

Business Case Study - Staff Planning

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Questions:

Q1. The company wants to know the optimized staffing recommendations for the business case described. Write the mathematical model for the deterministic optimization problem. Define and explain your decision variables, objective function and the constraint.

Ans:

Mathematical Equation

Index definition:

- i = Bank Location
- j = Month

Parameters:

- Demand: $Demand(i,j)$
- Staff availability %: $Staff.Av(i,j)$
- Full time Employee (FTE) Salary/month: $FTE_Salary(i,j)$
- Unit Outsourcing Cost: $UnitCost(i,j)$
- FTE_AppServe Rate : 40 application per month working 100%

Decision Variable:

- FTE equivalent at any location in a month (Continuous Variable) : $X(i,j)$
- Outsourced Insurance application quantity outsourced in a month : Integer Variable : $Y(i,j)$
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Objective Function:

1. Annual total cost for FTE (TC-FTE)
2. Annual total cost of outsourced insurance application (TC-Out)

Minimize the total annual cost = $\text{Min} ((TC-FTE) + (TC-Out))$

Constraints:**1. Demand Constraints:**

FTE/Month + Outsourced Insurance Application Quantity = Insurance Application demand per month

$$X(i,j)*Staff.Av(i,j)*40 + Y(i,j) = Demand(i,j) \text{ iterate across for all } i \& j$$

2. Regulatory constraints:

A&B cities have a regulatory restriction that outsourced insurance application can't be more than 30% & 40% of total number of applications respectively

$$Y(i,j) \leq Demand(i,j)*0.30 \text{ where } i=A, j=\text{all months}$$

$$Y(i,j) \leq Demand(i,j)*0.40 \text{ where } i=B, j=\text{all months}$$

3. $X(i,j)$ = Continuous Variable**4. $Y(i,j)$ = Integer Variable**

Q2. Code the problem in Python using any optimization package of your choice.

Ans: Please refer the attached Jupyter Notebook

Q3. The company also wants to know the staffing recommendations for the worst-case and best-case scenarios. As mentioned earlier, there are days that an employee will be unavailable to process applications due to training, off days, etc. This will affect employee availability.

Let's say you have the data for the minimum and maximum availability of the employees for each month, as shown in the table given below.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Lower Bound</i>	70%	65%	70%	75%	70%	65%	60%	65%	70%	65%	60%	60%
<i>Upper Bound</i>	90%	85%	80%	85%	85%	85%	80%	75%	85%	90%	75%	70%

Assuming that the distribution is the same across all the states, answer the following questions:

What is the optimal number of staff members for the worst and best cases?

Ans:

The Optimal number of staff members for the Worst case: **Total Staff 2761.27 & 76.7 per month per city**

The Optimal number of staff members for the Best case: **Total Staff 3343.18 Total & 92.9 per month per city**

What are the percentages of outsourcing for the worst and best cases?

Ans:

The Percentages of outsourcing for the Worst case: **35.13 %**

The Percentages of outsourcing for the Best case: **4.1%**

What is the average cost per application for the worst and best cases?

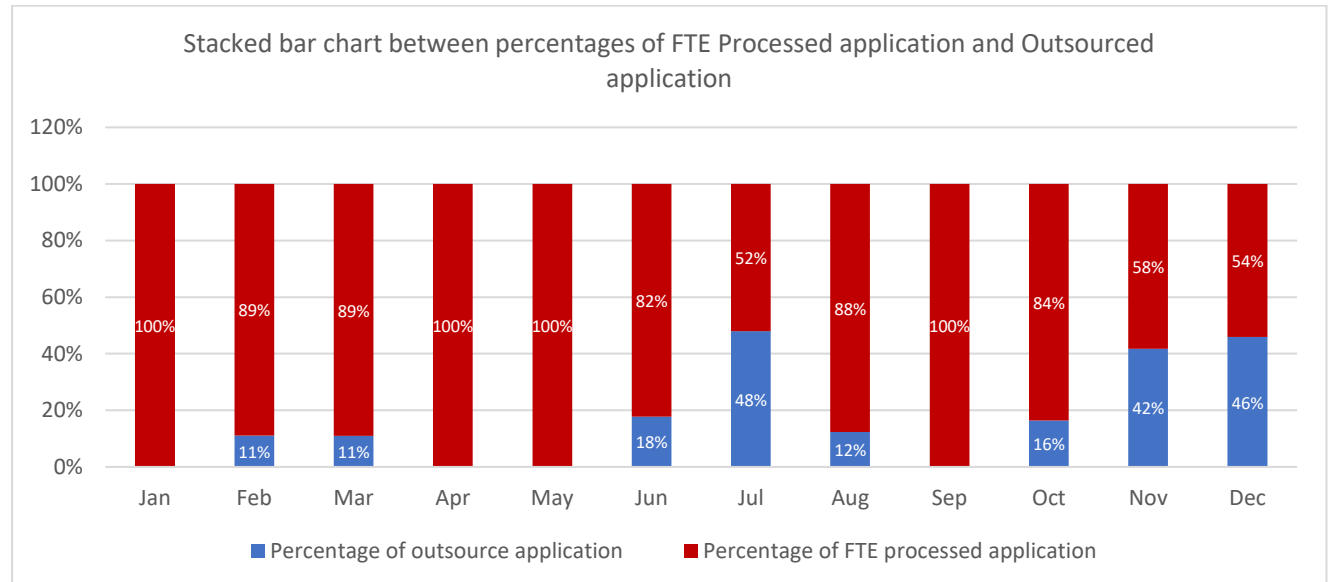
Ans:

