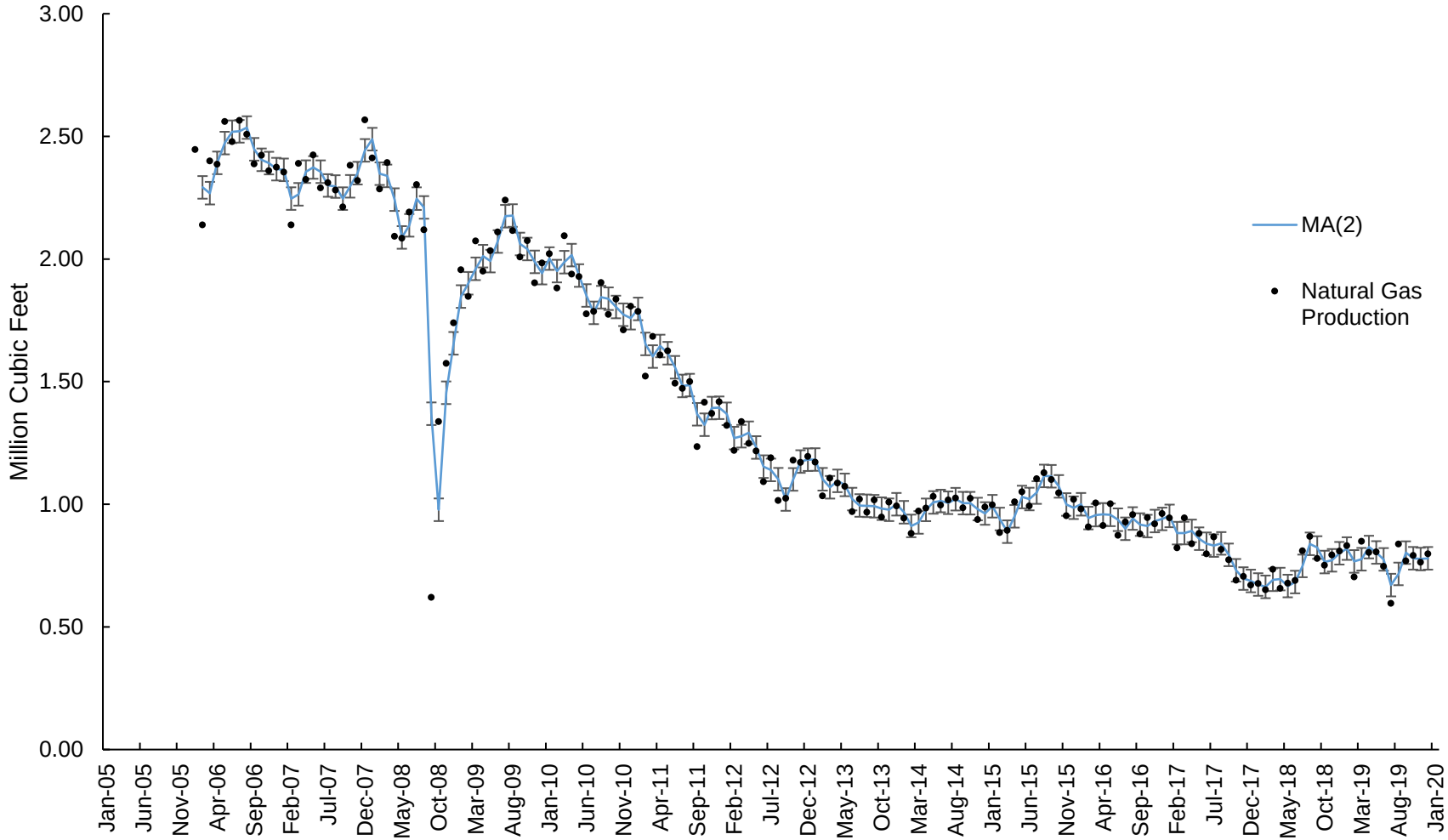
Visualizing Trends and Uncertainty

Figure 1. Actual and Moving Average Natural Gas Production in Texas, Jan, 2006 - Dec 2019



Source: *Author's elaboration with data from the Energy Information Administration*
Remark: *Error bars denotes standard errors.*

The relevant points of this data visualization are:

- The main purpose of this figure is to visualize trends using a time-series or line-chart and visualize uncertainty using error bars.
- Figure 1 shows the actual natural gas production in Texas by month from January 2005 to December 2019 in million cubic feet and the MA(2) of natural gas production in Texas along with standard error bars.
- Figure 1 aids to visualize there is a negative trend in the natural gas production in Texas from January 2005 to December 2005.
- Otherwise stated there is a downward slope trend in the natural gas production in the State of Texas.
- As observed in Figure 1, except for September 2008, a MA(2) might be helpful in forecasting the natural gas production by month in the State of Texas.
- This time-series graph also helps in identifying troughs in the natural gas production in Texas such as the one experienced in September 2008.
- This is an initial analysis to visualize the natural gas production trend by providing a MA(2) forecasts along with error bars to account for uncertainty.
- However, if a forecasting model were required additional techniques might be applied such as Vector Autoregression model to account for the shocks in variables that potentially drive the natural gas production or ARIMA to account for co-integration and autoregression factors.
- Economic theory along with consulting with subject matter experts in the State of Texas might be helpful in identifying relevant factors to improve the model's accuracy.

I presented in Table 1 the six Tufte's principles recommended for a data visualization along with a description of each principle. Additionally, I indicated which of these principles I used when creating Figure 1 and explained their applications.

Table1. Tufte's Principles applied in Figures 1

Tufte's Principles	Figure1	Detailed description	Application
Show comparisons	✓	Making comparisons is helpful in identifying magnitude visually	Figure 1 compares the natural gas production by month from January 2005 to December 2019 in Texas.
Show causality	✓	The data visualization could have as major goal to show causality. How a variable cause another visually could provide a first insight in identifying causation.	In general, Figure 1 shows a negative or downward trend as time goes by.
Use multivariate data	✓	Use multiple variables to accomplish the goal of the data visualization	Figure 1 visualizes actual natural gas production, forecasted natural gas production using a MA(2), and time.
Completely integrate text, images, and numbers	✓	Integrate relevant notes, remarks, and images to better inform your audience about the information you want to communicate	Figure 1 shows error bars to visualize uncertainty when forecasting natural gas production. It also uses relevant labels to indicate the actual natural gas production and its forecasted value.
Establish credibility	✓	One form to establish credibility is to include the data source and also start from the origin or allow the reader to identify the scale you are using	I included the source at the end of Figure 1.
Focus content	✓	Use space efficiently and avoid *chartjunk* by including relevant data to communicate your idea and stress on your main goal of your data visualization.	Forecasted values are shown in blue to make the distinction between actual and forecasted values.