

Case 8 – Project Assignment

Case material for VBA Programming in Business Economics by Sanne Wøhlk

Please use the Excel file corresponding to this case and the folder *Case8_Data* which contains data files.

When assigning employees to projects it is extremely important that the manager considers the qualifications of the employees and the qualifications needed in order to obtain a successful result for each project. In the following, we consider the problem of assigning employees to projects in order to maximize the total match of the assignment (“match” will be defined below). In the following, each project requires exactly one employee. Excess employees can be left unassigned, but if there are not enough employees to cover all projects, execution of the program should stop and the user should be informed.

The Excel file contains two subs for generating projects and employees. These are described below.

The *GenerateProjects* sub generates a number of projects and prints them to the sheet *Projects*. Column A gives the project number. For each of 15 possible qualifications, columns B through P state whether that qualification is needed for the project (indicated by 1) or not (indicated by 0). As input the procedure takes an integer number indicating the number of projects to be generated.

The *GenerateEmployees* sub generates a number of employees and prints them to the sheet *Employees*. Column A gives the employee number. For each of 15 possible qualifications, columns B through P states whether the employees have that qualification (indicated by 1) or not (indicated by 0). As input the procedure takes an integer number indicating the number of employees to be generated.

For each combination of employee and project, the *match* can be calculated as

$$M_{ij} = \sum_{q=1}^{15} P_{iq} \cdot E_{jq}$$

where M_{ij} is the match of employee j to project i , and where P_{iq} is 1 if project i requires qualification q (0 otherwise), and E_{jq} is 1 if employee j has qualification q (0 otherwise).

Consider for example the following qualifications for an employee and the following qualifications needed for a project. The match of this project-employee combination is 4.

Project	1	0	1	1	1	1	0	1	0	1	0	0	0	0	0	0
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Employee	0	1	1	1	0	1	0	1	1	0	0	1	0	0	0	0
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Employees can be assigned to projects using one of the following three strategies:

Simple Strategy: For the first project, assign the employee who best matches the project. For the remaining projects in turn, select among the employees who have not been assigned to a project so far, the one with the best match.

Global Strategy: Until all projects have an employee assigned to them, choose among all the unassigned projects and the unassigned employees the combination that has the highest match.

2-step Strategy: Follow the following two steps

1. For each employee, j , let x_j be the maximal match that can be obtained for any project. I.e. $x_j = \max_i \{M_{ij}\}$. Subtract x_j from every match value (i.e. for every project) for that employee. This results in a table of transformed match values. (Note that the values in this table might be negative and remember that e.g. -4 is greater than -8).
2. Apply the Global strategy to the table of transformed match values in order to determine the assignment.

Through a user form the following information should be obtained from the user and appropriate action should be taken.

- a. Input data should be obtained from
 - i. An external file.
 1. Data files should be located in a sub folder called *Data*.
 2. The format of all data files is the same. (Please refer to one of the files to see the format)
 3. In the data files, the information given is the number of employees, the number of projects, and a table giving the match of each combination of employee and project.
 - ii. Generated randomly using the two existing subs.
- b. If an external file is selected, a list of all available data files in the data folder should be available for the user to select a file. (This should work even if new files are added to the folder)
- c. If *Generate data randomly* is selected, the user should be allowed to indicate the number of projects and employees to generate. In this case the match table should be generated.
- d. Solution choice: The user should be allowed to choose between
 - i. Assign using the Simple Strategy
 - ii. Assign using the Global Strategy
 - iii. Assign using the 2-step Strategy
 - iv. Perform a simulation study in order to determine which of the three strategies performs best. Besides writing the result in text, one or several charts should be generated (automatically) to display the result.

For choice I through iii, the actual assignment should be displayed along with the value of the total match.