The Average cost per application for the Worst case: **172.99**

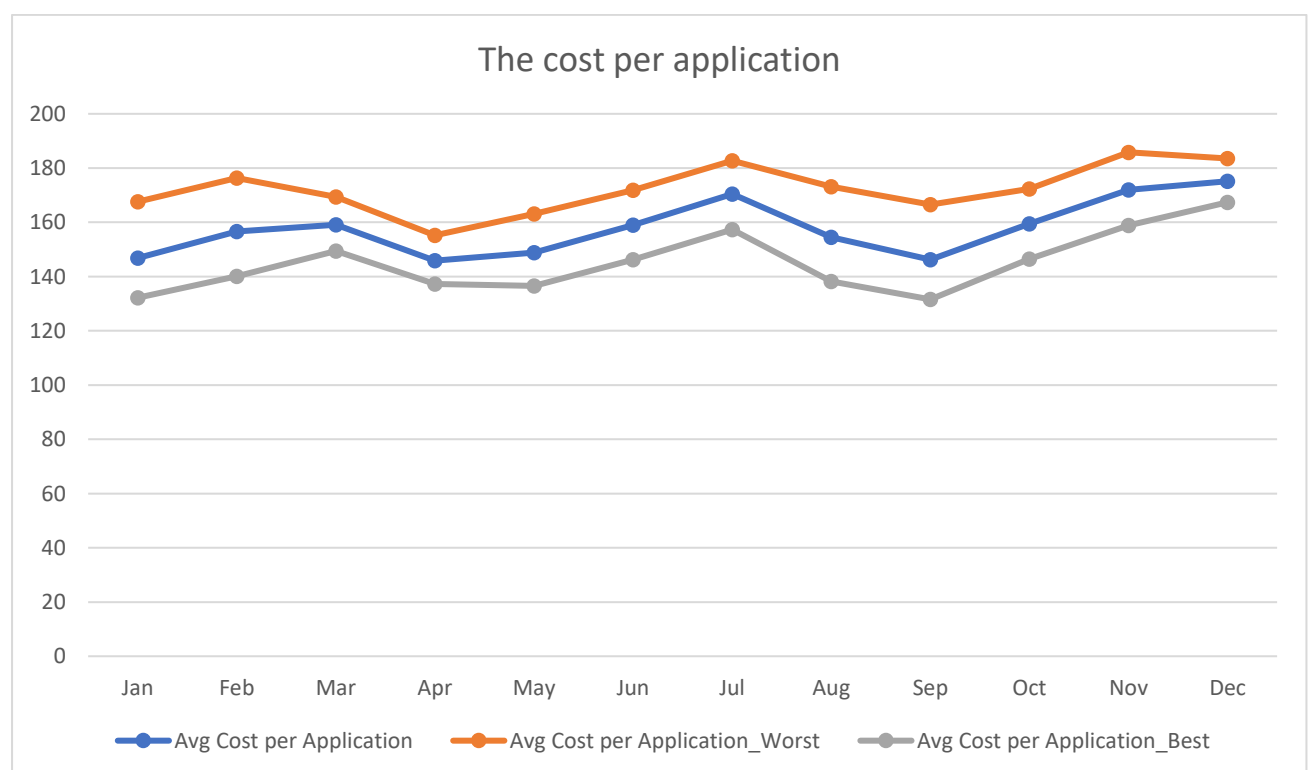
The Average cost per application for the Best case: **145.88**

Q4. Create the following visualisations using your preferred method (i.e. Python, PowerPoint, Excel, etc.) and add it to your report.

Use the solution of Q2 to create a stacked column chart that shows the percentage of applications processed by the staff and by the vendor for each month (%staff processed applications + %vendor processed applications should add up to 100%).



Create a graph to show how the cost per application increases with respect to any change in the parameters in your analysis. (Hint: Use the cost per application that you calculate in Questions 2 and 3, i.e., the actual scenario, best case, and worst case.)



Excel sheet final result calculated for question number 4:

Month	Percentage of outsource application	Percentage of FTE processed application
Jan	0%	100%
Feb	11%	89%
Mar	11%	89%
Apr	0%	100%
May	0%	100%
Jun	18%	82%
Jul	48%	52%
Aug	12%	88%
Sep	0%	100%
Oct	16%	84%
Nov	42%	58%
Dec	46%	54%

Month	Avg Cost per Application	Avg Cost per Application Worst	Avg Cost per Application Best
Jan	146.9	167.6	132.2
Feb	156.6	176.3	140.1
Mar	159.1	169.3	149.5
Apr	145.9	155.2	137.3
May	148.9	163.1	136.6
Jun	159.0	171.8	146.2
Jul	170.4	182.7	157.4
Aug	154.5	173.1	138.2
Sep	146.2	166.5	131.6
Oct	159.4	172.4	146.5
Nov	172.0	185.8	158.8
Dec	175.1	183.5	167.4