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OPTIMIZATION TECHNIQUES IN MANAGEMENT EDUCATION: PREMIUM SOLVER AS A TOOL FOR OPTIMIZATION

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Abstract

Business organizations put a high value on reliable information about the future: future sales, future costs, future patterns of consumer demand, future prices of supplies. Many management problems arise simply because the future is unknown or has a high degree of uncertainty about it. In present paper, we are discussing methods to predict future values of some key business variables by considering the general principles of forecasting and quantitative analysis. Quantitative analysis is the scientific approach to managerial decision making. Whim, emotions and guesswork are not part of the quantitative analysis approach. The approach starts with data. Like raw material for a factory, this data is manipulated or processed into resulting information that is value able to people in making decisions. The processing and manipulating of raw data into meaningful information is the heart of quantitative analysis. Computers have been instrumented in the increasing use of quantitative analysis. Management Science also is the scientific discipline devoted to the analysis & solution of complex decision problems. Management science is aided by a diverse collection of computer based methods and tools for building, manipulating and solving various models, which is referred as decision technology. These methods and tools include spreadsheets, data management, data analysis, special software for implementing management approach. In present discussion we are using Premium Solver for optimization models.

KEY WORDS: *Quantitative Analysis, Management Science, Decision Technology.*

1.1 INTRODUCTION

All organizations are faced at one time or many times with making decisions involving limited resources or ensuring that certain requirements must be satisfied. We often formulate these decision problems as optimization models that seek to maximize or minimize some objective function satisfying a set of constraints.

An important category of optimization models is called mathematical programming. In a mathematical programming, constraints are expressed mathematically using en-equalities (≤ or ≥) and equalities. The term programming was coined because these models find the best program or course of action to follow. We will deal with four important types of mathematical programming model.

Linear models- those in which all constraints are linear functions of the decision variables, all of which can assume any continuous value;

Multi-objective models- linear models that have more than one objective to meet or conflicting goals that must be resolved;

3. *Integer models*- linear models for which some or all of the decision variables must have integer (whole number) values for an optimal solution to be realistic; and
4. *Nonlinear models*- those for which the objective function and/or constraint functions are not linear.

1.2 Premium Solver

Premium Solver is an add-in included with Excel for solving linear programs and other types of optimization problems. Solver may be used to solve problems with up to 200 decision variables, 100 regular constraints and 400 simple constraints (lower and upper bounds on the decision variables).

To begin Solver, select *Tools* from the main menu and the *Solver.* The *Solver Parameter* dialog box will appear. The *Set Target Cell* box should contain the cell location of objective. In the *By Changing Cells* box, you specify the location of the decision variables. Finally, constraints are specified in the *Subject to the constraints* box by clicking on *Add. Change* allows you to modify a constraint already entered, and *Delete* allows you to delete a previously entered constraint. *Reset All* clears the current problem and resets all parameters to their default values. *Options* invokes the Solver options dialog box, in which you have to specify *Assume Non-Negative, Assume Linear Model.*

1.3 Mathematical Models For Optimization

An optimization model seeks to identify the best values of decision variables to achieve some objectives. Most optimization models have constraints, limitations, requirements or other restrictions that are imposed on any solution, such as “Do not exceed the allowable budget” or “Ensure that all demand is met”

1.3.1 A Product Mix Model

Let ABC Micro Products, assembles two models A and B. Both models use many of the same electronic components. Two of these components, which have very high quality, and both models A and B require both components, which are obtained from a single overseas manufacturer. For the next month, the supply of these components is limited to 6000 components of I and 3500 components of II. To assemble one unit of A 12 components of I and 6 components of II are required while to assemble 1 unit of B 12 components of I and 10 components of II are required. By selling one unit of A a profit of 25 is earned while from B a profit of 40. How many of each product should be assembled during the next month to maximize the manufacturer’s profit? Assume that the firm can sell all its produces.

