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MATHEMATICAL MODELLING

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ABSTRACT: Mathematicians are in the habit of dividing the universe into two parts: mathematics, and everything else, that is, the rest of the world, sometimes called "the real world". People often tend to see the two as independent from one another – nothing could be further from the truth. When you use mathematics to understand a situation in the real world, and then perhaps use it to take action or even to predict the future, both the real-world situation and the ensuing mathematics are taken seriously Whether the problem is huge or little, the process of "interaction" between the mathematics and the real world is the same: the real situation usually has so many facets that you can't take everything into account, so you decide which aspects are most important and keep those. But you have to check back: are the results practical, the answers reasonable, the consequences acceptable? If so, great! If not, take another look at the choices you made at the beginning, and try again. This entire process is what is called mathematical modelling. Nowadays, in the United States at least, these are taught in science or engineering departments. These branches of science are big and they are very old. What about areas that have become major appliers of mathematics during the last century? Information theory and cryptography may be included in the curricula of electrical engineering, inventory control, programming (as in "linear"), scheduling and queuing in operations research, and fair division and voting in political science.

1.INTRODUCTION

Problems of intelligent citizenship vary greatly in complexity: deciding whether to vote sincerely in the first round of an election, or to vote so as to try to remove the most dangerous threat to your actual favourite candidate; planning the one-way traffic patterns for your downtown; thinking seriously, when the school system argues about testing athletes for steroids, whether you prefer a test that catches almost all the users at the price of designating some non-users as (false) positives, or a test in which almost everybody it catches is a user, but misses some of the actual users.Mathematical Modelling in School.Let us now look at mathematical modelling as an essential component of school mathematics. How successfully have we done this in the past? What are the recollections, and the attitudes, of our graduates? People often say that the mathematics they learned in school and the mathematics that they use in their lives are very different and have little if anything to do with each other. Here's an example: the textbook or the teacher may have asked how long it takes to drive 20 miles at 40 miles per hour, and accepted the answer of 30 minutes. But how does all this come up in everyday life? When you live 20 miles from the airport, the speed limit is 40 mph, and your cousin is due at 6:00 pm, does that mean you leave at 5:30 pm? Your actual thinking may be quite different. This is rush hour. There are those intersections at which you don't have the right of way.Variety of Modules.We have seen that modelling arises in many major disciplines within science, engineering, and the even social sciences. As such, it will be at the heart of courses in many disciplines, and at the heart of many varied careers.

2.MATHEMATICAL MODELING:

Is often used in place of experiments when experiments are too large, too expensive, too dangerous, or too time consuming.

Can be useful in "what if" studies; e.g. to investigate the use o *pathogens* (viruses, bacteria) to control an insect population. Is a modern tool for scientific. Has emerged as a powerful, indispensable tool for studying a variety of problems in scientific research, product and process development, and manufacturing.

2.1 Example: Roadmaps of the Human Brain

1. Cortical regions activated as a subject remembers the letters x and r.
2. Real-time Magnetic Resonance Imaging (MRI) techno-logy may soon be incorporated into dedicated hardware bundled with MRI

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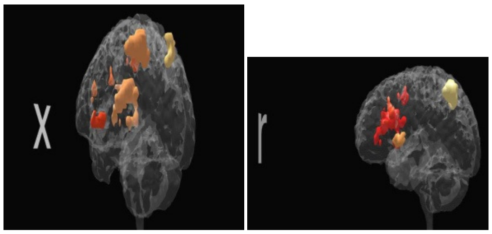
scanners allowing the use of MRI in drug evaluation, psychiatry, & neurosurgical planning.



2.2 Example: Climate Modeling

3-D shaded relief representation of a portion of PA using color to show max daily temperatures.

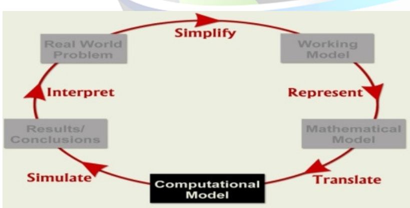
Displaying multiple data sets at once helps users quickly explore and analyze their data.

