

Introduction to Optimization Through the Lens of Data Science Course Exercises

Exercises - Section 4: Lecture 12 – Creating Subscripted Variables – Questions - Part 3

For each of the following descriptions, create the necessary notation and Python code for the data and/or variables.

DESCRIPTION	MATH	GUROBIPY
1. The height of each person		
(data)		
2. The weight of each person		
(data)		
3. The height and weight of		
each person (data)		
4. The height of each person		
at each age (ages 1, 2, 3,)		
(data)		
5. The distance between		
every pair of the largest 50		
cities in the United States		
(data)		
6. Cost per share of each		
investment (data)		
7. Amount of money invested		
in each investment (data)		
8. Amount of money invested		
in each investment (variable)		
9. Number of sweatshirts		
purchased (variable) if size is		
the only important attribute		
10. Number of sweatshirts		
purchased of each color		
(variable)		
11. Number of sweatshirts		
purchased of each color and		
size (variable), if both		
attributes are important (for		
example,		



Introduction to Optimization Through the Lens of Data Science Course Exercises

12. An airline wants to hire	
flight attendants who live in	
each city. The airline will	
then assign each flight	
attendant to a daily schedule	
that allows the flight	
attendant to return home	
each evening. Specify	
notation and Python code for	
(1) data showing the	
minimum number of flight	
attendants the airline needs	
to hire in each city, (2) a	
variable for the number of	
flight attendants the airline	
will hire in each city, and (3) a	
constraint to require the	
airline to hire enough flight	
attendants in each city.	
13. An airline wants to hire	
flight attendants who prefer	
to work on each aircraft type	
(Boeing 747, Airbus A380,	
etc.). The airline will then	
assign each flight attendant	
to a daily schedule that	
allows the flight attendant to	
work on the preferred	
aircraft. Specify notation and	
Python code for (1) data	
showing the minimum	
number of flight attendants	
the airline needs to hire for	
each aircraft type, (2) a	
variable for the number of	
flight attendants the airline	
will hire for each aircraft	
type, and (3) a constraint to	
require the airline to hire	
enough flight attendants for	
each aircraft type.	



Introduction to Optimization Through the Lens of Data Science Course Exercises

14. An airline wants to hire	
flight attendants who live in	
each city and who prefer to	
work on each aircraft type	
that the airline operates in	
that city. The airline will then	
assign each flight attendant	
to a daily schedule that	
allows the flight attendant to	
work on the preferred aircraft	
and return home each	
evening. Specify notation	
and Python code for (1) data	
showing the minimum	
number of flight attendants	
the airline needs to hire in	
each city for each aircraft	
type, (2) a variable for the	
number of flight attendants	
the airline will hire in each	
city for each aircraft type, and	
(3) a constraint to require the	
airline to hire enough flight	
attendants in each city for	
each aircraft type.	
15. Cost of hiring a flight	
attendant in each city (data;	
can be different from city to	
city because the cost of living	
in each city is different)	
16. Cost of hiring a flight	
attendant who prefers each	
aircraft type, in each city	
17. Total cost of hiring all	
flight attendants, assuming	
cost differs both by aircraft	
type and by home city	
18. Total cost of hiring all	
flight attendants, if only city	
is taken into account for	
hiring and cost	
19. Total cost of hiring all	
flight attendants, if both city	
and aircraft type are	
important for hiring but cost	
depends only on home city	



Introduction to Optimization Through the Lens of Data Science Course Exercises

20. Total cost of hiring all	
flight attendants, if both city	
and aircraft type are	
important for hiring, and cost	
depends on both city and	
aircraft type	

In the next set of exercises, think about which parts of the description are relevant, and write the math and gurobipy code including only relevant factors. Different people might have slightly different answers here depending on how you envision the situation; the important thing is to get used to thinking about what features might be relevant, just like one might consider in determining features to use in a data science model.

DESCRIPTION	MATH	GUROBIPY
21. Cost of hiring a flight		
attendant who prefers each		
aircraft type and does or		
doesn't speak Spanish, in each		
city (assume all three factors		
are relevant)		
22. Cost of hiring a flight		
attendant who prefers each		
aircraft type and does or		
doesn't speak Spanish, in each		
city, if Spanish-speaking ability		
is not relevant for any costs or		
constraints or decisions in the		
model		
23. Cost of hiring a flight		
attendant who prefers each		
aircraft type, has each hair		
color, is each different height,		
speaks or doesn't speak Ancient		
Greek, and does or doesn't have		
a pet dog, in each city		
24. Cost of hiring a flight		
attendant who prefers each		
aircraft type, wants to work		
each different number of hours		
per week (from 30 to 60), has		
each hair color, does or doesn't		
have a pet dog, speaks or		
doesn't speak Spanish		
(relevant), in each city		

NOTES:		

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