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Sensitivity Analysis Technique in Minimizing Death Rate

K. Sunmathi¹, B. Kjaleesha², Dr. S. Shenbaga Ezhil³

¹M. Phil(Scholar), ²Assistant Professor, Department of Mathematics, St. Joseph's College of Arts, Science for Women, Hosur

³M. Phil(Scholar), Department of Mathematics, JPR Institute of Technology Sriperumpudur, Chennai

Abstract: This paper deals with the Sensitivity Analysis Technique in Minimizing Death Rate. The Preliminaries need are discussed in detail. The data required for death rate from 2010-2017 are collected from newspapers. Next the linear programming problem is framed for the data and Two-phase method is applied in general. In sensitivity analysis, the Rank Correlation Coefficient (RCC) method is used to correlate to identify the variable to change in the LPP for better reduction. The results thus obtained are discussed.

Keywords: Sensitivity, LPP, Variables, Minimization, Rank Correlation

I. INTRODUCTION

Employing techniques from other mathematical sciences, such as mathematical modeling, mathematical optimization and statistical analysis, operations research arrives at optimal or near-optimal solutions to complex decision-making problems.

Operational research (OR) encompasses a wide range of problem solving techniques and methods in the pursuit of improved decision making and efficiency. The computational nature of OR had a strong tie to computer science and analysis. It faces a problem to determine which techniques are most appropriate based on nature of the system, improvement and constraints on time and computing power.

Sensitivity Analysis is defined as the technique used to determine how different values of an independent variable will impact a particular dependent variable under a given set of assumptions. It is used within specific boundaries that will depend on one or more input variables like effect which changes in interest rates have on a bond's price.

Sensitivity Analysis is also known as the what- if analysis. It can be used for any activity analysis or system. It helps in analyzing how sensitive the output is by the changes in one input while keeping the other inputs constant. It works on the simple principle change the model and observes the behavior. It is a way to predict the outcome of a decision if a situation turns out to be complicated compared to the key predictions.

The current paper is a comparative assessment of several methods and is intended to demonstrate calculation rigor and compare parameter sensitivity ranking resulting from various sensitivity analysis techniques.

II. LINEAR PROGRAMMING

It is a technique for determining an optimal value of interdependent activities. A particular plan of action from several alternations can be done based on the available resources. Linear indicates that all relationships involved are linear.

A. Mathematical Formulation Of Lpp

Many problems deal with the allocation of resources-money, materials, machines, space, time.., in limited order to maximize profit or minimize cost. In such cases, applying the linear programming technique helps in finding the optimal value.

The objective function is to

$$\text{Max/Min } Z = c_1X_1+c_2X_2+\dots+c_nX_n$$

Subject to the constraints

$$a_{11}X_1+a_{12}X_2+\dots+a_{1n}X_n \leq b_1$$

$$a_{21}X_1+a_{22}X_2+\dots+a_{2n}X_n \leq b_2$$

$$\dots\dots\dots$$

$$a_{m1}X_1+a_{m2}X_2+\dots+a_{mn}X_n \leq b_m$$

Where $X_1, X_2, \dots, X_n \geq 0$.

This is called the canonical form of a linear programming problem.

III. MINIMIZATION OF DEATH RATE USING BY LINEAR PROGRAMMING PROBLEM SOLVING IN TWO-PHASE METHOD

Given data are collected from Newspaper ‘Daily Thanthi’ which are collected from various durations. Then by using those data, the linear programming problems are formed to optimize and hence to produce the minimum death for the peoples, operation research simplex method is used to solve problems and the results are obtained.

The following table gives a detail of dengue effect and accidental cases in Tamilnadu.

