Richmond Bank Core Deposit Forecasting

Forecasting Methods
SCMA-669-902-2021Spring
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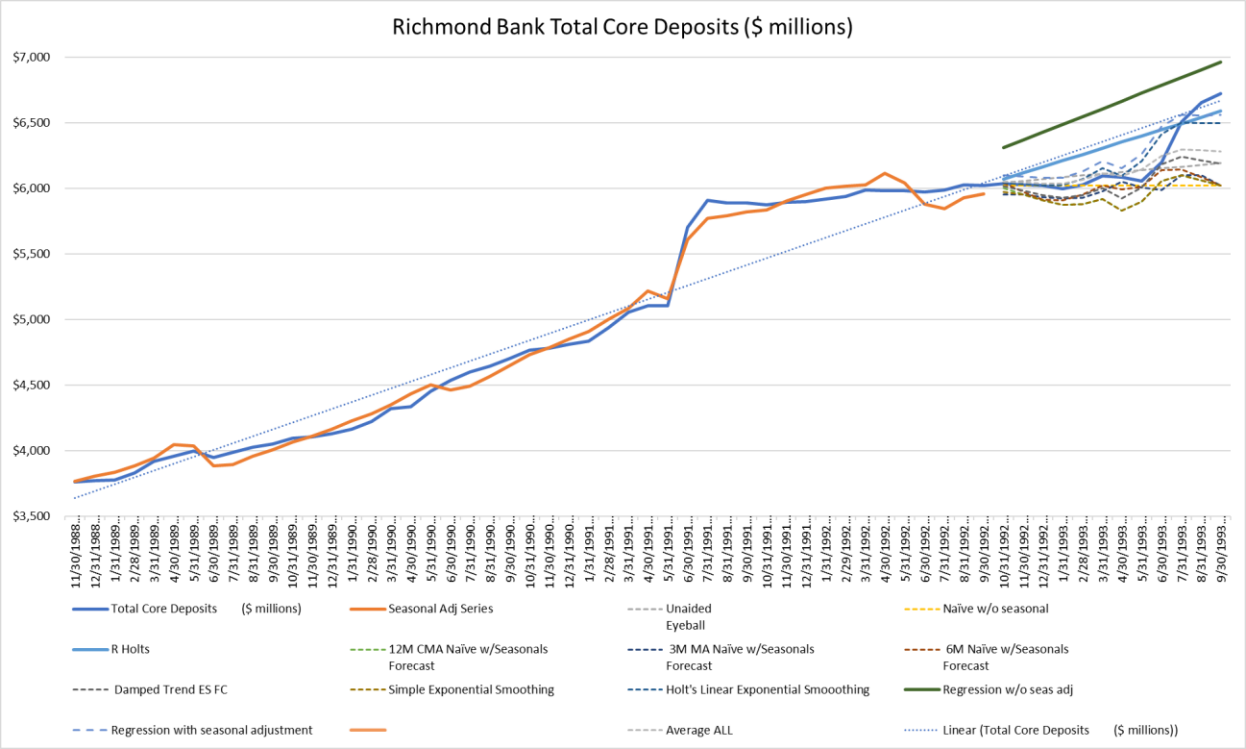
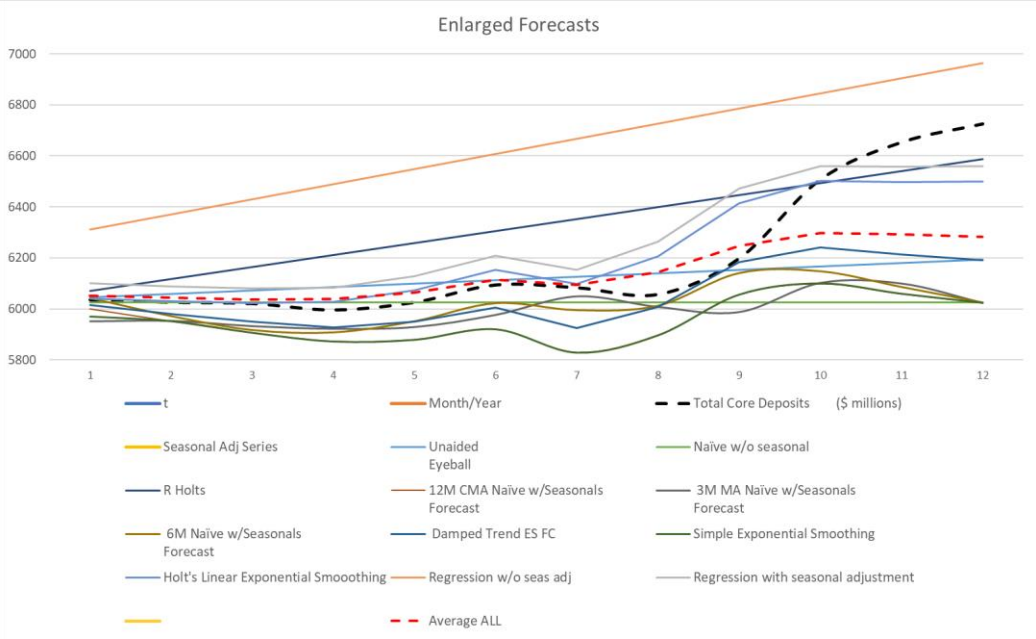
I chose the Core Deposits data set, well, because it's from a bank of our own Richmond, VA. There are 47 rows of data and I forecasted up to one year ahead. The **Holt's Linear Exponential Smoothing** is the "best forecast" because it had the overall lowest "Quick and Dirty" MAPE (1.2%), the lowest overall Maximum MAPE (3.49%), and consistently more accurate projections for each of the forecast horizons. Below in green are the out of sample top two methods for forecasting each horizon of the 1, 5, 9, and 12 months ahead.

