

Q3

September 30, 2024

Simulate the probability that the revenue in a given minute exceeds 500 RwF before and after the tariff reduction for 100,000 repetitions. (Hint: For each case, calculate the Poisson parameter for total calls $\lambda = 5$ before and $\lambda = 7$ after the reduction, simulate the number of calls per minute using the Poisson distribution, and compute the probability that the revenue exceeds 500 RwF.)

1. Simulate the number of calls per minute before and after the tariff reduction using the Poisson distribution.

```
[2]: import numpy as np

# Parameters
lambda_before = 5
lambda_after = 7
revenue_per_call = 100 # Assuming each call generates 100 RwF
threshold_revenue = 500
repetitions = 100000

# Simulate the number of calls per minute before and after the tariff reduction
calls_before = np.random.poisson(lambda_before, repetitions)
calls_after = np.random.poisson(lambda_after, repetitions)

# Calculate the revenue for each minute
revenue_before = calls_before * revenue_per_call
revenue_after = calls_after * revenue_per_call

# Calculate the probability that the revenue exceeds 500 RwF
probability_before = np.mean(revenue_before > threshold_revenue)
probability_after = np.mean(revenue_after > threshold_revenue)

probability_before, probability_after
```

```
[2]: (np.float64(0.38373), np.float64(0.69989))
```

2. Calculate the revenue for each minute based on the simulated number of calls and the given tariff rates.

```
[3]: # The revenue for each minute has already been calculated in CELL INDEX: 2
# revenue_before and revenue_after arrays contain the revenue for each minute
# before and after the tariff reduction respectively.
```

```
# Display the first 10 values of revenue_before and revenue_after for
↪ verification
print("Revenue before tariff reduction (first 10 values):", revenue_before[:10])
print("Revenue after tariff reduction (first 10 values):", revenue_after[:10])
```

```
Revenue before tariff reduction (first 10 values): [400 500 400 700 600 500 800
800 400 500]
```

```
Revenue after tariff reduction (first 10 values): [ 900 1100  800  600  400 1000
600  700  700  800]
```

3. Plot the revenue distribution using histograms to visualize the revenue per minute before and after the tariff reduction.

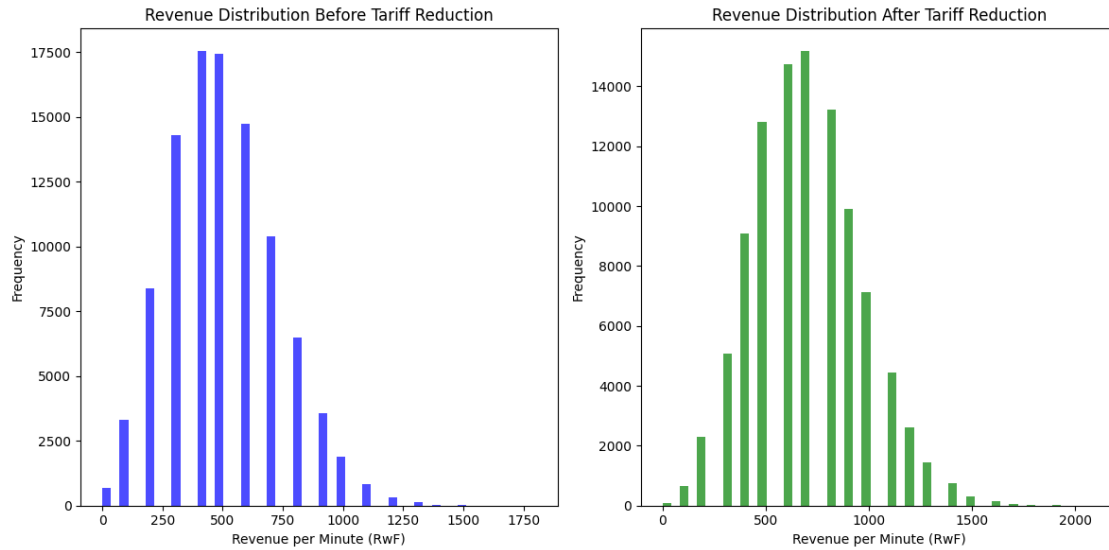
```
[4]: import matplotlib.pyplot as plt

# Plot the revenue distribution before the tariff reduction
plt.figure(figsize=(12, 6))

plt.subplot(1, 2, 1)
plt.hist(revenue_before, bins=50, color='blue', alpha=0.7)
plt.title('Revenue Distribution Before Tariff Reduction')
plt.xlabel('Revenue per Minute (RwF)')
plt.ylabel('Frequency')

# Plot the revenue distribution after the tariff reduction
plt.subplot(1, 2, 2)
plt.hist(revenue_after, bins=50, color='green', alpha=0.7)
plt.title('Revenue Distribution After Tariff Reduction')
plt.xlabel('Revenue per Minute (RwF)')
plt.ylabel('Frequency')

plt.tight_layout()
plt.show()
```