Here, from above description one can tabulate this information as

Product	**Component I**	**Component II**	**Profit**
A	12	6	25
B	12	10	40
Available	**6000**	**3500**	

Let assume that we produced X_1 units of A and X_2 units of B. Here, we refer to the unit profits as *objective function coefficient*, the per-unit requirements for the limited components of each product as *constraint coefficient*, and the available quantities of components I and II as the *right-hand side values.* The left hand sides of the constraints are called *constraint functions.* Thus for the component A limitation, $12X_1 + 12X_2$ is the constraint function with constraint coefficients of 12 & 12 and 6,000 is the right-hand side value. Hence, the mathematical model is

Maximize $Z = 25X_1 + 40X_2$

Subject to

$12X_1 + 12X_2 \leq 6000$ Component I Constraint

$6X_1 + 10X_2 \leq 3500$ Component II Constraint

$X_1 \geq 0$ and $X_2 \geq 0$. Non-negativity Constraint

The above model is called a **linear programming (LP) model.** To be a linear program, the following three conditions must be met:

I. The objective and constraints must be represented using *linear functions* of the decision variables. This means that all decision variables can be raised *only* to the first power and can be multiplied *only* by a constant term.
II. Constraints must be of a ≤, ≥ or = type. A constraint using a *strict inequality* (< or >) is not permitted.
III. Variables can assume any fractional numerical value; that is, they are continuous.

Traditionally to find solution for this type of linear programming model, depending on number of variables one can use either Graphical or Simplex Method. But, now, we will develop model in Excel and solve it by using Add-Ins Premium Solver.

Product Mix Model (Linear Programming Model):

To solve above model we have to prepare model in Excel as below.

	A	B	C	D	E
1	ABC Micro Products				
2					
3	**Parameters and Uncontrollable Variables**				
4					
5	**Product**	**A**	**B**		
6	Profit	25	40	Availability	
7	Component I	12	12	6000	
8	Component II	6	10	3500	
9					
10					
11	*Linear Programming Model*				
12					
13	**Product**	**A**	**B**	**Total**	**Unused**
14	Quantity Produced	0	0	0	
15	Component I Used	=B7*B14	=C7*C14	=B15+C15	=D7-D15
16	Component II Used	=B8*B14	=C8*C14	=B16+C16	=D8-D16
17	Profit	=B6*B14	=C6*C14	=B17+C17	

Here, one can select Solver from Excel-Tool Menu and by setting the following one can get the solution as

	A	B	C	D	E
1	**ABC Micro Products**				
2					
3	**Parameters and Uncontrollable Variables**				
4					
5	**Product**	**A**	**B**		
6	Profit	25	40	Availability	
7	Component A	12	12	6000	
8	Component B	6	10	3500	
9					

10					
11	**Linear Programming Model**				
12					
13	**Product**	**A**	**B**	**Total**	**Unused**
14	Quantity Produced	375	125	500	
15	Component A Used	4500	1500	6000	0
16	Component B Used	2250	1250	3500	0
17	Profit	9375	5000	14375	

1.3.2 Logistics (Transportation) Model

In many situations a company produces products at locations called supply points and ships these products to customer locations called demand points. Typically, each supply point has a limited capacity that it can ship, and each must receive a required quantity of the product. Spreadsheet models can be used to determine the minimum-cost shipping method for satisfying customer demands.

Viraj Electric Shipment Viraj Electric has three electric power plants that supply the power needs of four cities. Each power plant can supply the amounts shown following table.

	City 1	**City 2**	**City 3**	**City 4**	**Supply**
Plant 1	8	6	10	9	**35**
Plant 2	9	12	13	7	**50**
Plant 3	14	9	16	5	**40**
Demand	**45**	**20**	**30**	**30**	

Traditionally to get initial basic solution, one can use methods like North-West-Corner Rule, Least Cost Method, Vogel's Approximation method etc. In addition to this, he/she has to use MODI's algorithm to test whether the initial basic solution is optimal or not. But, at present formulate this problem as a mathematical linear programming model. For this assume that C_{ij} be the transportation cost associated with transporting 1 unit from i^{th} origin/plant to j^{th} destination/city and X_{ij} be the number of units transported from i^{th} origin to j^{th} destination then the linear programming model for the above problem becomes

Minimize: $8X_{11} + 6X_{12} + 10X_{13} + 9X_{14} +$
$9X_{21} + 12X_{22} + 13X_{23} + 7X_{24} +$
$14X_{31} + 9X_{32} + 16X_{33} + 5X_{34}$

Subject to

$X_{11} + X_{12} + X_{13} + X_{14} = 35$
$X_{21} + X_{22} + X_{23} + X_{24} = 50$
$X_{31} + X_{32} + X_{33} + X_{34} = 40$
$X_{11} + X_{21} + X_{31} = 45$
$X_{12} + X_{22} + X_{32} = 20$
$X_{13} + X_{23} + X_{33} = 30$
$X_{14} + X_{24} + X_{34} = 30$
All $X_{ij} \geq 0$

Viraj Electric Shipment (Transportation Model)

To solve above model we have to prepare model in Excel as below.

