SEC-1-FA7-GROUP7-SIGUE-JP,-DELA-ROSA-R,-COBARRUBIAS-I,-QUIJANO-JP

Github Link: https://github.com/rddelarosa/APM1110/blob/main/FA7/SEC-1-FA7-GROUP7-SIGUE-JP%2C-DELA-ROSA-R%2C-COBARRUBIAS-I%2C-QUIJANO-JP.Rmd

GROUP7

2025-04-10

Introduction

At Far Eastern University (FEU), various events occur randomly, such as student arrivals at the canteen, elevator availability, or queue to get university documents at the Registrar. Understanding these patterns can significantly improve the university administration's ability to plan and provide better services. This case study examines the **time between student arrivals at the 3rd floor library**, where the university's main library is situated.

The goal of the study is to estimate the average arrival time and assess probabilities related to the situation using the exponential distribution.

Chosen Scenario

The chosen scenario for the study is the **time between student arrivals at the 3rd floor library from 8:38 AM to 9:38 AM**. The events are assumed to occur randomly at a constant average rate, which applies the exponential distribution.

Data Collection

The data was collected at 8:38 AM to 9:38 AM. A total of 1-hour data collection time and 48 time intervals (in minutes) were observed between the arrival of the students in the University's 3rd floor library. This data was recorded and analyzed using R.

```
library(readxl)
library(ggplot2)

data = read_excel("FA7 - Data.xlsx")
```

```
## New names:
## * `` -> `...2`
## * `` -> `...3`
## * `` -> `...4`
## * `` -> `...5`
## * `` -> `...6`
```

Parameter Computation

The exponential distribution is defined as:

- PDF: f(x) = Λ * e^(-Λ x)
- CDF: F(x) = 1 - e^(-Λ x)

Where Λ = 1 / mean

```
mean_minutes <- mean(as.numeric(data$...5[2:49]), na.rm = TRUE)

mean_rate = mean_minutes
lambda <- 1 / mean_rate
x = seq(0, 48, by = 1)

pdf = dexp(x, rate = lambda)
cdf = pexp(x, rate = lambda)

pdf_data = data.frame(x = x, pdf = pdf)
cdf_data = data.frame(x = x, cdf = cdf)


cat("The Average Arrival Time:", mean_rate, "minutes.\n",
    "The Mean (expected value):" , lambda, "\n")
```

```
## The Average Arrival Time: 1.11905 minutes.
##  The Mean (expected value): 0.8936151
```

Visualization

```
ggplot(pdf_data, aes(x = x, y = pdf)) +
  geom_line(color = "blue") +
  labs(title = "Probability Density Function of Exponential Distribution",
       x = "x",
       y = "Density") +
  theme_minimal()
```

