

Case 10 – Uncertain LPs/ILPs

Case material for VBA Programming in Business Economics by Sanne Wøhlk

This case is about linear programming. We refer the reader who is not familiar with the topic to the material on the topic on book's webpage. A number of data files are provided for this case.

When a linear programming problem (LP) or an integer linear programming problem (ILP) is solved, for example with the Excel Solver, it is assumed that all coefficients are known in advance. Very often these coefficients are merely estimates of the true value and there is a high degree of uncertainty involved. Solving a problem with the wrong value of one or more coefficients result in a wrong optimal solution and can cause the company to lose money.

In this case, you make a program where the user can select a file containing an LP/ILP problem and determine which (one or several) variables should be considered as uncertain. First the problem should be solved to optimality. Next a simulation study should be performed with the indicated values as uncertain. Information about the objective value should be collected and displayed graphically in a way appropriate for the purpose, along with standard statistical information, e.g. mean value.

Data:

A *Data* folder contains a number of files with LP/ILP problems. All files have the same format. This format is described below and an example is shown.

- Cell A1 states whether the problem is LP or ILP (It is LP if all variables are continuous).
- Cell A2 indicates if the problem should be minimized or maximized.
- Row 4 gives the variable names
- Row 6 states the type of each variable (cont for continuous, bin for binary, and int for integral). All variables are non negative.
- Row 8 gives the objective coefficient of each variable. If the variable can be chosen to be uncertain, rows 9 and 10 give the lower and upper bound of the objective coefficient. (In the example below, if x_1 is chosen to be uncertain, the objective coefficient of x_1 is uniformly distributed in the range from 160 to 180. In the example, x_2 cannot be chosen to be uncertain.)
- Starting from row 12, the constraints are given. After the constraint matrix (in the example the constraint matrix is "B12:F21"), there is an empty column (in the example this is column G). The next column gives the relation to the right hand side (\leq , \geq , or $=$), and the following column gives the right hand side values. Note that the size of the constraint matrix varies from problem to problem.

Communication with user:

The program should use one or several user forms to get the following information from the user:

- Which file should be solved. A listbox or a combobox should be used to let the user choose from a list of available files.
- Should the problem be solved to optimality with the estimated values or should a simulation also be performed.
- If a simulation should be performed: The number of iterations.
- If a simulation should be performed: Which of the possible variables are uncertain (one or several).

