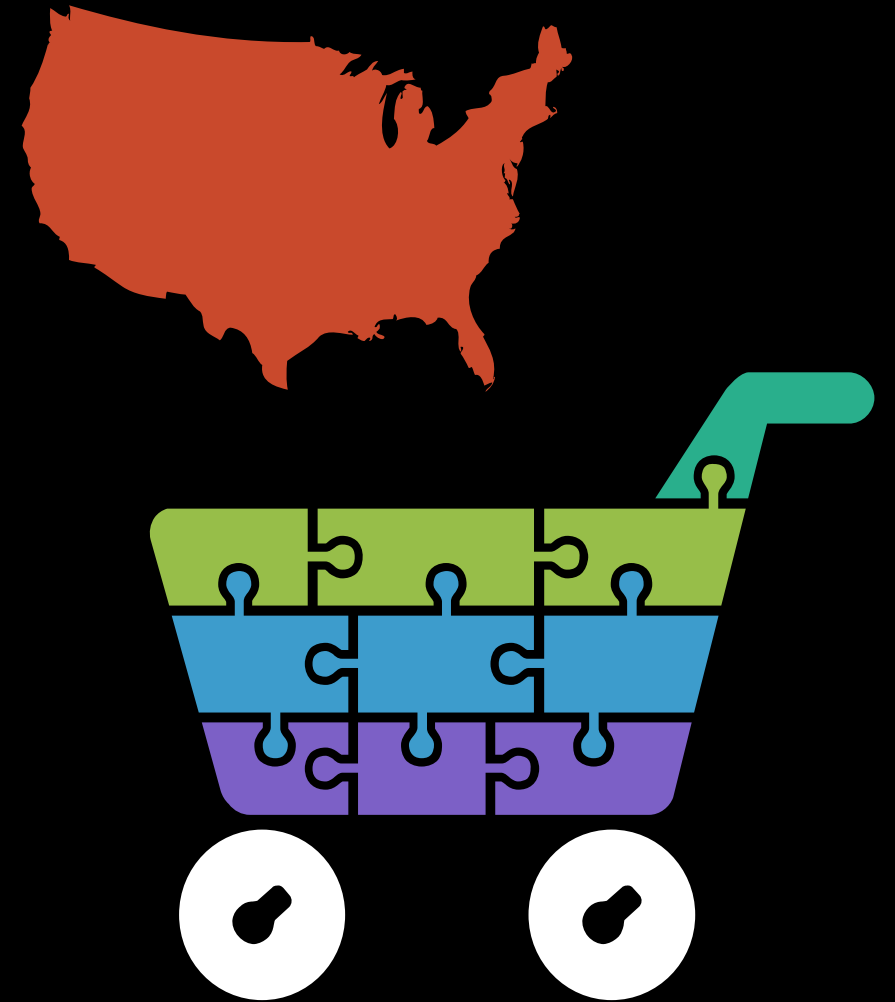


ECON6210

# US E-Commerce Retail Sales

Diane Zhu



# Introduction

E-Commerce Retail Sales are sales of goods and services where orders are placed and prices are negotiated over electronic networks.

With the rise of internet, E-Commerce has taken major consumer markets

## China

Alibaba's 2017 Singles' Day smashes record with \$25B of sales!

