

Optimization of Mathematical Model for Medical Sciences

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ABSTRACT: This article mainly concerns with mathematical modeling in medicine. There is one area in medicine namely pharmacy-kinetics which have already been mathematic zed. There are large areas in medical science which are not amenable to mathematical treatment, and modeling constantly endeavor to widen the areas to which mathematical techniques can be applied for gaining a better insight, and help deepen our understanding of those areas which have already been mathematic zed. The skills needed to be successful in applying mathematics are quite different from those needed to understand concepts, to prove theorems or to solve equations. The difficulty is not in learning and understanding the mathematics involved but in seeing where and how to apply it. In this paper an attempt is made to demonstrate the essentials of mathematical modeling without going deep in to the details on specialized topics.

Keywords: mathematical modeling, medical sciences

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I. Introduction:

In most of the procedures with which one is worried in the investigation of the medicinal sciences, one need to manage collections of people, be they living or be they dead, which end up plainly influenced by some trademark. They may meet and trade thoughts, the gathering may bring about the transference of some irresistible ailment, et cetera. The life of every individual comprises of a prepare of such episodes, one after the other. From another perspective every individual from the human group comprises of a collection of cells. These cells respond and interface among each other, and every individual carries on with an existence which might be again considered as a progression of occasions, one after the other. In the event that one thinks about these people, be they individuals or be they cells, as moving in a wide range of measurements, reversibly or irreversibly, constantly or irregularly, by unit stages or per saltum, at that point the technique for their development turns into an investigation in energy, and can be drawn closer by the strategies commonly embraced in the investigation of such frameworks. It is the protest of this correspondence to approach this field in an orderly way, to discover answers for a portion of the varieties which may emerge, and to show sure of these by cases.

One measurement, irreversible, I have been in the propensity for utilizing vector charts for the portrayal of such issues. They have the favorable position that the theories which are received are unmistakably imagined too by the non-numerical peruser as by the scientific, and they additionally help in helping one to understand the different alterations which may happen, thus to treat the investigation of the general issue efficiently. To settle thoughts let us think about a basic case; the connection of an array of people to normal colds. In the accompanying arrangement of compartments are grouped at any moment the quantities of people who have encountered, 0, 1, 2, 3 ... assaults of this protest. The historical backdrop of every individual comprises of a progression of unit steps, starting in the compartment which depicts his underlying condition. The bolts in the outline show the shot of section starting with one compartment then onto the next—in other words the possibility of encountering a further assault amid the tiny timeframe.

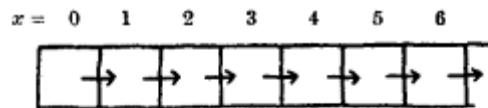


Fig. 1

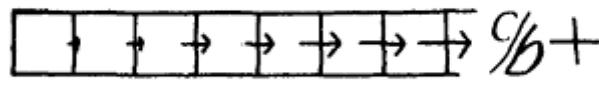
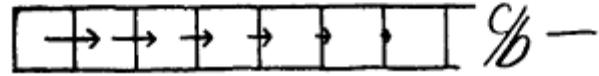


Fig. 2



In fig. 1 these bolts are of equivalent size, and by this we comprehend that the progressive possibilities were of steady esteem; in fig. 2 the bolts increment in measure, signifying an expansion of vulnerability with each assault; in fig. 3 they diminish, which indicates that the individual is ending up decreasingly at risk, or in therapeutic speech he is building up an insusceptibility. Guided by the outline, and utilizing the classification v_x = the quantity of people who have encountered x assaults (or right away "of review x "); f_{hxdt} = the likelihood that a person of review x will go to review $x + 1$ in the time dt , and noticing that the variety of the number in any review is the distinction between the quantity of incomers into that review, and the number who go out from that review, we have

$$dv_x = (f_{t,x-1} v_{x-1} - f_{t,x} v_x) dt. \quad \dots \dots \dots \quad (1)$$

In this case and in what follows, for the sake of conciseness, the solutions will be given for instantaneous point sources; other initial conditions may be obtained by summation. In the first place let us assume that $f(x)$ is of the form $A > tf(x)$, that is to say, that the time function applies generally to the probability of exit from all compartments. (The general case will be considered later in dealing with two dimensional problems.)

