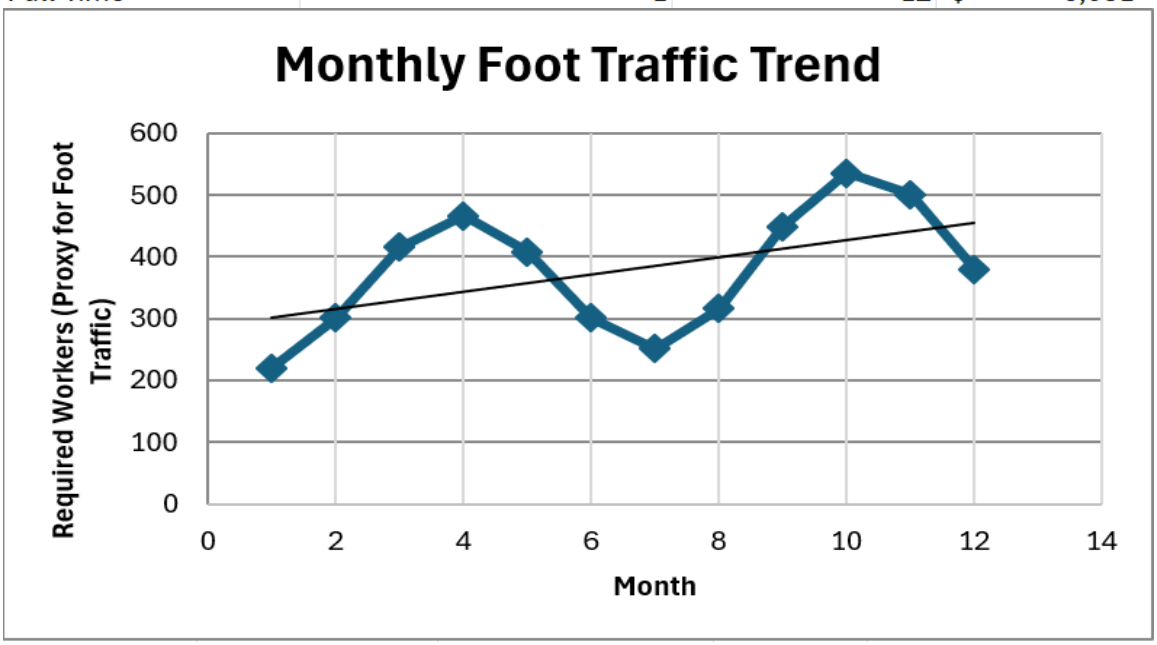
Module 08 – Scheduling Problem

Exploratory Data Analysis

Month	Required Workers	Available Temp Workers	Surplus/Deficit	Positive/Negative
1	220	416	196	(+)
2	301	416	115	(+)
3	416	416	0	N/A
4	466	466	0	N/A
5	408	466	58	(+)
6	301	466	165	(+)
7	251	416	165	(+)
8	316	449	133	(+)
9	449	449	0	N/A
10	536	539	3	(+)
11	501	536	35	(+)
12	380	536	156	(+)

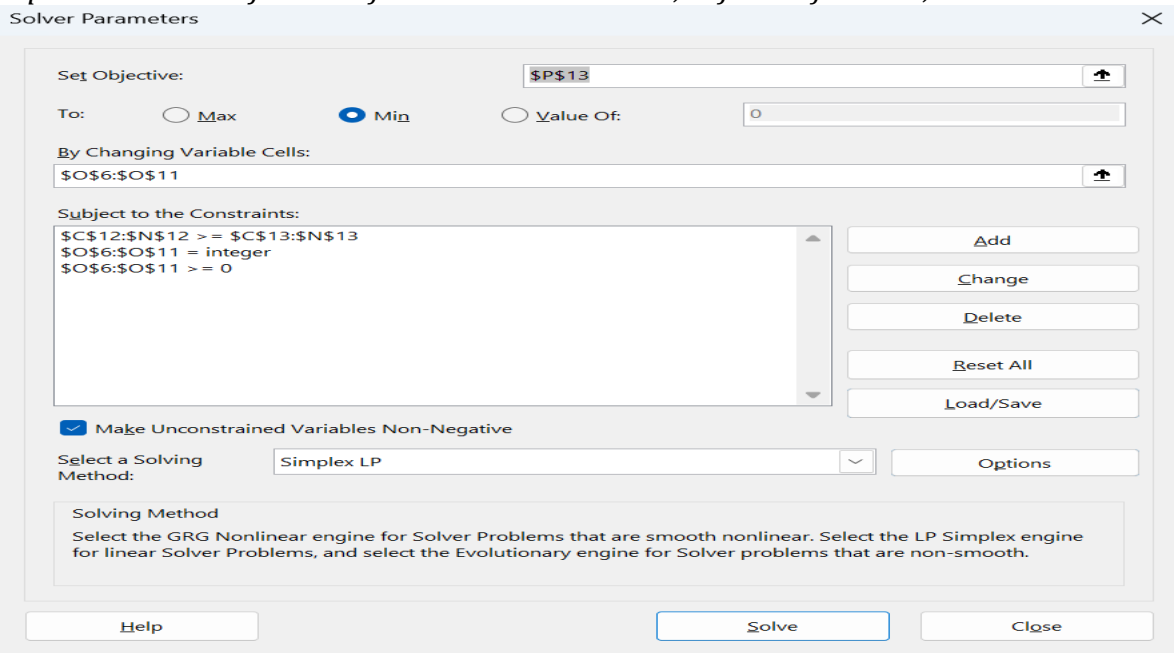
Agency	Beginning Month of Service	Duration of Service	Monthly Salary
WigglePop Wonders	6	3	$ 7,954
The Jellybean Treasury	10	3	$ 7,501
PopRocks & PixieDust	4	3	$ 6,625
Gumdrops & Giggles	8	2	$ 8,146
Cocoa Quirk	1	3	$ 7,101
Full-Time	1	12	$ 6,031



Trend: The foot traffic is slowly increasing as the months go from January → October. After that, there is a decrease from October → December.

