Question 1

The company wants to know the optimised staffing recommendations for the business case described. Write the mathematical model for the deterministic optimisation problem. Define and explain your decision variables, objective function and the constraint. (Hint: Use months of the year as the model timeline).

1. Index

a) Bank Location: there are 3 different Bank location states – A, B & C
   i= [A, B, C]
b) Month: there are 12 months for which data is provided- Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov & Dec

   j= [Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec]

2. Parameter

a) Demand: $Demand[i,j]$ which denotes demand of particular State in a given month and converting it into dictionary.
b) Staff availability: It denotes availability of the FTE (Full time Employee) for a given State & in a given month.
   Denoted by $StaffAv[i,j]$
c) FTE Salary: Salary paid by the company to Full time Employee.
   Denoted by $FTE\_Salary[i,j]$
d) Unit Outsourcing cost: It depends upon the Units outsourced for a given month and state.
   Denoted by $unitCost[i,j]$
e) FTE_AppServeRate: It denotes the No of Applications processed with 100% availability. Value is given as 40 as per data set.

3. Decision variable

a) FTE equivalent at any location in a given month. It can have both Integer and float value and thus, it's a Continuous variable.
   Denoted by $X[i,j]$
b) Outsourced insurance application quantity in a month and given state. It would be of Integer type.
   Denoted by $y[i,j]$

4. Objective function:
   We need to Minimize the Overall Cost associated with FTE and outsourced vendor application cost under given Business constraints.
   (in Business terms)
   Objective function=Annual total cost of FTE + Annual total cost of Outsourced insurance application
   (in Mathematical terms)

Objective Function(Minimize)= $\sum_i \sum_j X[i,j] * FTE\_Salary[i,j] + \sum_i \sum_j y[i,j] * unitCost[i,j]$

5. Constraint: It denotes the Business Limitation or restriction on the resources or timelines we might have.

a) Demand constraint: It represents the Overall Applications handled by both FTE and Vendor staff should be equivalent to the Demand of Applications for given State and month.
(In Business terms)

FTE_Equivalent per month * FTE Staff Availability * 40(i.e. no of applications processed in given month with 100% availability) + Outsourcing App insurance quantity = Demand for given State and month

(In Mathematical terms)

$X[i,j] * StaffAv[i,j] * 40 + y[i,j] = Demand[i,j]$

b) Regulatory constraint:
State A outsourced applications cannot be more than 30% of total applications demand each month.

$y[i,j] <= 0.30 * Demand[i,j]\ where\ i = A\ and\ j = all\ 12\ months$

State B outsourced applications cannot be more than 40% of total applications demand each month.

