US Unemployment Rate
12/08/2025

The unemployment rate is the number of unemployed as a percentage of the labor force. Labor force in turn is comprised of people 16 years and older, who do not reside in institutions (e.g., penal or mental facilities, and elderly homes), and who are not on active duty in the Armed Forces. U.S. Bureau of Labor Statistics compiles unemployment rate using two monthly surveys 1) the household survey that estimates population, civilian workforce, labor force participation, and unemployment rates, and 2) the establishment survey that provides payroll and wage numbers. The household and establishment surveys together provide a consistent overall employment picture.

This article uses unemployment rate from the Federal Reserve Economic Data (FRED) database available at https://fred.stlouisfed.org/.

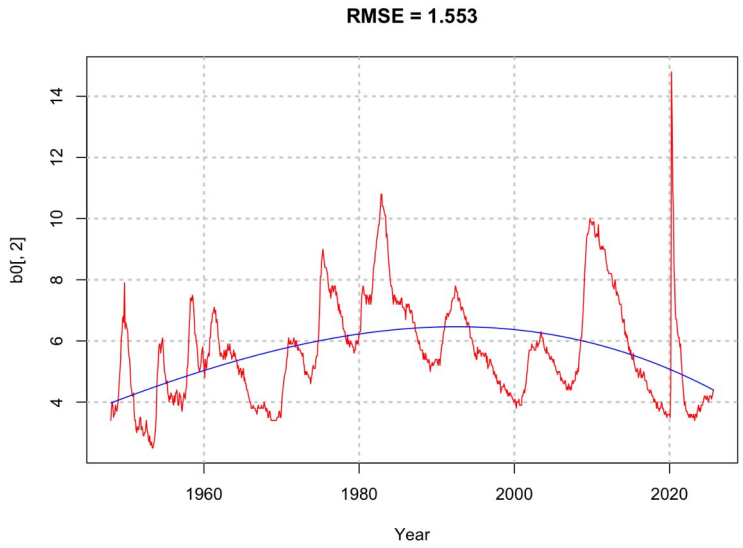

Figure 1, US Unemployment Rate from 1948 to 2025.

Figure 1 shows the unemployment rate and a quadratic linear fit. The linear fit captures the overall trend but shows several high unemployment rates in the 1980s, a wide peak after the 2008 great financial crisis, and a sharp peak in the 2020 global pandemic. The seasonality of the unemployment rate is modeled using the Fourier transformation. Figure 2 shows the spectrogram of the residual term from the trend model.

Several important seasonality frequency components are located at indexes of 3, 4, 6, 9, 10, and 15 corresponding to seasonalities of 26 years, 19 years, 13 years, 9 years, 8 years, and 5 years. The Fourier transformation therefore includes all the frequency components whose index are below 15. The 5 and 8 year cycles are mostly found before 1980 whereas the 9 and 13 year cycles are found in the recent past. The much longer cycles, e.g., 19 and 26 year cycles are between the major unemployment rate spikes.

There are also a large number of short cycles, corresponding to higher frequency indexes in Figure 2 that may be the results of the inherent “noise” in the data.

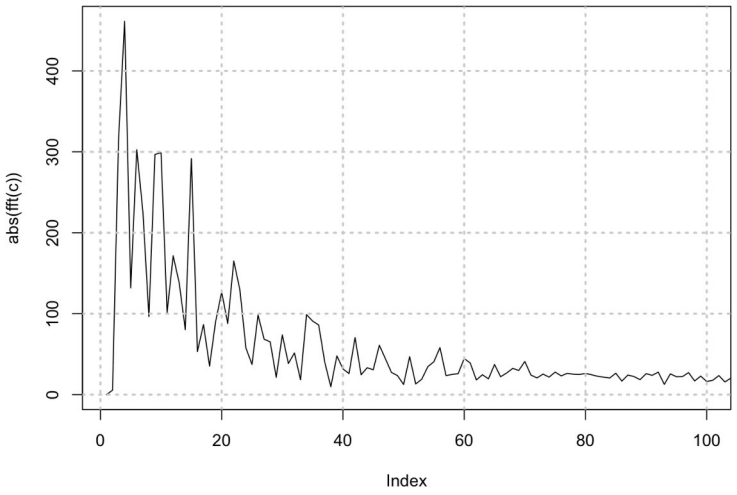

Figure 2, Fourier Transformation of the Residual Term from the Trend Model.

