

Blue Moon? - or - Busch Light?

Best Estimators of Economic Restraints

- BEER Prediction -



On the forecasting of personal financial spending habits exhibiting sparsity, leptokurtosis, temporal correlations, and small- sample-size observations

~ Mark Kurzeja ~

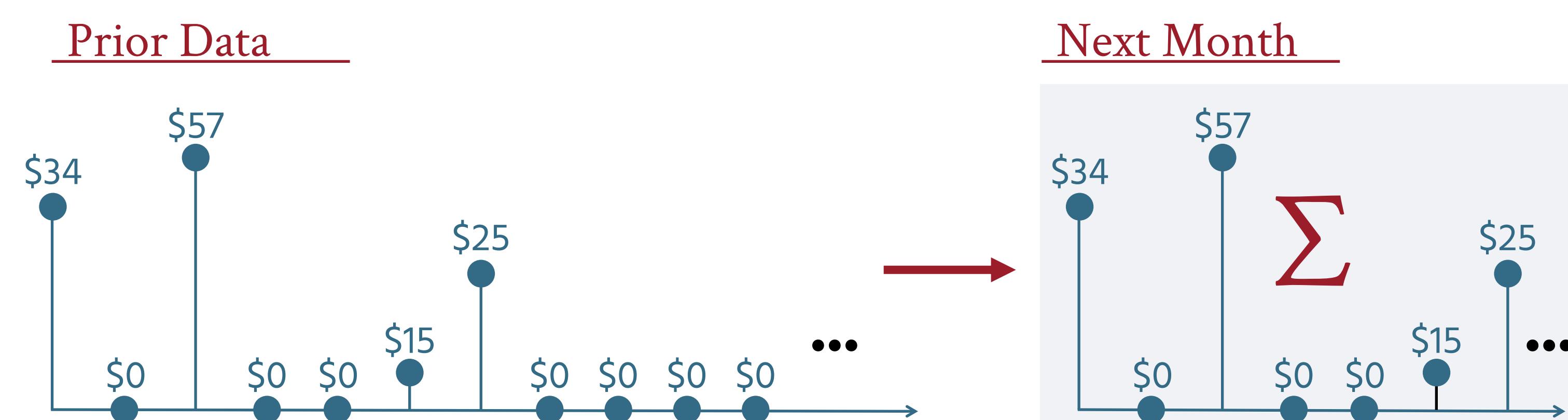
PROBLEM STATEMENT

Imagine you and I are out for drinks. We go to the bar, and begin talking about predicting the future. Annoyed with my optimism about prediction, you say to put my money where my mouth is, and you offer me the following bet:

“Pull out a piece of paper. Write down the exact dollar amount that you think you’re going to spend this month on anything you like. If you’re right, within \$100, I’ll give you \$1,000. Otherwise, you will owe me \$1,000”