	F/C Horizon			
	1 Mo.	5 Mo.	9 Mo.	12 Mo.
Naive	1.39%	3.01%	6.64%	10.42%
3M MA Naïve w/Seasonals	1.45%	3.25%	6.06%	10.42%
Simple ES	1.86%	3.15%	5.49%	10.42%
Holt's Linear Exponential Smooothing	1.18%	2.15%	3.44%	3.36%
Damped Trend ES FC	1.35%	2.46%	2.51%	7.96%
Regression W/o Sea Adj.	4.33%	6.44%	6.20%	3.54%
Reg with Seasonal adj	1.81%	2.08%	3.06%	2.45%

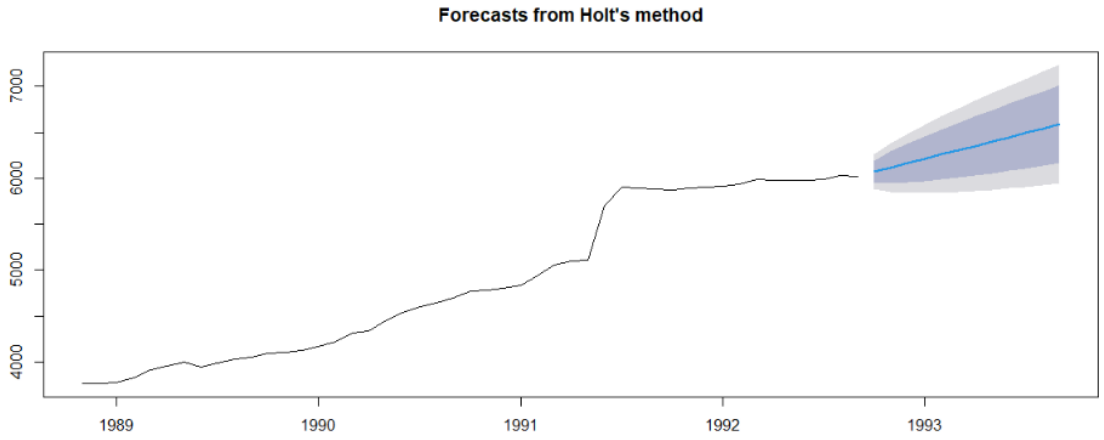
This dataset had some surprises I had to deal with. A little less than ¾ through the data (6/30/1991-7/31/1991), there was a noticeably significant increase in total core deposits that then appeared to follow at a decreased slope. After this was recognized, adjustments were made accordingly throughout various forecasts. Something interesting about the actual data provided was the rather sharp increase after June 1993. The models did not quite pick up the turbulence needed around this time because of the lack of inconsistency/data of previous increases around the same past months.



Overall, the Unaided, Holts Linear ES, and both regressions overestimated while the Naïve, 12M CMA, 3M MA, 6M MA, Damped Trend ES, and Simple Exponential Smoothing underestimated. I have "smoothed" the forecasts and enlarged the vertical axis bounds for easier viewing and comparison.



The regression w/o seasonal adjustment is the most notable inaccurate forecast (orange line). For a few of the forecasts, Alpha's and Beta's were being maxing out on the scale of zero to one. The simple exponential smoothing used an Alpha of one, the Dampened Trend ES used an Alpha of one, and a theta of almost one while also the Holt's Linear ES model used an Alpha of one and a Beta of zero. When experimenting with variations of each, it made sense to keep at those values or otherwise the forecast would be on a too much downward of a trend. After seeing the holdout data, I believe they were maxed out because the data was due for a sharp increase to continue on the correct upward slope path (to minimize the MSE) but it was hard to see with the naked eye. Forecasting with R had its positives and negatives. As discussed earlier in the semester for our R presentation, it took a little time to be able to read in and use the data. Once the data was labeled correctly as time series, a very simple holts' function was used (with the forecast library). This model did not seem to use seasonality but rather provide confidence intervals of possible forecast values ("R_Software_Model" tab).