A. Detail of data collected in dengue effect

| Year | No. of people Dengue effect | No. of people Dengue death | Total dengue effect |
|-------|-----------------------------|----------------------------|---------------------|
| 2010 | 2051 | 8 | 25500 |
| 2011 | 2501 | 9 | |
| 2012 | 12826 | 66 | |
| 2013 | 8122 | 0 | |
| 2014 | 2804 | 3 | 23870 |
| 2015 | 4535 | 2 | |
| 2016 | 2531 | 5 | |
| 2017 | 14000 | 45 | |
| Total | 49370 | 148 | 49370 |

Table 2.1

B. Detail of data collected in accident case

| Year | Accident | Accident death | Total accident |
|-------------------|----------|----------------|----------------|
| 2010 | 14241 | 15409 | 58176 |
| 2011 | 14359 | 15422 | |
| 2012 | 15072 | 16175 | |
| 2013 | 14504 | 15563 | |
| 2014 | 15176 | 26068 | 64792 |
| 2015 | 15642 | 17666 | |
| 2016 | 17218 | 17343 | |
| 2017(up to march) | 16756 | 4148 | |
| Total | 122968 | 127794 | 122968 |

Table 2.2

1) *Forming Of The Linear Programming Problem:* The entire state of Tamilnadu is considered together as dengue effect in first 4 years (2010-2013) and remaining 4 years (2014-2017; other accident case in first 4 years (2010-2013) and remaining 4 years(2014-2017). The suffering of people in these year are divided into two categories: dengue death and other death and the total percentage of people who have died due to these factors are given below

Solution

| Year wise | Factors for sufferings(in Percentage) | | No. of people effected Dengue and accident case |
|-----------|---------------------------------------|---------------|---|
| | Dengue Effect | Accident case | |
| 2010-2013 | 25.5 | 58.2 | 83.7 |
| 2014-2017 | 23.9 | 64.8 | 88.7 |

Table 2.3

Let X_1 denote the number of peoples who effect in dengue and X_2 denote the number of peoples accident case The objective function and the complete LPP can be represented as follows:

$$\text{Min } Z=0.148x_1+127.8x_2$$

Subject to

$$25.5x_1+58.2x_2 \geq 83.7$$

$$23.9x_1+64.8x_2 \geq 88.7$$

$$\text{With } X_1, X_2 \geq 0.$$

IV. TWO PHASE SIMPLEX METHOD

Steps taken to construct LPP for this model are discussed below

A. Phase-I

In phase I we construct an auxiliary LPP containing a basic feasible solution to the original problem.

- 1) *Step: 1* Assign cost -1 to each artificial variable and zero to all other variable and hence given a new objective function $Z^* = -A_1, -A_2, -A_3, \dots$ where A_i 's are artificial variables.
- 2) *Step: 2:* Here, the new objective function is to be maximized for the given set of constraints.
- 3) *Step: 3:* Solve the auxiliary LPP by simplex method until any of the following three cases arise.
 - a) $\text{Max } Z^* < 0$ and at least one artificial variable appears in the optimum basis at positive Level.
 - b) $\text{Max } Z^* = 0$ and at least one artificial variable appears in the optimum basis at zero level.
 - c) $\text{Max } Z^* = 0$ with no artificial variable appears in the optimum basis. In case (i) The given LPP does not possess any feasible solution. Where as in case (ii), (iii). We get phase-II.

B. Phase-II

The optimum basic feasible solution of phase-I will be used as a starting solution for the original LPP.

Assign the actual costs to the variable in the objective function and a zero cost to every artificial variable. Proceed till an optimal basic feasible solution is obtained or till there is an indication of an unbounded solution.

By the above steps, now we change the previous LPP into required LPP

The objective function is

$$\text{Max } Z^* = -\text{Min } Z$$

$$\text{(i.e) Max } Z^* = -24.7x_1 - 61.5x_2$$

Assign cost -1 to each artificial variable and cost zero to all other variable, we get a new objective function.