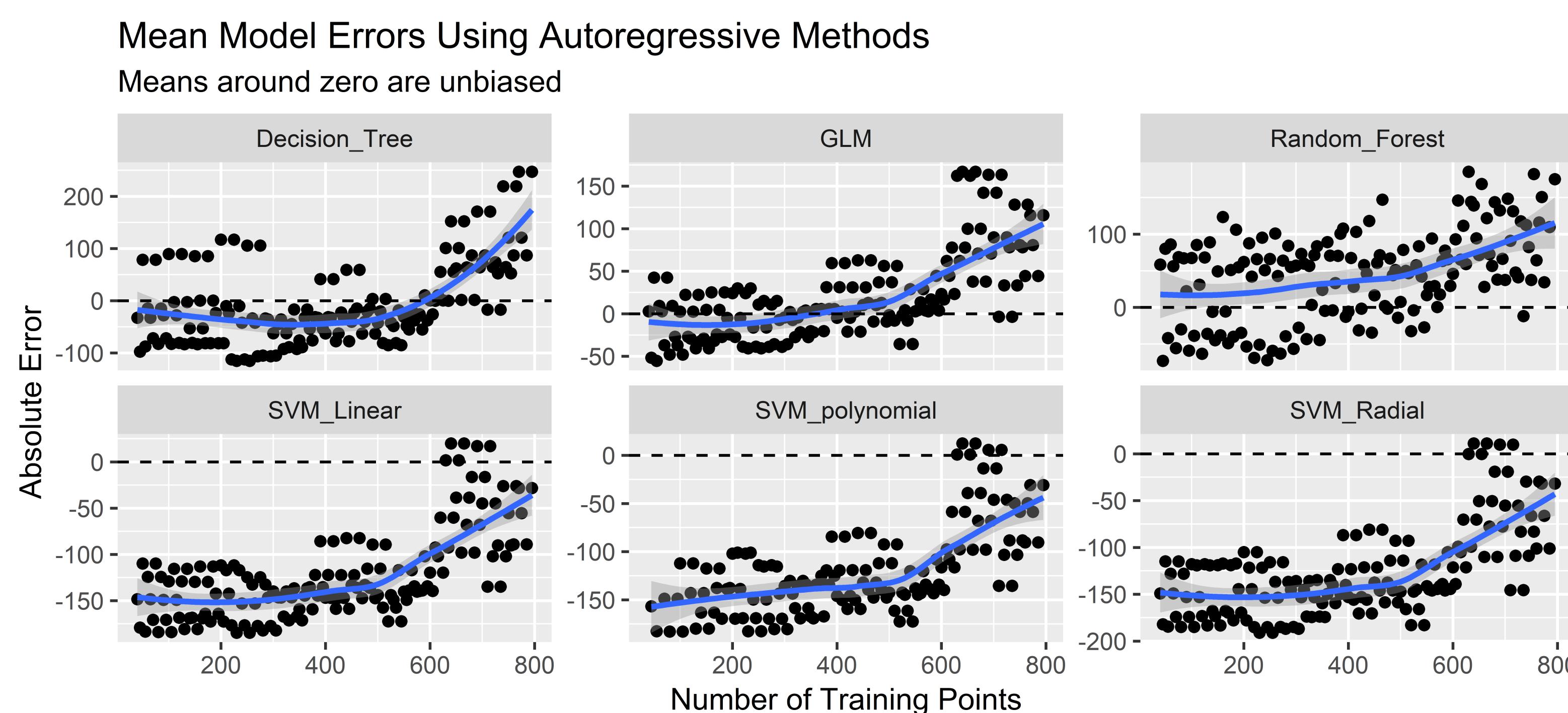
Do you think I should take the bet? If the payoffs or tolerance were different should I take the bet? How would this change my spending in the short term? I'm at a bar, after all. Should I order a cheaper Busch Light instead of my favorite beer, a Blue Moon, to avoid the chance of going over? Would little changes like that make a difference?

Wouldn't it be nice to predict spending in advance so that you don't have to wonder? Whether its to lessen the surprise of the unpredictable, or to decide what beer you're able to afford for the night, BEER prediction aims to inform personal financial decisions in the short term for long term success



AUTOREGRESSIVE METHODS

Autoregressive models attempt to model time series data using regression models. The covariates are the lags themselves. These models were trained on the raw time series to discern if they could remain unbiased despite the issues inherent in the data.

