

### Introduction to Optimization Through the Lens of Data Science Course Exercises

Exercises - Section 2: Lecture 4 - Modeling recursive constraints - Questions

For each description (which includes mathematical notation and gurobipy definitions), write a constraint mathematically and in gurobipy that captures the relationship described. Some of the constraints will look recursive, and others will not.

ENGLISH	MATH	GUROBIPY
1. A resort hotel takes	<u>Given:</u>	<u>Given:</u>
up an entire tiny island.		
All hotel guests and	x = number of guests	X =
workers eat their		model.addVar(vtype=gp.GRB.INTEGER,
meals at the hotel's	y = number of workers	name="x")
dining room. To cook	except cooks	
the meals, the resort		у =
requires at least one	z = number of cooks	model.addVar(vtype=gp.GRB.INTEGER,
cook per 20 residents		name="y")
(guests plus workers,	All variables are non-	
including cooks). Write	negative and must be	Z =
a constraint or	integer	<pre>model.addVar(vtype=gp.GRB.INTEGER, name="z")</pre>
constraints to ensure	Integer	name- Z )
that there are enough		
cooks on the island.	Constraint(s)	
cooks on the island.	Constraint(s):	Constraint(s):



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2. A history book requires an average of	Given:	Given:	
1 page of endnotes for	x = pages of main text	x = model.addVar(name="x")	
every 20 pages of the main text. A publisher	y = pages of endnotes	y = model.addVar(name="y")	
has agreed to publish a history book of total length up to 400 pages. Write a constraint or	All variables are non- negative		
constraints to ensure that the book isn't too long.	Constraint(s):	Constraint(s):	
3. A city wants to plant in a park at least one	Given:	Given:	
shade tree per 10,000	x = number of shade	х =	
square feet of unshaded area. Each	trees	<pre>model.addVar(vtype=gp.GRB.INTEGER, name="x")</pre>	
shade tree will cover		Constraint(s):	
(when grown and pruned) 4,000 square	Constraint(s):	Constraint(s).	
feet. Write a			
constraint or			
constraints to ensure			
that enough shade			
trees are planted in a			
200,000 square foot park.			



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4. A classroom requires 50 lumens of	Given:	Given:
illumination per square foot. When purchasing lightbulbs for a 20-foot by 40-foot classroom, a	x = total lumens of bulbs purchased	<pre>x = model.addVar(vtype=gp.GRB.INTEGER, name="x")</pre>
school wants to make sure to purchase powerful-enough bulbs. Write a constraint or constraints to ensure that the total illumination is high enough.	Constraint(s):	Constraint(s):
5. A personal financial	Given:	Given:
advisor charges clients an annual up-front fee of 1% of the amount the client invests.	x = financial advisor's fee	x = model.addVar(name="x")
Write a constraint or constraints to define the amount a client pays if the client has a total budget of <i>B</i> dollars for investment and fees.	Constraint(s):	Constraint(s):



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6. Once per week, an
internet influencer (my
wife suggested one of
the Kardashians) posts
videos of herself
wearing different
outfits. She gets paid
by a fashion designer
to post at least one
video wearing a new
outfit per $k$ followers
that she has at the end
of the week (i.e., after
posting). Past data
shows that posting a
video in a new outfit
increases her number
of followers by an
average of $n$ . Write a
constraint or
constraints for the
number of new outfits
she needs to post
videos of herself
wearing.
_

#### Given:

x = number of new outfits

F = initial number of followers

n = new followers pervideo posted wearing anew outfit

k = required minimum ratio of followers to videos

#### Constraint(s):

#### Given:

x =
model.addVar(vtype=gp.GRB.INTEGER,
name="x")

F # initial number of followers

n # new followers per video posted
wearing a new outfit

k # required minimum ratio of
followers to videos

#### Constraint(s):

NOTES:		

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