$$\text{Max } Z^* = 0x_1 + 0x_2 + 0s_1 + 0s_2 - A_1 - A_2$$

Subject to

$$23.5x_1 + 58.2x_2 - S_1 + S_2 + A_1 = 83.7$$

$$23.9x_1 + 64.8x_2 + S_1 - S_2 + A_2 = 88.7; \text{ with } X_1, X_2 \geq 0.$$

| | | | | | | | | | |
|-------|-------|-----------|---------|-------|-------|-------|-------|-------|-------|
| | | C_j | 0 | 0 | 0 | 0 | -1 | -1 | |
| C_B | Y_B | b_i | X_1 | X_2 | S_1 | S_2 | A_1 | A_2 | R_i |
| -1 | A_1 | 4 | 4 | 0 | -1 | 1.2 | 1 | -1.2 | 1→ |
| 0 | X_2 | 1.37 | 0.37 | 1 | 0 | -0.02 | 0 | 0.02 | 3.71 |
| | | Z_j | -4 | 0 | 1 | -1.2 | -1 | 1.2 | |
| | | Z_j-C_j | -4 ↑ | 0 | 1 | -1.2 | 0 | 2.2 | |

Phase-I

C. Initial table

| | | | | | | | | | |
|-------|-------|-----------|-------|-----------|-------|-------|-------|-------|-------|
| | | C_j | 0 | 0 | 0 | 0 | -1 | -1 | |
| C_B | Y_B | b_i | X_1 | X_2 | S_1 | S_2 | A_1 | A_2 | R_i |
| -1 | A_1 | 83.7 | 25.5 | 58.2 | -1 | 0 | 1 | 0 | 1.44 |
| -1 | A_2 | 88.7 | 23.9 | 64.8 | 0 | -1 | 0 | 1 | 1.37→ |
| | | Z_j | -49.4 | -123 | 1 | 1 | -1 | -1 | |
| | | Z_j-C_j | -49.4 | -123 ↑ | 1 | 1 | 0 | 0 | |

- 1) Since all $Z_j-C_j \leq 0$, the current solution is not optimal and now we have to determine the entering variable and the leaving variable.
- 2) The most negative Z_j-C_j corresponds to X_2 , and so X_2 enters into the basis.
- 3) The leaving variable corresponds to the minimum value of R_j which is A_2 .
- 4) Here the pivot element is 64.8.

D. First iteration

| | | | | | | | | | |
|-------|-------|-----------|---------|-------|-------|-------|-------|-------|-------|
| | | C_j | 0 | 0 | 0 | 0 | -1 | -1 | |
| C_B | Y_B | b_i | X_1 | X_2 | S_1 | S_2 | A_1 | A_2 | R_i |
| -1 | A_1 | 4 | 4 | 0 | -1 | 1.2 | 1 | -1.2 | 1→ |
| 0 | X_2 | 1.37 | 0.37 | 1 | 0 | -0.02 | 0 | 0.02 | 3.71 |
| | | Z_j | -4 | 0 | 1 | -1.2 | -1 | 1.2 | |
| | | Z_j-C_j | -4 ↑ | 0 | 1 | -1.2 | 0 | 2.2 | |

- 1) Since all $Z_j-C_j \leq 0$, the current solution is not optimal and now we have to determine the entering variable and the leaving variable.
- 2) The most negative Z_j-C_j corresponds to X_1 , and so X_1 enters into the basis.
- 3) The leaving variable corresponds to the minimum value of R_j which is A_1 .
- 4) Here the pivot element is 4.

E. Second Iteration

Here x_1 enter into the basis

| | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|--|
| | | C_j | 0 | 0 | 0 | 0 | -1 | -1 | |
| C_B | Y_B | b_i | X_1 | X_2 | S_1 | S_2 | A_1 | A_2 | |
| 0 | X_1 | 1 | 1 | 0 | -0.25 | 0.3 | 0.25 | -0.3 | |
| 0 | X_2 | 1 | 0 | 1 | 0.09 | -0.12 | -0.09 | 0.12 | |
| | | Z_j | 0 | 0 | 0 | 0 | 1 | 1 | |

Since all $Z_j-C_j \geq 0$

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An optimum solution to the auxiliary LPP has been obtained $X_1=1, X_2=1$.

