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OPERATION RESEARCH WITH RELIABILITYFOR SOLVING STATIC GAME PROBLEM USING SIMPLEX METHOD

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ABSTRACT - In this paper, we have identified the basic concepts of game theory by taking problem in the reliability field by which we define game taking mixed strategy using simplex method,also define the strategies, the players, payoff functions, etc. Limitations and practical applications of linear programming and mathematical formulation are also explained. Computational theory technic gives accurate value, traditional and suited simplex method for optimality. For examining solution, reliability Game theory is a new concept using computational technic of simplex method.

KEYWORDS - Game theory, Game problem, Reliability, Optimum Solution, Payoff, Strategies, Simplex Method.

INTRODUCTION –In the field of reliability, Game theory have two parts as cooperative and other is non-cooperative. For non-cooperative games theory includes games related to consumers, factories, regulating agencies, retail network etc.

While performing reliability problems, Game theory (G.T) plays an important role by defining Games, strategies, including players, payoff functions etc. Game theory provides some advantages while use of concepts of gaming to few reliability problems which are,

1. G.T gives solution to reliability problems
2. G.T provides new technics while solving solution to reliability problems.
3. Through discussions between reliability theory and game theory arises concepts.

Basic Concepts based on Reliability Theory:

- Team of Players- Main body of the game has at least two different teams of players in a game that may be business related.
- Some strategies- As per rules for players there exist two kind of strategies one is pure and other one is mixed strategies.
- Part of actions- In case of static game all players may apply any action simultaneously. Whereas in case of dynamic game all players apply any action within a particular order.
- About Information-
    - Complete Information- Payoff is known to every player.
    - Incomplete Information- Few of the players know the Payoff.
- Perfect information- Before any decision all players have knowledge of previous action.
- Payoff- Either discrete or continuous strategies are with all players.
- An equilibrium- Optimal strategies play an important role for all players.
- Result- Thus all players show their interest to combination of equilibrium payoff, strategies actions etc.

Many Reliability problems can be is analyzed by the Game Theory as by designing for an optimal reliability, also by analyzing of trade-off factors, problem in reliability sampling by testing, system reliability management and many more. Dantzig's [1] suggested that the entering vector is to be so chosen corresponding to which $Z_j - C_j$ is most negative. Khobragade's [4] suggested that the entering vector is so chosen corresponding to which

$\frac{(Z_j - C_j)\theta_j}{C_j}$ is most negative.They found that if they choose the vector y_j in such a way , $\frac{(Z_j - C_j)\theta_j}{C_j \Sigma y_{ij}}, (c_j > 0, y_{ij} \geq 0)$ is most negative, then in some problems, fewer iteration are required .This has been illustrated by giving solution to a problem. They provide insight on the latest applications of linear programming problem in various fields like sports, lean manufacturing, financial planning, and radiotherapy [6], [7].

The advantage of excel solver technique is easy to implementation and get the faster and appropriate Solution for large amount of data .

Maxmin Principle- Maximizes the minimum guarantee increase of team T1.

MinimaxPrinciple- Minimizes the maximum decrease.

Objective is to Maximizes the minimum increase or Minimizes the maximum decrease.

Saddle point- Maxmin value = Minimax value

Value of the game- If the game has a saddle point the value of the cell at saddle pointis called the value of the game.

Two-teams zero-sum game- In a game with two teams if the increase of one team is equal to the decrease of another team then that game is called two-teams zero-sum game.

Terminology of Game Theory-

Players- TeamT1 and TeamT2.

Strategy- PURE STRATERGY and MIXED STRATERGY

GAME WITH MIXED STRATERGY

Example- Construct the following payoff matrix with respect to Team T1 and solve it optimally.

Team T_1

Team T_2

3	4
5	1

So if no saddle point it is mixed Strategy.

	Team T_1		Row Min	
Team T_2	3	4	3	→ Maxmin Value
	5	1	1	
Col. Max	5	4 ↓ Minimax Value		

Here Maxımin $\neq$Minimx → not having Saddle point

Now process for Mixed Strategy.

Step 1-

		Oddments
3	4	4
5	1	1
Oddments: 3	2	

Probability

$p_1 = 4 / [4+1] = 4/5$ $p_2 = 1 / [4+1] = 1/5$

$q_1 = 3 / [3+2] = 3/5$ $q_2 = 2 / [3+2] = 2/5$

Value of the game

$$V = [3\times4+5\times1] / [4+1] = 17/5$$

Similarly

$$V = [4\times4+1\times1] / [4+1] = 17/5$$

Solution

HenceStrategy Team $T_{1=}$ [4/5, 1/5] , Team $T_{2=}$ [3/5, 2/5] and V= 17/5

ProbabilitySum = 1 but individually it is less than 1.

