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Some Characteristics and Classifications of Mathematical And Epidemic Models

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Abstract: Mathematical models are important basic tools in basic scientific research in many areas of biology, including physiology, ecology, evolution, toxicology, immunology, natural resource management, and conversation biology. Mathematical biology may sound like a narrow discipline, but it encompasses all of biology and virtually all of stress of mathematical sciences, including Statistic, Operational research and scientific computing. In this paper we investigate and discuss the characteristics and classificationsof mathematical and epidemic models.

***Key words*:** Mathematical models, epidemic models, characteristic, classifications.

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I. INTRODUCTION

The Mathematical relations we get may be in items of algebraic, transcended, differential, difference, integral, integral- differential equations or even in terms of inequalities. In the same way to solve a given physics, biological mode for it, then solve the model and finally interpret the solution in terms of the original problem.

One principle of great importance to science is the following, whenever we want to find the value of an entity which cannot be measured directly, we introduced symbols x, y, z…… to represent the entity and some others which vary with it, then we apply to laws of physics, chemistry, biology or economics and use whatever information is available to us to get relations between these variables. Some of which can be measured or are known and others which cannot be directly measured and have to be found.We use Mathematical relations developed to solve for the entities which cannot be measured directly in terms of those entities whose values can be measured or are known.

II. SOME CHARACTERISTICS OF MATHEMATICAL MODELS

i. Realism of models: We want a mathematical model to be as realistic as possible and to represent reality as closely as possible.
ii. Hierarchy of models: mathematical modelling is not a one-shot affair: Models are constantly improved to make them more realistic. Thus for every situation, we get a hierarchy of models, each more realistic than the preceding and their agreement with observations.
iii. Relative precision of models: Different models in differ in their precision and their agreement with observations.
iv. Models may lead to expected or unexpected predictions or even to nonsense: Usually models give predictions expect on common sense considerations, but the model predictions are more quantitative in nature. Sometimes they give unexpected predictions and then they may lead to break troughs or deep thinking about assumptions.
v. Sticking to one model may prevent insight: A model helps thinking, but it can also direct thinking in one narrow channel only. Sometimes insight is obtained by breaking with traditional models and designing entirely new ones with new concepts.
vi. Partial modeling for subsystems: Before making a model for the whole system, it may be convenient to make partial models for subsystems, test their validity and then integrate these partial models in to a complete model.
vii. Estimation of Parameters: Every model contains some parameters and these have to be estimated. The model itself suggests experiments or observations and the method of calculation of these observations and the method of calculation of these parameters. Without this explicit specification, the model is incomplete.

viii. Validation by independent data: Sometimes parameters are estimated with the help of some data and the same data are used to validate the model. This is illegitimate. Independent data should be used to validate the model.

ix. New models to simply existing complicated models. We start with simple models, introduce more and more variables and more and more functions to make the models more realistic and more and more complicated and with the additional insights obtained. We should again be able to simplify the complex models.

x. Transferability of mathematical model: A mathematical model for one field may be equally valid for another field but greater care must be exercised in this process. A model which is transfer to a number of fields is very useful, but no model should be thrust on a field unless, it is really applicable there.

xi. Prediction –Validation- iteration cycle: A mathematical model predicts conclusions which are then compared with observations. Usually there in some discrepancy. To remove this discrepancy, we improve the model, again predict and again try to validate and this iteration is repeated till a satisfactory model is obtained.

xii. Models for strategies and tactical thinking: Models may be constructed for determining guidelines for particular situations or they may be for determining an overall strategy applicable to a variety of situations.

xiii. Constraints of additively and normality: Models which are linear , additive and in which the probability distribution follows the normal law are relatively simpler, but relatively more realistic models have to be from these constrains.

xiv. Mathematical modeling and mathematical techniques emphasis in the applied mathematics has very often been on mathematical techniques, but the heart of applied mathematics is mathematical modeling [4].

3. Classification of Mathematical models:

i. Mathematical models may be classified according to the subject matter of the models. Thus we have mathematical models in physics, Mathematical model in Chemistry, Mathematical model in Biology, Mathematical model in Biology, Mathematical model in Medicine, Mathematical model in Psychology,Mathematical model in Sociology, Mathematical model in Engineering and so on.

ii. We may also classify Mathematical models according to the mathematical techniques used in solving them.

iii. Mathematical models may also be classified according to the purpose, we have for the model. Thus we have the mathematical models for description, Mathematical model for insight, Mathematical model for prediction, Mathematical model for Optimization etc.

iv. Mathematical models may also be classified according to their nature. Thus, mathematical models may be linear or non- linear according as the basic equations describing them are linear or non- linear. Mathematical models may be static or dynamic according as the time variations in the system are not or are taken in to account. Mathematical models may be deterministic or stochastic according as the chance factors are not or are taken in to account.

v. Mathematical models may be Discrete or Continuous according as the variables involved are discrete or continuous [4]

III. EPIDEMIOLOGY

Epidemiology is the study of health and disease in human population. It is the study of the distribution and determinants of health related events in specified populations, and the applications of the study to control health problems. It is discipline, which deals with all aspects of epidemics. e.g. spread, control, vaccination strategy etc.[1].

IV. TYPES OF EPIDEMIC MODELS

Two types of models are useful in the study of the infectious diseases at the population scale; these are stochastic and deterministic models.

Stochastic model: A Stochastic model is a tool for estimating probability distributions of potential outcomes by allowing for random variation in one or more inputs over time. Stochastic models dependent on the chance variations in risk of exposure, disease and other illness dynamics.

Deterministic model: When dealing with large populations as in the case of tuberculosis, deterministic or compartmental mathematical models are often used. In a deterministic model, an individual in the population are assigned to different subgroups or compartments each representing a specific stage of the epidemic. The transmission rates from one class to another are mathematically expressed as derivatives, hence the model is formulated using differential equations. While building such models it must be assumed that the population size in a compartment is differentiable with respect to time and that the epidemic process is deterministic .In others word, the changes in population of a compartment can be calculated using only the history that was used to develop the model.

because they require less data, are relatively easy to set up, and because the computer software are widely available and user- friendly. The dynamics of the SI, SIS, SIR and SEIR models are now well understood so that deterministic models used to explore whether a particular control strategy will be effective. Furthermore, many other complex models exist that can incorporate stochastic elements [2][3] [5].

V. CONCLUSION

Theoretical development has presented more than just mathematical exercises. Theory and fact are intertwined, mutually nourishing each other .One of the most important development in biology within the last quarter- century has been the integration of mathematical and theoretical reasoning into it. And it is a great example of applications of mathematics in to it.

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