$y[i,j] <= 0.40 * Demand[i,j]\ where\ i = B\ and\ j = all\ 12\ months$

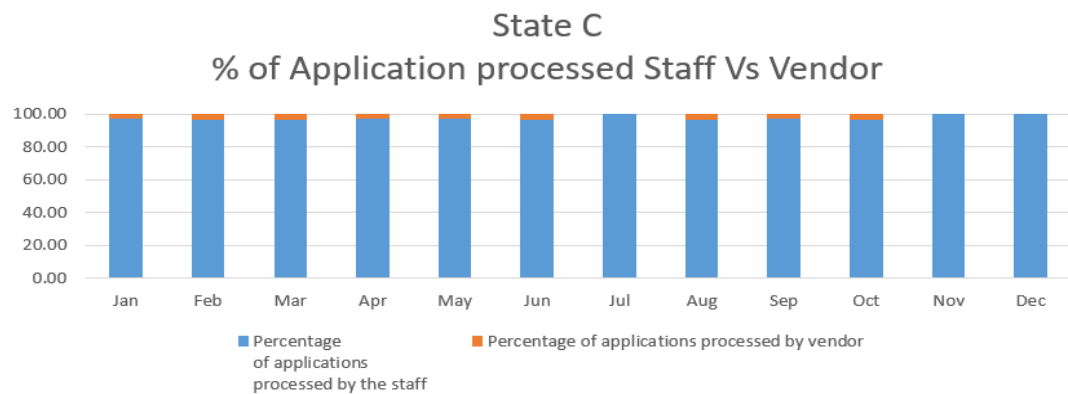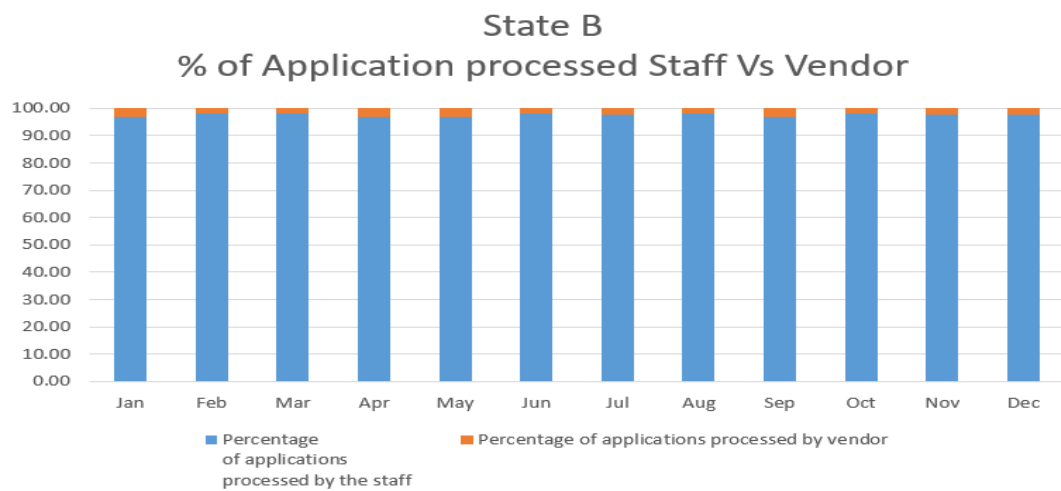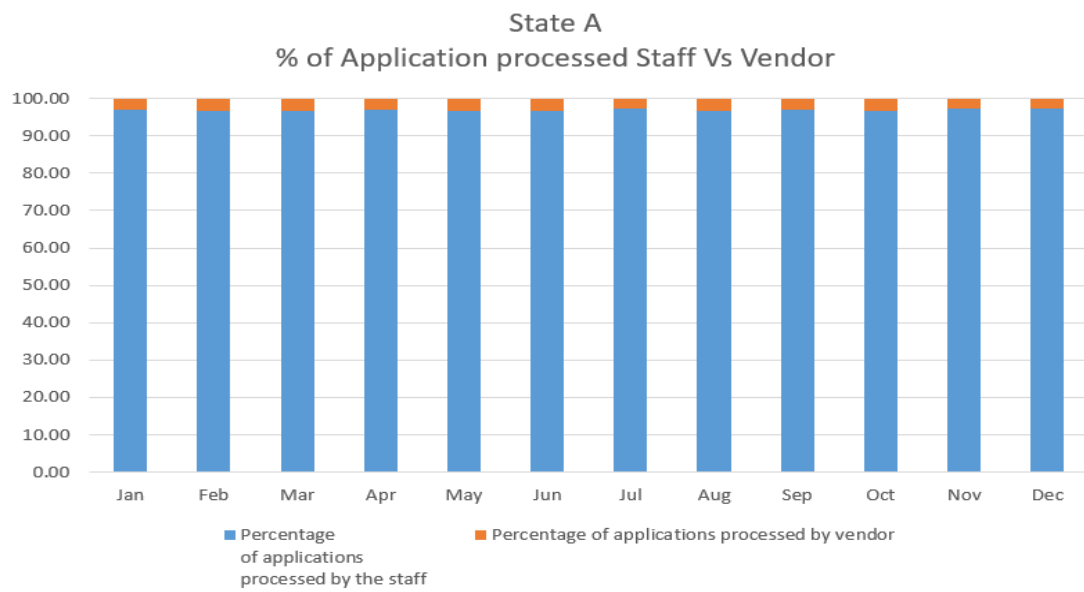# Question 4

Creating Visualisations

Create the following visualisations using your preferred method (i.e. Python, PowerPoint, Power BI, 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 best case, and the worst case).