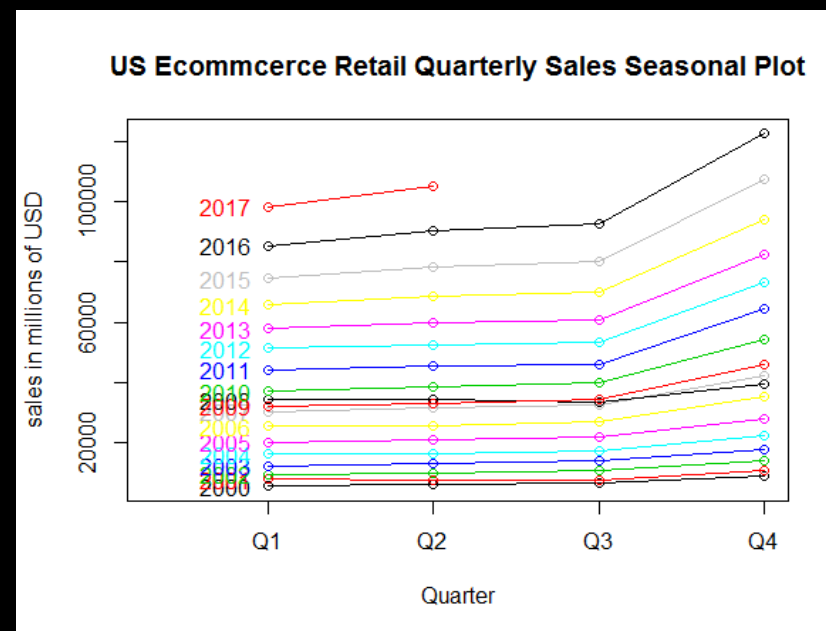
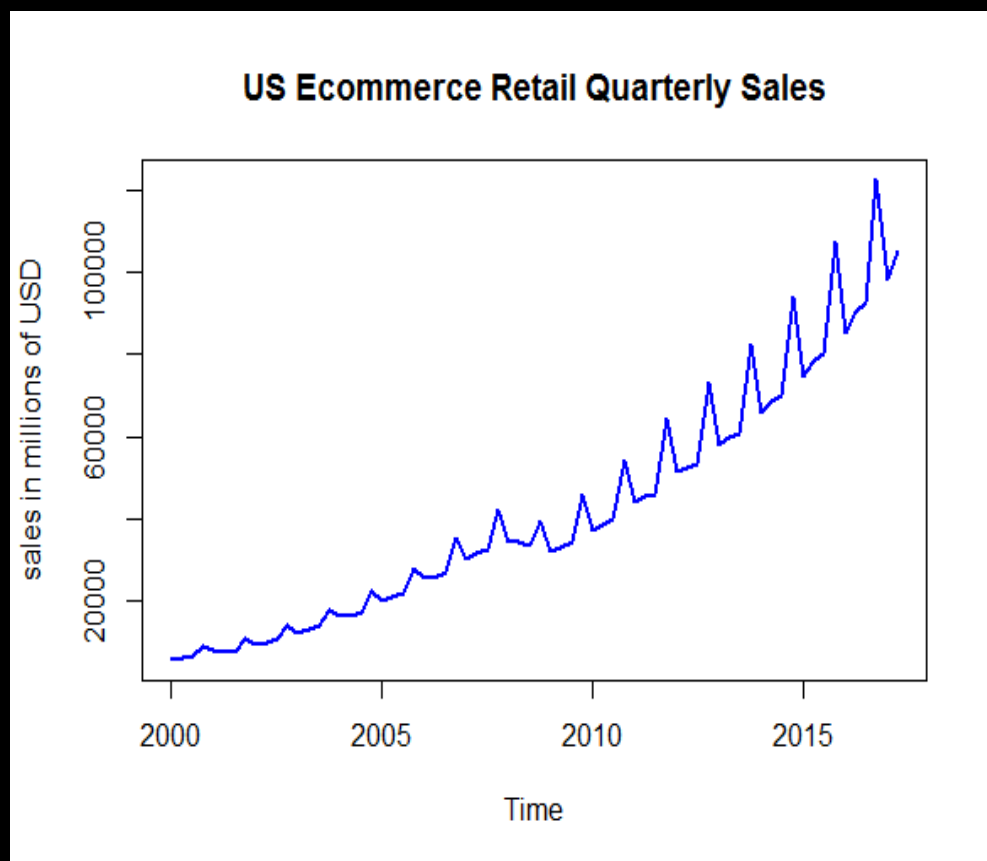
## USA

Share of e-commerce sales in total retail sales accounts for 9.1% Q3 2017  
Amazon is the biggest e-commerce retailer; 70% of revenues comes from online sales



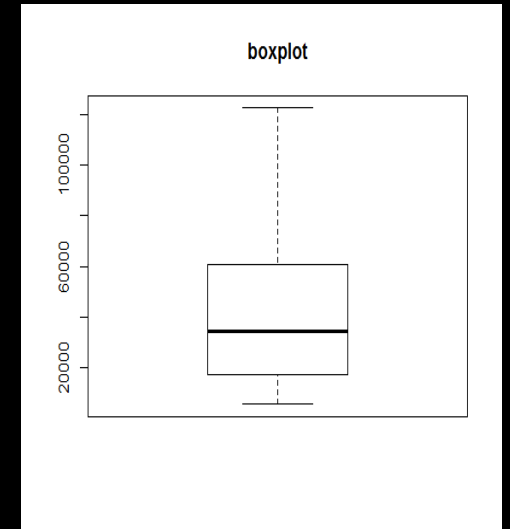
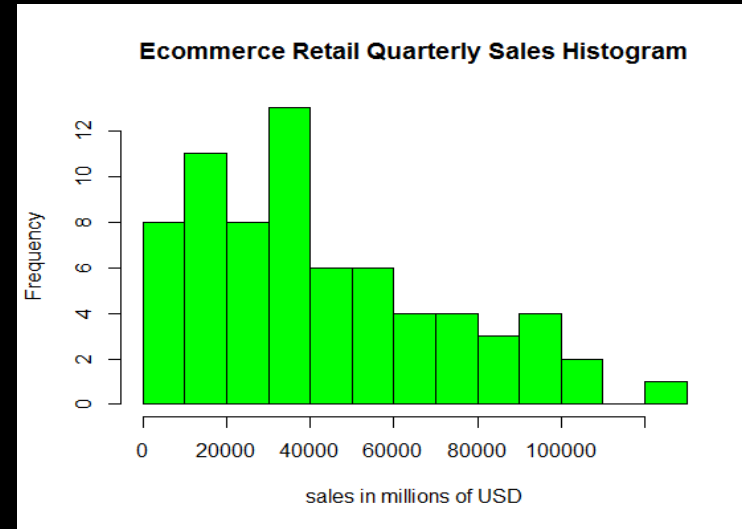
# Descriptive Data

