Business Forecasting

Midterm Exam: Forecasting Public Transit Raidership in the US

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Exam Paper Index

Business Forecasting Mid-Term Exam

Introduction

Public transit ridership refers to the number of people who use public transportation services, such as buses, trains, subways, trams, and other forms of mass transit, to travel from one place to another. It is an important metric to assess the usage and popularity of public transportation systems in a given area. Understanding public transit ridership is crucial for transportation authorities, city planners, and policymakers because it can help inform decisions about funding, service improvements, and the overall effectiveness of a public transit system. The dataset below shows the Public Transit Raidership of the US from 2000 Jan.

https://fred.stlouisfed.org/series/TRANSIT

Import Data

Please do the following steps once the csv file is on your desktop.

```
library(readr)
TRANSIT <- read_csv("Downloads/TRANSIT.csv")
Transit_Raw <- TRANSIT$TRANSIT
Transit_ts <- ts(Transit_Raw, frequency = 12, start = c(2000,1))
plot(Transit_ts)
```

Plot and Inference

- Show a time series plot.
- Please summaries your observations of the times series plot

Central Tendency

- What are the min, max, mean, median, 1st and 3rd Quartile values of the times series?
- Show the box plot.
- Can you summarize your observation about the time series from the summary stats and box plot?

Decomposition

- Plot the decomposition of the time series.
- Is the times series seasonal?
- Is the decomposition additive or multiplicative?
- If seasonal, what are the values of the seasonal monthly indices?
- For which month is the value of time series high and for which month is it low?
- Can you think of the reason behind the value being high in those months and low in those months?
- Show the plot for time series adjusted for seasonality. Overlay this with the line for actual time series? Does seasonality have big fluctuations to the value of time series?

Naïve Method

- Output
- Perform Residual Analysis for this technique.
    - Do a plot of residuals. What does the plot indicate?
    - Do a Histogram plot of residuals. What does the plot indicate?
    - Do a plot of fitted values vs. residuals. What does the plot indicate?
    - Do a plot of actual values vs. residuals. What does the plot indicate?
    - Do an ACF plot of the residuals? What does this plot indicate?
- Print the 5 measures of accuracy for this forecasting technique
- Forecast
    - Time series value for next year. Show table and plot
- Summarize this forecasting technique
    - How good is the accuracy?
    - What does it predict the value of time series will be in one year?
    - Other observation

Simple Moving Averages

- Plot the graph for time series.
- Show the Simple Moving average of order 3 on the plot above in Red
- Show the Simple Moving average of order 6 on the plot above in Blue
- Show the Simple Moving average of order 9 on the plot above in Green
- (Bonus) show the forecast of next 12 months using one of the simple average order that you feel works best for time series
- What are your observations of the plot as the moving average order goes up?

Simple Smoothing

- Perform a simple smoothing forecast for next 12 months for the time series.
    - What is the value of alpha? What does that value signify?
    - What is the value of initial state?
    - What is the value of sigma? What does the sigma signify?
- Perform Residual Analysis for this technique.
    - Do a plot of residuals. What does the plot indicate?
    - Do a Histogram plot of residuals. What does the plot indicate?
    - Do a plot of fitted values vs. residuals. What does the plot indicate?
    - Do a plot of actual values vs. residuals. What does the plot indicate?
    - Do an ACF plot of the residuals? What does this plot indicate?
- Print the 5 measures of accuracy for this forecasting technique
- Forecast
    - Time series value for next year. Show table and plot
- Summarize this forecasting technique
    - How good is the accuracy?
    - What does it predict the value of time series will be in one year?
    - Other observation

Holt-Winters

- Perform Holt-Winters forecast for next 12 months for the time series.
    - What is the value of alpha? What does that value signify?
    - What is the value of beta? What does that value signify?
    - What is the value of gamma? What does that value signify?

    - What is the value of initial states for the level, trend and seasonality? What do these values signify?
    - What is the value of sigma? What does the sigma signify?
- Perform Residual Analysis for this technique.
    - Do a plot of residuals. What does the plot indicate?
    - Do a Histogram plot of residuals. What does the plot indicate?
    - Do a plot of fitted values vs. residuals. What does the plot indicate?
    - Do a plot of actual values vs. residuals. What does the plot indicate?
    - Do an ACF plot of the residuals? What does this plot indicate?
- Print the 5 measures of accuracy for this forecasting technique
- Forecast
    - Time series value for next year. Show table and plot
- Summarize this forecasting technique
    - How good is the accuracy?
    - What does it predict the value of time series will be in one year?
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Accuracy Summary

- Show a table of all the forecast method above with their accuracy measures.
- Show the best and worst forecast method for the accuracy measure of your choice. Why did you choose that accuracy measure?

Conclusion

- Summarize your analysis of time series value over the time-period.
- Based on your analysis and forecast above, do you think the value of the time series will increase, decrease or stay flat over the next year? How about next 2 years?