Max $Z^{**}=0$ and no artificial variable appear in the basis we go the phase II.

| | | | | | | | | |
|-------|-------|-------|--------|--------|-------|-------|-------|-------|
| | | C_j | -0.148 | -127.8 | 0 | 0 | -1 | -1 |
| C_B | Y_B | b_i | X_1 | X_2 | S_1 | S_2 | A_1 | A_2 |
| 0 | X_1 | 1 | 1 | 0 | -0.25 | 0.3 | 0.25 | -0.3 |
| 0 | X_2 | 1 | 0 | 1 | 0.09 | -0.12 | -0.09 | 0.12 |
| | | Z_j | 0 | 0 | 0 | 0 | 1 | 1 |

Phase-II

Consider the final simplex table of phase I consider the actual cost associated with the original variables. Delete the artificial variables A_1, A_2 .

$$\text{Max } Z^{**} = -0.148X_1 - 127.8X_2 + 0S_1 + 0S_2$$

Subject to constraints

$$25.5x_1 + 58.2x_2 - S_1 + A_1 = 83.7$$

$$23.9x_1 + 64.8x_2 - S_2 + A_2 = 88.7$$

Initial table

Since all $Z_j - C_j \geq 0$, optimal solution is reached.

Here, $X_1=1, X_2=1$.

$$\text{Max } Z^* = -\text{Min } Z$$

$$\text{Max } Z^* = -(0.148X_1 + 127.8X_2)$$

$$\text{Max } Z^* = -0.148X_1 - 127.8X_2$$

$$\text{Max } Z^* = -127.95$$

$$\text{Min } Z = -127.95$$

$$\text{Min } Z = 127.95$$

Here both X_1 and X_2 shows the same inference in death rate. So to identify the variable to sensitive we can go with sensitivity analysis.

V. SENSITIVITY ANALYSIS

A. Measurement Of Sensitivity Analysis

Below are mentioned the steps used to conduct sensitivity analysis:

- 1) Firstly the base case output is defined; say the NPV at a particular base case input value (V_1) for which the sensitivity is to be measured. All the other inputs of the model are kept constant.
- 2) Then the value of the output at a new value of the input (V_2) while keeping other inputs constant is calculated.
- 3) Find the percentage change in the output and the percentage change in the input
- 4) The sensitivity is calculated by dividing the percentage change in output by the percentage change in input.

This process of testing sensitivity for another input (say cash flows growth rate) while keeping the rest of inputs constant is repeated till the sensitivity figure for each of the inputs is obtained. The conclusion would be that the higher the sensitivity figure, the more sensitive the output is to any change in that input and vice versa.

B. Methods Of Sensitivity Analysis

There are different methods to carry out the sensitivity analysis:

- 1) Modeling and simulation techniques
- 2) Scenario management tools through Microsoft excel

There are mainly two approaches to analyzing sensitivity:

- 1) *Local sensitivity analysis* is derivative based (numerical or analytical). The term local indicates the derivatives which are taken at a single point. Mathematically, the sensitivity of the cost function with respect to certain parameters is equal to the partial derivative of the cost function with respect to those parameters.
- 2) *Global sensitivity analysis* is the second approach to sensitivity analysis, often implemented using Monte Carlo techniques. This approach uses a global set of samples to explore the design space.

The sensitivity methods include the utilization of the following one-at-time sensitivity measures:

- 1) partial derivatives (PD),
- 2) one standard deviation increase and decrease of inputs ($\pm SD$), a 20% increase and decrease of inputs ($\pm 20\%$),
- 3) a sensitivity index (SI).

The sensitivity measures investigated to utilize an array of input and output values generated through random sampling include:

- 1) an importance index (II),
- 2) a relative deviation of the output distribution (RD),
- 3) a relative deviation ratio (RDR),
- 4) partial rank correlation coefficients (PRCC),
- 5) Standardized regression coefficients (SRC) and rank regression coefficients (RRC).