Let us adopt the nomenclature $\mu_r \equiv \sum_{x=0}^{\infty} \frac{(x-\mu)^r v_x}{N}$ where μ is

the mean $\left(\sum_{i=1}^N \frac{xx_i}{N} \right)$, and N is the total number of individuals.

When $f_x = b + cx$ (a first approximation), we find

$$v_x = N \frac{b}{c} \left(\frac{b}{c} + 1 \right) \dots \left(\frac{b}{c} + x - 1 \right) \frac{\left(1 - \frac{\mu}{\mu_{x'}} \right)^x}{x'!} \left(\frac{\mu}{\mu_{x'}} \right)^{\frac{b}{c}} \dots \dots \dots \quad (2)$$

(The values for the moments are obtained by differentiating the particular moment and making use of equation (1)).

Thus v_k is the $(x + 1)^{th}$ term of the expansion of the binomial.

$$N \left\{ \frac{\mu_2}{\mu} + \left(\frac{\mu_2}{\mu} - 1 \right) \right\} \cdot \frac{b}{c}$$

$$\text{also } \frac{c}{b} = \frac{\mu_2 - \mu}{\mu^2}, \text{ and } \mu_3 \mu + \mu_2 \mu = 2\mu_3^2. \dots \quad (3)$$

If we write $\lambda_r \equiv \sum_s x^r v_s$, $N = \frac{\lambda_r^2 (\lambda_2 - \lambda_1)}{2\lambda_r^2 - \lambda_1 (\lambda_3 + \lambda_2)}$ (4)

In the case where $\frac{c}{b}$ tends to zero, the solution reduces to

$$v_x = Ne^{-\mu} \frac{\mu^x}{x!}, \quad \dots \dots \dots (5)$$

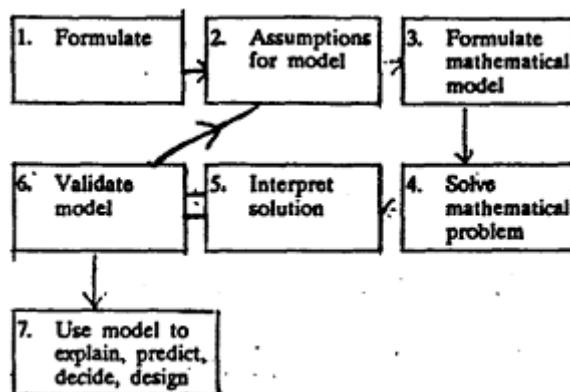
i.e. Poisson's farthest point of the binomial. It is intriguing to take note of that the lime work 4>, has been killed, and does not influence the relative disseminations given in (2) and (5). This is of significance in managing numerous issues, for instance (a) the impacts of regular varieties which apply by and large to people of all evaluations, and which presumably work in all scourges, (6) varieties in the harmfulness of the life form over the span of the pestilence to which it gives rise, and (c) any varieties relying on the qualities fxr or Ar, which are themselves elements of the time and thus might be communicated as </>, are disposed of and don't influence the appropriation given by the arrangement.

II. Review Of Literature:

The vast majority of the early improvements in systems are because of physical sciences. Klamin (1971) proposed a five phase model of the critical thinking process. The stages being acknowledgment, plan, arrangement, calculation and clarification, Klamin depicted critical thinking as a direct procedure beginning at organize one and continuing to organize five and soon thereafter the issue is tackled. Lin (1976) included the assessment of demonstrating process as 6th stage. In a consequent paper Lin (1978) routed to another essential idea of a scope of models rather than a solitary best model.