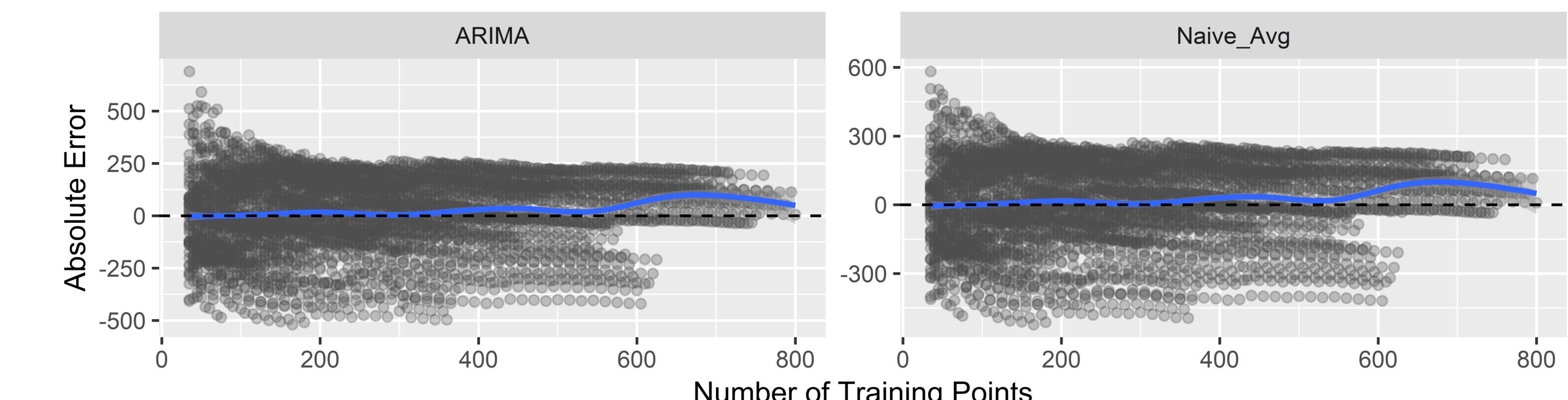


In some cases, methods predict the mean structure reasonably well, but fail to handle the variance appropriately. We see the bias-variance tradeoff with most methods. However, two methods are worth further exploration. They are both remarkably unbiased for large parts of the training space: namely Prophet from Facebook and the Random Forest model using the tuple \rightarrow tuple maps. They can be trained on as few as 50 or as many as 500 samples without exhibiting significant bias in the estimates. Future research will be dedicated towards controlling the variance of these mean estimates to provide tight bounds on the predictive intervals.

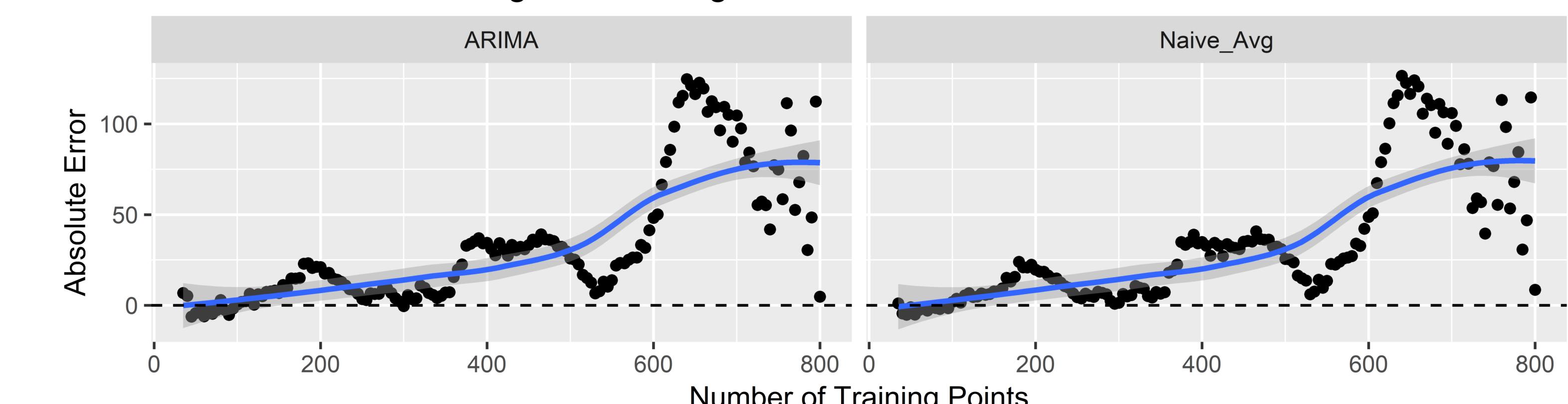
NAÏVE APPROACH

The first two baseline methods that were used were the classic ARIMA model and the utilization of a lookback average to extrapolate the next month. The lookback average was calculated by taking windows of different training sizes, computing the average of the window, and then scaling this estimation linearly to a monthly time scale.