Four additional techniques have been used to estimate parameter sensitivity rankings based on the partitioning of input data (Crick et al. 1987).

These methods include

- 1) The smirnov test (S),
- 2) The Cramer-von Mises test (CM),
- 3) The Mann-Whitney test (MW),
- 4) The square-ranks test (SR).

C. Standardized Regression Coefficients and Rank Regression Coefficients (SRC & RRC).

The use of the regression technique allows the sensitivity ranking to be determined based on the relative magnitude of the regression coefficients. The coefficients are indicative of the amount of influence the Standardization in regression analysis takes place in the form of a transformation by ranks or by the ratio of the parameter's standard deviation to its mean. The rank regression coefficient (RRC) is calculated by performing regression analysis on rank-transformed data rather than the raw data. The RRC is often referred to as a standardized rank regression coefficient.

D. Rank Correlation Coefficient

$$\rho = r_{X_1 X_2} = 1 - \frac{6 \sum D^2}{n(n^2 - 1)}$$

- 1) Finding the rank correlation coefficient between Z and X_1

Here, Z=Total number of dengue and accident death rate

X_1 =dengue death rate

| Z | X ₁ | R _Z | R _{X₂} | D | D ² |
|-----------------|----------------|----------------|----------------------------|----|----------------|
| 15417 | 8 | 7 | 4 | 3 | 9 |
| 15431 | 9 | 6 | 5 | 1 | 1 |
| 16241 | 66 | 4 | 8 | -4 | 16 |
| 15563 | 0 | 5 | 1 | 4 | 16 |
| 26071 | 3 | 1 | 2 | -1 | 1 |
| 17678 | 12 | 2 | 6 | -4 | 16 |
| 17348 | 5 | 3 | 3 | 0 | 0 |
| 4193 | 45 | 8 | 7 | 1 | 1 |
| $\Sigma D^2=60$ | | | | | |

The rank correlation coefficient is $r_{zx1}=0.29$

2) Finding The Rank Correlation Coefficient Between Z and X₂

Here, Z=Total number of dengue and accident case rate

X₂=Accident case rate

| Z | X ₂ | R _Z | R _{X₂} | D | D ² |
|----------------|----------------|----------------|----------------------------|---|----------------|
| 15417 | 15409 | 7 | 7 | 0 | 0 |
| 15431 | 15422 | 6 | 6 | 0 | 0 |
| 16241 | 16175 | 4 | 4 | 0 | 0 |
| 15563 | 15563 | 5 | 5 | 0 | 0 |
| 26071 | 26068 | 1 | 1 | 0 | 0 |
| 17678 | 17666 | 2 | 2 | 0 | 0 |
| 17348 | 17343 | 3 | 3 | 0 | 0 |
| 4193 | 4148 | 8 | 8 | 0 | 0 |
| $\Sigma D^2=0$ | | | | | |

The rank correlation coefficient is $r_{zx2}=1$

3) Finding The Rank Correlation Coefficient Between X₁ and X₂

Here, X₁=dengue death rate

X₂=accident case rate

| X ₁ | X ₂ | R _x | R _{X₂} | D | D ² |
|------------------|----------------|----------------|----------------------------|----|----------------|
| 8 | 15409 | 5 | 7 | -2 | 4 |
| 9 | 15422 | 4 | 6 | -2 | 4 |
| 66 | 16175 | 1 | 4 | -3 | 9 |
| 0 | 15563 | 8 | 5 | 3 | 9 |
| 3 | 26068 | 7 | 1 | 6 | 36 |
| 12 | 17666 | 3 | 2 | 1 | 1 |
| 5 | 17343 | 6 | 3 | 3 | 9 |
| 45 | 4148 | 2 | 8 | -6 | 36 |
| $\Sigma D^2=108$ | | | | | |

The rank correlation coefficient is $r_{x1x2}=-0.3$

VI. SCATTER PLOT

The above correlation of the variables are scattered below.

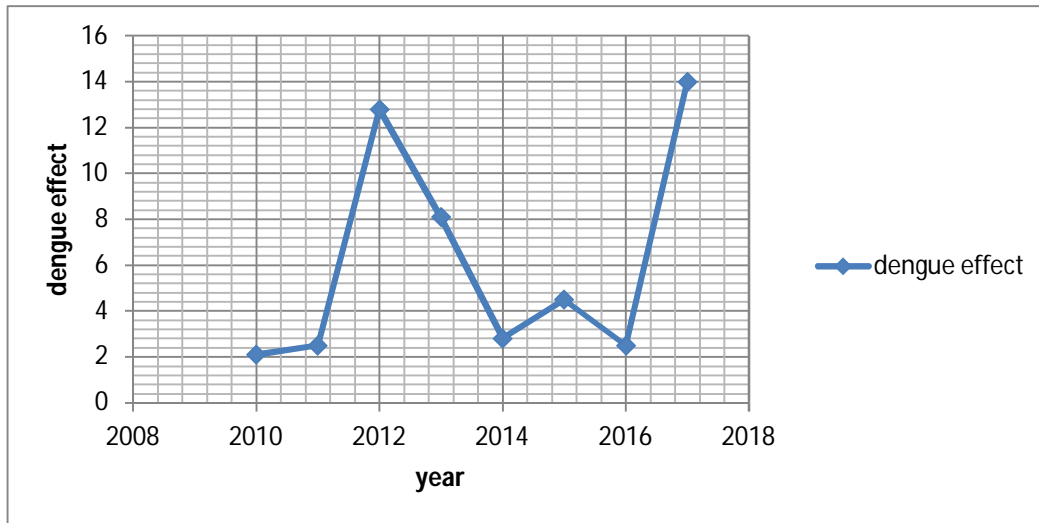
A. Scatter plot between the dengue effect and accident case rate

| Year | Dengue effect | Accident case |
|------|---------------|---------------|
| 2010 | 2.1 | 14.2 |
| 2011 | 2.5 | 14.4 |
| 2012 | 12.8 | 15.1 |
| 2013 | 8.1 | 14.5 |
| 2014 | 2.8 | 15.2 |
| 2015 | 4.5 | 15.6 |
| 2016 | 2.5 | 17.2 |
| 2017 | 14 | 16.8 |

