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BOOKS

- Bowersox, Donald J., Closs, David J., (1996), "Logistical Management." Tata McGraw, Hill, New Delhi.
- Hunker, H.L. and A.J. Wright (1963), "Factors of Industrial Location in Ohio" Ohio State University, Nigeria.

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- Garg, Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–23

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- Kumar S. (2011): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, Kurukshetra University, Kurukshetra.

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APPLICATION OF GOAL PROGRAMMING TO COMPARE PERFORMANCE IN GOVERNMENT AND PRIVATE SECTOR: A CASE STUDY FOR SPECIAL ECONOMIC ZONES

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ABSTRACT

Special Economic Zones (SEZs) in our country have been mooted to act as engine of economic growth. Initially, these SEZs were operating only in government sector, but after initiation of open economy, doors were opened for private sector players too. It is generally believed that government sectors fail to compete with private sector. So as a test case a study was taken up for units operating in Vishakhapatnam SEZ. The units were divided between government and private sector and data on relevant parameters like, employment generated, export figures, investment attracted etc were collected. This was followed by application of Zero-One Goal Programming technique for evaluating the performance of operational Special Economic Zones (SEZs) in Government and Private sectors in order to determine the better performing sector.

KEYWORDS

excel solver, goal programming, special economic zones.

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INTRODUCTION

In the present day circumstances, Operations Research techniques have greater role to play because of competitive coal market demands, a low operating cost, a high productivity performance and multi-criteria decision making with conflicting objectives. Numerous unseen variables are being observed during mining activities in both Underground and Opencast methods. Sometimes it becomes cumbersome and irritating to find which goal has to be given priority in our mining management and thus it calls for application of various optimization techniques and computers. These problems have slowly attracted the attention of many academicians and practitioners in India too. Over the years a few publications on optimization techniques and computers use have come out for the use of operations research practitioners.

REVIEW OF LITERATURE

The effectiveness of Operations Research methods as an industrial tool for decision analysis has been documented by Gaither (1959) and Douglas (1981). Goal Programming is one of the most widely used techniques for solving many real world managerial Multi Criteria Decision Making problems, particularly in case where the criteria are defined as linear analytic functions of decision variables belonging to a compact feasible set. The technique can be utilized as a powerful tool for solving many complex managerial decision problems. Charnes and Cooper (1961) and Ignizio (1956) have described Goal Programming as a workhorse which is strong and rugged and easy to use rather than as a thorough bred one requiring devoted attention by skilled attendant and used only by specially trained riders.
In simple algebraic equations, the system of equations has equalities only on the basis of which variables are evaluated. However, in Linear Programming examples, there will be a set of compound inequalities, meaning inequalities will have both **maximum** and **minimum** values. Linear Programming models are solved to find *optimum* values of variables to simultaneously satisfy minimum and maximum inequalities involved in the equations. In the next step, the variables can be re-stricted to acquire Integer values only, and further, conditions can be imposed to restrict these integer values to take a value of either 0 or 1 only.
In real world situation, the mathematical modeling very often produces a set of equations where the Linear Programming models fail to yield an optimum solution. In that case Linear Goal Programming technique is used by which the inequalities are turned into equalities by adding either a *negative* or *positive* quantity called *deviational variables.* Then the technique proceeds to minimize these *deviational variables,* thereby, yielding an optimum solution.
The principle of Goal Programming is to minimize the deviation in attainment of an aspired Goal value. The goal of minimization or maximization of objective(s), in constraining goal situation(s), is obtained by minimizing the over- or under- achievement of all these goals, taken together, in decreasing priority order.

NEED/IMPORTANCE OF THE STUDY

In India, both Public Sectors (Government owned) and Private sectors are performing in different field of economic activities. Special Economic Zones (SEZs) have been mooted to operate in different zones of this country. The Special Economic Zone (SEZ) policy in India first came into inception on April 1, 2000. The prime objective was to enhance foreign investment and provide an internationally competitive and hassle free environment for exports. The idea was to promote exports from the country and realising the need that level playing field must be made available to the domestic enterprises and manufacturers to be competitive globally.
At present there are eight functional SEZs located at Santa Cruz (Maharashtra), Cochin (Kerala), Kandla and Surat (Gujarat), Chennai (Tamil Nadu), Visakhapatnam (Andhra Pradesh), Falta (West Bengal) and Noida (Uttar Pradesh) in India. Further an SEZ in Indore (Madhya Pradesh) is now ready for operation. In addition, 18 approvals have been given for setting up of SEZs at Positra (Gujarat), Navi Mumbai and Kopata (Maharashtra), Nanguneri (Tamil Nadu), Kulpi and Salt Lake (West Bengal), Paradeep and Gopalpur (Orissa), Bhadohi, Kanpur, Moradabad and Greater Noida (UP), Vishakhapatnam and Kakinada (Andhra Pradesh), Vallarpadam/Puthuvypeen (Kerala), Hassan (Karnataka), Jaipur and Jodhpur (Rajasthan) on the basis of proposals received from the state governments.
Any private/public/joint sector or state government or its agencies can set up an SEZ. There has always been an ongoing debate as to which, whether government should promote private sector or should open up its door more towards establishing public sector undertakings (PSUs). Given the fact that so many PSUs are ailing causing a drain of nation's exchequer, this debate has its own merit. Further it was thought that ailing of PSUs can't be generalized and a particular sector be chosen for analysis. Accordingly, SEZs operating in Vizag were chosen and divided among themselves in Public and Private sectors. Vizag zone was chosen because it offered plenty of SEZ units which are operational in both these sectors.

DATA COLLECTION

Over a time period of 7 years, data collected for Private and Public sector SEZs in Vizag Zone is as produced below:

TABLE 1 (a): VIZAG SEZ PUBLIC SECTOR DATA

YEAR	EXPORTS (RS.'CRORES)	INVESTMENT (RS.'CRORES)	EMPLOYMENT (NO.)	IMPORT (RS.'CRORES)	FDI (RS.'CRORES)	INDIRECT EMPLOYMENT (NO.)
2009-10	917.85	862.67	3057	782.84	116.48	
2010-11	1582.76	883.97	4150	1431.6	116.48	
2011-12	2404.15	903.97	4647	2101.73	116.48	
2012-13	3123.26	1239.96	4647	2292.4	116.48	
2013-14	2155.41	1239.96	4647	2034.3	116.48	
2014-15	1707.998	1239.96	4647	1766.34	116.48	
2015-16	717.57	1239.96	4647	1679.03	116.48	
SUM TOTAL	12609.00	7610.45		12088.24	815.36	0.00

TABLE 1 (b): VIZAG SEZ PRIVATAE SECTOR DATA

YEAR	EXPORTS (RS.'CRORES)	INVESTMENT (RS.'CRORES)	EMPLOYMENT (NO.)	IMPORT (RS.'CRORES)	FDI (RS.'CRORES)	INDIRECT EMPLOYMENT (NO.)
2009-10	4636.21	10442.22	47142	1803.077	1708.38	20716
2010-11	11752.94	14413.41	78591	5338.944	2203.48	31434
2011-12	16668.78	16962.68	112585	4233.221	2263.04	32461
2012-13	23024.15	23518.11	138151	5087.642	3197.05	45768
2013-14	29647.4	30252.79	152743	5303.614	3527.921	47239
2014-15	43290.78	32230.97	197587	11489.45	3882.236	48583
2015-16	39847.68	42358.87	231964	13355.34	4857.809	51198
SUM TOTAL	168867.94	170179.05	Data not available	46611.29	21639.92	277399.00

Source 1: Government of India, Ministry of Commerce, Export Promotion Council for EOUs and SEZs, http://www.epces.in/view_section.php?lang=0&id=0,1,20 accessed on 22nd June, 2016.

Source 2: Development Commissioner Office of VSEZ

OBJECTIVES

It is required to select the Sector (viz. Public or Private), which has exhibited maximum cumulative export at a minimum cumulative investment, having generated maximum employment in the terminal year (7-th year) simultaneously requiring minimum import requirement while attracting maximum foreign direct investment (FDI) along with generation of maximum of Indirect employment.

RESEARCH METHODOLOGY

REWRITING THE OBJECTIVES AS GOALS

A careful examination of the two tables above (Table-1a and Table-1b) the objectives can be broken in the following way.

(i) The main objective is selection of a sector between 2 types of SEZ sectors operating in Vizag Zone, is proposed to be undertaken. This selection of a sector is called Goal-1.
The secondary associated objectives are as described subsequently.

(ii) To achieve maximum cumulative Export value over the last 7-year span (Rs. in crores) This export goal is called Goal-2.

(iii) To have incurred minimum Investment expenditure over the last 7-year span (Rs. in crores) This investment goal is called Goal-3.

(iv) To have generated maximum employment in the last 7-th year (no.). This employment goal is called Goal-4.

(v) To have minimum of cumulative import requirement over the last 7-year span (Rs in crores). This import is called Goal-5.

(vi) To have attracted maximum cumulative foreign direct investment (FDI) over the last 7-year span (Rs in crores) This FDI goal is called Goal-6.

(vii) To have generated maximum indirect employment in last 7-th year (no.). This indirect employment is called Goal-7.

PROBLEM DATA PREPARATION IN TABULAR FORM

TABLE 2: SUMMARISED DATA

COLLECTED DATA	PUBLIC SECTOR (X1)	PVT. SECTOR (X2)
Available SEZ sectors	1	1
Export Sum Total of last 7 years, Rs Crore	12609.00	168867.94
Investment Sum Total of last 7 years, Rs Crore	7610.45	170179.05
Employment in 7th year, No.	4647	231964
Import Sum Total of last 7 years, Rs Crore	12088.24	46611.29
FDI Sum Total of last 7 years, Rs Crore	815.36	21639.92
Indirect Employment in 7th year, No.	0 (Data not available)	51198

GOAL FIXATION

TABLE 3: SECTOR SELECTION CRITERIA AND GOAL FIXATION

Goal	Parameter	Govt. Sector (X1)	Private Sector (X2)	Selection Criteria (How to select between X1 and X2)	Goal Value as per Selection Criteria
Goal-1	SEZ sectors are mutually exclusive ie. Both sectors can't be selected at a time (No.)	1	1	Select any 1 (either X1 or X2)	1
Goal-2	Export Sum Total of last 7 years, (Rs Crore)	12609.00	168867.94	Maximum of X1, X2	168867.94
Goal-3	Investment Sum Total of last 7 years, (Rs Crore)	7610.45	170179.05	Minimum of X1, X2	7610.45
Goal-4	Employment in 7th year, (No.)	4647	231964	Minimum of X1, X2	231964
Goal-5	Import Sum Total of last 7 years, (Rs Crore)	12088.24	46611.29	Minimum of X1, X2	12088.24
Goal-6	FDI Sum Total of last 7 years, (Rs Crore)	815.36	21639.92	Maximum of X1, X2	21639.92
Goal-7	Indirect Employment in 7th year (No.)	0	51198	Maximum of X1, X2	51198

GOAL PROGRAMMING FORMULATION OF THE PROBLEM

Let there be *i* no. of goals (objectives) and *j* no. of sectors.
Then,
i=1,2,3…..7 denote the 7 no. of goals (objectives) and,
j=1,2 denotes 2 no. of sectors viz. Public sector, X1 and Private sector X2.
The decision variable is X_j which is associated with the selection or non-selection of a *j-th* sector, ie.,

$X_{i,j}$ = 0, if for an *i-th* objective, *j-th* sector is rejected.
1, if for an *i-th* objective, *j-th* sector is selected.