Null Case: Using Past Averages and ARIMA to Predict New Points



Null Case Means: Using Past Averages and ARIMA to Predict Future Outflows

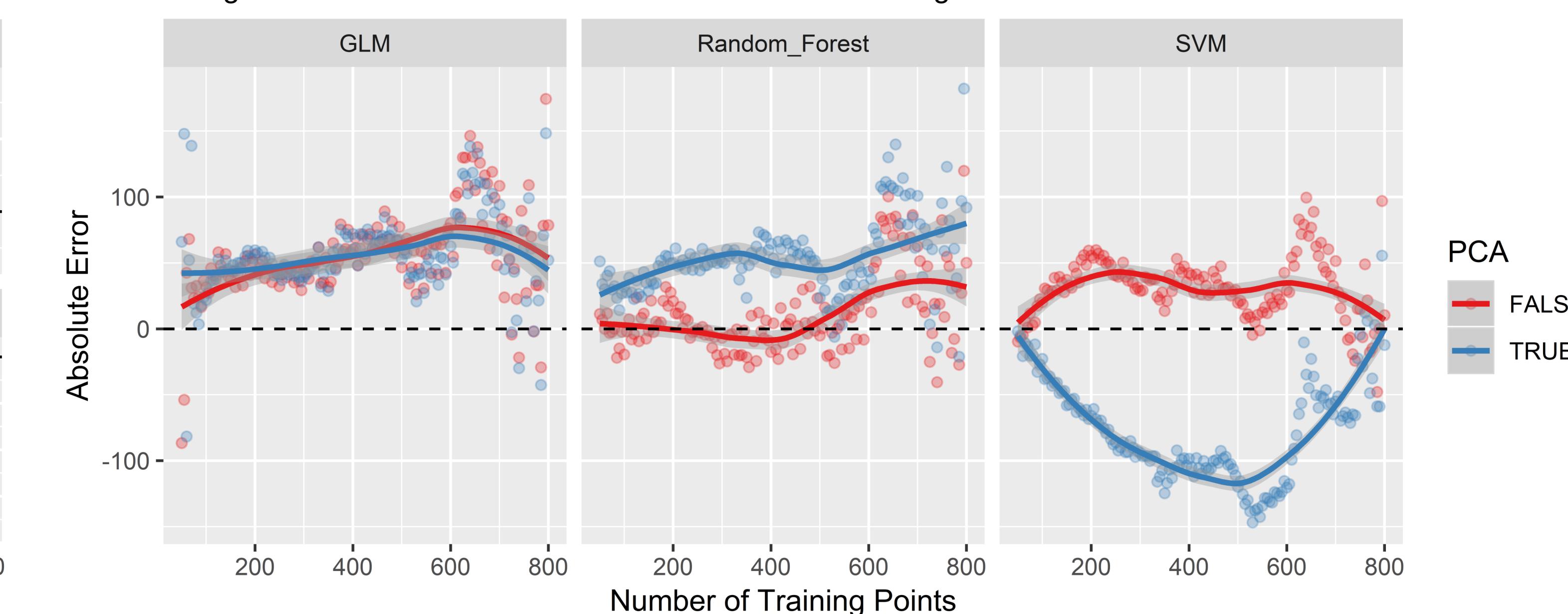


MARKOV AUTOREGRESSIVE MODELS

By aggregating the data into (Dollar Amount, Days till next Payment) tuples, I assumed a Markov style transition from tuple → tuple, using regression to learn the mean function maps in two dimensions. The models were trained on both the normal models and principal components models to attempt to break correlations in the regression