Here,

X= Year

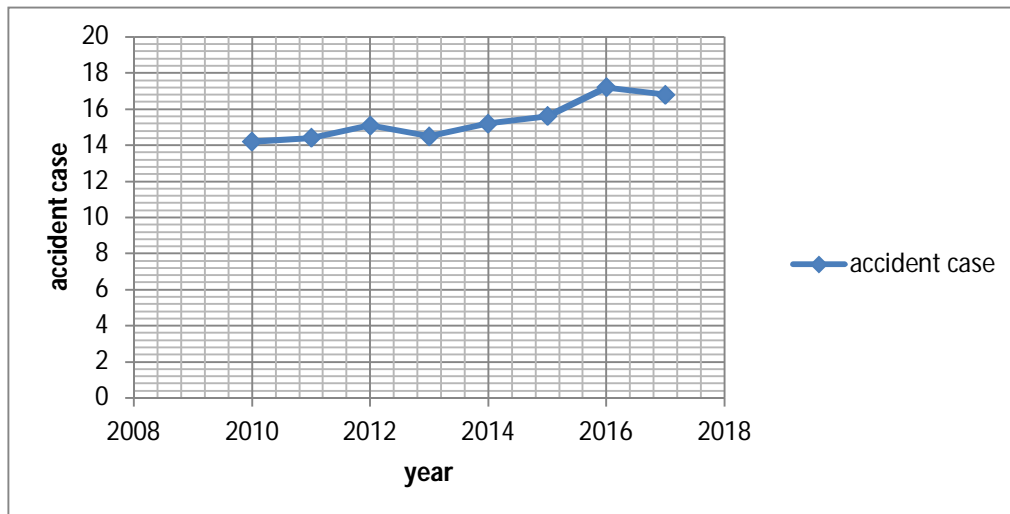
Y=dengue effect



Here,

X=year

Y=accident case

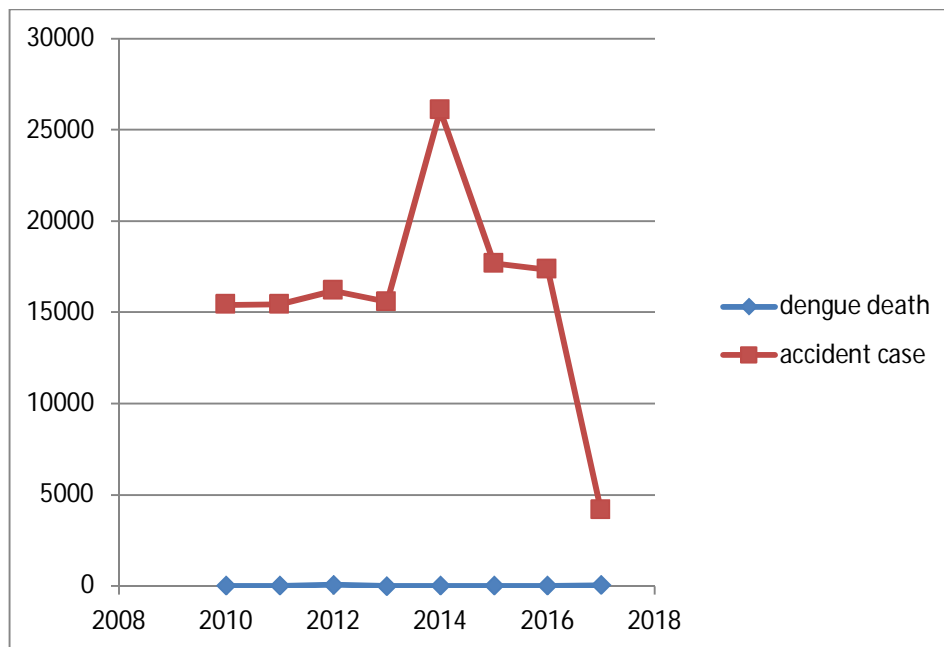


B. Comparison Scatter Plot Between Dengue Death And Accident Case

Here, X=year

Y=dengue effect and accident death rate

| Year | Dengue death | Accident death |
|------|--------------|----------------|
| 2010 | 8 | 15409 |
| 2011 | 9 | 15422 |
| 2012 | 66 | 16175 |
| 2013 | 0 | 15563 |
| 2014 | 3 | 26068 |
| 2015 | 12 | 17666 |
| 2016 | 5 | 17343 |
| 2017 | 45 | 4148 |



VII. RESULT

Comparing three rank correlation coefficient X_1 and X_2 are less related

- 1) If Z and X_1 are nearly independent variables with $r_{ZX_1}=0.29$.
- 2) If Z and X_2 are next optimum related variables with $r_{ZX_2}=1$.
- 3) If X_1 and X_2 are less related variables with $r_{X_1X_2}=-0.3$.

To prove minimize the death rate. We need to concentrate on accident case in common according to our data information. In particular, X_1 and X_2 are independent variables, we cannot apply partial rank correlation coefficient.

VIII. CONCLUSION

Applying Two-phase method by forming the LPP of collected data I concluded that both variables dengue and accident case has same values $X_1=1$ and $X_2=1$. With Min $Z=-127.95$

(i.e) Minimum death rate obtained in Two-Phase method is 1.3

Next, applied Rank Correlation Coefficient (RCC) between ZX_1 , ZX_2 , and X_1X_2 . As we know X_1 and X_2 are independent variables, we got very low correlation between them. Also comparing Z and X_1 we got the next low correlation. Finally for Z and X_2 the correlation coefficient is $r_{ZX_2}=1$, which is optimal.