It is evident that selection of a sector for any single objective is quite a simple task. However, it becomes difficult to find a selection in a multiple objective environment, and that too, in a scenario having conflicting objectives. It is quite likely that, for all the goal equations taken together, an infeasible solution will be arrived at. This infeasibility is countered by introduction of a pair of negative & positive *deviational variables* in every goal equation. That means the amount by which every individual goal may deviate either side from the targeted goal value. For a negative deviation (under-achievement) a positive quantity *p* is added and a positive quantity *q* is subtracted for positive deviation (over-achievement). Taken together, this is written as (n_i - p_i) where *I* stand for no. of objectives.
That means, in every goal equation a negative deviation variable will be added and a positive deviation variable will be subtracted.
That means the amount by which every individual goal will deviate from the targeted goal value. This *deviational variable* may be either positive (over-achievement, *p*) or negative (under-achievement, *n*), but, both negative and positive deviation can't occur simultaneously.
Mathematically, equations for various objectives (goals) can be written as.

(i) For, *i=1,* SEZ sectors are mutually exclusive goal, 1(X1) + 1(X2) +(n_1 +p_1) = 1
(ii) For, *i=2,* SEZ export goal, 12609.00 (X1) + 168867.94 (X2) +(n_2 +p_2) = 1
(iii) For, *i=3,* SEZ investment goal, 7610.45 (X1) + 170179.05 (X2) +(n_3 +p_3) = 1
(iv) For, *i=4,* SEZ employment goal, 4647(X1) + 231964 (X2) +(n_4 +p_4) = 1
(v) For, *i=5,* SEZ import goal, 12088.24(X1) + 46611.29 (X2) +(n_5 +p_5) = 1
(vi) For, *i=6,* SEZ FDI goal, 815.36(X1) + 21639.92 (X2) +(n_6 +p_6) = 1
(vii) For, *i=7,* SEZ indirect employment goal, 0(X1) + 51198(X2) +(n_7 +p_7) = 1
(viii) Finally, for *i=8*, an additional absolute objective is added to make X1 and X2 binary, meaning they are constrained to assume a value of either "0" or "1" only.

The generalized form of above equations, taken together, can be stated as,

$$\sum_{j=1}^{j} \mathrm{Ci,j\ Xj} + (\mathrm{ni} - \mathrm{pi}) = \mathrm{bi, such\ that\ Xj\ is\ non-negative\ binary\ only\ for\ all}\ i.$$

where,
$C_{i,j}$ is the *i-th* constant associated with LHS of equation,
n_i is the *i-th* negative deviation variables with LHS of equation,
p_i is the *i-th* positive deviation variables with LHS of equation, and
b_i is the *i-th* goal value associated with RHS of equation.
Optimal Solution is obtained by trying to minimize, $\sum_{i=1}^{i}(\mathrm{ni} - \mathrm{pi}) = 0$ for every i.

GOAL PROGRAMMING SOLUTION OF THE PROBLEM USING EXCEL SOLVER 2007

First of all (i) data is entered in the Excel worksheet, (ii) next initial values and formulae are entered (iii) finally, Solver is run.
The Initial table, as shown below, is created as per explanations provided subsequently.

