Exercises - Section 4: Lecture 12 - Multiple Subscripts - Questions

Just like the tradition of using letters at the start of the alphabet for data and using letters at the end of the alphabet for variables, the tradition for subscripts is to start with i, then j, k, et cetera. However, there are exceptions, especially when the letter chosen might have meaning; for example, "t" is a common subscript to refer to time. Different modelers will use different notation, so don't worry if yours is different from someone else's.

Suppose we have the following notation for a rental car fleet planning model:

ENGLISH	MATH	GUROBIPY
Car types: i=1 (small), i=2 (midsize), i=3 (luxury), i=4 (SUV), i=5 (minivan)	i	`i`
Rental locations (100 locations, so j=1,2,…,100)	j	`j`
Forecasted annual rental demand for car type i at location j (forecasted data)	D_{ij}	`D = {(i, j): d for i in range(1, 6) for j in range(1, 101)}`
Cost per car for car type i (known data; same cost regardless of location)	C_i	`C = {i: c for i in range(1, 6)}`
Number of cars of type i to purchase for location j (variable)	X_{ij}	`x= model.addVars([(i, j) for i in range(1, 6) for j in range(1, 101)], name="x")`

Fill in the table below, using the notation above to describe each of the following quantities mathematically and in Python.

QUESTION	MATH	GUROBIPY
1. Forecasted rental demand for luxury cars at location 75		
2. Forecasted rental demand for SUVs at location 31		
3. Cost per SUV		
4. Number of small cars to purchase at location 12		

5. Constraint: Need to purchase at least 20 small cars at location 12		
6. Constraint: Can't purchase more than 30 small cars at location 12		
7. Forecasted demand for midsize cars and minivans at location 31		
8. Forecasted demand for midsize cars and minivans at locations 31-40		
9. Forecasted rental demand for cars (not SUVs or minivans) at locations 1-50		
10. Total cars to purchase above midsize at location 4		
11. Total luxury cars to purchase across all locations		
12. Total vehicles to purchase (across all locations)		
13. Cost of midsize cars purchased at location 1		
14. Cost of SUVs purchased at location 96		
15. Cost of midsize cars and minivans purchased at location 96		
16. Cost of SUVs and minivans purchased at locations 90-100		
17. Cost of all cars (not SUVs or minivans) purchased across all locations		
18. Cost of all vehicles purchased across all locations		
19. Average purchase cost of all cars (not SUVs or minivans) at location 20		
20. Average purchase cost of all vehicles at all locations		
21. Forecasted purchase cost per rental of SUVs at location 17		
22. Forecasted purchase cost per rental of minivans across locations 1-10		

23. Forecasted purchase cost per rental over all vehicles at location 17		
24. Forecasted purchase cost per rental over all vehicles at all locations		

NOTES: