

DOR's Assessment and Forecasting of the Montana Land Information Account Collections

Forecasting Background

- Average vs Moving Average vs Exponential Smoothing
- Average is useful when there is no obvious trend in the data
- Moving Average helps visualize how the average changes over time, best used visually.
 - The only parameter of the moving average is the period
 - The longer the period of the Moving Average, the less sensitive it is to trends but results in a smoother (less noisy) curve
 - The Moving Average “forgets” older points – helpful if past data is no longer relevant to current trends
- Exponential Smoothing operates similarly to the Moving Average
 - The parameter is α . It operates as a weighting factor
 - α is between 0 and 1
 - The larger the α , the more relative weight is given to recent values.
 - This means as α approaches 1, there is less smoothing, the rough equivalent of a shorter period in the Moving Average
 - How to choose α ?
 - Best judgement or intuition
 - Optimized value to minimize squared error
- Quick Note on Confidence Intervals – These represent the likelihood that the true future value is contained within them. They are centered around the forecasted value and naturally grow wider as time goes on. Even confidence intervals of 90% are quite large.

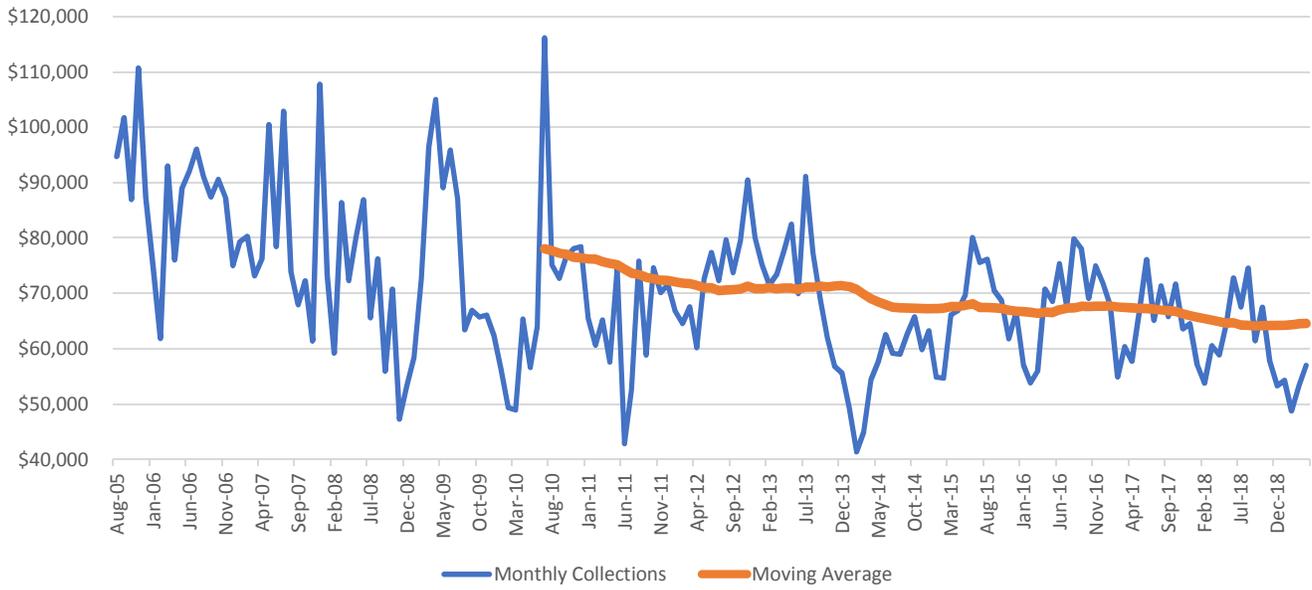
Our Forecast

- Do the first few years of revenues seem worth keeping in the model?
 - Exponential Smoothing does not forget old values, although it weights them less, they still exert a trend pressure that pushes down future revenue estimates.
- Should we keep old values in and use a high α ?
- Ultimately, I decided to run forecasts with and without the first three years, while letting excel pick α .
- All models predict falling revenues through FY 2022.
- The most optimistic model is the Yearly model with 2006-2008 removed, followed by the Regular Yearly model, the Monthly model with 2006-2008 removed, and finally the Regular Monthly model is the most pessimistic of the four options.