TABLE 4: INITIAL TABLE FOR ENTERING DATA IN MS EXCEL-2007 WORKSHEET

	A	B	C	D	E	F	G	H
1	**TABLE FOR SOLVER OPERATION**							
2	i ↓ GOAL	J → DECISION VARIABLE	J=1 (GOVT. SECTOR)	J=2 (PVT. SECTOR)	DEVIATION VARIABLE ↓	GOAL EQUATION (CONSTRAINTS) LHS OF EQUATION	RELATIONSHIP	RHS OF EQN
3		CONSTANT →	C_1	C_2	N_I (-VE DEVN)	P_I (+VE DEVN) $C_{i,j}$ XJ		B_I
4	I=1 (SELECT ANY 1)	AVAILABLE MUTUALLY EXCLUSIVE SEZS	1	1	0	0 SUMPRODUCT(C4:D4,$C$17:$D$17) + (E4-F4)	=	1
5	I=2 (MAXIMUM EXPORT)	EXPORT SUM TOTAL OF LAST 7 YEARS, RS CRORE	12609.00	168867.94	0	0 SUMPRODUCT(C5:D5,$C$17:$D$17) + (E5-F5)	=	MAX(C5:D5)
6	I=3 (MINIMUM INVESTMENT)	INVESTMENT SUM TOTAL OF LAST 7 YEARS, RS CRORE	7610.45	170179.05	0	0 SUMPRODUCT(C6:D6,$C$17:$D$17) +(E6-F6)	=	MIN(C6:D6)
7	I=4 (MAXIMUM EMPLOYMENT)	EMPLOYMENT IN 7TH YEAR, NO.	4647	231964	0	0 SUMPRODUCT(C7:D7,$C$17:$D$17) +(E7-F7)	=	MAX(C7:D7)
8	I=5 (MINIMUM IMPORT)	IMPORT SUM TOTAL OF LAST 7 YEARS, RS CRORE	12088.24	46611.29	0	0 SUMPRODUCT(C8:D8,$C$17:$D$17) +(E8-F8)	=	MIN(C8:D8)
9	I=6 (MAXIMUM FDI)	FDI SUM TOTAL OF LAST 7 YEARS, RS CRORE	815.36	21639.92	0	0 SUMPRODUCT(C9:D9,$C$17:$D$17) +(E9-F9)	=	MAX(C9:D9)
10	I=7 (MAXIMUM INDIRECT EMPLOYMENT)	INDIRECT EMPLOYMENT IN 7TH YEAR, NO.	0	51198	0	0 SUMPRODUCT(C10:D10,$C$17:$D$17)+(E10-F10)	=	MAX(C10:D10)
11	I=8 (ADDITIONAL OBJECTIVE OF BINARY REQUIREMENT)	RESTRICT DECISION VARIABLES TO ASSUME 0-1 VALUES ONLY	1	1		$C$17, $D$17	=	BINARY
12								
13	**OBJECTIVE FUNCTION**					SUM(E4:F10)	=	0
14								
15								
16	**VALUES OF XJ**		**X1**	**X2**				
17			1	1				
18								
19	COLOR CODE →	OBJECTIVE DESCRIPTION	OBJECTIVE FUNCTION		CHANGING CELLS	TARGET CELL		

(i) **DATA ENTRY**

First of all, an Excel worksheet is created and the collected data for SEZs in 2 sectors are entered from cell nos. A2:A11 to cell nos. D2:D11 as per headings shown.

(ii) ENTERING INITIALLY ASSUMED VALUES AND FORMULAE IN EXCEL WORKSHEET

The next step is to put initial values of variables and formulas for the constraints and objective function are entered. Appropriate explanations are provided at suitable places in the worksheet assumed.

The goal programming method is based up on iteration process, whereby, the decision variables and deviation variables are assigned certain values which are subsequently pushed to optimized values in subsequent iterations. Initially, values of both decision variables X1 and X2 are assumed to be 1. All positive and negative *deviation variables* are assumed to be 0 and put accordingly in the worksheet.

Proceeding further, it is required to calculate the multiplied value of $C_{i,j}X_j$. This requires computing the sum of the product of two sets of cells. Let, C1 and C2 be two constants which are to respectively multiplied by two decision variables represented by $X$1 & $X$2, subsequently their multiplication is to be added. The first way is to write the formula as C1*$X$1 + C2*$X$2.

Alternately, the convenient way is to replace simply by writing an easier formula SUMPRODUCT (C1:C2,$X$1:$X$2).

Thus, whereas the above two paragraphs denote the essentials of left-hand side (LHS) of constraining equations, the right-hand side (RHS) of these equations relate to b_i values called the goal (target values). Depending on the selection criteria of selecting maximum (MAX) or minimum (MIN) values, the formula of MAX or MIN is entered for all the *i* objectives.