The Quick and Dirty comparison with conditional formatting gives a good overview of how each of the forecasts did at different time periods. As noted earlier and indicated in the later years, the percentages are increasing because many of the models underestimated after June 1993. The Average column had a rather impressive performance of the forecasts combined and consistently small errors until the later months. This would have been even better if the Regression without seasonal adjustment were to be removed from the error population.

Month	Unaided Eyeball	Naïve w/o seasonal	R Holts	12M CMA Naïve w/Seasonals Forecast	3M MA Naïve w/Seasonals Forecast	6M Naïve w/Seasonals Forecast	Damped Trend ES FC	Simple Exponential Smoothing	Holt's Linear Exponential Smooothing	Regression w/o seas adj	Regression with seasonal adjustment	Average	
10/31/1992	0.14%	0.20%	0.59%	0.59%	1.40%	0.09%	0.35%	1.09%	0.07%	4.54%	1.06%	0.26%	
11/30/1992	0.53%	0.03%	1.54%	1.23%	1.20%	0.92%	0.76%	1.23%	0.07%	5.70%	1.03%	0.32%	
12/31/1992	0.84%	0.05%	2.40%	1.90%	1.46%	1.74%	1.20%	1.90%	0.03%	6.77%	0.98%	0.26%	
1/31/1993	1.48%	0.47%	3.61%	2.06%	1.23%	1.48%	1.13%	2.06%	0.52%	8.21%	1.45%	0.71%	
2/28/1993	1.20%	0.03%	3.87%	2.44%	1.60%	1.25%	1.28%	2.44%	0.77%	8.66%	1.69%	0.65%	
3/31/1993	0.29%	1.15%	3.49%	2.85%	1.92%	1.19%	1.48%	2.85%	0.98%	8.42%	1.90%	0.33%	
4/30/1993	0.69%	0.97%	4.45%	4.18%	0.55%	1.46%	2.60%	4.18%	0.23%	9.59%	1.13%	0.19%	
5/31/1993	1.35%	0.54%	5.67%	2.65%	0.81%	0.75%	0.83%	2.65%	2.47%	11.04%	3.40%	1.43%	
6/30/1993	0.74%	2.81%	4.02%	2.29%	3.38%	0.94%	0.24%	2.29%	3.49%	9.47%	4.43%	0.79%	
7/31/1993	5.25%	7.42%	0.19%	6.26%	6.22%	5.54%	4.09%	6.26%	0.09%	5.19%	0.82%	3.21%	
8/31/1993	7.13%	9.45%	1.68%	8.92%	8.31%	8.54%	6.61%	8.92%	2.33%	3.77%	1.43%	5.41%	
9/30/1993	7.92%	10.42%	2.03%	10.42%	10.42%	10.42%	7.96%	10.42%	3.36%	3.54%	2.45%	6.57%	
													MAPE
Average	2.30%	2.80%	2.79%	3.82%	3.21%	2.86%	2.38%	3.86%	1.20%	7.08%	1.81%	1.68%	2.98%
Max	7.92%	10.42%	5.67%	10.42%	10.42%	10.42%	7.96%	10.42%	3.49%	11.04%	4.43%	6.57%	
Min	0.14%	0.03%	0.19%	0.59%	0.55%	0.09%	0.24%	1.09%	0.03%	3.54%	0.82%	0.19%	

When comparing to the naïve, there were similar results however there were few models that did very good with many reaching close to or over one however Holt's Linear ES had the lowest percentages when being compared to the Naïve.

	Comparison to Naïve F/C Horizon			
	1 Mo.	5 Mo.	9 Mo.	12 Mo.
3M MA Naïve w/Seasonals	1.048	1.079	0.913	1.000
Simple ES	1.338	1.046	0.827	1.000
Holt's Linear Exponential Smooothing	0.853	0.716	0.518	0.322
Damped Trend ES FC	0.975	0.818	0.379	0.764
Regression W/o Sea Adj.	3.124	2.140	0.934	0.340
Reg with Seasonal adj	1.307	0.690	0.460	0.235

In my opinion, the models did not predict too bad, considering there was way less data available than the Clark Co. (47 vs 285 rows of data) but had lower percentage fits (on first page). Overall, my next thoughts on analyzing the forecasts would have been to figure out why many of the forecasts have made the sharp increase in the later months a little too early. If you look closely to months 3, 4, and 5 of 1989, there is a slight increase that may be causing the models to overestimate early.

To play it safe and allow for room to forecast a little over rather than under, the Holt's Linear Exponential Smoothing would be the best model to use for the majority of takeoff points due to the low MAPE, the lowest overall Maximum MAPE (3.49%), and consistent accurate projections for the majority of the forecast horizons. The numerical values for each forecast are listed below. All work is shown in excel workbook Bryce_Bowles_My_Forecast_Project.xlsx and Bryce_Bowles_My_Forecast.R.

Numerical values of each forecast

t	Month/Year	Actual/ Holdout Data	Unaided Eyeball	Naïve w/o seasonal	R Holts	12M CMA Naïve w/Seasonals Forecast	3M MA Naïve w/Seasonals Forecast	6M Naïve w/Seasonals Forecast	Damped Trend ES FC	Simple Exponential Smoothing	Holt's Linear Exponential Smooothing	Regression w/o seas adj	Regression with seasonal adjustment
48	10/31/1992	$ 6,036	$ 6,044.74	$ 6,024.00	$ 6,071.50	$ 6,000.49	$ 5,951.68	$ 6,041.51	$ 6,015.01	$ 5,970.24	$ 6,039.93	$ 6,310.05	$ 6,099.70
49	11/30/1992	$ 6,026	$ 6,058.15	$ 6,024.00	$ 6,118.50	$ 5,951.73	$ 5,953.58	$ 5,970.71	$ 5,980.40	$ 5,951.73	$ 6,029.98	$ 6,369.44	$ 6,088.16
50	12/31/1992	$ 6,021	$ 6,071.56	$ 6,024.00	$ 6,165.50	$ 5,906.53	$ 5,932.82	$ 5,916.13	$ 5,948.99	$ 5,906.53	$ 6,023.00	$ 6,428.82	$ 6,079.88
51	1/31/1993	$ 5,996	$ 6,084.97	$ 6,024.00	$ 6,212.50	$ 5,872.52	$ 5,922.53	$ 5,906.99	$ 5,928.52	$ 5,872.52	$ 6,026.92	$ 6,488.21	$ 6,082.86
52	2/28/1993	$ 6,026	$ 6,098.38	$ 6,024.00	$ 6,259.47	$ 5,879.05	$ 5,929.32	$ 5,950.83	$ 5,948.78	$ 5,879.05	$ 6,072.27	$ 6,547.60	$ 6,127.88
53	3/31/1993	$ 6,094	$ 6,111.79	$ 6,024.00	$ 6,306.46	$ 5,920.17	$ 5,977.13	$ 6,021.43	$ 6,004.01	$ 5,920.17	$ 6,153.65	$ 6,606.98	$ 6,209.51
54	4/30/1993	$ 6,083	$ 6,125.20	$ 6,024.00	$ 6,353.40	$ 5,828.72	$ 6,049.56	$ 5,994.04	$ 5,924.54	$ 5,828.72	$ 6,096.90	$ 6,666.37	$ 6,152.00
55	5/31/1993	$ 6,057	$ 6,138.61	$ 6,024.00	$ 6,400.40	$ 5,896.77	$ 6,008.14	$ 6,011.59	$ 6,007.01	$ 5,896.77	$ 6,206.84	$ 6,725.76	$ 6,262.93
56	6/30/1993	$ 6,198	$ 6,152.02	$ 6,024.00	$ 6,447.40	$ 6,056.22	$ 5,988.27	$ 6,139.53	$ 6,182.97	$ 6,056.22	$ 6,414.49	$ 6,785.14	$ 6,472.71
57	7/31/1993	$ 6,507	$ 6,165.42	$ 6,024.00	$ 6,494.40	$ 6,099.92	$ 6,102.50	$ 6,146.47	$ 6,241.06	$ 6,099.92	$ 6,500.87	$ 6,844.53	$ 6,560.37
58	8/31/1993	$ 6,653	$ 6,178.83	$ 6,024.00	$ 6,541.38	$ 6,059.54	$ 6,100.09	$ 6,084.77	$ 6,213.01	$ 6,059.54	$ 6,497.66	$ 6,903.92	$ 6,557.89
59	9/30/1993	$ 6,725	$ 6,192.24	$ 6,024.00	$ 6,588.37	$ 6,024.00	$ 6,024.00	$ 6,024.00	$ 6,189.62	$ 6,024.00	$ 6,499.15	$ 6,963.30	$ 6,560.39

(All values are in Bryce_Bowles_My_Forecast_Project.xlsx)