US Historical Interest Rate
12/06/2025

The term “interest rate” refers to the effective federal funds rate (EFFR) which is the volume-weighted median interest rate banks charge each other for their overnight loans. This rate fluctuates between the federal open market committee's (FOMC) target range, and affects other lending rates like mortgages and credit cards. The target rate also acts as a tool for the federal reserve to manage US economic activities, employment, and inflation.

This article uses EFFR data downloaded from the federal reserve economic data (FRED) database available at https://fred.stlouisfed.org/.

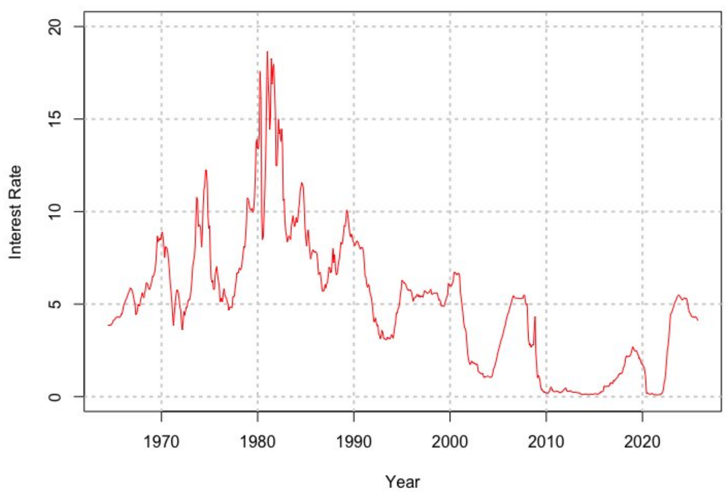

Figure 1, Effective Federal Fund Rate (EFFR) from 1964 to 2025.

The downloaded interest data was first transformed into the “present value” using the monthly interest rate to help “smooth” the data that are otherwise extremely volatile over the years from nearly zero percent in 2010 to 18 percent in 1980 (see Figure 1). The data transformation follows the familiar relation between the present value and the monthly interest rate as below:

$$PV_{this\,month} = PV_{last\,month} \times \left(1 + \frac{EFFR_{last\,month}}{100}\right)^{1/12}$$

Figure 2 shows the computed present value and a linear fit and the data become quite gentile over the same period of time. To convert the present value back to the interest rate, the following formula can be very helpful:

$$EFFR_{this\,month} = 100 \times \left[\left(\frac{PV_{this\,month}}{PV_{last\,month}}\right)^{12} - 1\right]$$

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The linear fit captures the overall trend but the apparent waviness or seasonality in the data must be accounted for. The seasonality of the present value is modeled using the Fourier transformation. Figure 3 shows the spectrogram of the residual term from the trend model.

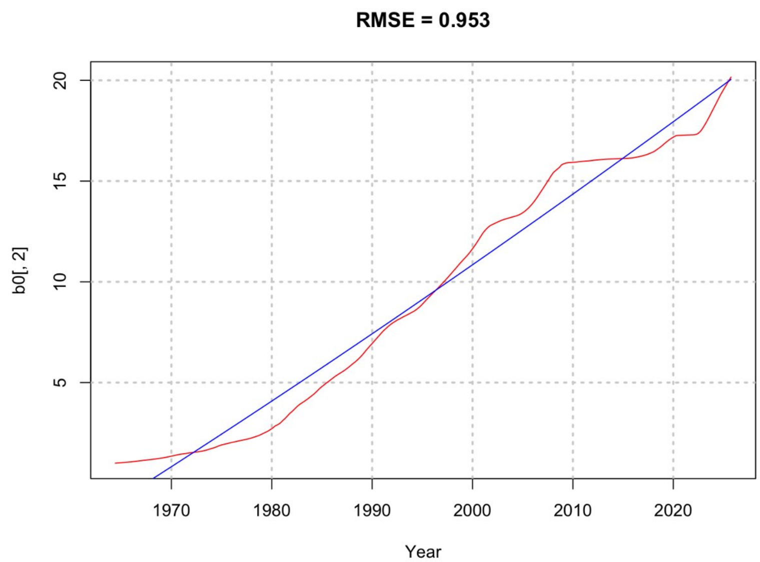

Figure 2, Present Value using Monthly Published EFFR (red) and the General Trend Line (blue) of a Linear Model.