Once the formulae for constraining equations are well entered in all the cells, formula for objective function is entered. As stated earlier, simple summation of all positive and negative *deviation variables* will yield the desired optimized value. Accordingly, formula for "addition of negative deviation variable and subtraction of positive deviation variable" is entered in Target Cell of the worksheet.

(iii) LOADING EXCEL SOLVER IN MS EXCEL-2007

The above Goal Programming model is solved using EXCEL SOLVER 2007 in the MS-Excel suit of MS-Office 2007. The steps are briefly described as below (https://support.office.com/en-us/article/load-the-solver-add-in-in-excel-612926fc-d53b-46b4-872c-e24772f078ca):

1. In Excel 2007, click the **Microsoft Office Button** , and then click **Excel Options**.
2. Click **Add-Ins**, and then in the **Manage** box, select **Excel Add-ins**.
3. Click **Go**.
4. In the **Add-Ins available** box, select the **Solver Add-in** check box, and then click **OK**.

(**Notes:** (a) If the **Solver Add-in** is not listed in the **Add-Ins available** box, click **Browse** to locate the add-in. (b) If you get prompted that the Solver Add-in is not currently installed on your computer, click **Yes** to install it.)

5. After you load the Solver Add-in, the **Solver** command is available in the **Analysis** group on the **Data** tab.

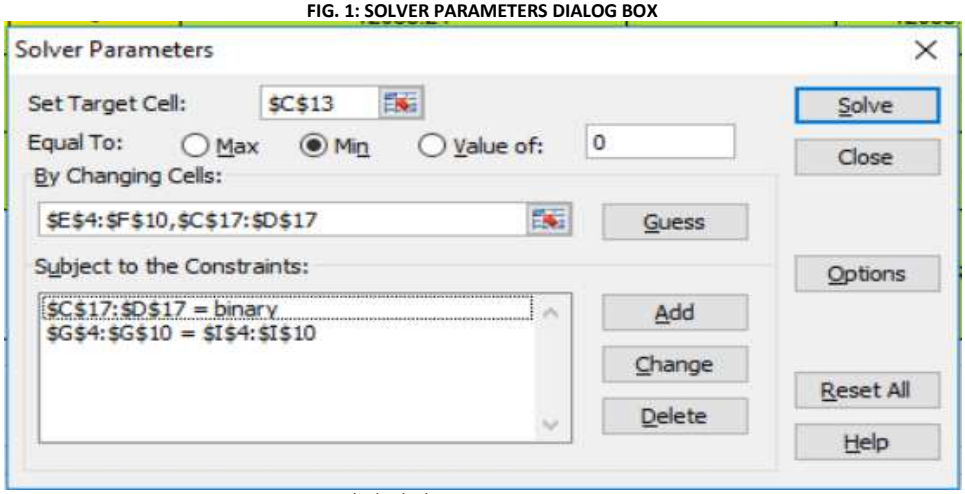
USING THE SOLVER DIALOGS

To let the Solver know which cells on the worksheet represent the decision variables, constraints and objective function, we click Solver button on the Data tab, which displays the Solver Parameters dialog.

In the **Set Target Cell** edit box, we type or click on cell D13, the objective function cell containing the formula SUM (E4:F10). Set Target Cell Equal to ⊙Min for minimization.

In the **By Changing Cells** edit box, we type $E$4:$F$10,$C$17:$D$17 or select these cells with the mouse.

FIG. 1: SOLVER PARAMETERS DIALOG BOX



To add the constraints, we click on the **Add button**, select cells $G$4:$G$10 in the Cell Reference edit box (the *left hand side*), and select cells $I$4:$I$10 in the Constraint edit box (the *right hand side*); the default relation <= is changed to =.