Hence I conclude my work result as, if we reduce the accidental case rate by considering its factors there will be more minimization in death data rate.

REFERENCE

- [1] "About Operations Research". INFORMS.org. Retrieved 7 January 2012.
- [2] "Mathematics Subject Classification". American Mathematical Society. 23 May 2011. Retrieved January 2012.
- [3] S. Kalavathy , Third edition 2010 second reprint 2011 by "Operation Research with C programs".
- [4] P.R. Vittal, V. Malini, Printed and Published by Margham Publications, Chennai-600 017.
- [5] Box, G.E.P.; Hunter, W.G.; Hunter, J.S. Statistics for experimenters: an introduction to design, data analysis, and model building. New York: John Wiley & Sons;1978.
- [6] Conover, W.J. Practical nonparametric statistics. 2nd Ed. New York: John Wiley & Sons;1980.
- [7] Crick, M.J.; Hill, M.D.; Charles, D. the role of sensitivity analysis in assessing uncertainly. In: Proceedings of an NEA workshop on uncertainly analysis for performance assessments of radioactive waste disposal systems. Paris: OECD; 1987: 1-258.
- [8] Dalrymple, G.J.; Broyd, T.W. The development and use of parametric sampling techniques for probabilistic risk assessment. IAEA-SR-111/54P. In: Cullingford, M.C.; Shah, S.M.; Gittus, J.H. eds. Implications of probabilistic risk assessment. London: Elsevier; 1987.
- [9] Hamby, D.M. A probabilistic estimation of atmospheric tritium dose. Health Physics. 65:33-40; 1993.
- [10] Hamby, D.M. A review of techniques for parameter sensitivity analysis. Accepted for publication in Environmental Monitoring and Assessment. 1994.
- [11] Masakazu Kojima, Shinji Mizuno, and Akiko Yoshise. A polynomial-time algorithm for a class of linear complementarity problems. Mathematical Programming, 44:1 {26, 1989
- [12] Helton, J.C. Uncertainty and sensitivity analysis techniques for use in performance assessment for radioactive waste disposal, Reliability Engineering and System Safety. 42:327-367; 1993.
- [13] Hoffman, F.O.; Gardner, R.H. Evaluation of uncertainties in environmental radiological assessment models. In: Till, J.E.; Meyer, H.R. eds. Radiological assessments: a textbook on environmental dose assessment. Washington, DC: U.S. Nuclear Regulatory Commission; Report No. NUREG/CR-3332; 1983.
- [14] Iman, R.L.; conover, W.J. The use of the rank transform in regression. Technometrics. 21:499-509; 1979.
- [15] Iman, R.L.; conover, W.J. Small sample sensitivity analysis techniques for computer models, with an application to risk assessment. Communications in Statistics- Theory and Methods. A9:1749-1842; 1980.
- [16] Iman, R.L.; conover, W.J. A measure of top-down correlation. Technometrics. 29:351-357; 1987.
- [17] Iman, R.L.; Davenport, J.M. Rank correlation plots for use with correlated input variables in simulation studies. Sandia National Laboratories. Albuquerque, NM: Report No. SAND80-1903; 1980.
- [18] Iman, R.L.; Helton, J.C. An investigation of uncertainty and sensitivity analysis techniques for computer models. Risk Analysis. 8:71-90; 1988.
- [19] International Atomic Energy Agency. Evaluating the reliability of predictions made using environmental transfer models. Vienna; Safety series No. 100. Report No. STI/PUB/835; 1989, 1-106.
- [20] Rose, K.A. A simulation comparison and evaluation sensitivity methods applicable to large models. In: Lauenroth; Skogerboe; Flug eds. Analysis of ecological systems: State-of-the art in ecological modeling. New York; 1983.
- [21] Saltelli, A.; Marivoet, J. Non-parametric statistics in sensitivity analysis for model output: A comparison of selected techniques. Reliability Engineering and System Safety. 28:229-253;1990



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