

Important Notes in Using Worksheet ‘TCP’

Unless otherwise noted, the cell references in this document relate to locations in worksheet ‘TCP’. Blue-filled cells in the worksheet denote required user input. Text in adjacent cells describes the specificity of what is required there and the manner of its entry.

Note 0: Enter respectively in blue-filled cells H2 and J2 the number (k) of touring vehicles and the number (n) of locations to be visited. The upper triangular array of cells anchored in cell M6 should contain the distances d_{ij} between all pairs of location sites where $i, j = 0, 1, \dots, n$, $i < j$ and 0 denotes the depot from which all vehicles leave and return. Enter in blue-filled cells A6 and below the delivery quantities required at sites $1, \dots, n$. Read the notes in the vicinity of these cells. The VRPs presented in the manuscript and the Supplemental Material have symmetric distances where $d_{ij} = d_{ji}$ for all $i, j = 0, 1, \dots, n$ and $i > j$. Worksheet ‘VRP Model’ is set up for each VRP available among the Supplemental Material.

Note 1:

Translation of the string representation of a route to worksheet cells enabled the computations supporting the investigations reported in the manuscript. For a route of interest entered in string form in blue-filled cell Hi1, the translation occurs automatically in the following way. The left to right location indices of the string were correspondingly positioned vertically one per cell beginning in cell HL6. This allowed the elements of any routing string in cell Hi1 to be edited as desired and in turn evaluated for fleet distance, conformance to vehicle capacity restrictions, and other features.

Note 2

It is necessary to follow the entry of the string form of the route of interest in cell Hi1 with the desired number of stops to assign to each of the k touring vehicles. The entries are made in blue-filled cells HP6 and below. The entries are made in the cells right-adjacent to the vehicle identifiers $1, \dots, k$ in cells HO6 and below. Thereafter, calculated attributes of the route entered in cell Hi1 appear in cells HP4:HR4 and vehicle related information is displayed in cells HO6:HR6 and below. Type 1 and type 2 perturbation investigations begin with populating these cells.

Note 3:

Type 1 investigation is conducted in the area of cell GW1 by entering the required information in the blue-filled cells there. Begin with manual entry of the cell of the route of interest in cell GX1. It is recommended that you copy the route in cell Hi1 to GX1 by means of the cell formula +Hi1. Thereafter follow with striking keys command C then in top level menu click Edit Paste Special Values in that order. The result should be the ‘value’ form of the entry in cell GX1 and not the cell formula +Hi1. This is important. Once completed, enter location index 1 in blue-filled cell GV3 and then move to spin button in vicinity of cell GW3. Strike the up arrow there to increment the location index in cell GV3 by 1 and continue to do so until index n appears in cell GV3. With each strike of the up arrow, the best feasible type 1 repositioning of the index shown in cell GV3 is reported in cells GW4 and GW5. Upon completion of entry of all location indices $1, \dots, n$ in cell GV3, cells IK6:IN6 and below report in rank order the best found type 1 perturbations. See Note 5 below.

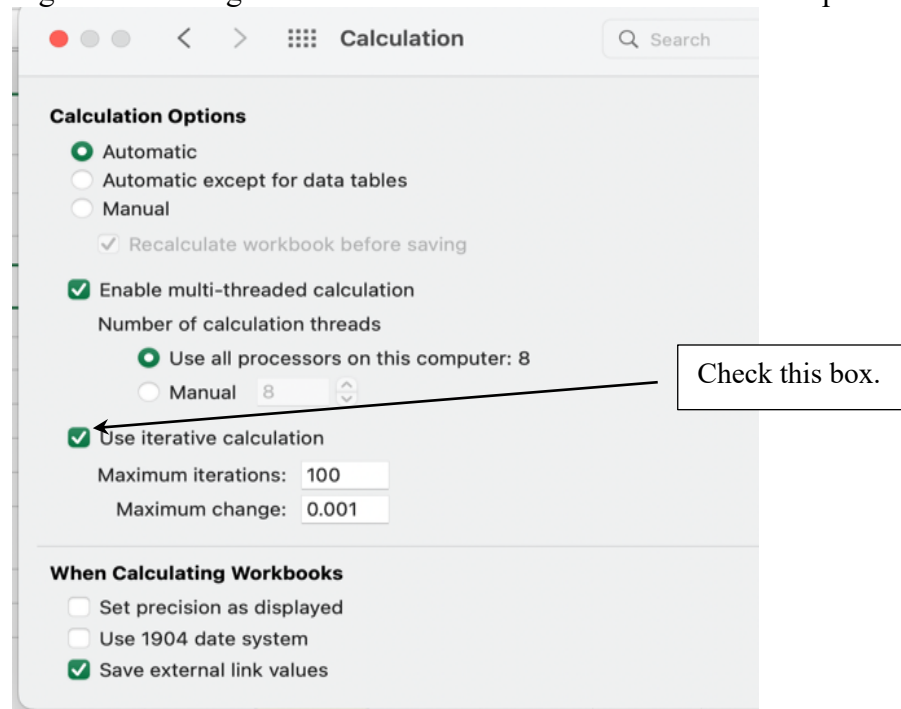
Note 4:

Type 2 investigation is conducted in the area of cell HW1 by entering the required information in the blue-filled cells there. Begin with manual entry of the cell of the route of interest in cell HX1. It is recommended that you copy the route in cell Hi1 to HX1 by means of the cell formula +Hi1. Thereafter follow by striking keys command C then in top level menu click Edit Paste Special Values in that order. The result should be the ‘value’ form of the entry in cell HX1 and not the cell formula +Hi1. This is important. Once completed, enter location index 1 in blue-filled cell HV3 and then move to spin button in vicinity of cell HW3. Strike the up arrow there to increment the location index in cell HV3 by 1 and continue to do so until index n appears in cell HV3. With each strike of the up arrow, the best feasible type 2 repositioning of the index shown in cell HV3 is reported in cells HV4 and HW4. The best pair interchange is location index in cell HV3 and HV4, i.e. best positional interchange for the index in blue-filled cell HV3 is with the index in cell HV4. Upon completion of entry of all location indices 1,...,n in cell HV3, cells IS6:IV6 and below report in rank order the best found type 2 perturbations. See Note 5 below.

Note 5:

In order to automatically identify and display the best-found type 1 and type 2 perturbations in cells IK6:IN6 and below for type 1 investigation and in cells IS6:IV6 and below for type 2 investigation, worksheet ‘VRP Model’ makes use of the circular reference option ‘Use iterative calculation’ in the manner shown in Figure 1 below for a Mac. Otherwise, the feature is not operative. For the Mac, go to the Excel high-level menu, select Preferences then under Formulas and Lists click on Calculation then check ☒ ‘Use iterative calculation’ under Calculation Options.

Figure 1. Electing with ‘check’ the ‘Use iterative calculation’ option for the Mac

**Note 6:**

Given the separate ranked best results (cells IK6:IN6 and below) for type 1 investigations and ranked best results (IS6:IV6 and below) for type 2 investigations, the user manually ranks them jointly to produce the order (list) for testing perturbation candidates in an iteration. Each candidate in the list is tested one at a time by temporarily editing the route in cell Hi1 accordingly. If the outcome in terms of fleet travel distance or fleet infeasibility is appealing, the editing is left in place and the perturbed route serves as the basis for testing the next perturbation candidate in the list; otherwise, Excel's 'undo' feature is used to remove the edit and return the Hi1 cell entry to its previous state (route). The testing goes on to the next candidate in the list.

Note 7:

The route of interest entered in blue-filled cell Hi1 must have no blanks or other characters between location indices separated by one comma only. The leftmost character must not be a comma. The rightmost character must be a comma. No characters should follow the rightmost character. The same protocol follows for the routing string entered in blue-filled cells GX1 and HX1 prior to performing type 1 and type 1 investigations. For best results, the spin buttons in the vicinities of cells GW3 and HW3 should advance from 1 to 2 ... to n in that order. Make sure the routing strings entered in cells GX1 and HX1 are values and not cell formulas as addresses in above Notes 3 and 4. Also, when editing the number of site visits assigned to vehicles 1,...,k in blue-filled cells HP6 and below that the cell entries HP6:HP20 sum to n. Cell entries after the kth vehicle should be blank. Make sure that Note 5 is observed before proceeding.