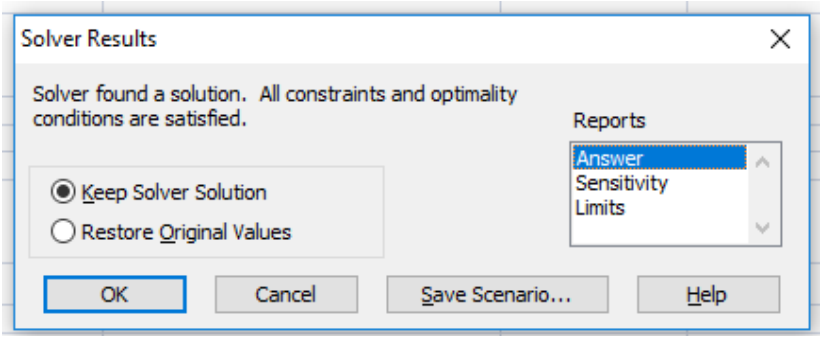
We choose the Add button again (either from the dialog above, or from the main Solver Parameters dialog) to define the non-negative binary constraint on the decision variables. Select cells $C$17:$D$17 in the Cell Reference edit box (the *left hand side*), and change default relation <= and select it as "bin". cells $I$4:$I$10. The word "=binary" is automatically entered in the Constraint edit box (the *right hand side*);

In this way the Problem is completely entered in the Excel worksheet.

FINDING AND USING THE SOLUTION

To find the optimal solution, we simply click on the **Solve button**. The message "Solver found a solution" appears in the Solver Results dialog, as shown below.

FIG. 2: SOLVER RESULTS DIALOG BOX



This is the "traditional" Solver dialog style from Excel 2007 and earlier. We now click on "Answer" in the Reports list box to produce an Answer Report, and click OK to keep the optimal solution values in cells C17:D17.

After a moment, the Solver returns the optimal solution: "0" in cell C17 and "1" in cell D17. This means that X1 representing the Public sector is rejected and, X2 representing the Private sector is selected. The final table obtained after running the solver is as shown below:

TABLE 5: FINAL TABLE AFTER SOLVER RUN IN MS EXCEL-2007 WORKSHEET

1	**TABLE FOR SOLVER OPERATION**								
2	i ↓	j → DECISION VARIABLE →	j=1 (GOVT. SECTOR)	j=2 (PVT. SECTOR)	DEVIATION VARIABLE ↓		GOAL EQUATION (CONSTRAINTS)		
							LHS of Equation	Relationship	RHS of Eqn
3	GOAL	CONSTANT →	C_1	C_2	n_i (-ve devn)	p_i (+ve devn)	$C_{i,j}$ Xj		b_i
4	i=1 (SELECT ANY 1)	Available Mutually Exclusive SEZs	1	1	2.56546E-12	0	1	=	1
5	i=2 (MAXIMUM EXPORT)	Export Sum Total of last 7 years, Rs Crore	12609.00	168867.94	0	0	168868	=	168867.94
6	i=3 (MINIMUM INVESTMENT)	Investment Sum Total of last 7 years, Rs Crore	7610.45	170179.05	0	162568.6	7610	=	7610.45
7	i=4 (MAXIMUM EMPLOYMENT)	Employment in 7th year, No.	4647	231964	2.18985E-07	0	231964	=	231964.00
8	i=5 (MINIMUM IMPORT)	Import Sum Total of last 7 years, Rs Crore	12088.24	46611.29	0	34523.048	12088	=	12088.24
9	i=6 (MAXIMUM FDI)	FDI Sum Total of last 7 years, Rs Crore	815.36	21639.92	0	1.1489E-08	21640	=	21639.92
10	i=7 (MAXIMUM INDIRECT EMPLOYMENT)	Indirect Employment in 7th year, No.	0	51198	2.32513E-08	0	51198	=	51198.00
11	i=8 (ADDITIONAL OBJECTIVE OF BINARY REQUIREMENT)	Restrict Decision variables to assume 0-1 values only	1	1			1	=	1
12									
13	**OBJECTIVE FUNCTION**						SUM(E4:F10)	=	0
14									
15									
16	**VALUES OF Xj**		**X1**	**X2**					
17			0.0000	1.0000					
18									
19	COLOR CODE →	OBJECTIVE DESCRIPTION	OBJECTIVE FUNCTION		CHANGING CELLS		TARGET CELL		

After a moment, the Solver creates another worksheet containing an **Answer Report**, like the one below, and inserts it to the left of the problem worksheet in the Excel workbook.

