Final Monthly Forecast: April

By: Deepak Vanjani

April Forecast

- Unemployment Rate: <u>3.79%</u>
- Nonfarm Payrolls Employment Growth: <u>170K</u>

Method: Equal-Weighted Average of the Most Reliable Models

- Explored baseline methods, determined which methods were the most reliable using RMSE & diagnostics, checked expert forecasts, and averaged forecasts

- Reasons:
  - Minimizes risk
  - Reduces chance of over fitting, since the procedure isn't dependent on data
  - If forecasts have low bias, the increase in precision improves square loss risk
  - If all methods are performing similarly, it allows all methods to contribute to the forecast
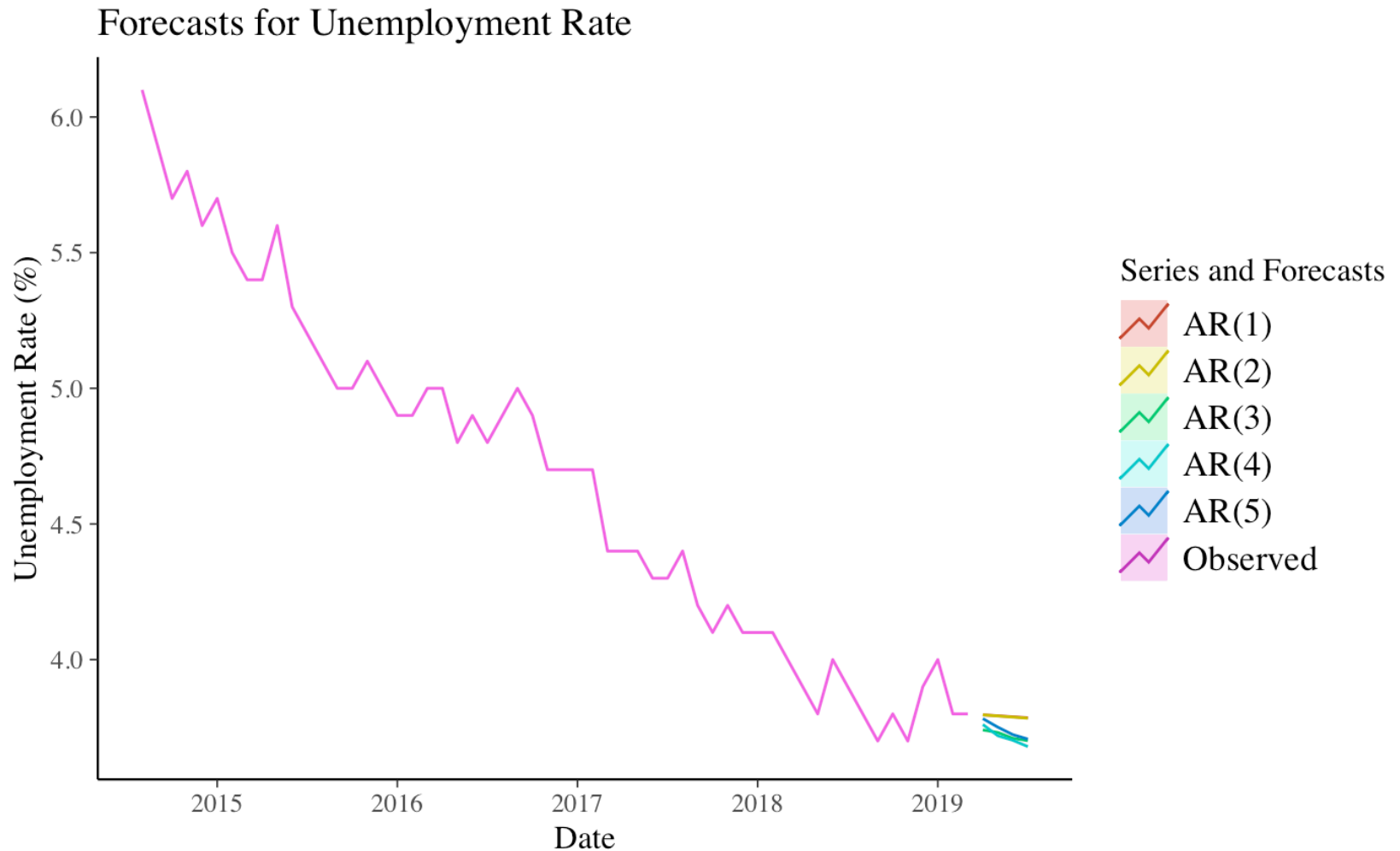
Previous Forecasts

Month	Actual	UNRATE Forecast	Method
January	4.0%	3.7%	Expert
February	3.8%	3.95%	Equal-weighted Average (Less Selective)
March	3.8%	3.8%	Equal-weighted Average (More Selective)