Wood (1969) portrayed demonstrating process as an iterative procedure with assessment of the outcomes in the light of obsenable reality prompting alteration of the model and redundancy of the stages - a type of parameter distinguishing proof issues. Corridor (1972) additionally built up the iterative system and Bajpai et al (1975) utilized a stream piece outline to delineate their ideas of methodologies of numerical displaying. A further change toward this path is because of d'Irveno and McLone (1977) where approach is to begin by developing the most straightforward model. On the off chance that this is wrong at that point backpedal and make the model more modern ordinarily by dropping or modifying at least one of the presumptions. A novel treatment of demonstrating process by Penrose (1978) comprises of six phases in a roundabout movement His portrayal is duplicated in Fig. 1

The cases are numbered and joined by bolts to demonstrate the typical bearing of movement starting with one then onto the next, however it is common to come back to a portion of the crates a few times as one's thoughts create. A decent record of complex linkage procedure of scientific displaying was given by Clements (1989).



In this article display building is considered inside the expansive procedures having epistemological, generous, specialized and purposive parts. Inside the epistemological segment, criteria for the development and assessment of the models are put forward. Inside the considerable parts the idea of hypotheses, its hypothetical terms and the idea of important information are defined. The specialized part manages the stray pieces of displaying - the scientific frameworks utilized their properties, estimation, and estimation. Inside the purposive segment, we examine the objectives of the demonstrating exertion. These incorporate clarification, depiction and elucidation. They likewise incorporate a thought of the employments of a model. These parts are profoundly interrelated.

Characterization of models: Mathematical models are regularly co-ordinated by three qualifications: The primary separates, process models from basic models, the second deterministic models from probabilistic models, and the third, utilizing discrete from consistent. On a fundamental level, an eight-cell table can be built and every phone fitted with scientific models sharing the criteria characterizing the phone.

Comprehend the structure of frameworks relations. The apparatuses utilized incorporate diagram hypothesis, lattice variable based math, gatherings, semi gatherings. Boolean polynomial math, mathematical topology, Measurable models are utilized to show forms whose results are administered by a probabilistic mechanism(s). Deterministic models shun stochastic instruments for deterministic components and relations. Process models might be deterministic or stochastic, yet basic models have a tendency to be deterministic.

The refinement between numerical models and measurable investigation is an exceptionally bluned one. Formal methodologies can and do fuse mistake particular which different methodologies for the most part don't. This illuminates estimation. Second, the properties of the measurable instruments are expressed and set up scientifically. At long last, new numerical models and their uses produce estimation issue and factual inquiries.

The Theory, Model and Data Mangle: This triangle gives a strategy to choosing models most appropriate for a substantive issue where expertise indicates elective model candidate6 and choice of most.

productive models. There are three sets of mappings - amongst hypothesis and model, amongst model and information and amongst hypothesis and information and all are essential.

The hypothesis - display linkage is worried about communicating a compatibility between a hypothesis and its portrayal in a numerical model. The hypothesis needs to outline the model with little twisting or misfortune. Deductively, there is a scientific formalization of the hypothesis while inductively this can be a formal generalization of the hypothesis. The scientific model at that point must be helpful. These outcomes can be mapped to hypothesis and information. Deductively demonstrate maps to information by indicating or foreseeing experimental results. Likewise deductively numerical outcomes guide to hypothesis by indicating hypothetical ramifications of the determinations through mappings connecting hypothesis and model. The hypothesis, the model and the information need to bode well and be predictable with one Process models expressly, endeavor to demonstrate the progressions and give an - which is the stub of assessing models comprehension of the components of progress.

Among the regularly utilized devices are differential conditions and contrast conditions. Allegory, Analogy and Model: There are no Structural models endeavor to speak to and obvious basic definitions for the terms like representation, similarity and model, however despite the fact that they are in no way, shape or form equivalent words, they do share certain highlights. Comprehensively one might say that they all endeavor to improve our comprehension of new data as far as what is as of now commonplace. As per Sutton (1978), "Analogies are broadened likenesses in which an endeavor is made to follow numerous purposes of correlations, Metaphors curve ... less express and substantially more rationally prodding ... compelling the listener to look among his related thoughts for conceivable associations and, a model can be thought of as a broadened illustration".

