THE ROLE OF MATHEMATICS IN THE PRESENT-DAY SOCIETY

It is accepted that mathematics was created by man to help himself to solve certain problems which he faced in his battle for survival. Therefore, it will be correct to begin from the assertion that mathematics arose from necessity thus giving one more example in support of the maxim that " Necessity is the mother of invention". For instance, the valley of the river Nile was regularly inundated by floods, and with each flood the land markings of the fertile agricultural lands got obliterated and even changed. It was therefore felt necessary to re-demarcate the boundaries of such land holdings from time to time and thus that branch of study called geometry arose as an intellectual consequence of the measurement of land, it can be inferred that algebra arose as an intellectual consequence of practical arithmetic.

While struggling with problems for survival, man also attempted intellectual pursuits and one of the earliest and important problems which baffled man intellectually was "Planetary Motion" from the time of Ptolemy (150 *A.D.*). Various mathematical models have been set up to explain planetary motion. However, the first breakthrough came as a result of Kepler's empirical Laws of Planetary Motion and Newton's Law of Gravitation. With the creation of the Calculus by Newton and Leibnitz towards the end of the 17th century, the problems of planetary motion got almost completely solved.

With the success of Newtonian mechanics in the 17th century, mathematicians and physicists began constructing more and more mathematical models to explain various physical phenomena. Well known examples are heat, light, sound, electromagnetism, astronomy, fluid mechanics, quantum mechanics, statistical mechanics and relativity.

Another branch of study which came into prominence in the 17th century was probability. It is believed that the invention was due to its necessity in the realm of gambling . A gambler is supposed to have questioned Galileo as to why in three successive throws of a die., a score of 10 appeared more often than 9. However, probability and thereafter statistics have become very respectable and useful branches of study. Although such studies began in the 17th century, mathematical models of situations which involved the chance element were not set up and studied so extensively as in the Physical Sciences where the models which were seriously studied were mostly deterministic and involved no chance element. Applications of the concept of probability and statistical methods increased by leaps and bounds during the 20th century.

The Society today is very complex. Because of the communications revolution, different parts of the world have come closer, and organizations where millions of people interact with one-another have become common. Before man liberated himself from tribal life, what mattered was the management of a small tribe confined to a small village. There would have been occasional wars between tribes but once the war was over, it would again have been tribal life limited to a small geographical area. With advances in civilization and the associated development of communications, the small tribal unit would have enlarged by the fusion of several such tribal units together.

If the management of the organizational unit is not accompanied by a corresponding improvement in the efficiency of data management and the decision making process, the unit will collapse. Whether the ancient civilization such as the Greek and Roman or even our own Anuradhapura and Polonnaruwa collapsed primarily due to this factor is not known, and probably will never be known with certainty. However, mathematical methods are increasingly being used in management today and the following are only a few examples.

Consider air travel. When a person wishes to get from one airport to another, there could be several different ways of doing it with varying number of stop-overs. For an arbitrary pair of such airports, the question of determining whether there is a direct flight from one to the other is

fairly simple. However, if a person wishes to know in how many ways he can travel with one-stop over, or with two stop-overs or a still higher number of stop-overs, the problem becomes progressively more and more difficult. With the very large number of routes operated by each of the many airlines, the problem will be almost unmanageable expect for certain special pairs of airports. Matrix multiplication which can be computerized becomes useful in solving this problem.

For instance, suppose we have n airports A_1, A_2, A_3,...A_n. We construct a matrix A whose $(i, j)^{th}$ element is k if there are k direct flights from A_i to A_j. The diagonal elements of this matrix are taken to be zero. If a_{ij} is the number of direct flights from airport A_i to A_j, then $a_{ik}\, a_{kj}$ will be the total number of one stop flights from A_i to A_j with a stop-over at A_k.

Therefore, $\sum_{k=1}^{n} a_{ik}\, a_{kj}$

will be the total number of flights connecting A_i and A_j with exactly one stop-over. But this is the $(i, j)^{th}$ element of A^2. Thus A^2 gives the numbers of flights with two stop-overs from one airport to another. It is now not difficult to see that A^3 gives the number of flights with three stop-overs from one airport to another. When n is small, neither matrix multiplication nor computers will be required to handle this problem. But in the world today where n is large, we cannot do without either of these. This model will apply to travel by road between two cities in a country when the cities are connected by public transport systems.

It is well known how the computer has changed the present day world. How a pocket calculator helps an individual in solving problems which would have required sophisticated mathematics a decade ago is described in the sequel. In the world today, even children talk of interest rates, and both in investment and borrowing, certain compound interest have to be made. Simple arithmetic says that this involves the calculations of numbers of the for $(1 + r/100)^n$ where r is the percentage rate of interest for the relevant unit of time and n is the number of such units of time involved. For this given values of r and n, the above value has to be obtained and the practice before calculators came was to use tables which had been constructed for specific values of r and specific values of n. A pocket calculator will do the calculation for any reasonable value of n and r.

Other techniques such as statistical methods, game theory and linear programming have been effectively used in solving problems which are relevant to day-to-day problems of the present complex society we live in.

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