## 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:

$$\sum_{i=1}^{1000} |x_i - d|$$

And this formula for part 2:

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

Thus, the mathematical model for this problem would be:

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

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

subjected to the following constrains that:

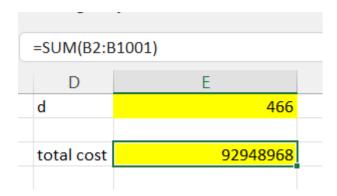
$$d \in \mathbb{Z}$$

In excel, we have the following construction:

B2		$\vee$ ] : $[\times \checkmark fx]$		=((A2-\$E\$1)^2 + ABS(A2-\$E\$1))/2	
	Α	В	С	D	E
1	location	cost		d	466
2	1101	201930			
3	1	108345		total cost	92948968
4	29	95703			
5	67	79800			
6	1102	202566			
7	0	108811		mean	466.504
8	1	108345			
9	65	80601			
10	1008	147153			
11	65	80601			
10	25	02006			

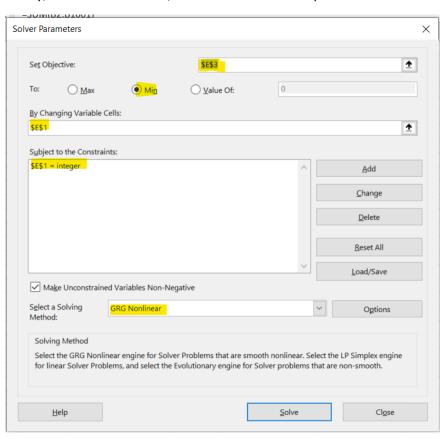
In column A2:A1001, we have the input arguments for all the crabs, which represent their initial starting locations.

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 d)
- 4. Constrain **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 **d** and the corresponding total cost.