Figure 3 shows the seasonality modeling result. The RMSE decreases from 1.553 to 0.865, a considerable improvement. The seasonality model captures the major "waves" in the data, but fine details in the data are largely missing. The next step of modeling is then to add the autoregression model for the residual term from the seasonality model.

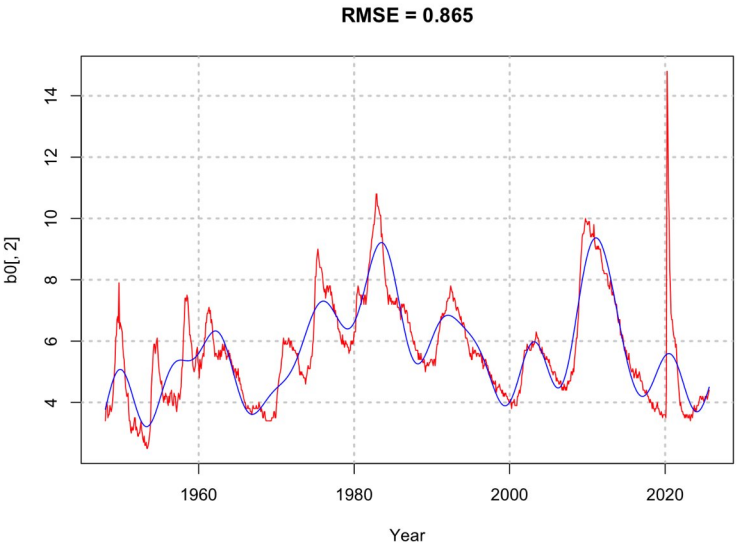

Figure 3. Unemployment Rate (red line) and Model of both the Trend and Seasonality (blue line).

The partial autocorrelation function (PACF) of the residual term from the seasonality model is shown in Figure 4. It suggests that the monthly unemployment rate is strongly correlated to its last month's rate, although the data also show minor negative correlations to the unemployment rates of other prior months. These other month terms are substantially smaller in magnitude than the immediate past month's correlation therefore they are ignored in the autoregression model for the residual term.

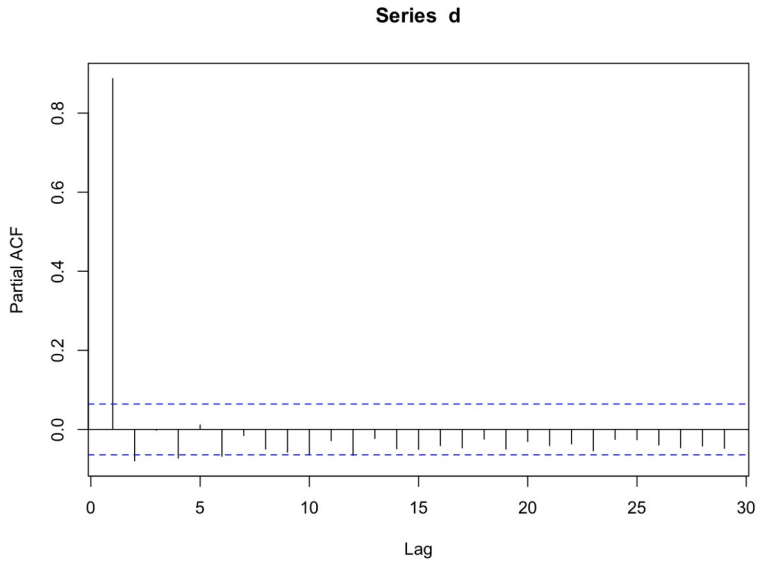

Figure 4, Partial Autocorrelation Function of the Residual Term (d) from the Seasonality Model.