Note: You can create the charts in Python or some other visualisation tools and make it a part of your final report directly.

State A
% of Application processed Staff Vs Vendor

- ■ Percentage of applications processed by the staff
- ■ Percentage of applications processed by vendor

State B
% of Application processed Staff Vs Vendor

- ■ Percentage of applications processed by the staff
- ■ Percentage of applications processed by vendor

State C
% of Application processed Staff Vs Vendor

- ■ Percentage of applications processed by the staff
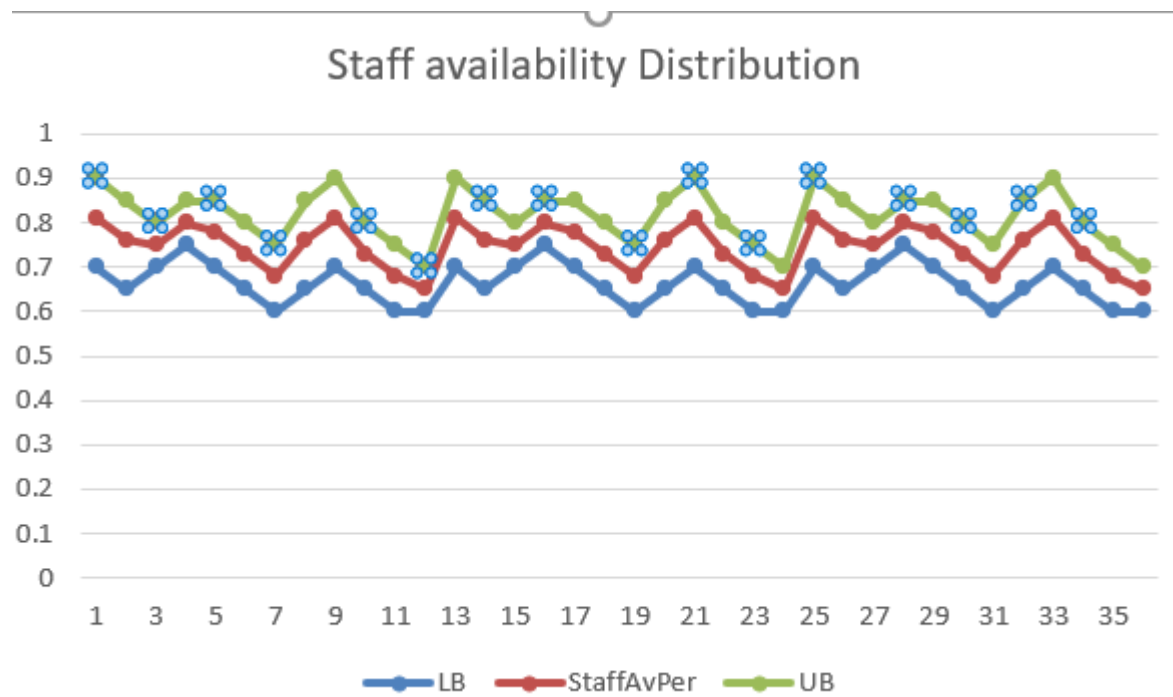- ■ Percentage of applications processed by vendor

Cost per application increases with respect to any change in the parameters. In our case, As the Staff Availability Increases, the Cost per application reduces and vice-versa.

Stats:

Average Cost per application for Average Staff Availability: 158.54

Average Cost per application for Lowest Staff Availability [LB]: 172.99

Average Cost per application for Highest Staff Availability [UB]: 145.88

Staff availability Distribution

Thank you