Model Formulation

Write the formulation of the model into here prior to implementing it in your Excel model. Be explicit with the definition of the decision variables, objective function, and constraints.



MIN: $23{,}862X_1 + 22{,}503X_2 + 19{,}875X_3 + 16{,}292X_4 + 21{,}303X_5 + 72{,}372X_6$

Workers required each day:

$0X_1 + 0X_2 + 0X_3 + 0X_4 + 1X_5 + 1X_6 \geq 220$ } January
$0X_1 + 0X_2 + 0X_3 + 0X_4 + 1X_5 + 1X_6 \geq 301$ } February
$0X_1 + 0X_2 + 0X_3 + 0X_4 + 1X_5 + 1X_6 \geq 416$ } March
$0X_1 + 0X_2 + 1X_3 + 0X_4 + 0X_5 + 1X_6 \geq 466$ } April
$0X_1 + 0X_2 + 1X_3 + 0X_4 + 0X_5 + 1X_6 \geq 408$ } May
$1X_1 + 0X_2 + 1X_3 + 0X_4 + 0X_5 + 1X_6 \geq 301$ } June
$1X_1 + 0X_2 + 0X_3 + 0X_4 + 0X_5 + 1X_6 \geq 251$ } July
$1X_1 + 0X_2 + 0X_3 + 1X_4 + 0X_5 + 1X_6 \geq 316$ } August
$0X_1 + 0X_2 + 0X_3 + 1X_4 + 0X_5 + 1X_6 \geq 449$ } September
$0X_1 + 1X_2 + 0X_3 + 0X_4 + 0X_5 + 1X_6 \geq 536$ } October
$0X_1 + 1X_2 + 0X_3 + 0X_4 + 0X_5 + 1X_6 \geq 501$ } November
$0X_1 + 1X_2 + 0X_3 + 0X_4 + 0X_5 + 1X_6 \geq 380$ } December

X_1 = the number of workers assigned to shift 1

X_2 = the number of workers assigned to shift 2

X_3 = the number of workers assigned to shift 3

X_4 = the number of workers assigned to shift 4

X_5 = the number of workers assigned to shift 5

X_6 = the number of workers assigned to shift 6

X_7 = the number of workers assigned to shift 7

Model Optimized for Min Costs to Cover Store Foot Traffic

Implement your formulation into Excel and be sure to make it neat. This section should include:

- *A screenshot of your optimized final model (formatted nicely, of course)*
- *A text explanation of what your model is recommending*

	Days On = 1, Days Off = 0												Workers	
Agency	1	2	3	4	5	6	7	8	9	10	11	12	Schedule	Wages per Worker
WigglePop Wonders	0	0	0	0	0	1	1	1	0	0	0	0	0	$ 23,862
The Jellybean Treasury	0	0	0	0	0	0	0	0	0	1	1	1	120	$ 22,503
PopRocks & PixieDust	0	0	0	1	1	1	0	0	0	0	0	0	50	$ 19,875
Gumdrops & Giggles	0	0	0	0	0	0	0	1	1	0	0	0	33	$ 16,292
Cocoa Quirk	1	1	1	0	0	0	0	0	0	0	0	0	0	$ 21,303
Full Time	1	1	1	1	1	1	1	1	1	1	1	1	416	$ 72,372
Available	416	416	416	466	466	466	416	449	449	536	536	536		
Required	220	301	416	466	408	301	251	316	449	536	501	380	Total ->	$ 34,338,478

My model is recommending that to minimize total costs in scheduling workers, certain steps must be taken. Following the data graph listed above, they must balance both full and part-time workers along with their average salary. They must make available between 12 months 416, 416, 416, 466, 466, 466, 416, 449, 449, 536, 536, & 536 workers, respectively. By doing so, the Net Flow between the agencies will fulfill the required workers' need to work each month.

Model with Stipulation

Please copy the tab of your original model before continuing with the next part to avoid messing up your original solution.

Please do both of the following:

1. *Unfortunately, leadership wishes to have a reduction in the workforce. While the monthly salary for full-time employees is cheaper than temporary workers, there are other costs associated with full-time employees that they wish to cut. Add a constraint to your model that takes your first model's recommended number of full-time employees and constrains it to be only 80% of it. Add a text explanation of the change in the optimal value, as well as any other changes noticed between the models.*
   By altering the number of full-time workers hired by 20%, there are a series of outcomes. As seen in the model, the workers' schedule drops from 416 to 332.8. Additionally, the Available number of workers between the 12 months drops to 332.8, 332.8, 332.8, 382.8, 382.8, 382.8, 332.8, 365.8, 365.8, 452.8, 452.8, & 452.8. As a result of these factors, the minimized function for Total Cost drops more than $6,000, meaning the business will achieve savings of $6,000 annually if the cutting of hours is put into effect.

2. *Alternatively, leadership would like to see what the average monthly salary for an employee would need to be to cut out all temporary workers, as they believe that will help negate excess spending. Convert your model (or do the math out yourself) to figure out what monthly salary you would need to pay your full-time employees to only have full-time workers at the same optimal cost as the original model.*
   The cost is $30,106,732 Annually & $2,508,894 Monthly for the Full-time workers.

3. *Considering trends and seasonality of this business, what would you recommend leadership to do? Feel free to play with the model and recommend something else.*
   I would recommend employing 80% of the workforce as full-time employees and 20% of the workforce as part-time workers. I believe that model would result in the most cost savings and be economically feasible in the short and long term.