**Time** 2000 Q1 to 2017 Q2      **Source** FRED

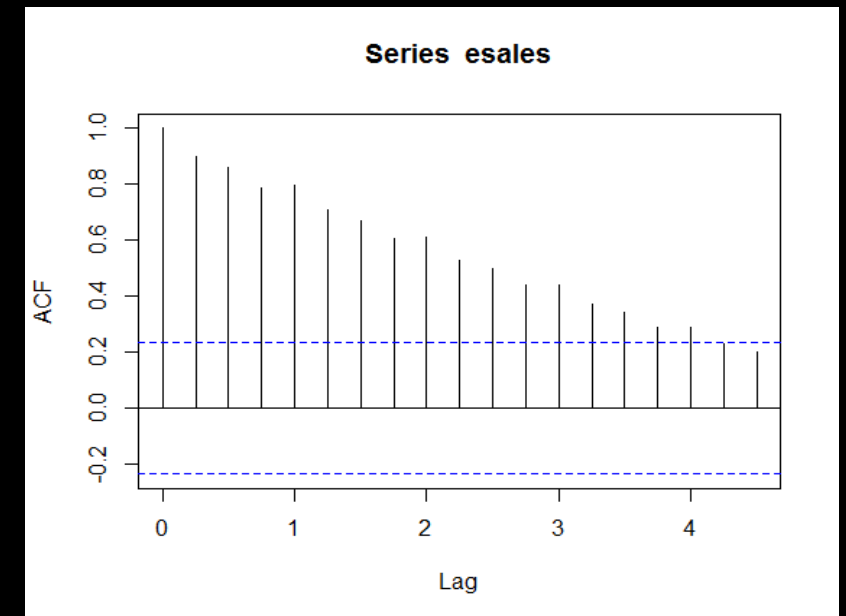
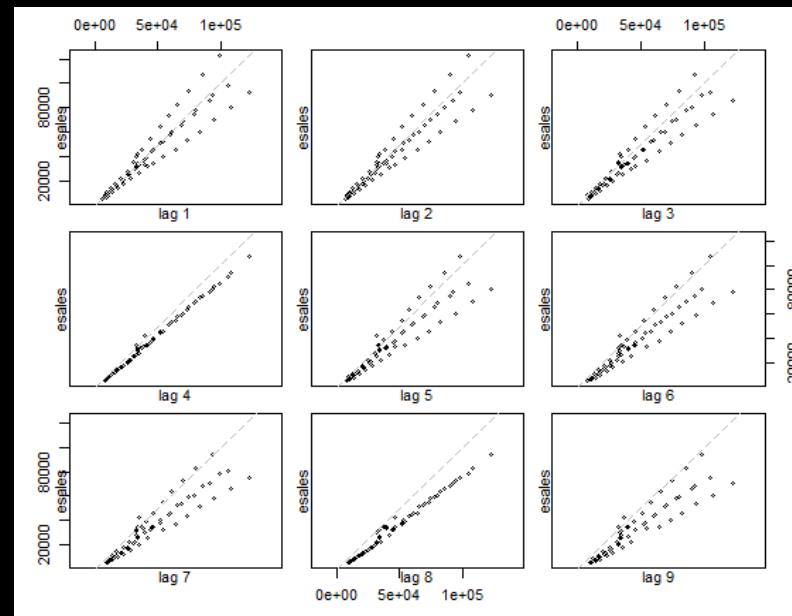


# Summary Statistics

Min. 1st Qu. Median Mean 3rd Qu. Max.  
5562 17511 34380 42272 60411 122515  
(In millions of dollars)

