

Case 4 – Seat Reservation

Case material for VBA Programming in Business Economics by Sanne Wøhlk

This case is about the Seat Reservation Problem. If you are not familiar with the problem then consult the book's background information on the topic.

Consider the data file of this case. The number of train stations including the first and the last one will be referred to as k and can be found in cell B3 of the file. The number of seats is referred to as n and can be found in cell B4. The number of reservations is referred to as m and can be found in cell B5. For each reservation i , $s(i)$ and $t(i)$ indicates the station where the passenger wants to get on the train and off the train, respectively. These values can be found for each passenger in columns B and C.

The assignment of seats happens in real time, i.e. the decision regarding reservation i must be made without knowledge of the reservations $i+1, i+2, \dots$. We consider two strategies: *First Interval* and *Best interval*. To measure the quality of a solution we use two measures:

- *NA*: The number of accepted reservations, i.e. m minus the number of rejected reservations.
- *Volume*: Number of seat-intervals used, i.e. $\sum_{i \text{ is accepted}} (t(i) - s(i))$.

The assignment of reservations to seats can be illustrated as follows. In this example, *NA* is 8 and *Volume* is 22. Furthermore, in the data file column D can be used to state the seat assigned to the reservation and column E can be used to indicate if a reservation is rejected.

1	1	1					2	2	3	3	3	3			
2	5	5	5	5							4	4	4	4	4
3				6	6					8	8	9			

Based on the data file you should write one or several macros to perform the following tasks. Sheet 2 contains data that can be used to test point 1-3.

1. Assign a given sequence of reservations to seats using the *First Interval* strategy. The macro should be flexible in the sense that it does not have assumptions about the number of stations, number of seats, and number of reservations. These three values should be read from cells B3, B4, and B5, respectively. The assignment should be illustrated graphically as shown above and the quality of the solution should be stated using each of the two measures.
2. Assign a given sequence of reservations to seats using the *Best Interval* strategy. Again, the macro should be flexible in the sense that it does not have assumptions about the number of stations, number of seats, and number of reservations. These three values should be read from cells B3, B4, and B5, respectively. The assignment should be illustrated graphically as above and the quality of the solution should be stated using each of the two measures.

3. Write a macro *Comparison* that can be used to compare the assignments made in 1) and 2) based on the two sets of data given in the sheet 2. The data may be manually copied to sheet 1.
4. Create a macro that can generate new reservations based on the information given in cells B3 and B5. How the data should be generated is your choice.
5. In order to determine which of the two strategies that give the best solution, it would be obvious to make assignments based on each method – not only for one data set but for several sets of randomly generated data. Write a macro that can be used for this. Use your macro from 4) to generate data and your macros from 1) and 2) to perform the assignments. The number of repetitions should be read from cell B6.