TABLE 6: MICROSOFT EXCEL 12.0 ANSWER REPORT

Microsoft Excel 12.0 Answer Report
Worksheet: [VIZAG PERFORMANCE GOVT-PVT STUDIES.xlsx]Vizag_GovtVrsPvt_ByGP Final Tab
Report Created: 02-11-2018 00:58:54

Target Cell (Min)

Cell	Name	Original Value	Final Value
$C$13	MINIMIZE ALL DEVIATION VARIABLES GOVT. SECTOR (X1)	0	455598.498

Adjustable Cells

Cell	Name	Original Value	Final Value
$E$4	Available Mutually Exclusive SEZs NEGATIVE	0	0
$F$4	Available Mutually Exclusive SEZs POSITIVE	0	1.59909E-11
$E$5	Export Sum Total of last 7 years, Rs Crore NEGATIVE	0	0
$F$5	Export Sum Total of last 7 years, Rs Crore POSITIVE	0	156258.942
$E$6	Investment Sum Total of last 7 years, Rs Crore NEGATIVE	0	0
$F$6	Investment Sum Total of last 7 years, Rs Crore POSITIVE	0	0
$E$7	Employment in 7th year, No. NEGATIVE	0	0
$F$7	Employment in 7th year, No. POSITIVE	0	227317
$E$8	Import Sum Total of last 7 years, Rs Crore NEGATIVE	0	0
$F$8	Import Sum Total of last 7 years, Rs Crore POSITIVE	0	2.06979E-07
$E$9	FDI Sum Total of last 7 years, Rs Crore NEGATIVE	0	0
$F$9	FDI Sum Total of last 7 years, Rs Crore POSITIVE	0	20824.556
$E$10	Indirect Employment in 7th year, No. NEGATIVE	0	0
$F$10	Indirect Employment in 7th year, No. POSITIVE	0	51198
$C$17	FINAL OPTIMAL OUTPUT VALUE X1	1.0000	1.0000
$D$17	FINAL OPTIMAL OUTPUT VALUE X2	1.0000	0.0000

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$G$4	Available Mutually Exclusive SEZs LHS	1	$G$4=$I$4	Not Binding	0
$G$5	Export Sum Total of last 7 years, Rs Crore LHS	168867.94	$G$5=$I$5	Not Binding	0
$G$6	Investment Sum Total of last 7 years, Rs Crore LHS	7610.45	$G$6=$I$6	Not Binding	0
$G$7	Employment in 7th year, No. LHS	231964.00	$G$7=$I$7	Not Binding	0
$G$8	Import Sum Total of last 7 years, Rs Crore LHS	12088.24	$G$8=$I$8	Not Binding	0
$G$9	FDI Sum Total of last 7 years, Rs Crore LHS	21639.92	$G$9=$I$9	Not Binding	0
$G$10	Indirect Employment in 7th year, No. LHS	51198.00	$G$10=$I$10	Not Binding	0
$C$17	FINAL OPTIMAL OUTPUT VALUE X1	1.0000	$C$17=binary	Binding	0.0000
$D$17	FINAL OPTIMAL OUTPUT VALUE X2	0.0000	$D$17=binary	Binding	0.0000

RESULTS AND DISCUSSION

Thus, the above solution presents a rosy picture for the SEZs performing in the Privatesector. All the goals have been given equal priorities (importance). Other goals can also be incorporated in this model. During data collection, it is observed that a lot of un-utilized land is surplus in various units. The model can be extended to find out most efficient land use sector. Various other types of objectives can also be formulated to suit requirement of the user/policy maker.

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