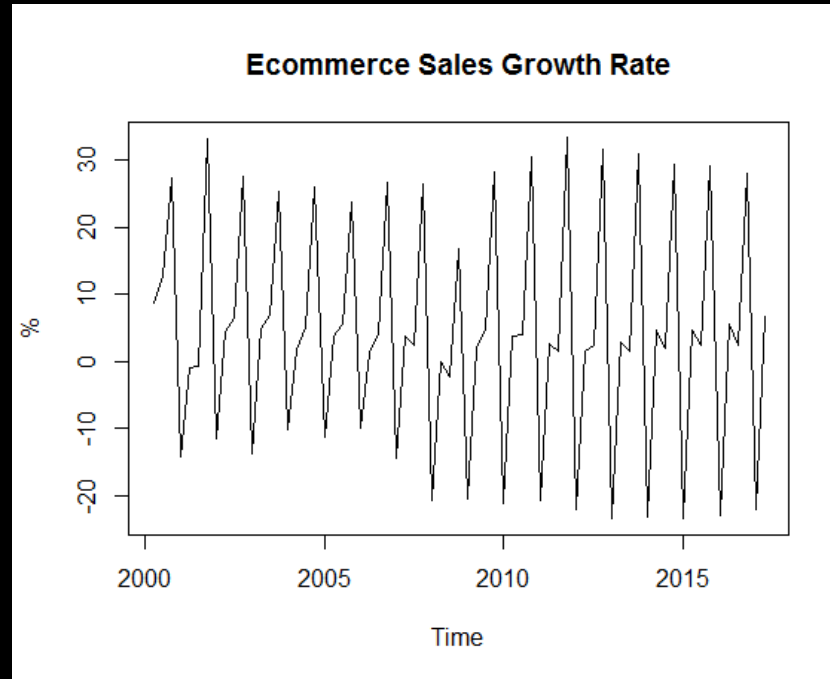
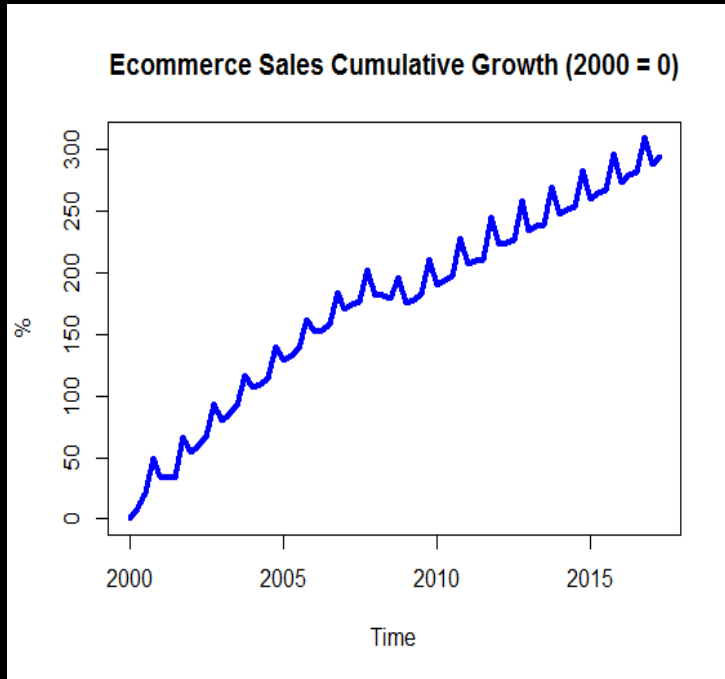


# Autoregression Test

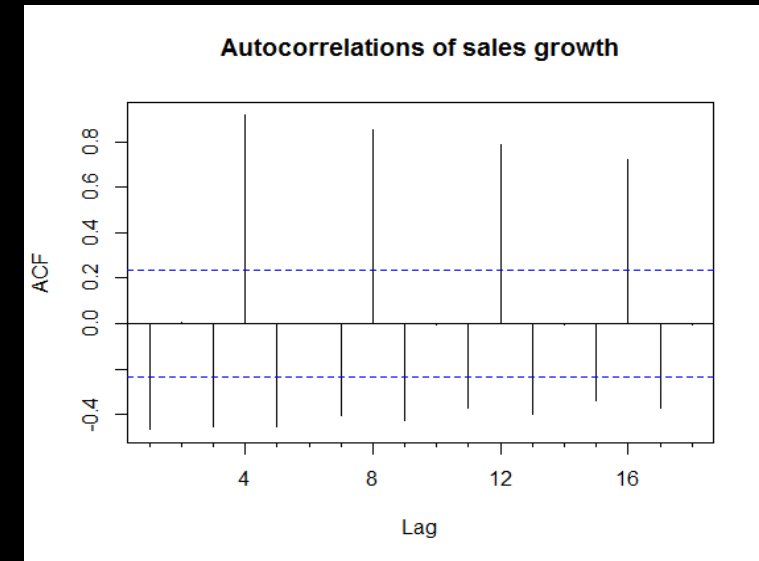


# Sales Growth Rate

Natural logs to compute % sales growth



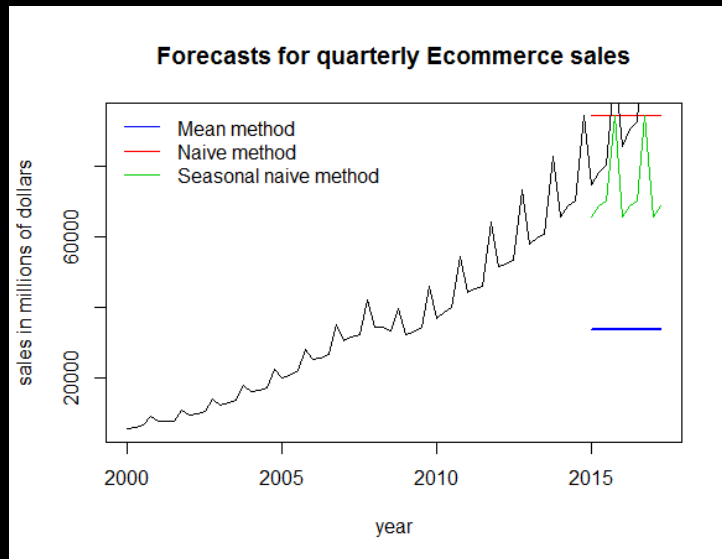
Peaks are four quarters apart



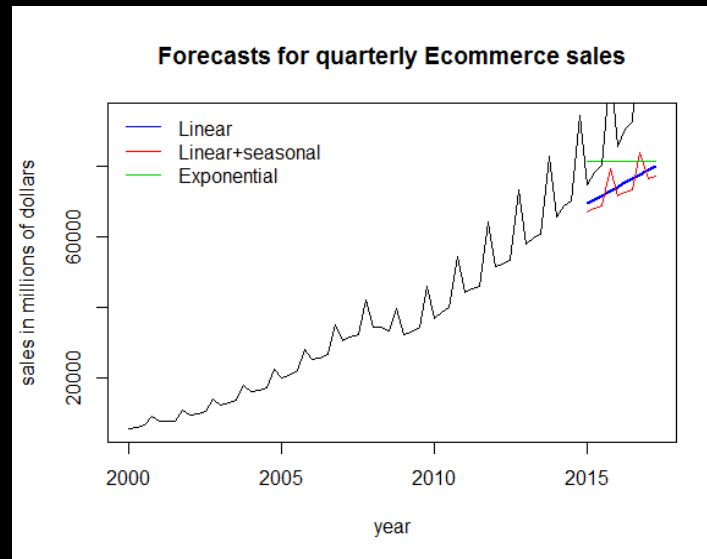
Strong and consistent seasonality; varies hugely throughout the year

# 17 Forecast Methods

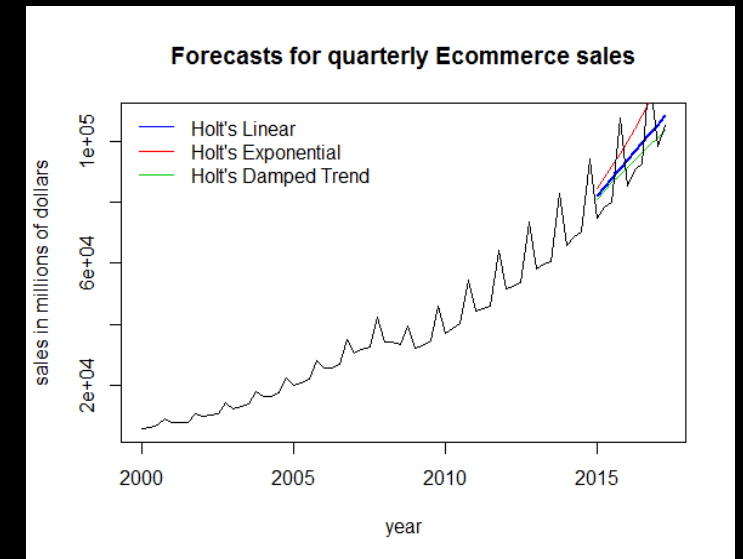
80%: training data (2000 to 2017); 20%: testing data (2015 to Q2 2017)



