason and his crew arrive on time only on the day in which the very first stone is laid at an auspicious moment.

But no one dares to get across with the mason on this habitual delay. Everybody was aware of his bad temper and harsh words. Even now he shouts at someone in his crew in an incredible language of his own. Allegedly, the poor guy has not taken three-four-five accordingly. This is how they refer to the Pythagorean Theorem: three-four-five. The theorem says that, in a right angle triangle, the sum of the squares of the side lengths of the perpendicular sides is equal to the square of the diagonal. Most comprehensive example of this theorem is the right triangle with side lengths of three, four and five units. That is how the term has been coined by people who knew the theorem by its application. Though the mason may have never heard about Pythagoras, he is not only entrusted with the application of the Pythagorean Theorem, but also loyal enough to it, as to respond rigorously when it is being misused by somebody.

Historical evidence prove that the theorem which is attributed to Pythagoras had been known even before Pythagoras, in Babylonian, Chinese and Indus civilizations. This depicts the remarkable co-existence of mathematics and day

to day life. Millions of day to day lives together make the history of mankind. Man invented (or rather discovered, it is another chicken-or-egg dilemma!) mathematics from the day to day experience of life. They may have observed this relationship of side lengths of right triangles, probably during some construction or measurement work. Numerous people like our mason may have benefitted from that observation. A small minority among them like Pythagoras may have pondered about proving the observation. Though a proof does not make any sense to the mason who always verifies something by application and intuition, for the people who bother about deriving further results or abstractions, a proof marks a milestone. At one time in history, the task of creating knowledge

## Pythagoras theorem



was transferred from people like our mason, to people like Pythagoras. This originated a well-organized system of postulates, results and proofs, and it was called mathematics. This theorem, which is an element of this system, is named not after the masons who first observed or applied it, but Pythagoras, who seemingly gave the first-ever acceptable proof. One would say that the mason just applies the theorem of Pythagoras, yet he got it not from Pythagoras, but his master, the late mason. The great masters observed it through their day to day life experiences.

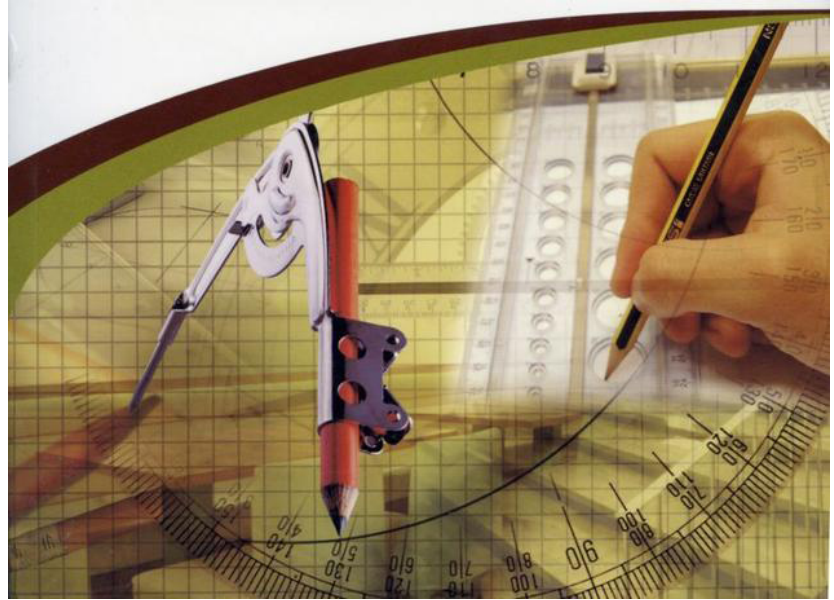
As mentioned early, well-organizing of such observations gave birth to the system we call mathematics. The basic principles used in the organizing procedure lay the foundation. It is

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nothing else, but mathematical logic. If you work-out a mathematical problem, or prove a theorem, then you are supposed to be logical. Loosely, you should make sure that you are not violating the logical principles. You need to be logical, or rather rational in your day to day life as well. So, we are using so much logic in our day to day conversations, though unintentionally.

The most important logical principle in mathematics must be the rule of implication. Descarte, the famous mathematician and logician, Carrol, the famous writer, and Russel, the famous philosopher were masters of this rule. However, I found that even my master, the chief at my office had mastered the rule. I am just reminded of his face, as I see the time. Four minutes late than usual! I wasted two minutes on looking for the socks, one minute for the breakfast of the cat, and slowed down at the old fishmonger, her daughter, the mason and the crew. This may have taken an extra minute. Though it is only four minutes right now, it will grow during the trip. The variation of the traffic jam with time is non-linear. It is nearly exponential. That means, I would be considerably late today.

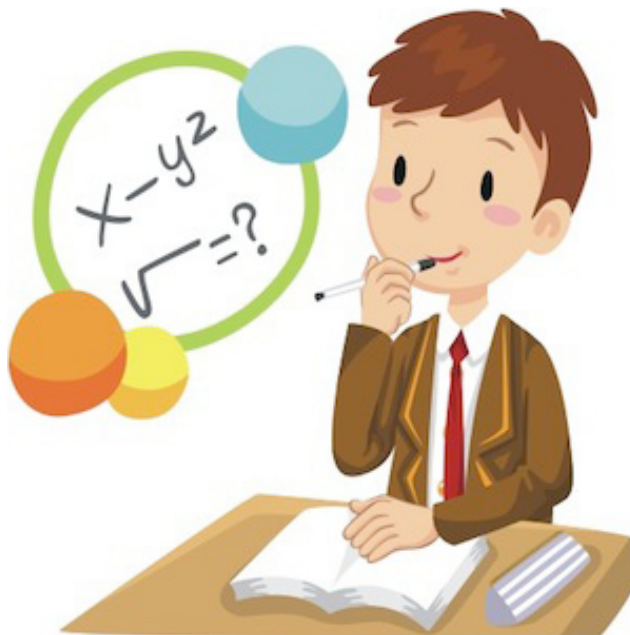
Being late is never tolerated in work. Our boss introduced an effective method to avoid it. He informed that, if somebody is late for more than four days a month, he or she would not be given a bonus at the end of that month. Last month, I was late



only on two days. Yet I received no bonus at all. There is nothing wrong with the boss. He simply used the rule of implication. Suppose a statement implies another statement. Whenever it is true, it must be true. But false does not require to be true. For instance, for a real number, the implication *if, then* is obviously true. Whenever a value is substituted for satisfying, also is satisfied. But for the selection, the statement is false, but the statement is true. Similarly, for the

selection of only two late records, the statement *I was late more than four days* becomes false, but *I would not be granted any bonus* can be true. The implication is not violated.

The strategy was logic. It is the same strategy used by mankind to organize and systematize their observations. Mathematics is such a system. These observations were called *mathematical principles* within that system. Yet they can never be separated from their origin: the day to day life. That is why they are being reflected from day to day activities. It's not incorrect to call this an application of mathematical principles. Yet these principles originated from day to day activities themselves and not through pencils and papers. It is no wonder that the day to day life is full of mathematical elements. We must be amazed, if there was any day to day life with no mathematical elements, or mathematics with no day to day applications.



**Anuradha Mahasinghe**  
Department of Mathematics  
University of Colombo