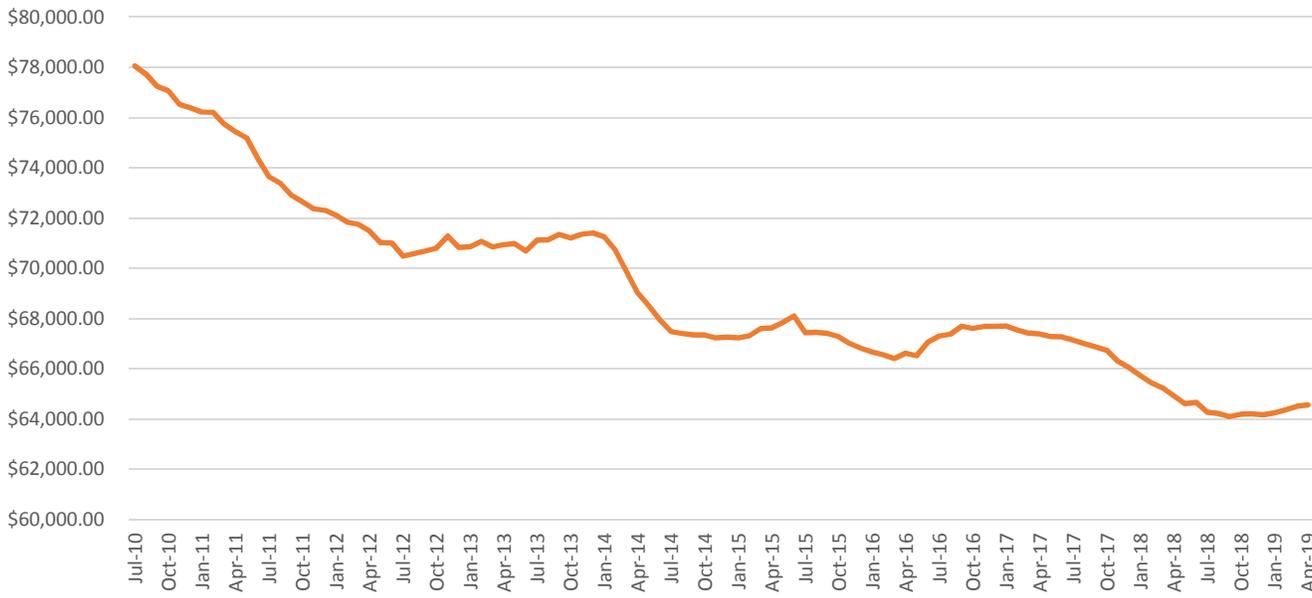
Monitoring Revenue

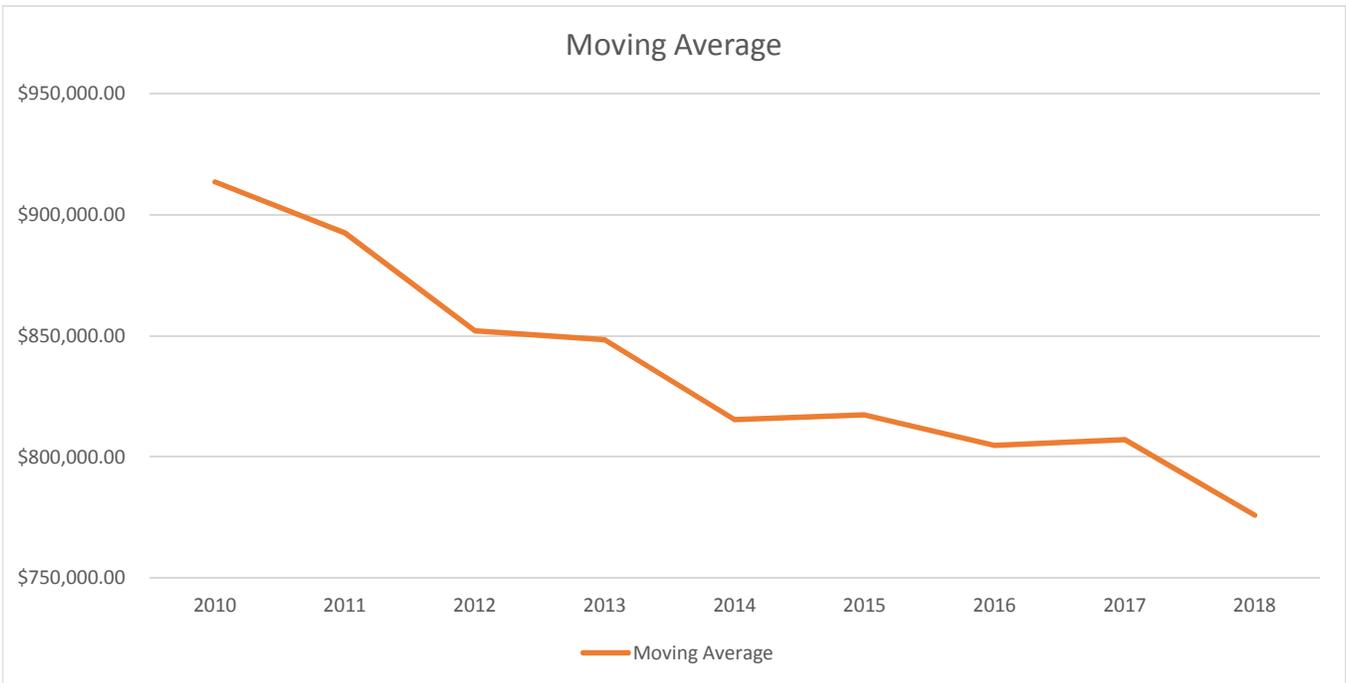
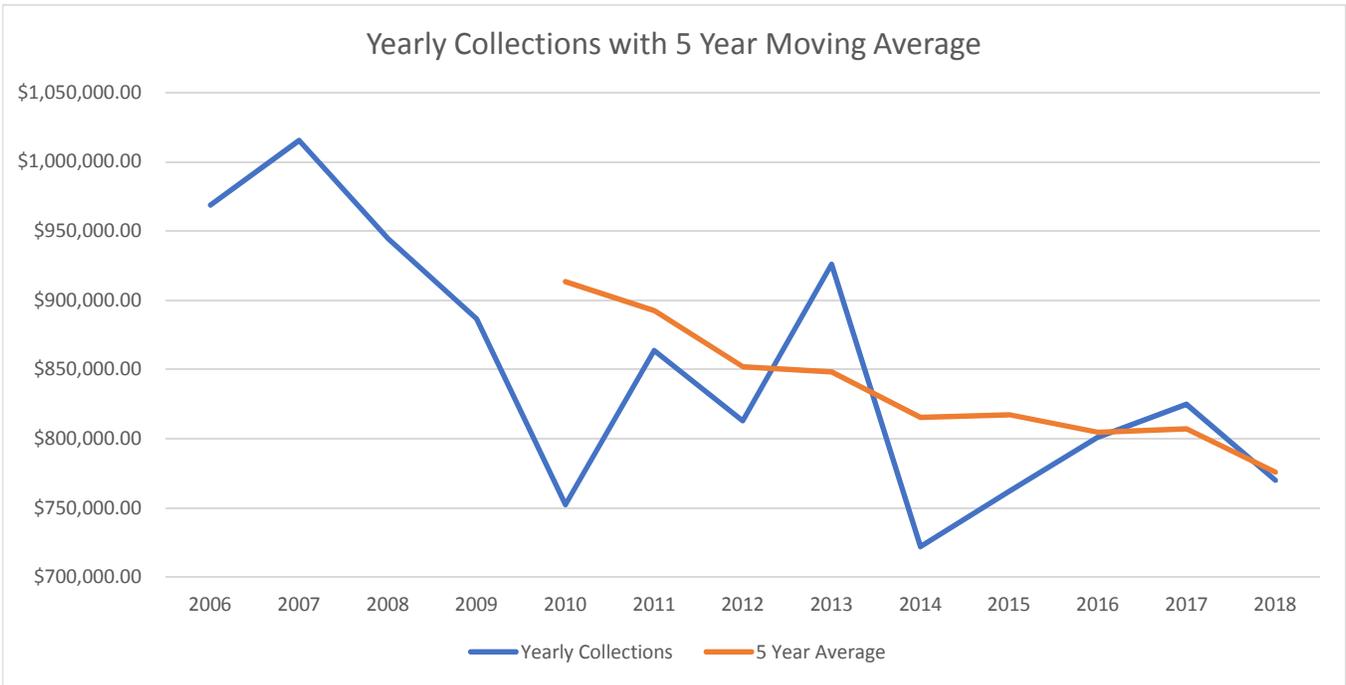
- Compare year to date collections with 5-year average
- Extrapolate out fiscal year end collections from current data

