42189 – Transport System Analysis F25
Week 3 exercises

Exercise 1

You are asked to model trip distribution within the three central zones of Labtown. These are numbered 1, 2, 3. You have information on marginal totals, i.e. O_i, and D_j, both in the base year as well as the scenario year. In addition to this, you also have information on the generalised cost, gc_{ij}, and the initial matrix t_{ij} based on a sample of the trips in the base year.

O / D	Base		Scenario	
Zone	O_i	D_j	O_i	D_j
1	50	100	60	110
2	90	60	120	100
3	100	80	120	90

	Base			Scenario		
gc_{ij}	$j = 1$	$j = 2$	$j = 3$	$j = 1$	$j = 2$	$j = 3$
$i = 1$	10	21	22	12	21	22
$i = 2$	21	12	27	21	14	23
$i = 3$	23	27	12	23	23	16

t_{ij}	$j = 1$	$j = 2$	$j = 3$
$i = 1$	7	2	4
$i = 2$	8	9	6
$i = 3$	10	5	11

1. Assume a model with independence among origins and destinations, i.e. $T_{ij} = A_i B_j O_i D_j$. Calculate the base matrix, T_{ij}^B, using this model. Do you think this is a useful model?

2. Now consider a model based on the initial solution, i.e. $T_{ij} = A_i B_j O_i D_j t_{ij}$. Calculate the base matrix, T_{ij}^B, using this model. Do you think this is a useful model?

3. Now consider a gravity model, i.e. $T_{ij} = A_i B_j O_i D_j f(gc_{ij})$. A first question is what cost function to use. To find a suitable cost function, you have additional data on travel to/from zones 1, 2, and 3. These data are in the file: Week3_Distribution_data.xlsx.

   One way to estimate a cost function is to regress $\ln(T)$ on generalised cost, gc. You are welcome to use other approaches. Following this you should calculate the base matrix, T_{ij}^B, using the gravity model. Do you think this is a useful model?

4. Assume one of your colleagues has found the correct trip matrix for the base year

T_{ij}^C	$j = 1$	$j = 2$	$j = 3$
$i = 1$	31	4	15
$i = 2$	32	36	22
$i = 3$	37	20	43

   Try to evaluate the methods you applied in exercises 1-3 against the correct trip matrix. One way to compare them could be using the root mean square error (RMSE), i.e.

$$RMSE = \sqrt{\frac{1}{9}\sum_{i,j}\left(T_{ij}^C - \hat{T}_{ij}\right)^2}$$

   Argue which of the three methods, you prefer considering that you in question 5 will be asked to investigate what happens in Labtown when a cross-city tunnel is opened between zones 2 and 3.

5. Use your preferred model from 1-3 to predict the number of trips in the future scenario where a cross-city tunnel is opened between zones 2 and 3 leading to lower generalised cost between these two zones. Note that some of the other generalised cost values have been increased due to rising congestion in the scenario. Comment on your results.