Example 2

Solution:

Team T_2

Team T_1	$T_2 1$	$T_2 2$	$T_2 3$
$T_1 1$	1	-1	3
$T_1 2$	3	5	-3
$T_1 3$	6	2	-2

STEP-1: $Intially\ take\ Row - Min\ [-1, -3, -2]$

$$then \qquad Column - Max\ [6, 5, 3]$$

$$Thus, we\ found\ that\ all\ the\ value\ are\ different\ .$$

$\therefore There\ is\ no\ saddle\ point.\ Hence\ there\ exist\ Mixed\ Strategy.$

By keeping reliability theory we use L.P.P method and Simplex method forGame Problem**.**

Value of game lies between -1 and 3 i.e. -1 ≤ v ≤ 3

STEP-2: New matrix is non-zero and non-negatives so, we add M = 4 to all element of the matrix to make all positive. But some of them are negative. Now we obtained new pay-off matrix.

Let $V = r - 4$

	$T_2 1$	$T_2 2$	$T_2 3$
$T_1 1$	5	3	7
$T_1 2$	7	9	1
$T_1 3$	10	6	2

Probabilit… $, x_b, x_c]$ and $[y_a, y_b, y_c]$

STEP-3: In the fie…

$$Min \qquad y_a + y_b + y_c = 1$$

Subject to constraint;

$$5y_a + 3y_b + 7y_c \le r$$

$$7y_a + 9y_b + y_c \le r$$

$$10y_a + 6y_b + 2y_c \le r$$

And $\qquad y_a, y_b, y_c \ge 0$

STEP-4: For$r\ positive$dividing above equations by r

$$\frac{y_a}{r} + \frac{y_b}{r} + \frac{y_c}{r} \le \frac{1}{r}$$

Putting

$$\frac{y_a}{r} = Y_a, \qquad \frac{y_b}{r} = Y_b, \qquad \frac{y_c}{r} = Y_c$$

Now,

Max $Z = \frac{1}{r} = \ Y_a + Y_b + Y_c$

Subject to $5Y_a + 3Y_b + 7Y_3 \leq 1$

$$7Y_a + 9Y_b + Y_c \leq 1$$

$$10Y_a + 6Y_b + 2Y_c \leq 1$$

$Y_a, Y_b, Y_c \geq 0$

STEP-5: Applying **Simplex method** introducing ***slack variables***.

Max $Z = Y_a + Y_b + Y_c$

Subject to

$$5Y_a + 3Y_b + 7Y_c = 1$$

$$7Y_a + 9Y_b + Y_c = 1$$

$$10Y_a + 6Y_b + 2Y_c = 1$$

Therefore, value of original game $V = 1$

Optimal strategy for $B = [\,0\,,\ \frac{1}{2}\ ,\ \frac{1}{2}\,]$

By duality of the problem.

Optimal strategy for $A = [\,\frac{2}{3}\ ,\ \frac{1}{3}\ ,0\,]$

RELIABILITY-GAME value is $V = 1$

CONCLUSION

Reliability Game theory is a new concept using simplex method. Game problems are successfully solved using new method. Thus, we get number of iterations is either less or remained the constant while comparing with the solution using simplex method. Thus, for both theory and practical purpose reliability game theory is necessary. Combination of reliability theory and game theory gives truthful results.

REFERENCES

[1] Dantzig G. B. (1951): Maximization of linear function of variables subject to linear inequalities in 21 ed. Koopman cowls commission monograph 13, John Wiley and Sons, Inc., New York.

[2] Beale E M L (1955): Cycling in the dual Simplex algorithm, Nav. Res. logist Q.2, 269-75.

[3] Gass S. I. (1964): Linear programming, McGraw-Hill Book Co. Inc., New York.

[4] Khobragade N.W. and Khot P.G (2005): Alternative approach to the simplex method-II, Acta Ciencia Indica, vol. xxx I M, No.3, 651, India.

[5] Vaidya N. V. and Khobragade N. W. (2012): "Optimum Solution to the Simplex Method -An Alternative Approach" in International Journal of Latest Trends in mathematics. Page No. 99 to 105 Vol.-2 No.3 Nov.2012.

[6] Khobragade N. W., Lamba N.K. and Khot P. G. (2013): "Solution of LPP by KKL Method" IJEIT, Vol.3 Issue.4. Pp.334-340.

[7] Khobragade N. W., Lamba N.K. and Khot P. G. (2013): "Solution of Game Theory Problems by KKL Method", IJEIT, Vol.3 Issue.4. Pp.350-355.