III. Mathematical Models For Physiological Molecular Pk-Pd: Molecular, Cell, Tissue & Whole Body

In recent time, pharmacological writing has revealed numerous examples of overcoming adversity and furthermore less effective endeavors towards focused medicines, for example, monoclonal antibodies, related or not with cytotoxic particles (e.g., gemtuzumab ozogamicin, as of late pulled back from the US advertise [103]), new galenic frames or physically supported (e.g., by magnets) vectors for mediate conveyance as close as conceivable to tumor tissues. It isn't the motivation behind this article to audit them, yet rather to pressure the way that such, at times magnificent, directed treatments can't do every one of the employments, since they may on occasion demonstrate unpredicted poisonous reactions that additionally must be considered and that 'old' medications, for example, 5-fluorouracil, can at present be extremely helpful, particularly in consolidated treatments. Traditional anticancer medications are regulated each day in fruitful blends into the general flow at the entire body level in patients, have lethal reactions on solid tissues and might be conveyed by diversely requested calendars. The synergistic impacts of medication blends have been all around tended to from a somewhat traditional perspective blending hereditary qualities and insights [37], yet not in a physiological viewpoint. This unavoidably returns by down to business clinical contemplations to a still present inspiration to speak to the impacts of medication mixes in a physiological and dynamic route by entire body PK– PD models. In reality, relating blood PK to restorative viability and poisonous quality specifically is sad on the off chance that one doesn't consider blood PK, as well as tissue PK, together with tissue PD models – or better stated, 'PD-populace elements' models of the impacts of medications on both needed and undesirable focuses in cell populaces, tumor and sound. Different entire body compartmental PK ODE models have been distributed lately in fantastic diaries committed to PK and its clinical applications in oncology. They speak to cutting edge pharmacological displaying, now and again being 'semi physiological' [38]. Instead of announcing these compartmental models that are effortlessly extendable to easy to use programming for populace considers, this article will concentrate on physiological PK– PD demonstrating at the level of an individual patient, which as I would see it is the prompt fate of displaying for therapeutics. As specified in the principal segment, drugs act at the atomic level in fringe tissues however are conveyed (potentially after past intestinal ingestion) into the focal blood compartment at the entire living being level. Physiological portrayals of the destiny of medications must consider this multiscale setting and depend on conditions managing drug focuses in blood and tissues for entire body physiologically based PK (WBPBPK, a term authored by Malcolm Rowland [12]) and atomic responses in light of law of mass activity or Michaelian energy for intracellular PK and PD (thus, WBPBPKPD). Physiologically based displaying suggests going past generally illustrative blood PK parameters (e.g., half-lives, most extreme fixation, crest focus time and zone under bend) and however much as could reasonably be expected includes tissue attributes, for example, enzymatic exercises for cell PK and specifically DNA twofold strand breaks for cell PD. In more detail, PK– PD atomic model outline for anticancer medication advancement is worried about medication focuses in the plasma, in organs and in cell populaces that are sedate targets, be they wanted (tumor tissues) or not (beneficial tissues subject to lethal reactions). The atomic decision of component portrayal, both for PK (mediate changes from its contribution to the general flow) and for PD