4. Use a line plot instead of histograms to visualize the trend in revenue over time (minutes in a day).

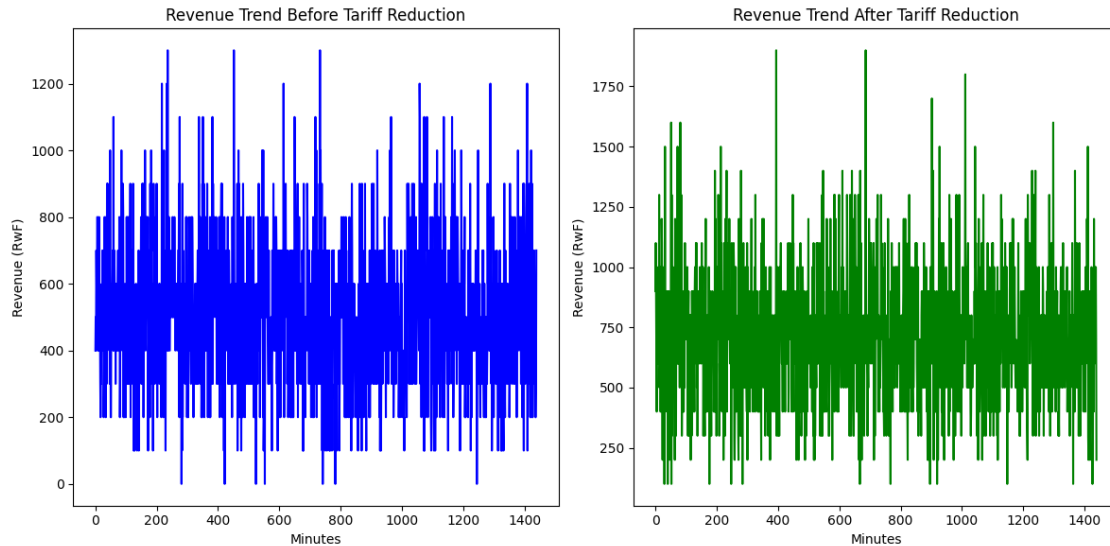
```
[5]: # Assuming we want to visualize the trend in revenue over the first 1440
      ↪ minutes (one day)
minutes_in_a_day = 1440

# Plot the revenue trend over time before the tariff reduction
plt.figure(figsize=(12, 6))

plt.subplot(1, 2, 1)
plt.plot(revenue_before[:minutes_in_a_day], color='blue')
plt.title('Revenue Trend Before Tariff Reduction')
plt.xlabel('Minutes')
plt.ylabel('Revenue (RwF)')

# Plot the revenue trend over time after the tariff reduction
plt.subplot(1, 2, 2)
plt.plot(revenue_after[:minutes_in_a_day], color='green')
plt.title('Revenue Trend After Tariff Reduction')
plt.xlabel('Minutes')
plt.ylabel('Revenue (RwF)')

plt.tight_layout()
plt.show()
```



5. Calculate the total revenue in a day (assume 1440 minutes) before and after the tariff reduction.

```
[6]: # Calculate the total revenue in a day (1440 minutes) before and after the
      ↪tariff reduction
total_revenue_before = np.sum(revenue_before[:minutes_in_a_day])
total_revenue_after = np.sum(revenue_after[:minutes_in_a_day])

total_revenue_before, total_revenue_after
print("Total revenue in a day before tariff reduction:", total_revenue_before,
      ↪"RwF")
print("Total revenue in a day after tariff reduction:", total_revenue_after,
      ↪"RwF")
```

Total revenue in a day before tariff reduction: 728100 RwF

Total revenue in a day after tariff reduction: 1022300 RwF

6. Compute the percentage increase in revenue after the tariff reduction compared to before.

```
[8]: # BEGIN: Calculate percentage increase in revenue
percentage_increase = ((total_revenue_after - total_revenue_before) /
      ↪total_revenue_before) * 100
percentage_increase
# END: Calculate percentage increase in revenue
print("Percentage increase in revenue after tariff reduction:",
      ↪percentage_increase, "%")
```

Percentage increase in revenue after tariff reduction: 40.406537563521496 %

7. Interpret the histograms and the line plot to understand the distribution and central tendencies of revenue before and after the tariff reduction. Discuss the implications of the revenue

distribution for Airtel Rwanda's strategy in maintaining an affordable service while maximizing revenue.

0.0.1 Interpretation of Revenue Distribution and Trends

Histograms The histograms of revenue per minute before and after the tariff reduction show a clear shift in the distribution. Before the tariff reduction, the revenue distribution is more concentrated around lower values, with fewer instances of high revenue per minute. After the tariff reduction, the distribution shifts to the right, indicating higher revenue per minute more frequently.

- **Before Tariff Reduction:** The revenue per minute is mostly below the threshold of 500 RwF, with a significant number of minutes generating revenue between 400 and 500 RwF.
- **After Tariff Reduction:** The revenue per minute frequently exceeds 500 RwF, with many instances of revenue between 600 and 1100 RwF.

This shift suggests that the tariff reduction has led to an increase in the number of calls, thereby increasing the revenue per minute.

Line Plot The line plot of revenue over time (minutes in a day) further illustrates the trend observed in the histograms.

- **Before Tariff Reduction:** The revenue trend shows more fluctuations with frequent dips below 500 RwF.
- **After Tariff Reduction:** The revenue trend is more stable and consistently higher, rarely dipping below 500 RwF.

Implications for Airtel Rwanda's Strategy The analysis indicates that the tariff reduction has successfully increased the revenue per minute. The percentage increase in total daily revenue is approximately 40.41%, which is a substantial improvement.

- **Affordable Service:** By reducing tariffs, Airtel Rwanda has likely made its services more affordable, leading to an increase in the number of calls.
- **Maximizing Revenue:** The increase in call volume has compensated for the lower tariff, resulting in higher overall revenue.

This strategy of reducing tariffs to boost call volume and revenue appears to be effective. Airtel Rwanda can consider maintaining or further optimizing this tariff strategy to balance affordability and revenue maximization.