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Optimization using MS-Excel Solver

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Abstract

MS Excel has a built in ADD-IN pack (available under tools menu) known as "**Solver**" which is a powerful tool for solving optimization problems. The solver add-in for Excel is an easy way to solve linear, non-linear and integer programming problems in operations research. After formulating the real life problems, can be solved easily by using MS Excel Solver. In this article we illustrate the method of solving the linear programming problem using Solver.

Introduction

Operations research Techniques gained importance as a subject after World War II. The term operations research was coined as a result of research on military operations during the war.

Today the impact of Operations Research can be felt in many areas. A large number of management consulting firms are currently engaged in Operations Research activities. Apart from military and business applications the Operations Research activities include transportation systems, libraries, hospitals, city planning, financial institutions etc.

Sakai Troxell, (2002) addresses the issue of how to help undergraduate business students handle some of the problems they might encounter when using optimization software. Salim A. Saleh *et al.,* (2009) in his describes advanced methods for finding a verified global optimum and finding all solutions of a system of linear programming, as implemented in the Premium Solver Platform, an extension of the Solver bundled with Microsoft Excel. It also describes the underlying tools that allow Excel spreadsheets to be used over linear data, with fast computation of optimization. Hilal A. Abdelwali *et al.,* (2019) in his paper explains step by step tutorial to solve transportation problems by using an MS Excel solver add-on. This research is carried out based on the actual data of a transportation company.

Many Operations Research models require high-speed computation. When the number of variables is large, the models can be solved only through computer programming. The solver add-in from Excel is an easy way to solve linear, non-linear and integer programming problems.

Solving Linear Programming Problem Using Solver - An Overview

Let's step through an example to get started.

Maximize $Z = 2x_1 + 4x_2 + x_3 + x_4$

Subject to the constraints,

$x_1 + 3x_2 + x_4 \leq 4$

$2x_1 + x_2 \leq 3$

$x_2 + 4x_3 + x_4 \leq 3$
$x_1, x_2, x_3, x_4 \geq 0$

The terminologies such as "Target Cell" (for the objective) and "Changing Cells" (for the decision variables), we used these terms – at Microsoft's request – to mirror the terms used in the Goal Seek feature, which predated the Solver in Excel and in other spreadsheet programs.

Enter the above date in Ms-Excel worksheet as follows.

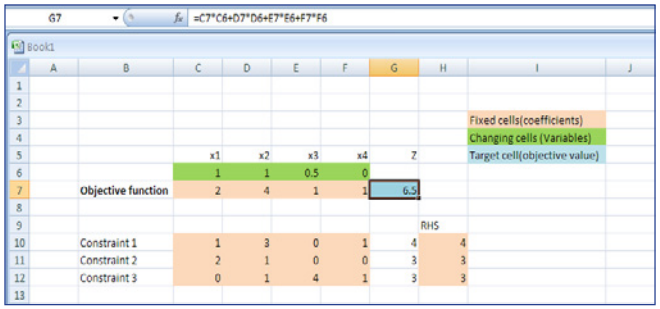

Figure 1: View of Excel Sheet

In this case, the fixed cells are simply the objective and constraints, set up in block form. The changing cells will eventually contain the optimal values of x_1, x_2, x_3 and x_4. The target cell contains the objective function defining Z in terms of x_1, x_2, x_3 and x_4 (= C7*C6 + D7*D6 + E7*E6 + F7*F6). Similarly, the cells F10, F11 and F12 contain formulae that compute the Right Hand Side values of the constraints (i.e.) F10 contains "= C10*C6 + D10*D6 + E10*E6 + F10*F6". Now choose solver from tools menu. The solver parameter window will open. Set the target cell to the location of your objective function value, select max and set the changing cells to the locations of your decision variables. Click on the constraints box and select Add. The Add constraint window will appear. It is shown below.

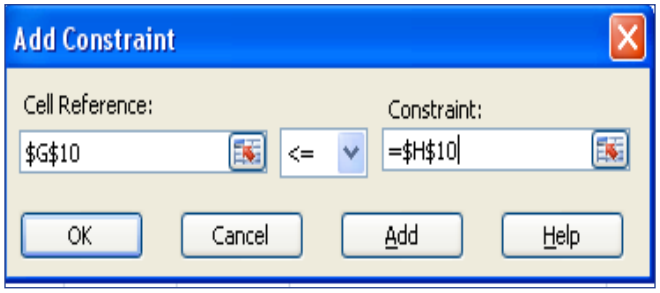

Figure 2: Adding Constraint using solver

In the problem the cell G10 is less than or equal to 4. Click Add and repeat the same for all the constraints (including non negativity constraints). After inserting all the constraints select cancel to return to the solver parameters.

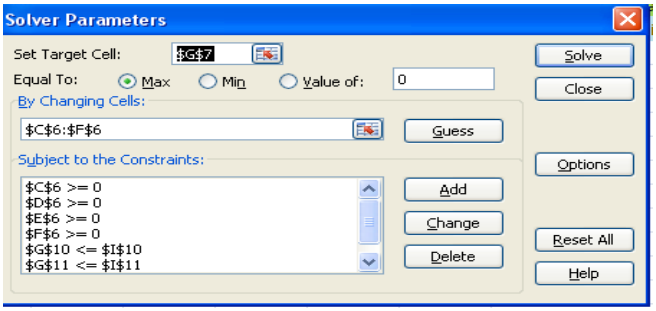

Figure 3: Solver

Now click solve. Select keep solver solution and click ok. Now we will get the result (x_1 = 1, x_2=1, x_3= 0.5, x_4= 0 and Max Z = 6.5).

Conclusion

Solving Linear Programming Problem manually for large number of variables and for large number of constraints is a cumbersome process. Solving it using software is the easiest one. MS Excel is an easy available package. The same may also used to analyse the sensitivity of the linear programming problem. Also the solver add-in from Excel is an easy way to solve Linear Programming Problem.

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