(activity on the objective at the cell and tissue levels) makes such models agreeable to consider by various parameters hereditary (e.g., enzymatic polymorphism) and epigenetic varieties between people. This may in this way prompt plainly identifiable (gave obviously that comparing biomarkers are accessible, which tragically isn't generally the case) physiological portrayal of various profiles coordinated towards individualized medications. To date, most endeavors have been made on tranquilize preparing protein hereditary qualities, with constrained achievement [6], however it isn't improbable that by taking physiological contrasts between patients, which are not generally clarified by hereditary qualities, into account in medicate handling, one can enhance this circumstance. This is no less than one non-unimportant inspiration to ponder PK– PD on physiological instead of just hereditary bases. Various PK– PD models in view of differential conditions exist for different anticancer medications and some of them are sub-atomic based, yet not every one of them are physiologically based (they all the more regularly depend on compartment outline that is phenomenological guided by tranquilize blood focus bend fitting, with barely any physiological contemplations) and even less among them are entire body composed. A vital issue for these models is the test distinguishing proof of their parameters, since they incorporate significantly more than effectively open blood PK qualities. Managing tissue PK and PD, they should be distinguished at first in cell societies (regardless, deified cell societies, at that point ex vivo transplants, which are shorter lived). At that point, going from in vitro to in vivo, in research facility creatures by utilizing solid tissue tests and tests from xenografts remaining for in vivo have tumors and in the end in clinical trials, by utilizing converse issue examination systems, for instance. All in all this is a long procedure and scarcely ever yields viable quantitative prescient models in a sensible time period. All the more unobtrusively, subjective forecasts might be acquired to look at changed treatment plans amongst them and afterward test these expectations in clinical settings, with the results being reaction to treatment and long haul survival. A case of a model for WBPBPK for capecitabine has been accounted for [39]. A hypothetical proposition of a basically intracellular PK– PD show, regardless including entire body implantation, for the joined conveyance of 5-fluororacil with folinic corrosive (a potentializing affiliation utilized as a part of the treatment of colorectal disease) has additionally been depicted [10]. An outline of the yield of this ODE display with occasional medication implantation is appeared in Figure 3. The conditions of the ODE framework depend on the law of mass activity and Michaelian energy when chemicals or transporters are worried by what is known about the intracellular physiology of medication preparing. Different models in view of the same physiological multiscale standards, with law of mass activity and Michaelian energy, specifically for irinotecan [Ballesta A, Dulong S, Abbara C et al.: A joined trial and scientific approach for molecularbased improvement of irinotecan circadian conveyance. Original copy Submitted] [40] and cytosine arabinoside [104], are as of now being planned and tentatively distinguished in cell societies or in research facility creature models. The remainder of these two models is in reality a crossover demonstrate, where consistent differential conditions for drugs and for administrative proteins apply their activities on a discrete operator based model for cell populace progression [104]. On the off chance that one mulls over inside subject fluctuation in the reaction to drugs, as talked about in the main segment of this article, the effect of circadian tickers on tranquilize handling ought to be spoken to by occasional capacities to adjust the maximal action (Vmax) of compounds or transporter proteins. Such occasional capacities might be plain sine waves in the most basic type of circadian displaying, yet in addition substantially more nitty gritty ODE models of the clock [41], when point by point information of their capacity must be considered. This might be the situation when a switch effect of cytokines on the clock is to be viewed as, for example, tumor-discharged cytokines, which has just been demonstrated tentatively [42] and clinically [43]. For this situation, focuses for harmfulness to the focal and to the fringe tickers may likewise be added to the sound tissue lethality part of the entire body show, since some anticancer medications have been demonstrated to initiate circadian clock interruption [10]. Similarly, in an entire body point of view going past the portrayal of just multiplying tissues (solid and tumor), focuses of lethality for nonproliferative cell populaces, for example, cardiovascular (anthracyclines) or neurological (e.g., oxaliplatin) ought to be considered. Useful consequences for the encompassing tissues of extra medications, for example, mitigating, antiangiogenic, grid metalloprotease inhibitors and pH-changing immunostimulators may likewise be spoken to as per their successful relationship in particular consolidated medicines utilized as a part of the facility. They are various and it isn't the reason for this article to audit them, accepting that growth is essentially a malady of uncontrolled cell and tissue expansion. At the point when atomic models are accessible to consider these impacts, they ought to be utilized, contingent upon the medicines that are under investigation in the facility.

IV. Conclusion:

The results of this study show that it is reasonable to use this model to analyze dynamics of individual; this technique can be used to conclude how these parameters vary with respect to disease and aging while taking into account the highly nonlinear nature of blood pressure-cerebral blood flow variations. Thus, future work should consist of estimating standard errors of parameter estimates and formulation of a hypothesis testing

procedure to determine if differences in the fitted parameters exist between groups while taking into account intra-subject parameter uncertainty.

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