Estimating the Joint Distribution of Spending and Days Till Next Purchase

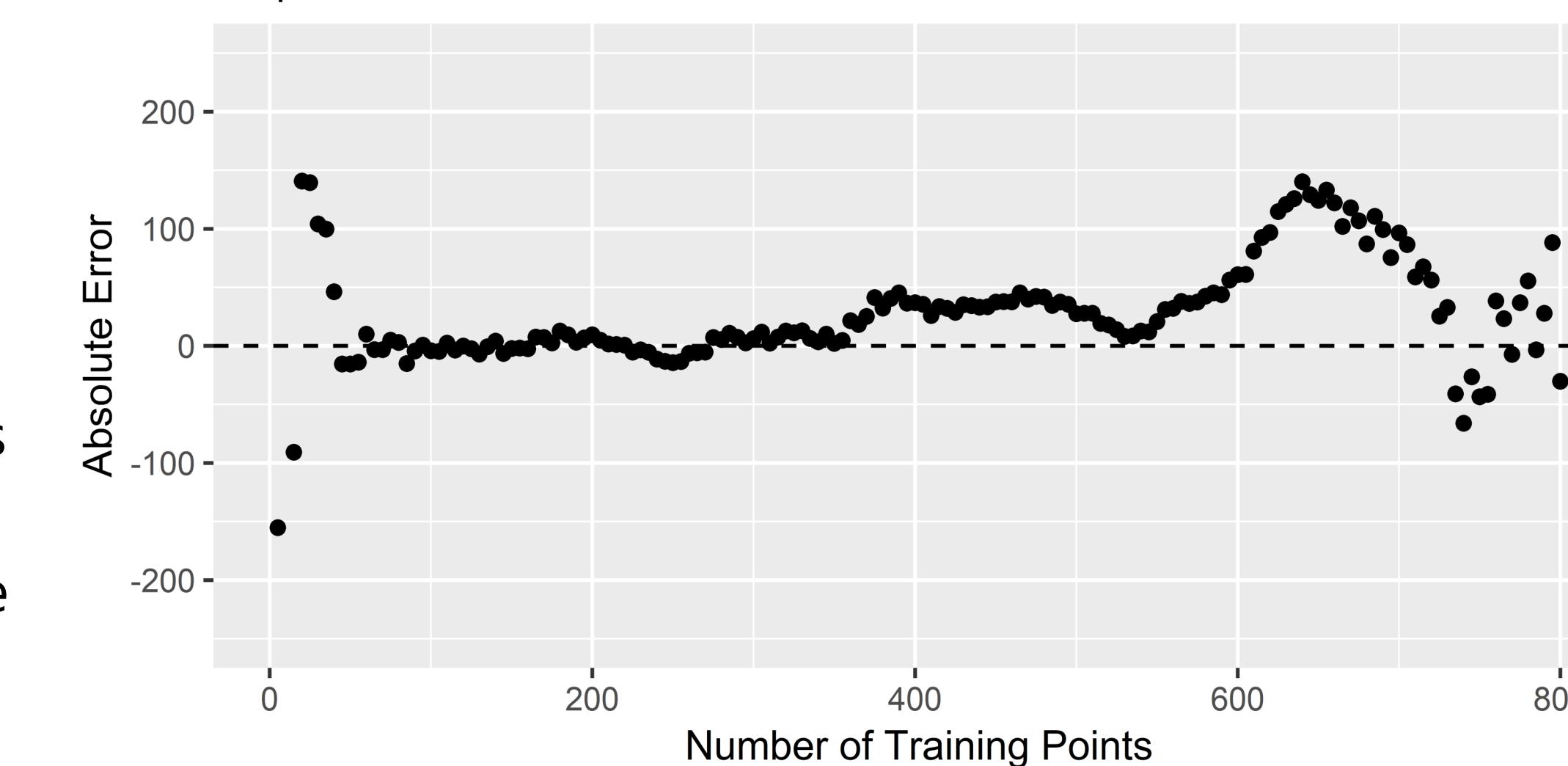
Using SVD to remove correlation introduced bias on average



MOST PROMISING BEER MODELS

Mean of Facebook Prophet Predictions

Prophet Predictions on the raw series



Random Forest Tuple->Tuple Mapping

Mean of Random Forest predictions Using raw tuple->tuple pairings