3. COMPUTIONAL MODEL:

3.1 Translate →Computational Model

Change Mathematical Model into a form suitable for computational solution.

- Existence of unique solution
- Choice of the numerical method
- Choice of the algorithm
- Software



cal Model into a form suit- able for computational solution.Computational models include software such as Matlab, Excel, or Mathematica, or languages such as Fortran, C, C++, or Java.

3.2 ESTIMATING TEMPERATURES:

The solutions shown represent only some possible solution methods. Please evaluate students' solution Methods on the basis of mathematical validity.

1. The temperatures here would seem to indicate that temperature changes continuously and constantly over intervals of equal length. That is, temperature appears to change linearly.
2. The only variable affecting the temperature, as far as we can see, is distance. Many other variables affect temperature, but those data are not given here. The student may be able to refine the model to include those variables later, if necessary. The temperature of the unknown is approximately 49°F.
3. The temperature changes at the same rate over equal distances. Let a, b, and x represent the temperature in degrees at points A, B, and X, respectively. If an unknown temperature point, X, lies
between (collinearly with) two known temperature points, A and
B where A is the lower temperature, then x =(AX/AB)(b –a)+a.
4. The model found in question 3 can be used twice. First, construct a line between any of the two known points (the line between 79° and 76° is shown). Second, construct a line through the last known point and the unknown point. Use the model to estimate the temperature at the point of intersection of the two lines. Finally, use that estimation to estimate the temperature at the desired point.
5. The model from question 4 can be used with any 3 known points. Students should find that different sets of known points produce different answers. They may conclude that the set of closest known points should be used or that the average of the answers for all sets of three known points should be used.
6. A model description is given in the solution to question 4. The topography of the area is one major variable that has been left out of the model. Hills and valleys affect the flow of air and, hence, temperatures.
7. The answers to the previous questions are replicated in the context of a linear graph.
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9. The answers to the previous questions are replicated in the context of a linear graph.
10. Linear functions describe the rate of change (in their slope) of the temperature. The distance is the x value and the temperature is the y-value.
11. For a linear function, the slope is the rate of change.

4. CONCLUSION:

Many types of modelling implicity involves claim about causality .its usually true of model involving differential equations. As the purpose of modelling is to increase your

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understanding of the world the validity if the model rests not only its fit to empirical observation ,but also One of the popular examples in computer science is the mathematicalmodels of various machines, an example is the deterministic finite automation (DFA) which is defined as an abstract mathematical concept, but due to the deterministic nature of a DFA, it is implementable in hardware and software for solving various Specific problems. For example, the following is a DFA M with a binary alphabet, which requires that the input contains an even number of 0s. state that the diagram is

$M = (Q, \Sigma, \delta, q0, F)$ where
$Q = \{S1, S2\}$,
$\Sigma = \{0, 1\}$,
$q0 = S1$,
$F = \{S1\}$, and
δ is defined by the following state Transition table:
The state $S1$ represents that there has
been an even number of 0s in the input
0 1
$S1$ $S2$ $S1$
$S2$ $S1$ $S2$ so far, while $S2$ signifies an odd number.
A 1 in the input does not change the
state of the automation. The language recognized by M is the regular language given by the regular expression 1*(0 (1*) 0 (1*))*, where "*" is the Kleene star, e.g., 1* denotes any non-negative number (possibly zero) of symbols "1".a market price $p1$, $p2$,..., pn. The consumer is assumed to have an ordinal utility function U (ordinal in the sense that only the sign of the differences between two utilities, and not the level of each utility, is meaningful), depending on the amounts of commodities $x1$, $x2$,..., xn consumed. The model further assumes that the consumer has a budget M which is used to purchase a vector $x1$, $x2$,..., xn in such a way as to maximize $U(x1, x2,..., xn)$. The problem of rational behavior in this model then becomes an optimization problem, that is: Note this model assumes the particleis a point mass, which is certainly known to be false in many cases in which we use this model; for example, as a model of planetary motion. Model of rational behavior for a consumer. In this model we assume a consumer faces a choice of n commodities labeled 1,2,...,n each with a market price $p1$, $p2$,..., pn.

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