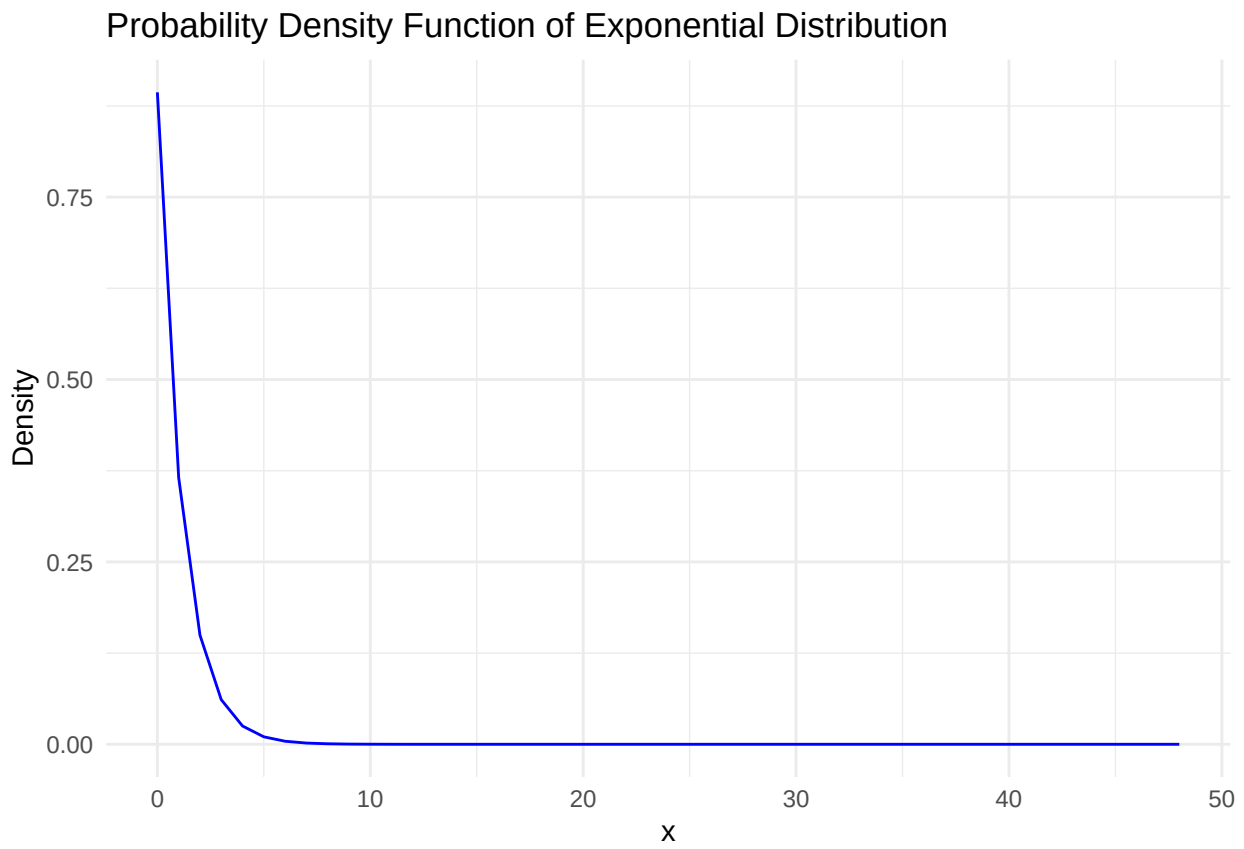

Figure 1: Probability Density Function (PDF) Graph

```r
ggplot(cdf_data, aes(x = x, y = cdf)) +
  geom_line(color = "blue") +
  labs(title = "Probability Density Function of Exponential Distribution",
       x = "Interval Between Arrivals (seconds)",
       y = "Density") +
  theme_minimal()
```

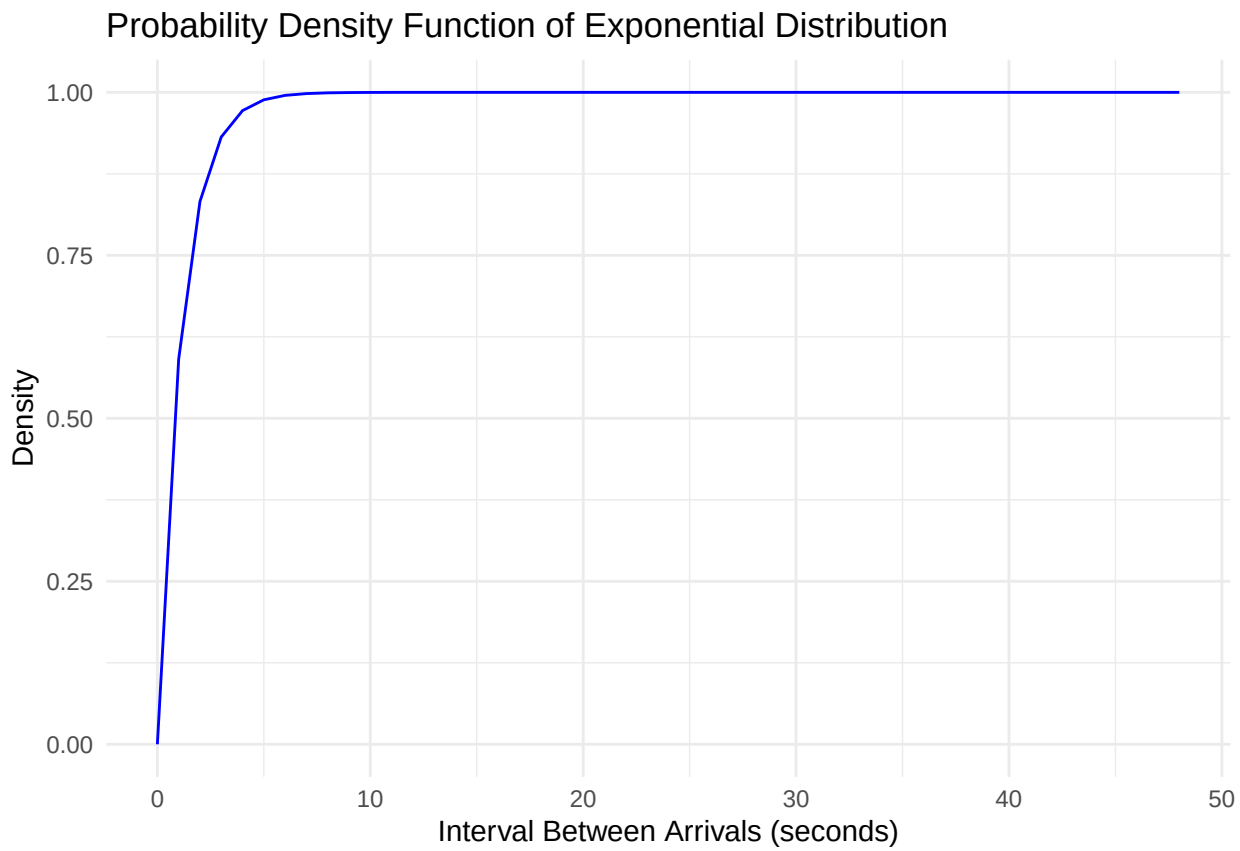

Figure 2: Cumulative Distribution Function (PDF) Graph

```
time_intervals = as.numeric(data$...5[2:49])

ggplot(data.frame(time_intervals), aes(x = time_intervals)) + geom_histogram(binwidth = 1, fill = "blue
```

