

# 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:*

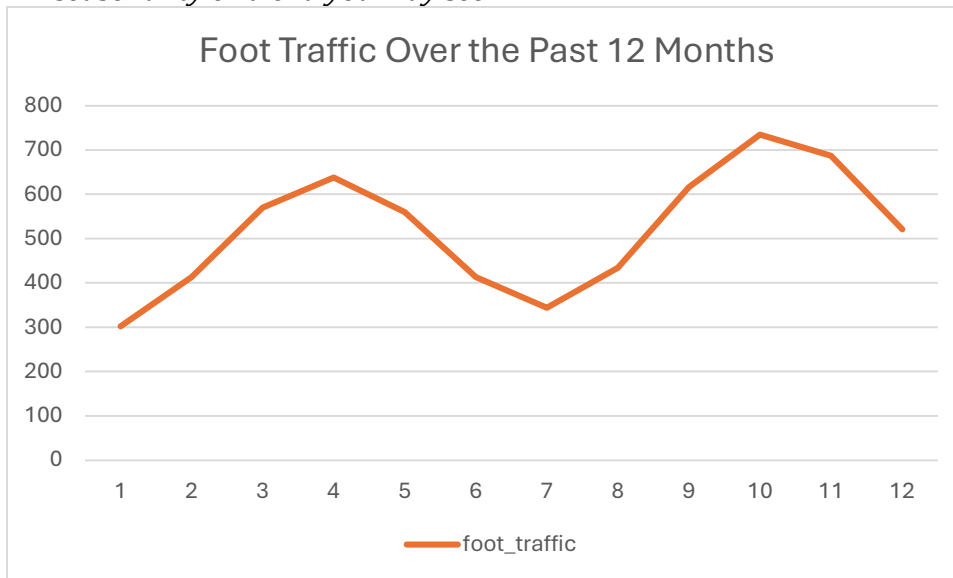
- *Make a table (similar to the textbook example) showing the temporary agency data*

Agency	Beginning month of service	Duration of service	Monthly salary
Twizzle & Sprinkle	5	3	6935
Tootie Fruity Trading Co.	12	3	7467
Fairy Floss Frenzy	8	3	6165
Crumb & Coated	3	2	5510
Peppermint Peekaboo	11	3	6568

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

Mean= 5257\$

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



There seems to be an up in foot traffic during the fall, September, October and fall in the winter season. Foot traffic also increase in January all the way to April where foot traffic falls down until August.

## 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.*

$$\text{MIN: } 20805x_1 + 22401x_2 + 18495x_3 + 11020x_4 + 19704x_5 + 63084x_6$$

$$\text{Month 1: } 0x_1 + 1x_2 + 0x_3 + 0x_4 + 1x_5 + 1x_6$$

$$\text{Month 2: } 0x_1 + 1x_2 + 0x_3 + 0x_4 + 0x_5 + 1x_6$$

$$\text{Month 3: } 0x_1 + 0x_2 + 0x_3 + 1x_4 + 1x_5 + 1x_6$$

$$\text{Month 4: } 0x_1 + 0x_2 + 0x_3 + 1x_4 + 0x_5 + 1x_6$$

$$\text{Month 5: } 1x_1 + 0x_2 + 0x_3 + 0x_4 + 0x_5 + 1x_6$$

$$\text{Month 6: } 1x_1 + 0x_2 + 0x_3 + 0x_4 + 0x_5 + 1x_6$$

$$\text{Month 7: } 1x_1 + 0x_2 + 0x_3 + 0x_4 + 0x_5 + 1x_6$$

$$\text{Month 8: } 0x_1 + 0x_2 + 1x_3 + 0x_4 + 0x_5 + 1x_6$$

$$\text{Month 9: } 0x_1 + 0x_2 + 1x_3 + 0x_4 + 0x_5 + 1x_6$$

$$\text{Month 10: } 0x_1 + 0x_2 + 1x_3 + 0x_4 + 0x_5 + 1x_6$$

$$\text{Month 11: } 0x_1 + 0x_2 + 0x_3 + 0x_4 + 1x_5 + 1x_6$$

$$\text{Month 12: } 0x_1 + 1x_2 + 0x_3 + 0x_4 + 1x_5 + 1x_6$$

### 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 Schedule	Wages per Worker
Shift		1	2	3	4	5	6	7	8	9	10	11	12		
X1	Twizzle & Sprinkle	0	0	0	0	1	1	1	0	0	0	0	0	0	20805
X2	Tootie Fruity Trading Co.	1	1	0	0	0	0	0	0	0	0	0	1	0	22401
X3	Fairy Floss Frenzy	0	0	0	0	0	0	0	1	1	1	0	0	175	18495
X4	Crumb & Coated	0	0	1	1	0	0	0	0	0	0	0	0	78	11020
X5	Peppermint Peekaboo	1	0	0	0	0	0	0	0	0	0	1	1	127	19704
X6	Full time worker	1	1	1	1	1	1	1	1	1	1	1	1	560	\$63,084
Available		687	560	638	638	560	560	560	735	735	735	687	687	0	
Required		302	413	570	638	560	413	344	434	616	735	687	521	Total ->	\$ 41,925,640

This model is a workforce scheduling and wage allocation table. It tracks different shift schedules (X1 to X6) and the number of workers available versus required for each day (1-12). The table also calculates wages per worker and provides a total wage cost of \$41,925,640, indicating workforce optimization for cost and coverage.

### 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.

		Days On = 1, Days Off = 0												Workers Schedule	Wages per Worker
Shift		1	2	3	4	5	6	7	8	9	10	11	12		
X1	Twizzle & Sprinkle	0	0	0	0	1	1	1	0	0	0	0	0	112	20805
X2	Tootie Fruity Trading Co.	1	1	0	0	0	0	0	0	0	0	0	1	0	22401
X3	Fairy Floss Frenzy	0	0	0	0	0	0	0	1	1	1	0	0	287	18495
X4	Crumb & Coated	0	0	1	1	0	0	0	0	0	0	0	0	190	11020
X5	Peppermint Peekaboo	1	0	0	0	0	0	0	0	0	0	1	1	239	19704
X6	Full time worker	1	1	1	1	1	1	1	1	1	1	1	1	448	\$63,084
Available		687	448	638	638	560	560	560	735	735	735	687	687	0	
Required		302	413	570	638	560	413	344	434	616	735	687	521	Total ->	\$ 42,702,918

The optimal value slightly increased, since temporary workers are more expensive in the long run than full-time workers.

- 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.

I would need a monthly salary of 4,753.47 so that all of the work could be done by full-time employees.

- 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 trends and seasonality, I would recommend leadership to hire a low amount of full time employee year round, and hire part-time employees during busy months of the year. So, I would hire part time employees from January to April, and then again from August to November.