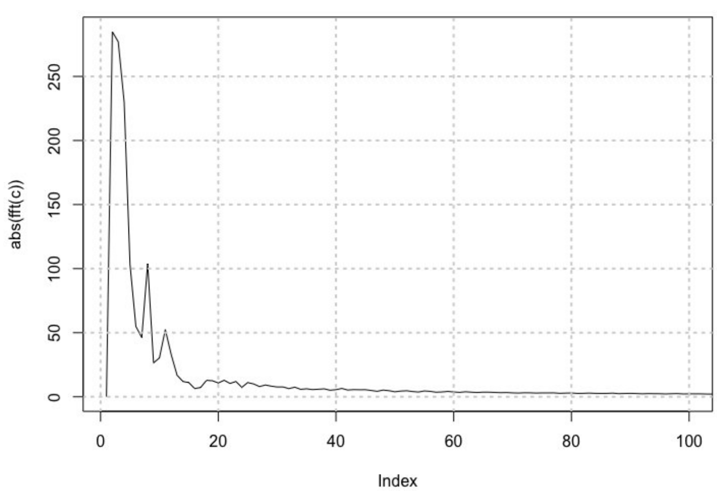

Figure 3, Fourier Transformation of the Residual Term from the Trend Model.

Several important frequency components are located at frequency indexes of 2, 3, 8, and 11 corresponding to a seasonality of 737/12/2 = 31 years, 737/12/3 = 20 years, 737/12/8 = 8 years, and 737/12/11 = 6 years. The Fourier transformation therefore includes all the frequency components whose index is below 14. Figure 4 shows the modeling result. The RMSE decreases from 0.953 to 0.111, a remarkable improvement. These cycles perhaps reflect the major interest rate changes as shown in Figure 1.

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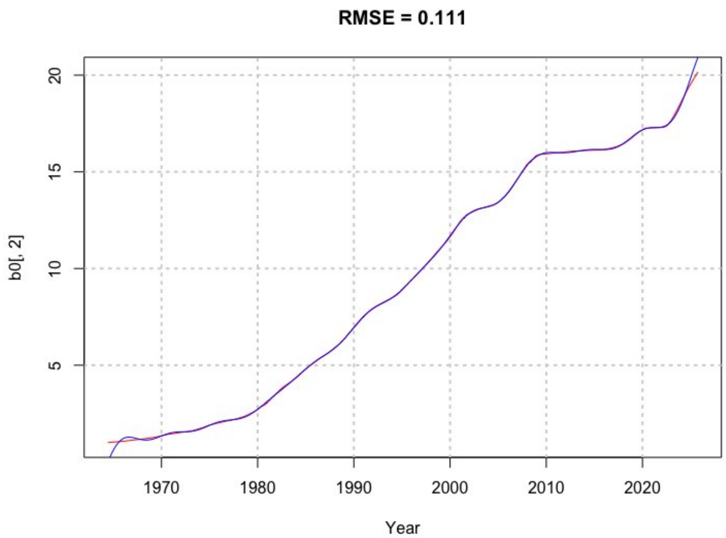

Figure 4. Present Value (red line) and Model of both the Trend and Seasonality (blue line).

The partial autocorrelation function (PACF) of the residual term from the seasonality model is shown in Figure 5. It suggests that the monthly present value is correlated to the present value of prior month. This value is then incorporated into the autoregression model of the residual term.

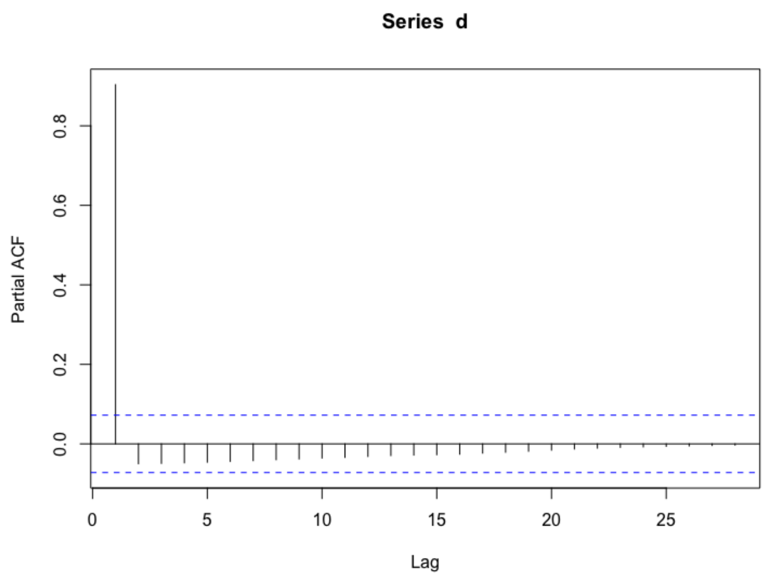

Figure 5, Partial Autocorrelation Function of the Residual Term (d) from the Seasonality Model.

The combined model is shown in Figure 6. The RMSE of the combined model further reduces from 0.111 to 0.013, a substantial improvement. A closeup view of the model is also shown in Figure 7 for the EFFR (converted back from the present value) for the recent years.

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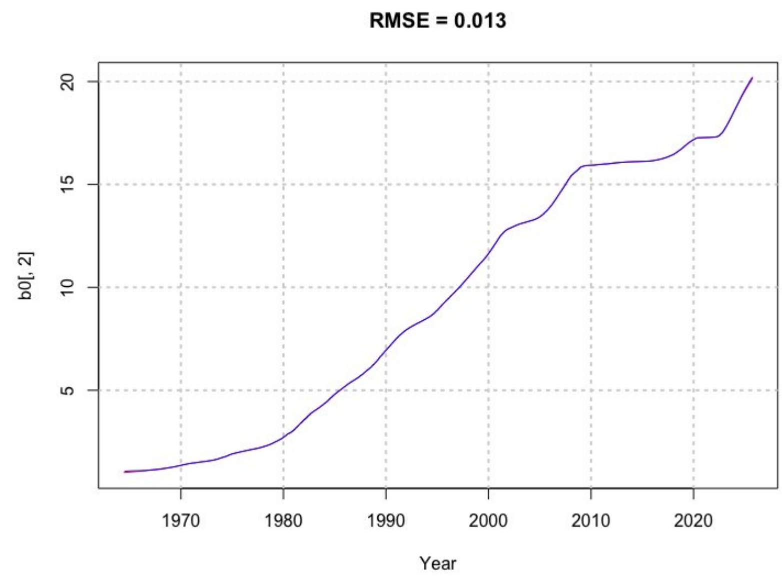

Figure 6, Combined Model with Trend, Seasonality, and Autoregression Components.

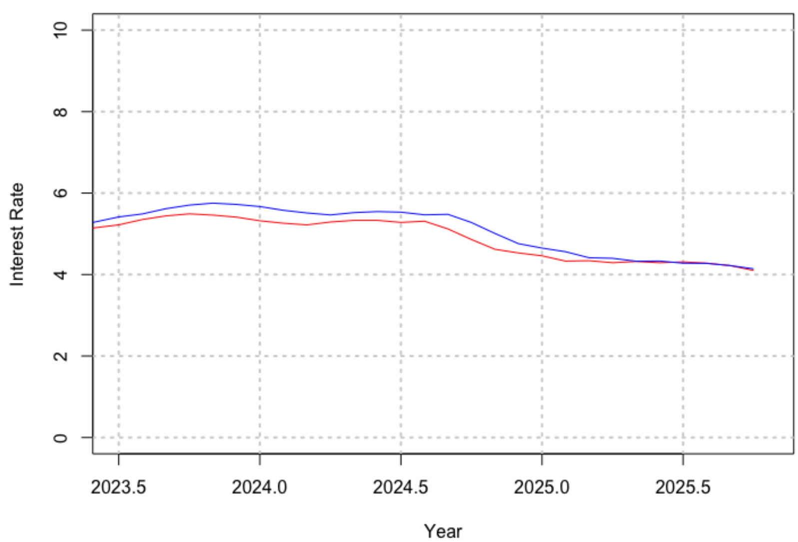

Figure 7, A Closeup View after Conversion of the Present Value in Figure 6 back to EFFR (red line) and Model Prediction (blue line)

Concluding Remarks

Transformation from interest rate to present value greatly reduces complications in data modeling. However, the large number of frequency components (total 14) as the modeling parameters reflects on the considerable irregularities in the interest rate. Nonetheless, the latest trend (see Figure 7) implies a strong will by the Federal Reserve to slowly yet firmly reduce the interest rate from the 2023 level.

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