Mean  
Naïve  
Seasonal Naive

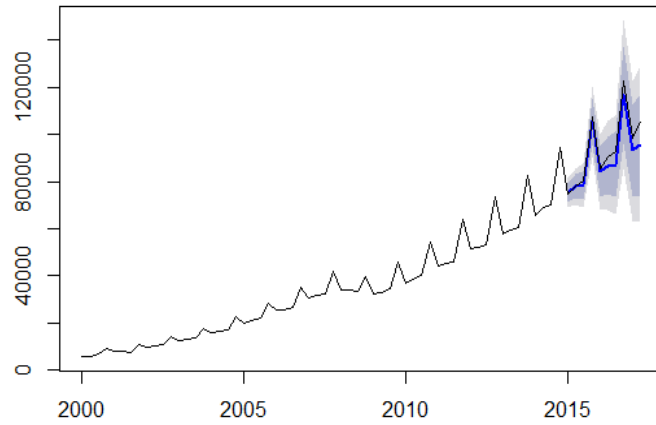


Linear Trend  
Linear Trend + Seasonal  
Exponential

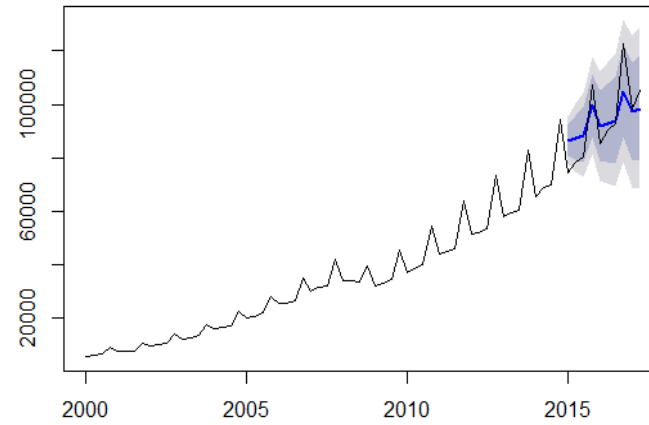


Holt's Linear  
Holt's Exponential  
Holt's Damped Trend

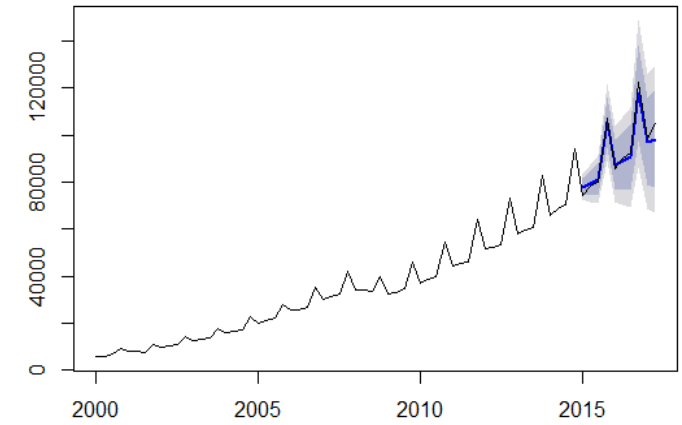
Forecasts from Holt-Winters' multiplicative method



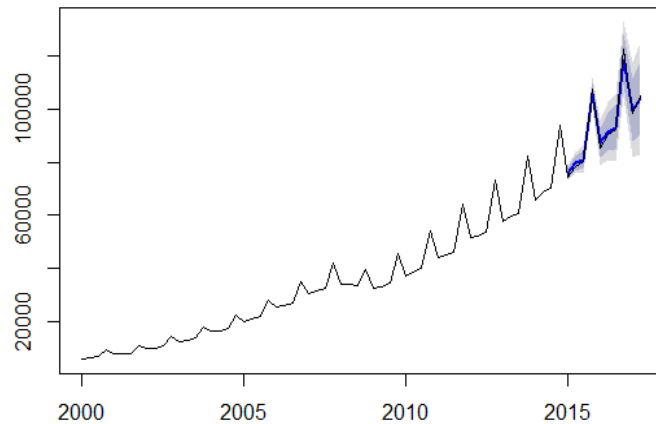
Forecasts from STL + Random walk with drift



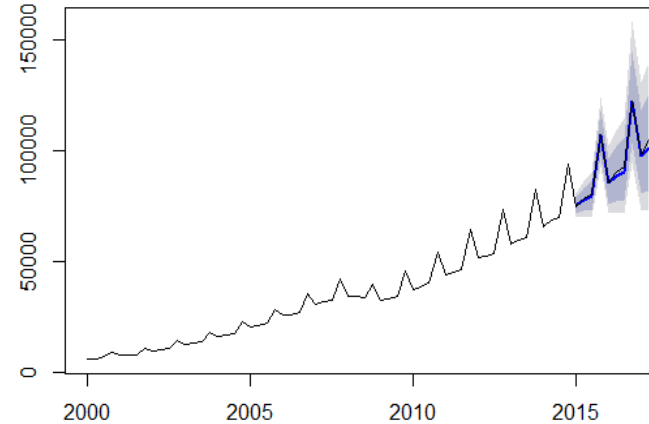
Forecasts from ETS(M,A,M)



Forecasts from ARIMA(0,1,0)(2,1,0)[4]



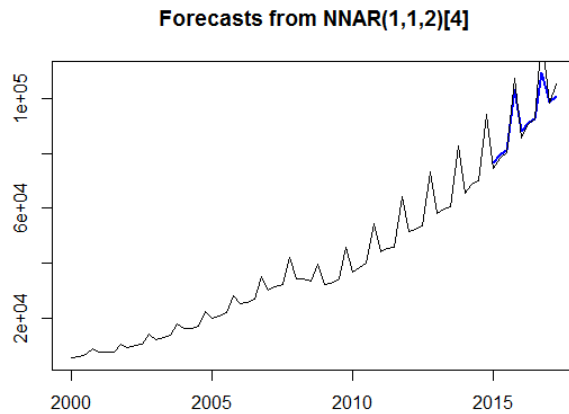
Forecasts from ARIMA(0,1,0)(0,1,1)[4]



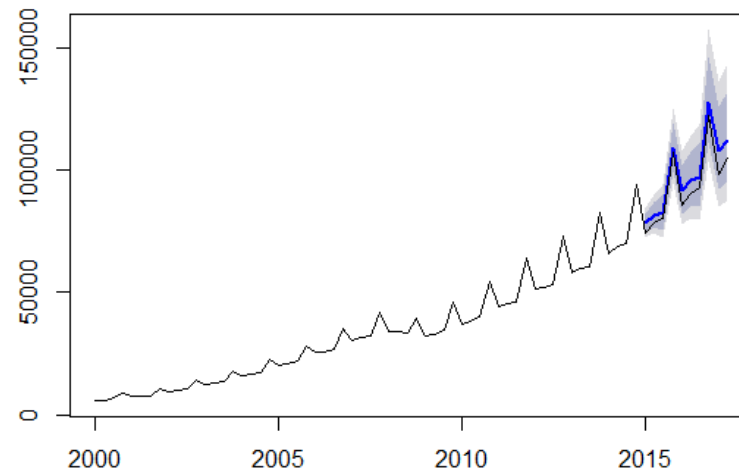
Holt-Winter's Multiplicative  
STL  
ETS  
  
ARIMA  
ARIMA log transformation

# Moreover..

ANN

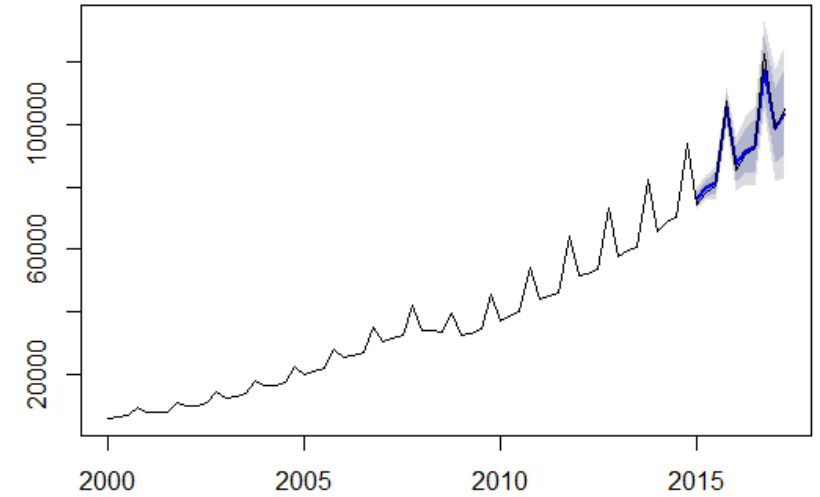


Forecasts from TBATS(0.047, {4,0}, 1, {<4,1>})



TBATS

Forecasts from auto.arima with weight 0.5  
Forecasts from ets with weight 0.5



HYBRID



## Accuracy Measures

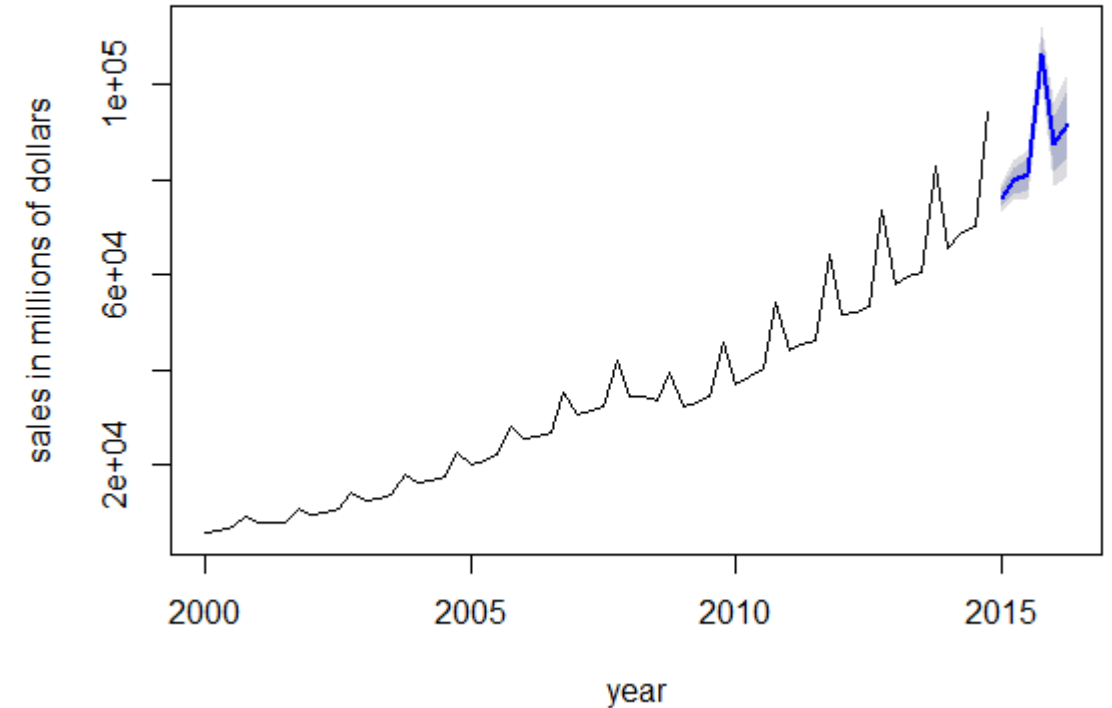
	ME	RMSE	MAE	MPE	MAPE	MASE	ACF1	Theil's U
<b>ARIMA test (log)</b>	<b>934.4749</b>	<b>1587.035</b>	<b>1066.962</b>	<b>0.962523</b>	<b>1.13463</b>	<b>0.211263</b>	<b>0.021684</b>	<b>0.094828</b>
ARIMA test	-324.354	1674.208	1471.478	-0.57205	1.561673	0.291359	-0.21399	0.099317
Hybrid test	-90.4632	2012.242	1696.276	-0.3762	1.77125	0.33587	-0.16956	0.12098
ETS test	1038.503	3134.33	2559.121	0.734028	2.667839	0.506717	0.14988	0.175381
ANN test	1463.377	4788.338	2982.549	0.997675	2.858992	0.590558	-0.17613	0.292727
Holt Winters test	3406.901	4484.507	3559.968	3.385482	3.590743	0.704889	0.500369	0.262906
TBATS test	-4943.45	5410.614	4943.455	-5.29756	5.297555	0.978826	0.456383	0.299584
STL test	-684.94	8754.818	7309.31	-2.11492	7.923312	1.447275	0.121379	0.512823
Holt damped test	982.6861	10438.3	7812.198	-0.28847	7.937521	1.54685	-0.27502	0.664879
Holt linear test	-1704.88	10276.94	9039.205	-3.08418	9.451351	1.789802	-0.33029	0.643676
Naive test	-688	14291.83	12021.6	-3.00524	13.0217	2.38033	0.192648	0.841458
Holt ES test	-9072.87	13709.34	13339.64	-10.7031	14.4535	2.641307	-0.31885	0.803924
ES test	12103.2	18715.52	14332.28	10.98651	13.91402	2.837855	0.192648	1.146369
linear trend test	18851.21	22400.42	18851.21	18.78294	18.78294	3.732622	-0.01283	1.398127
linear t+s test	19654.02	21699.25	19654.02	20.05306	20.05306	3.891582	0.162149	1.332881
S. Naive test	20305	22373.2	20305	21.13641	21.13641	4.020479	0.711209	1.292596
Mean test	59741.78	61423.64	59741.78	63.09631	63.09631	11.82914	0.192648	3.742561

# Forecast the Next 6 Qs

## Log Transformed ARIMA

Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2015 Q1	76043.16	74126.88	77959.44	73112.46 78973.86
2015 Q2	79761.39	77051.36	82471.42	75616.75 83906.03
2015 Q3	81145.74	77826.64	84464.84	76069.61 86221.86
2015 Q4	106197.33	102364.76	110029.89	100335.92 112058.73
2016 Q1	87379.05	81669.75	93088.34	78647.44 96110.65
2016 Q2	91610.23	84503.65	98716.81	80741.66 102478.80

Forecasting Next 6 Periods using ARIMA(log)



# Next Step: Multivariate Analysis

GDP

Personal  
Consumption  
Expenditure

Personal  
Disposable  
Income

Internet  
Users

Social Media  
Marketing  
Revenue

VAR Model to forecast a collection of related variables

# Thank you

