# EXCEL APPROACH TO SOLVING DAY 7'S CHALLENGE

**By Wong Chee Hong**

First, observe that this is an integer optimization problem. We are trying to find an **integer** point **d** such that the fuel cost to point **d** is minimum.

Thus, we can model the **total cost** of any given point **d** by this formula for part 1:

$$\sum_{i=1}^{1000} |x_i - d| \qquad ,where\ |x_i - d|\ is\ the\ individual\ cost$$

And this formula for part 2:

$$\sum_{i=1}^{1000} (x_i - d)^2 + |x_i - d| \qquad ,where\ (x_i - d)^2 + |x_i - d|\ is\ the\ individual\ cost$$

Thus, the mathematical model for this problem would be:

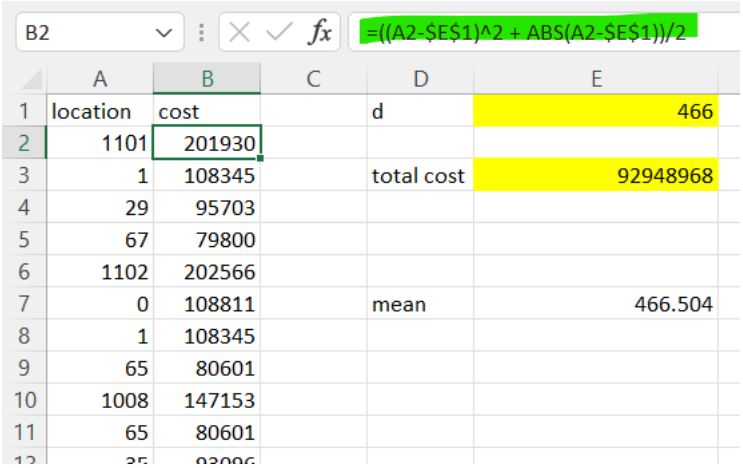
Minimize (depending on whether we are solving for part 1 or 2)

$$\sum_{i=1}^{1000} |x_i - d| \quad or \quad \sum_{i=1}^{1000} (x_i - d)^2 + |x_i - d|$$

subjected to the following constraints:

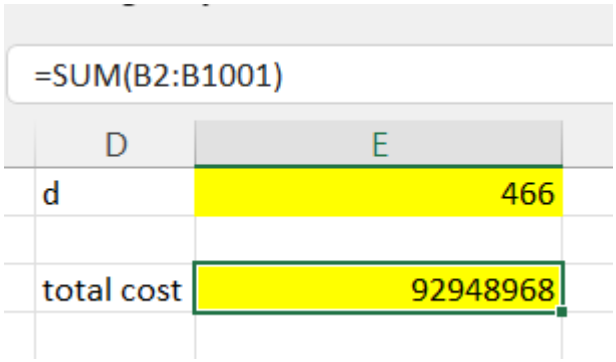
$$d \in \mathbb{Z}$$

In excel, we have the following construction:



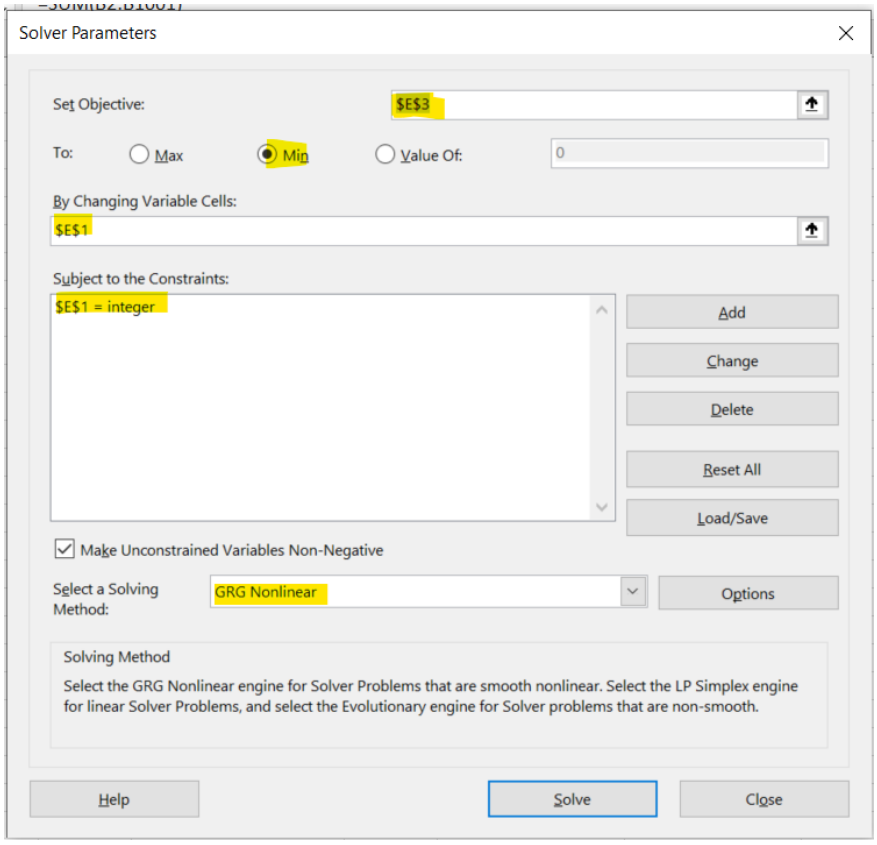

In column A2:A1001, we have the input arguments for all the crabs, which represent their initial starting locations.

In column B2:B1001, we calculate the individual fuel cost for each crab to travel to point **d**. Point **d** is represented by Cell E1 in the image above, and the formula for the individual fuel cost, which is based on **d**, is highlighted in in green. In this case, this formula is for part 2.




Then, the total cost can be obtained by performing a summation across cells B2:B1001. This value is stored in cell E3.

Finally, under Data > Solver, we can set the solver's parameter like so:




From topmost highlighted text to the bottom:

1. Set objective function (which is total cost stored in cell E3)
2. Select minimize (since the objective is to minimize total cost)
3. Changing variable cell $E$1 (which contains the value for $\mathbf{d}$)
4. Constrain $\mathbf{d}$ to be an integer.
5. Set solver to use GRG Nonlinear, since the total costs are non-linear for part 2. It can be set to Simplex LP for part 1 since the total cost is a linear function.
6. Hit solve and excel will generate the correct value of $\mathbf{d}$ and the corresponding total cost.