

## Homework assignment 4.

Consider data in *miles.csv* (attached file). (*This is Vehicle Miles Traveled series. This data set was created by appending the recent monthly figures from the U.S. Federal Highway Administration's Traffic Volume Trends to their Historic Monthly Vehicle Miles Traveled (VMT) data file. Source: U.S. Federal Highway Administration, Vehicle Miles Traveled [TRFVOLUSM227NFWA], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/TRFVOLUSM227NFWA>, March 30, 2024.*)

1.
  - (i) **(0.5 pt.)** Plot the corresponding time series. Do we have a trend in vehicle miles traveled given our data? How do you see it?
  - (ii) **(0.5 pt.)** Suppose you want to predict the vehicle miles traveled in month  $t$ , given data in month  $t - 1$ . Would you use raw or detrended data? Explain.
  - (iii) **(1 pt.)** Suppose you want to detrend the data. Use first differencing and percentage changes. Plot detrended data. Compare rolling means and stds of these methods. How do you know that detrending worked?
  - (iv) **(1 pt.)** Model linear, quadratic and exponential trends. Plot detrended data. Compare rolling means and stds of these methods. How do you know that detrending worked?
  - (v) **(bonus 0.5 pt.)** Describe one additional detrending method that hasn't been covered on lectures, apply it to the data and compare to standard methods.
  - (vi) **(1 pt.)** Which detrending method worked the best? How do you know it? Include stationarity tests for each detrended series.
2.
  - (i) **(0.5 pt.)** Is there a seasonality in the considered time series? (day of week, working days vs weekend, monthly seasonality, quarterly seasonality). How you can prove it?
  - (ii) **(1 pt.)** Explain why you might want to exclude seasonality from your data. What are the ways to exclude seasonality?
  - (iii) **(0.5 pt.)** Find a seasonal component (if it exists), and exclude it. Explain the results
  - (iv) **(bonus 0.5 pt.)** Find seasonal component with Fourier transform and exclude it from detrended data. Compare this method to previous ones.
  - (v) **(bonus 0.5 pt.)** Describe one additional method to remove seasonality that hasn't been covered on lectures, apply it to the data and compare to standard methods.