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

2. A history book requires an average of 1 page of endnotes for every 20 pages of the main text. A publisher has agreed to publish a history book of total length up to 400 pages. Write a constraint or constraints to ensure that the book isn't too long.	Given:
	
	x = pages of main text
	
	y = pages of endnotes
	
	All variables are non-negative
	
	Constraint(s):
		Given:
		
		`x = model.addVar(name="x")`
		
		`y = model.addVar(name="y")`
		
		Constraint(s):

3. A city wants to plant in a park at least one shade tree per 10,000 square feet of unshaded area. Each shade tree will cover (when grown and pruned) 4,000 square feet. Write a constraint or constraints to ensure that enough shade trees are planted in a 200,000 square foot park.	Given: x = number of shade trees Constraint(s):	Given: `x = model.addVar(vtype=gp.GRB.INTEGER, name="x")` Constraint(s):

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

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 per video posted wearing a new 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: