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Sensitivity Analysis

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Abstract: In this paper, we see the concepts of sensitivity analysis and its uses in various fields and an example on how it used in business era.

I. INTRODUCTION

Sensitivity Analysis is the study of how the uncertainty in the output of a mathematical model or system can be apportioned to different sources of uncertainty in its input. A related practice is uncertainty analysis, which as a greater focus on uncertainty quantification and propagation of uncertainty; ideally, uncertainty and sensitivity analysis should be run in tandem

The process of recalculating outcomes under alternative assumptions to determine the impact of a variable under sensitivity analysis can be useful for a range of purposes including

Testing the robustness of the results of a model or system in the presence of uncertainty

Increased understanding of the relationships between input and output variables in a system or model

Uncertainty reduction, through the identification of model inputs that cause significant uncertainty in the output and should therefore be the focus of attention in order to increase robustness

Searching for errors in the model

Model simplification

Enhancing communication from modelers to decision makers

Finding regions in the space of inputs factors for which the model output is either maximum or minimum or meets some optimum criterion

To seek to identity important connections between observations, model inputs, and predictions or forecasts, leading to the development of better models

A. Constraints

The choice of method of Sensitivity Analysis is typically dictated by a number of problem constraints or settings some of most common are

1) Computational expense
2) Correlated inputs
3) Non linearity
4) Model interactions
5) Multiple outputs
6) Given data

B. Approaches

There are a large number of approaches to performing a Sensitivity Analysis, many of which have been developed to address one or more of the constraints discussed above

They are also distinguished by the type of sensitivity measure, be it based (for example)variance decompositions, partial derivatives or elementary efferts.

In general, however, most procedures adhere to the following outline

Quantify the uncertainty in each input (example: ranges,probability distribution)

Identity the model output to be analysed.

Run the model a number of times using some design of experiments dictated by the method of choice and input uncertainty

Using the resulting model outputs , calculate the sensitivity measures of interest

C. Applications

Some example of Sensitivity Analyses performed in various disciplines follows here

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D. Environmental

Environmental computer models are increasingly used in a wide variety of studies and applications. for example:Global climate models are used for both short –term weather forecasts and long- term climate change. Moreover, computer models are increasingly used for environmental decision–making at a local scale, for example for assessing the impact of a waste water treatment plant on a river flow, or for assessing the behavior and life-length of bio-filters for contaminated waste water.

In both cases Sensitivity Analysis may help to understand the contribution of the various sources of uncertainty to the model output uncertainty and the system performance in general. In these cases, depending on model complexity, different sampling strategies may be advisable and traditional sensitivity indices have to be generalized to cover multiple model outputs, heteroskedastic efferts and correlated inputs

E. Social Science

Sensitivity Analysis is common practice in social science. A famous earlyexample is Mroz (1987), who analysed econometric models of female labor market participation

In modern econometrics the use of Sensitivity Analysis to anticipate criticism is the subject of one of peter Kennedy's ten commandments of applied econometrics

F. Engineering

Modern engineering design makes extensive use of computer models to test designs before they are manufactured. Sensitivity Analysis allows designers to assess the effects and sources of uncertainties, in the interest of building robust models

Sensitivity Analyses have for example been performed in biomechanical models, tunneling risks models amongst others.And also in business, chemistry, meta analysis, model calibration and improvement etc

[Sensitivity Analysis, also referred to as what-if or simulation analysis, is a way to predict the outcome of a decision given a certain range of variables. By creating a given set of variables, the analyst can determine how changes in one variable impact the outcome]

G. Sensitivity Analysis Example in Business

Assume Dilshad, a sales manager, wants to understand the impact of customer traffic on total sales. She determines that sales are a function of price and transaction volume. The price of a widget is $1,000 and Dilshad sold 100 last year for total sales of $100,000. Dilshad also determines that a 10% increase in customer traffic increases transaction volume by 5%, which allows her to build a financial model and sensitivity analysis around this equation based on what-if statements.It can tell her what happens to sales if customer traffic increases by 10%,50% or 100%.Based on 100 transactions today,a 10%,50% or 100% increase in customer traffic equates to an increase in transactions by 5,25 or 50.The sensitivity analysis demonstrates that sales are highly sensitive to changes in customer traffic.

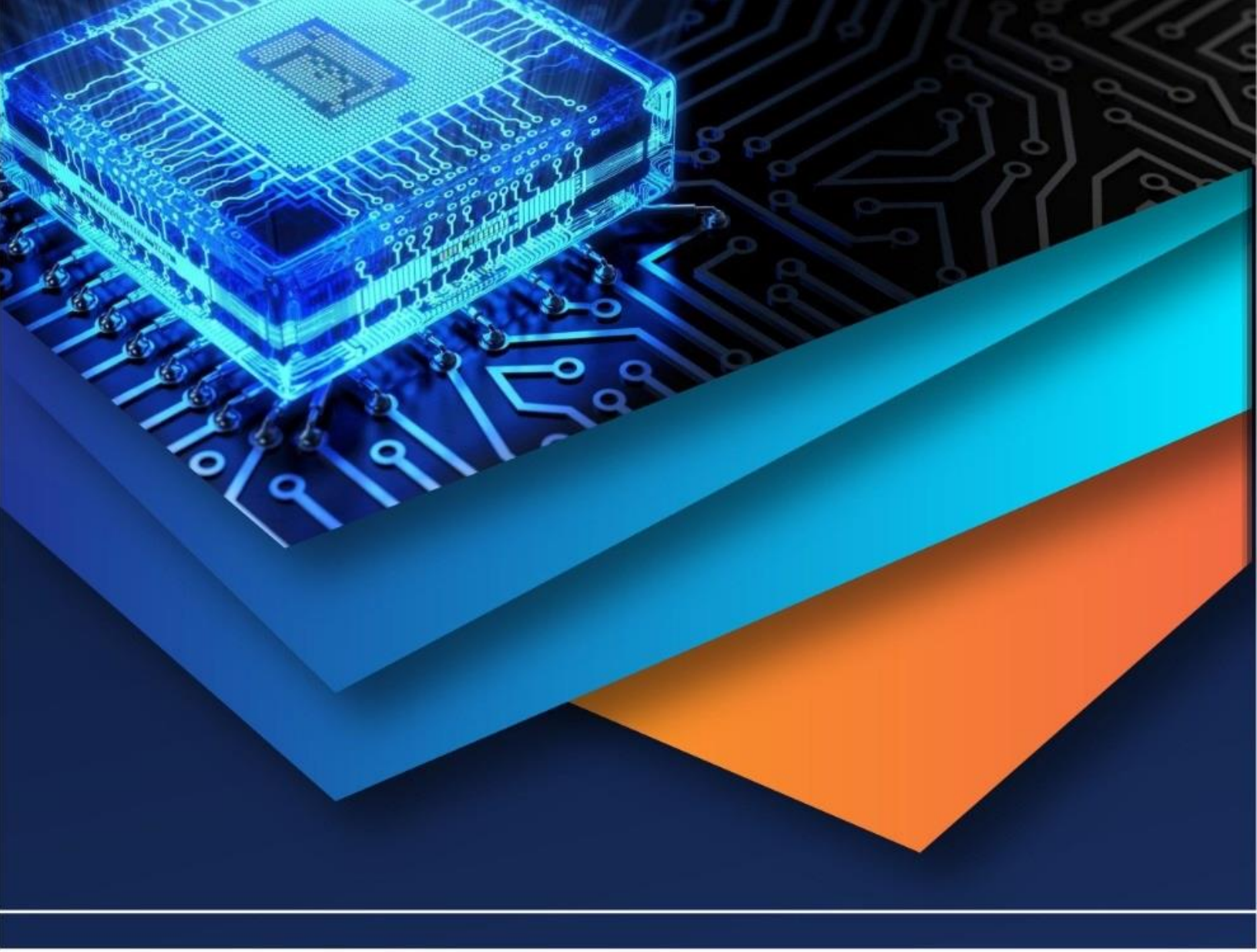
II. CONCLUSION

Hence,In this paper, we have discussed the concept of Sensitivity Analysis, its constraints and its uses in various fields. We havealso seen the applications of Sensitivity Analysis and the key role played by it in the above mentioned areas. We also went through an example of a sales manager and how she uses Sensitivity Analysis to solve her business problem maximizing the profit.

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