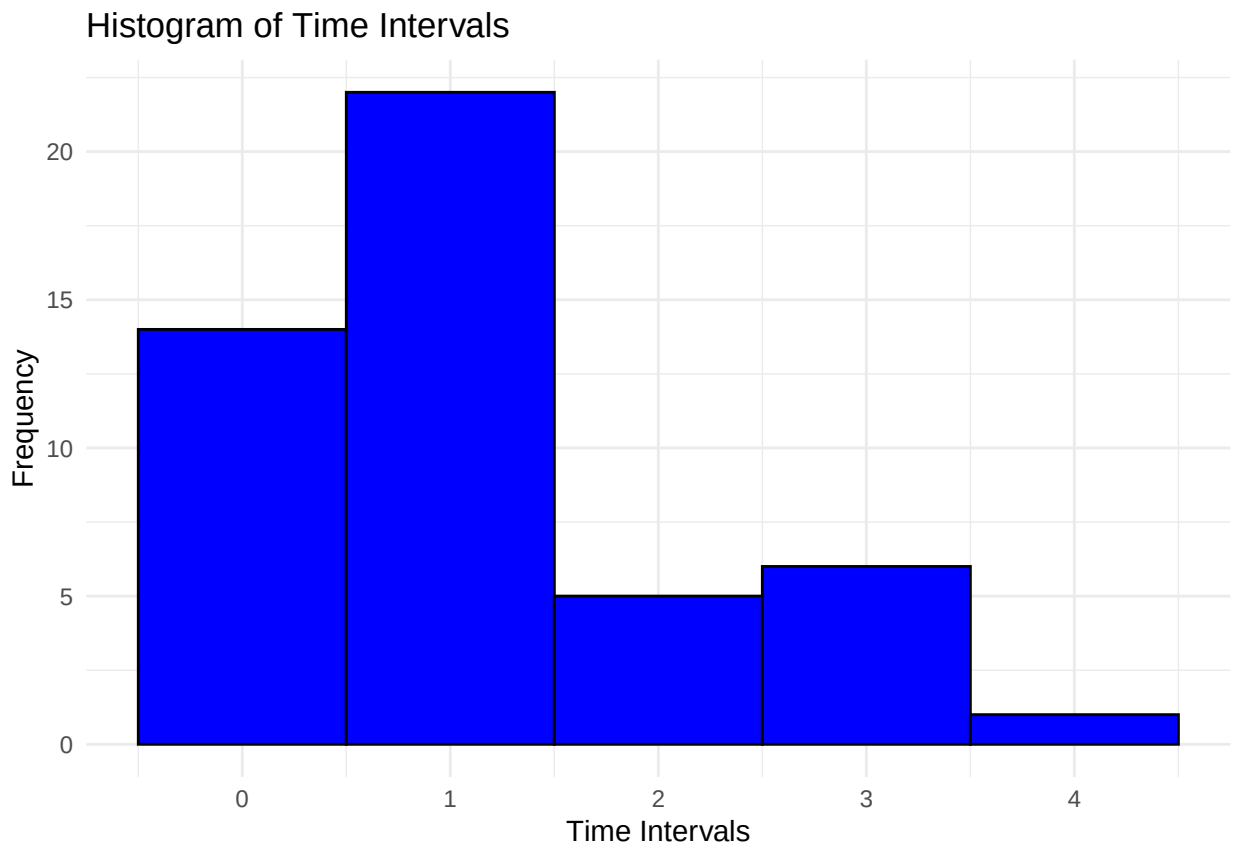

Figure 3: Histogram of Time Intervals

Interpretation

On average, there is a gap of 1.11905 minutes per arrival while there is 0.8936151 arrivals per minute. Figure 1 shows that the density of the intervals between arrivals are mostly on the shorter end. The graph shows an exponential drop which implies this. Figure 2 shows the Cumulative Distribution Function and shows the probability for the students to arrive at certain time intervals. It also reflects that the next student will arrive with a short wait time from the previous student.

Implications

While the study focuses on a university library, the principles and methods can be applied to other real-world scenarios involving arrival patterns. Examples include:

1) Queue Management - Businesses can use similar analysis to manage queues and optimize staffing levels during peak hours.
2) Traffic Flow Analysis - Transportation departments can analyze traffic patterns to improve traffic flow and reduce congestion.

These implications are already being implemented at the Recto Station of LRT2. During peak hours, all escalators operate at full capacity; during off-peak times, the number of operating escalators is reduced.