The combined model is shown in Figure 5. The RMSE of the combined model further reduces from 0.865 to 0.399. A closeup view of the model is also shown in Figure 6 for the unemployment rates of the recent years that follow a slow, upward creep from a historical low unemployment rate in early 2023.

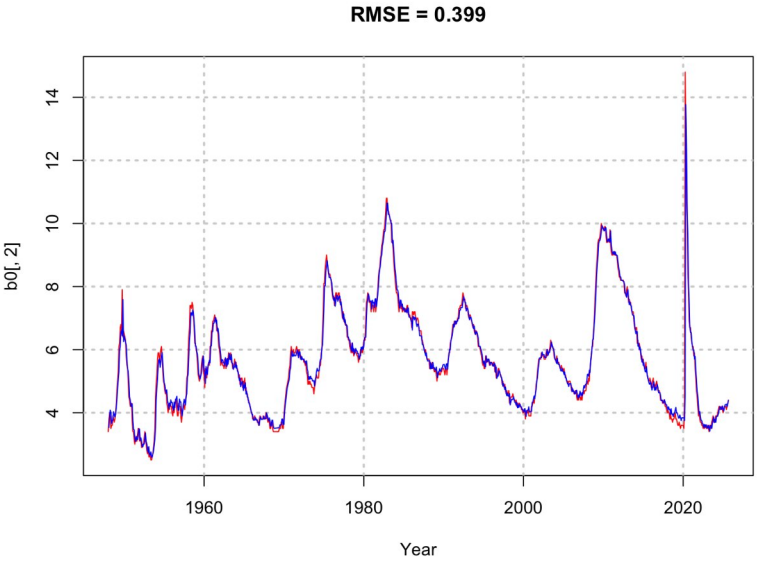

Figure 5, Combined Model with Trend, Seasonality, and Autoregression Components.

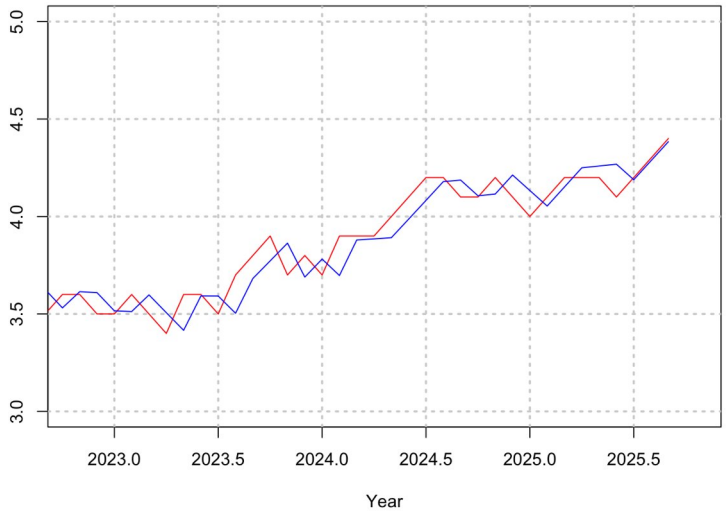

Figure 6, A Closeup View after Conversion of the CPI in Figure 6 back to Percent Change of CPI (red line) and Model Prediction (blue line)

Concluding Remarks

The very high autocorrelation (0.9) with the first lagged response variable in Figure 4 makes the medium to long term forecast of unemployment rate very difficult since the next month's unemployment rate will be correlated 90% to this month's number which can be affected by many unpredictable events. This is similar to other economic measures like inflation and interest rate that are also closely correlated to a single, past month values. Economic measures, like GDP and money supply, on the other hand, appear to have a longer term memory over several months and suffer to a less degree from such a high correlation. Therefore, medium term forecast of these measures may be possible.