

# Module 08 – Scheduling Problem

## Exploratory Data Analysis

*In this section, you should perform some data analysis on the data provided to you. Please format your findings in a visually pleasing way and please be sure to include these cuts:*

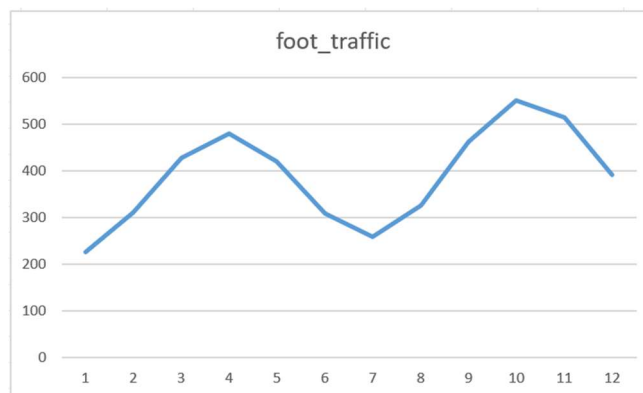
- *Make a table (similar to the textbook example) showing the temporary agency data*

Agency	Beginning_month_of_service	Duration_of_service	Monthly_salary
The Sassy Taffy	2	3	7737
Moonbeam Morsels	9	2	11072
Whirlipop Wonders	5	3	9291
Cocoa Quirk	12	3	8384
WigglePop Wonders	8	2	11079
Zesty Zagnut	11	2	10843

- *Run summary statistics on the sample of Full-Time employee salaries. Record the Mean to use in our model*

The mean salary for full-time employees was \$7,422 per month or \$89,064 per year

- *Make a line graph showing foot traffic over the next 12 months. Call out any seasonality or trend you may see.*



Around months 3-5, the foot traffic increases before dipping back down in months 6-8. In months 9-11, the foot traffic picks up again before starting to fall off in month 12.

## 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.

$$\text{MIN : } 23211X_1 + 22144X_2 + 27873X_3 + 25152X_4 + 22158X_5 + 21686X_6 + 89064X_7$$

Workers required each month

$$\text{Month 1: } 0X_1 + 0X_2 + 0X_3 + 1X_4 + 0X_5 + 0X_6 + 1X_7$$

$$\text{Month 2: } 1X_1 + 0X_2 + 0X_3 + 1X_4 + 0X_5 + 0X_6 + 1X_7$$

$$\text{Month 3: } 1X_1 + 0X_2 + 0X_3 + 0X_4 + 0X_5 + 0X_6 + 1X_7$$

$$\text{Month 4: } 1X_1 + 0X_2 + 0X_3 + 0X_4 + 0X_5 + 0X_6 + 1X_7$$

$$\text{Month 5: } 1X_1 + 0X_2 + 0X_3 + 1X_4 + 0X_5 + 0X_6 + 1X_7$$

$$\text{Month 6: } 0X_1 + 0X_2 + 1X_3 + 0X_4 + 1X_5 + 0X_6 + 1X_7$$

$$\text{Month 7: } 0X_1 + 0X_2 + 1X_3 + 0X_4 + 1X_5 + 0X_6 + 1X_7$$

$$\text{Month 8: } 0X_1 + 0X_2 + 0X_3 + 0X_4 + 0X_5 + 0X_6 + 1X_7$$

$$\text{Month 9: } 0X_1 + 1X_2 + 0X_3 + 0X_4 + 0X_5 + 0X_6 + 1X_7$$

$$\text{Month 10: } 0X_1 + 1X_2 + 0X_3 + 0X_4 + 0X_5 + 0X_6 + 1X_7$$

$$\text{Month 11: } 0X_1 + 0X_2 + 0X_3 + 0X_4 + 0X_5 + 1X_6 + 1X_7$$

$$\text{Month 12: } 0X_1 + 0X_2 + 0X_3 + 1X_4 + 0X_5 + 1X_6 + 1X_7$$

Nonnegativity & integrality condition:  $X_i \geq 0$  and integer for all  $i$

## 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

Workers	Months On =1, Months off = 0												Workers Scheduled	Wages per Worker
	1	2	3	4	5	6	7	8	9	10	11	12		
The Sassy Taffy	0	1	1	1	0	0	0	0	0	0	0	0	59	\$ 23,211
Moonbeam Morsels	0	0	0	0	0	0	0	0	1	1	0	0	131	\$ 22,144
Whirlipop Wonders	0	0	0	0	1	1	1	0	0	0	0	0	0	\$ 27,873
Cocoa Quirk	1	1	0	0	0	0	0	0	0	0	0	1	0	\$ 25,152
WigglePop Wonders	0	0	0	0	0	0	0	1	1	0	0	0	0	\$ 22,158
Zesty Zagnut	0	0	0	0	0	0	0	0	0	0	1	1	95	\$ 21,686
Full time Worker	1	1	1	1	1	1	1	1	1	1	1	1	420	\$ 89,064
Available	420	479	479	479	420	420	420	420	551	551	515	515		
Required	226	310	428	479	420	309	258	325	462	551	515	391	Total ->	\$ 43,737,341

My model is suggesting that the company should schedule 59 people that work months 2-4. They should hire 191 people that work months 9-10. Should hire 0 people that work months 5-7, 12-2, and months 8-9. They should hire 95 workers for the months 11-12, and 420 full time workers.

## 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 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.

Workers	Months On =1, Months off = 0												Workers	Wages per Worker
	1	2	3	4	5	6	7	8	9	10	11	12	Scheduled	
The Sassy Taffy	0	1	1	1	0	0	0	0	0	0	0	0	143	\$ 23,211
Moonbeam Morsels	0	0	0	0	0	0	0	0	1	1	0	0	215	\$ 22,144
Whirlipop Wonders	0	0	0	0	1	1	1	0	0	0	0	0	84	\$ 27,873
Cocoa Quirk	1	1	0	0	0	0	0	0	0	0	0	1	0	\$ 25,152
WigglePop Wonders	0	0	0	0	0	0	0	1	1	0	0	0	0	\$ 22,158
Zesty Zagnut	0	0	0	0	0	0	0	0	0	0	1	1	179	\$ 21,686
Full time Worker	1	1	1	1	1	1	1	1	1	1	1	1	336	\$ 89,064
Available	336	479	479	479	420	420	420	336	551	551	515	515		
Required	226	310	428	479	420	309	258	325	462	551	515	391	Total ->	\$ 44,228,745

This would mean that the company would only be able to hire 336 full-time workers. This mean that they would need to hire more temporary workers. Temporary workers increase for The Sassy Taffy and Moonbeam Morsels. They would need to hire 84 workers for Whirlipop Wonders and some additional workers for Zesty Zagnut. In total, the company's cost increases around \$500 because temporary workers cost more than full-time workers.

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 company would need to pay their workers a months salary of \$6,614,.84 so that all of the work could be done by full-time employees.

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.

Considering the trends, I think that the company should hire less temporary workers in the months 12- 1 and 6-8. This is because this is when there is the least amount of foot traffic. They could hire less workers because there isn't as much demand, so there will be less people in the store buying the products. As the foot-traffic increases, the company should hire more temporary workers so that they can meet the demand.

If I were in a management position I would suggest that the company fire the workers at times of need when the foot-traffic is high, but I would try to keep the costs of the full-time employees lower so we wouldn't need to hire a lot of temporary workers since they cost more.