Monthly Collections with 5 Year Moving Average

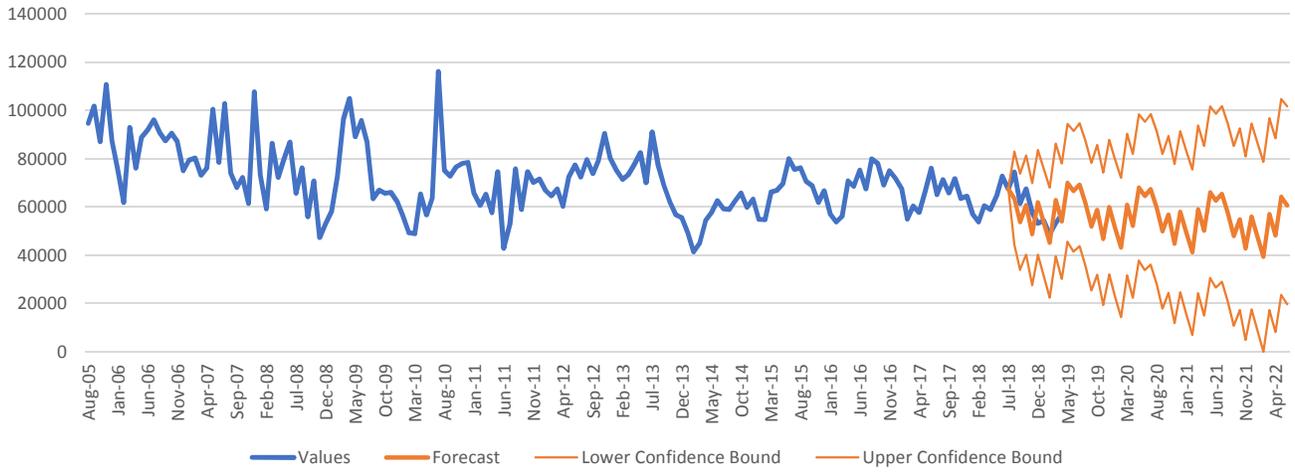


5 Year Monthly Moving Average

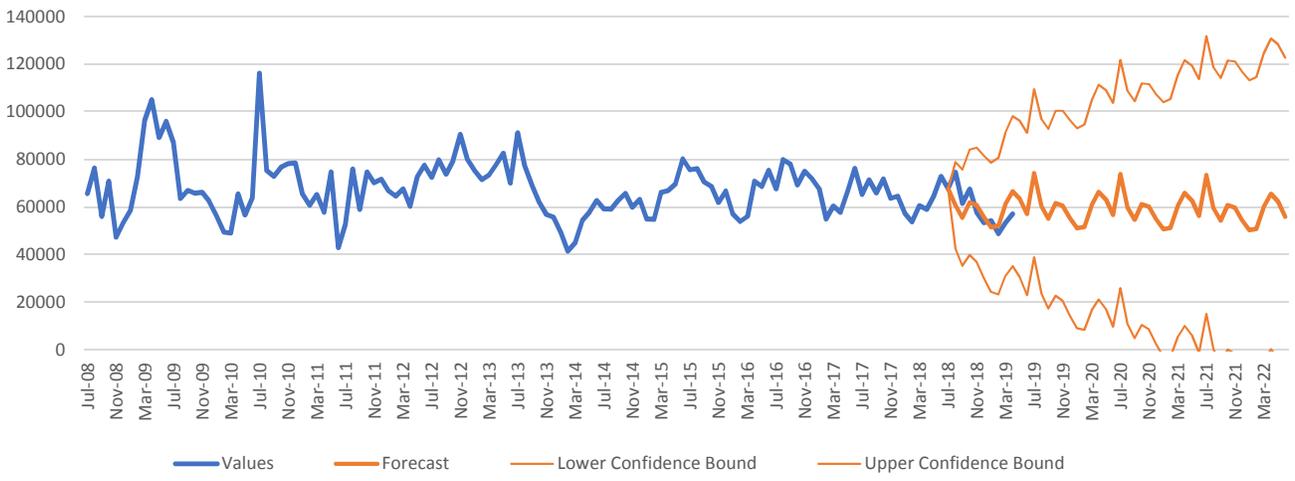




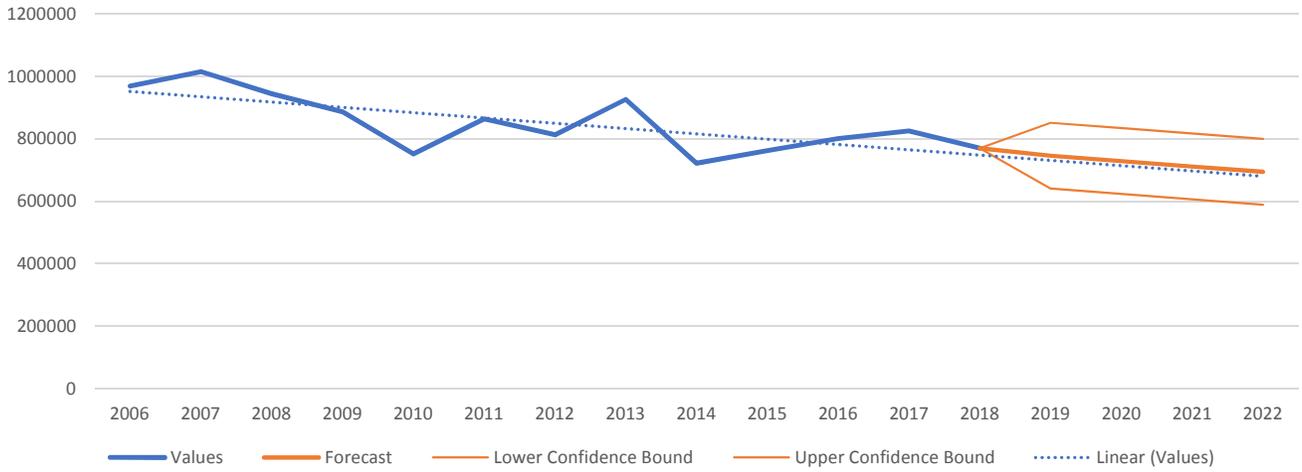
Monthly Smoothing - 90% CI - $\alpha=0.25$



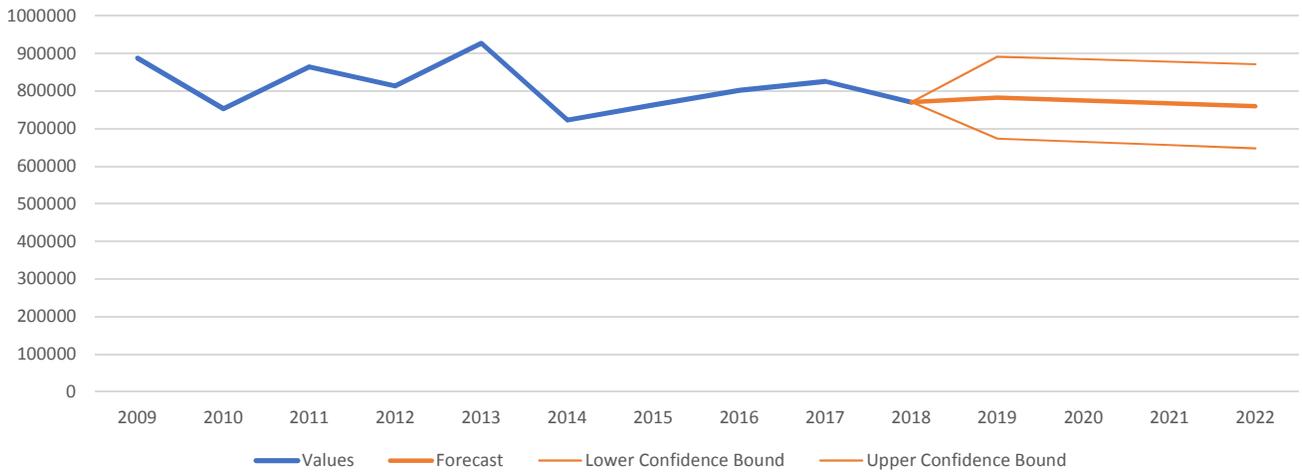
Monthly Smoothing - 90%CI - First 3 Years Removed - $\alpha=0.75$



Yearly Smoothing - 90% CI - $\alpha=0$



Yearly Smoothing - 90% CI - Remove 3 Years - $\alpha=0.13$



	Monthly Forecast		Yearly Forecast	
	Regular	Remove 3 Years	Regular	Remove 3 Years
2019	\$ 708,490	\$ 656,394	\$ 745,947	\$ 781,530
2020	\$ 688,799	\$ 715,765	\$ 728,748	\$ 773,943
2021	\$ 665,424	\$ 711,048	\$ 711,550	\$ 766,357
2022	\$ 642,048	\$ 706,331	\$ 694,352	\$ 758,771
Total of Period	\$ 2,704,761	\$ 2,789,538	\$ 2,880,597	\$ 3,080,601