	A	B	C	D	E	F	G
1	**Viraj Electric Company Transportation Problem**						
2	**Unit Shipping Cost**						
3					**To**		
4			**City 1**	**City 2**	**City 3**	**City 4**	**Supply**
5		**Plant 1**	8	6	10	9	**35**
6	*From*	**Plant 2**	9	12	13	7	**50**
7		**Plant 3**	14	9	16	5	**40**
8	Demand		**45**	**20**	**30**	**30**	
9							
10	**Shipments**				To		
11							
12			**City 1**	**City 2**	**City 3**	**City 4**	**Total Shipped**
13		**Plant 1**	0	0	0	0	=SUM(C13:F13)
14	**From**	**Plant 2**	0	0	0	0	=SUM(C14:F14)
15		**Plant 3**	0	0	0	0	=SUM(C14:F14)
16	**Total Received**		=SUM(C13:C15)	=SUM(D13:D15)	=SUM(E13:E15)	=SUM(E13:E15)	
17	**Total Cost**		**=SUMPRODUCT(C5:F7,C13:F15)**				

Here, set the following in Premium Solver

Set Target Cell as $C$18 to be Minimize

By Changing Cell as $C$13:$F$15

Subject to Constraints $G$13 <= $G$5, $G$14 <= $G$6
$G$15 <= $G$7 , $C$16 >= $C$8
$D$16 >= $D$8 , $E$16 >= $E$8
$F$16 >= $F$8

In options set Check Box True 1. Assume Linear Model
2. Assume Non-Negative

Then one will get the following solution

	A	B	C	D	E	F	G
1	*Viraj Electric Company Transportation Problem*						
2	**Unit Shipping Cost**						
3					**To**		
4			**City 1**	**City 2**	**City 3**	**City 4**	**Supply**
5		**Plant 1**	8	6	10	9	35
6	**From**	**Plant 2**	9	12	13	7	50
7		**Plant 3**	14	9	16	5	40
8		**Demand**	45	20	30	30	
9							
10	**Shipments**			**To**			
11							
12			**City 1**	**City 2**	**City 3**	**City 4**	**Total Shipped**
13		**Plant 1**	0	10	25	0	35
14	**From**	**Plant 2**	45	0	5	0	50
15		**Plant 3**	0	10	0	30	40
16	**Total Received**		45	20	30	30	
17	**Total Cost**		1020				

1.3.3 Assignment Model

An Assignment Problem is a particular case of transportation problem where the objective is to assign a number of resources to an equal number of activities so as to minimize total cost or maximize total profit. The problem of assignment arises because available resources such as men, machines etc. having varying degrees of efficiency for performing different activities such as job. Therefore, cost, profit or time of performing different activities is different. Thus, the problem is: *how should the assignments be made so as to optimize the given objective.*

1.4 CONCLUSION

The objective of the present paper was to illustrate the use of Information Technology tool and explain concept of optimization techniques in management. The main advantage of studying Premium Solver E-tool is that it trains a student to get conversant with the present and future business environment and to analyze it for managerial actions at general and functional levels. Also, instead of using traditional method for getting solution, one can get quick accurate solution. In addition, he/she can use the same model with changed values of parameters and able to find out new solution within short margin of time.

REFERENCE:

1. *Anand Sharma(2006),* Statistics for Management, Himalaya Publishing House.
2. *Basavraj S Benni(2006),* Enhancing the Management Teacher's Productivity through E-Tools: Demand Forecasting as a Case, JIMS 8m.
3. *Jaffrey D. Camm, James R. Evans (2000)*, Management Science & Decision Technology, South-Western College Publishing.
4. *John A Lawrence, Barry A Pasternack,* Applied Management Science – A Computer Integrated Approach for Decision Making, John Wiley & Sons.
5. *Mik Wisniewski(1996),* Quantitative Methods for Decision Makers*,* Macmilan.
6. *S. Christian Albright, Wayne Winston, Christopher J. Zappe(2000),* Data Analysis & Decision Making with Microsoft Excel, Duxbury.

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