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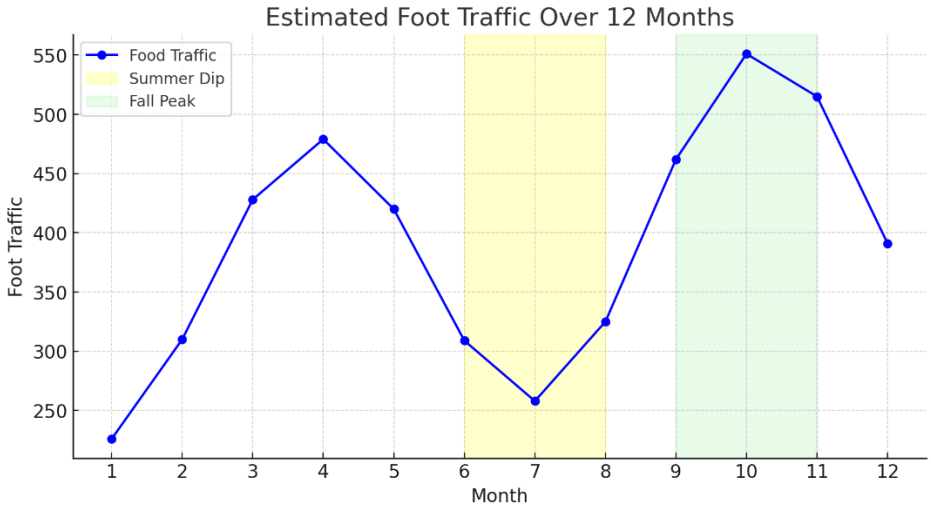
Module 08 – Scheduling Problem

Exploratory Data Analysis

temporary workers			
agency	beginning_month_of_service	duration_of_service	monthly_salary
Curly Q Confections	12	2	$ 6,412.00
The Candy Cauldron	8	3	$ 5,421.00
The Sassy Taffy	5	2	$ 5,321.00
Licorice Lagoon	2	3	$ 5,305.00
The Gooey Guild	10	3	$ 5,996.00
Bubbly Bear Co.	5	3	$ 5,225.00

full time salary		
	monthly_salary	yearly_salary
Average	$ 5,025.00	$ 60,299.95
Highest	$ 6,849.68	$ 82,196.16
Lowest	$ 2,772.79	$ 33,273.48



The line graph shows foot traffic over 12 months, revealing clear seasonal trends:

- A dip in the summer (June to August) when foot traffic is lower, possibly due to seasonal slowdowns.
- A peak in the fall (September to November), indicating increased activity during this period.
- The highest foot traffic occurs in October, while the lowest is in July.

These patterns suggest that external factors like weather, holidays, or business cycles might be influencing foot traffic.

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Model Formulation

MIN: 12824X1+16263X2+10642X3+15915X4+17988X5+15675X6+60300X7

Workers required each month:
1X1+0X2+0X3+0X4+0X5+0X6+1X7 >= 226 }January
0X1+0X2+0X3+1X4+0X5+0X6+1X7 >= 310 }February
0X1+0X2+0X3+1X4+0X5+0X6+1X7 >= 428 }March
0X1+0X2+0X3+1X4+0X5+0X6+1X7 >= 479 } April
0X1+0X2+1X3+0X4+0X5+1X6+1X7 >= 420 }May
0X1+0X2+1X3+0X4+0X5+1X6+1X7 >= 420 }June
0X1+0X2+0X3+0X4+0X5+1X6+1X7 >= 420 }July
0X1+1X2+0X3+0X4+0X5+0X6+1X7 >= 462 }August
0X1+1X2+0X3+0X4+0X5+0X6+1X7 >= 462 }September
0X1+1X2+0X3+0X4+1X5+0X6+1X7 >= 557}October
0X1+0X2+0X3+0X4+1X5+0X6+1X7 >= 515 }November
1X1+0X2+0X3+0X4+1X5+0X6+1X7 >= 515 }December

Nonnegativity & Integrality conditions
Xi>=0 and integer for all i

Decision variable: Workers scheduled
Objective function: Total wage expenditure

Model Optimized for Min Costs to Cover Store Foot Traffic

Agencies	Months On = 1, Months Off = 0												Workers Scheduled	Wages per Worker
	January	February	March	April	May	June	July	August	September	October	November	December		
Curly Q Confections	1	0	0	0	0	0	0	0	0	0	0	1	0.00	$ 12,824.00
The Candy Cauldron	0	0	0	0	0	0	0	1	1	1	0	0	42.00	$ 16,263.00
The Sassy Taffy	0	0	0	0	1	1	0	0	0	0	0	0	0.00	$ 10,642.00
Licorice Lagoon	0	1	1	1	0	0	0	0	0	0	0	0	59.00	$ 15,915.00
The Gooey Guild	0	0	0	0	0	0	0	0	0	1	1	1	95.00	$ 17,988.00
Bubbly Bear Co.	0	0	0	0	1	1	1	0	0	0	0	0	0.00	$ 15,675.00
Full time employee	1	1	1	1	1	1	1	1	1	1	1	1	420.00	$ 60,300.00
Available	420	479	479	479	420	420	420	462	462	557	515	515		
Required	226	310	428	479	420	309	258	325	462	551	515	391	Total ->	$ 28,656,891

The model is recommending a workforce scheduling plan to meet monthly foot traffic demands while managing costs. Key insights include:

1. **Worker Allocation**: Different agencies are scheduled for specific months based on projected demand. Some agencies, such as "The Candy Cauldron" and "The Gooey Guild," are only active in high-demand months.
2. **Full-Time Employees**: A baseline of full-time employees is consistently scheduled every month.
3. **Seasonal Hiring Strategy**:
    - Peak months (September-November): Additional agencies are scheduled to handle increased demand.
    - Low-demand months (June-August): Fewer agencies are scheduled to cut labor costs.

4. **Overstaffing vs. Requirements**: The "Available" workforce exceeds the "Required" workforce in all months, suggesting a buffer for unexpected surges or turnover.
5. **Cost Management**: The total wage expenditure is $28,656,891, balancing workforce efficiency with labor costs.

Overall, the model prioritizes cost-effective staffing while organizing to have workers during peak traffic months.

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.*

The number of full time employees passes from being 420 to 336. I added a constraint to the model for which the cell of full time workers schedules has to be <= of the 80% of the number I got initially.
This leadership move generates a cost saving of $42,672, bringing to a total of $28,699,563. The number of workers for the rest of the temporary agencies overall went up.

Workers Scheduled	Wages per Worker
0.00	$ 12,824.00
42.00	$ 16,263.00
0.00	$ 10,642.00
59.00	$ 15,915.00
95.00	$ 17,988.00
0.00	$ 15,675.00
420.00	$ 60,300.00
Total ->	$ 28,656,891

Workers Scheduled	Wages per Worker
0.00	$ 12,824.00
126.00	$ 16,263.00
84.00	$ 10,642.00
143.00	$ 15,915.00
179.00	$ 17,988.00
0.00	$ 15,675.00
336.00	$ 60,300.00
Total ->	$ 28,699,563

Comparison

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 monthly salary would be $4,334.07 compared to the $5,025 average full-time worker wage

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 think I would choose the first idea because it would bring cost savings while limiting firing of all the seasonal workers. It would be a less aggressive decision for the company towards its employees and would help reduce costs.