1. Consider a zone with the following characteristics:

Household type	No.	Income ($/month)	Inhabitants	Trips/day
0 cars	180	4000	4	6
1 car	80	18000	4	8
2 or more cars	40	50000	6	11

Due to a decrease in import duties and an actual income increase of 30%, it is expected that 50% of households without a car will acquire one in three years. Estimate how many trips the zone would generate in that case.

Solution: X_1 = Household type
X_2 = Income ($/month)
X_3 = Inhabitants
y = Trips/day

$$y = 7.7545 + 0.3574 X_1 + 0.000113 X_2 - 0.5560 X_3$$

Household type (X_1)	No.	Income ($/month) ($X_2$)	Inhabitants (X_3)	Trips/day
0 cars	90	5200	4	6.14
1 car	170	23400	4	8.63
2 or more cars	40	65000	6	12.76

Sum = 6.14 × 90 + 8.63 × 170 + 12.76 × 40 (trips) = 2530 (trips)

2. A small study area has been divided into four zones and a limited survey has resulted in the following trip matrix:

	1	2	3	4
1	—	60	275	571
2	50	—	410	443
3	123	61	—	47
4	205	265	75	—

Estimates for future total trip ends for each zone are as given below:

a Zones	Estimated future origins	b Zones	Estimated future destinations
1	1200	1	670
2	1050	2	730
3	380	3	950
4	770	4	995

Solution:

	1	2	3	4	
1	—	60	275	571	1200
2	50	—	410	443	1050
3	123	61	—	47	380
4	205	265	75	—	770
	378	386	760	1061	

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	1	2	3	4	
1	—	79	364	756	1199
2	58	—	477	515	1050
3	202	100	—	77	379
4	290	374	106	—	770
	550	553	947	1348	

	1	2	3	4	
1	—	60	275	571	906
2	50	—	410	443	903
3	123	61	—	47	231
4	205	265	75	—	545
	378	386	760	1061	2585
	670	730	950	995	

⇒

	1	2	3	4	
1	—	113	344	535	992
2	89	—	513	415	1017
3	218	115	—	44	377
4	363	501	94	—	958
	670	729	951	994	

3. Consider the following trip distribution/modal-split model: $V_{ij}^n = A_i O_i B_j D_j \exp(-\beta M_{ij}^n)$, where $M_{ij}^n = -(1/\tau^n) \log \sum_k \exp(-\tau^n C_{ij}^k)$ and $n=1$ stands for persons with access to car, $n=2$, persons without access to car, $k=1$ stands for car and $k=2$ for public transport.

If the total number of trips between zones i and j is $V_{ij}=1000$, compute how many will use car and how many public transport according to the model. The estimated parameter values were found to be: $\tau^1=0.10$ $\tau^2=0.05$ and $\beta=0.04$; also, for trips between i and j the modal costs were calculated as: $C_{ij}^1=30$ and $C_{ij}^2=40$.

Solution:

$V_{ij}^1 = A_i O_i B_j D_j \exp(-0.04 M_{ij}^1)$ $\quad M_{ij}^1 = -(1/0.10)\log(e^{-3}+e^{-4}) = -11.67$

$V_{ij}^2 = A_i O_i B_j D_j \exp(-0.04 M_{ij}^2)$ $\quad M_{ij}^2 = -(1/0.05)\log(e^{-1.5}+e^{-2}) = -8.91$

$V_{ij}^1 = A_i O_i B_j D_j \; 1.5949$

$V_{ij}^2 = A_i O_i B_j D_j \; 1.4282$

$\frac{V_{ij}^1}{V_{ij}^2} = \frac{1.5949}{1.4282}$ $\quad V_{ij}^1 = 528$ (use car)

$V_{ij}^1 + V_{ij}^2 = 1000$ $\quad V_{ij}^2 = 472$ (use public transport)