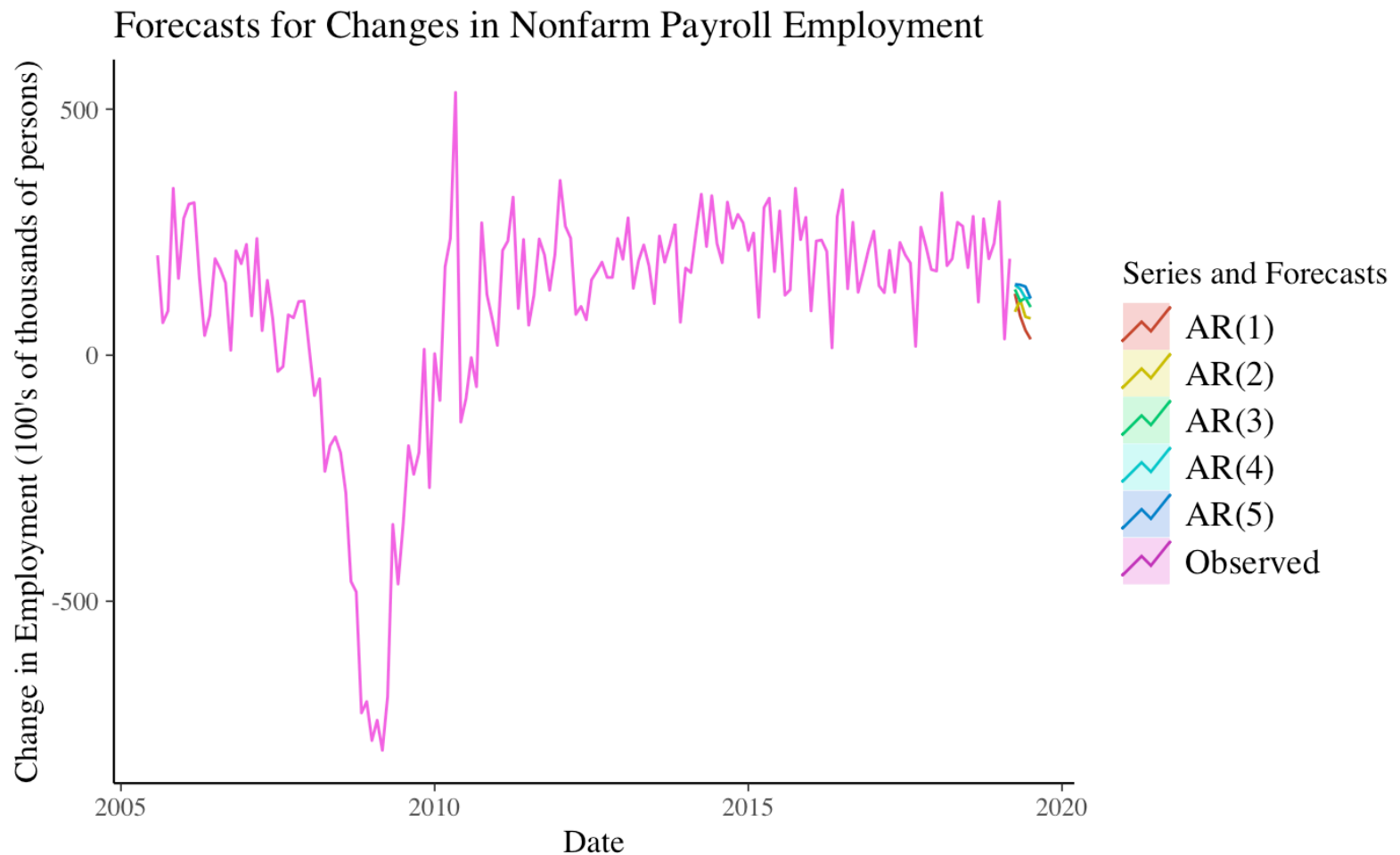| Month	Actual	PAYEMS Forecast	Method
January	304K	170K	Expert
February	20K	200K	Equal-weighted Average (Less Selective)
March	196K	155K	Equal-weighted Average (More Selective)

Baseline Methods Explored

- AR(1 – 5) by ERM with respect to square loss
- VAR(1 – 5) by minimizing additive square loss
- VAR(5) by Penalized ERM: 4 different penalties
- Bayesian: AR(6) with Laplace priors, mean = 0, default scale set by stan_glm
- Machine Learning Methods: Tree, Random Forrest, Boosting

AR(1 – 5) by ERM with respect to Square Loss – *Unrate*

Forecasts for Unemployment Rate

AR(1 – 5) by ERM with respect to Square Loss – *Payems*

Forecasts for Changes in Nonfarm Payroll Employment

AR(1 − 5) by ERM with respect to Square Loss

Unrate

Method	AR(1)	AR(2)	AR(3)	AR(4)	AR(5)
RMSE	**0.208**	**0.207**	0.199	0.196	0.195
AIC	**-243.67**	**-253.53**	-318.02	-343.01	-347.54

Payems

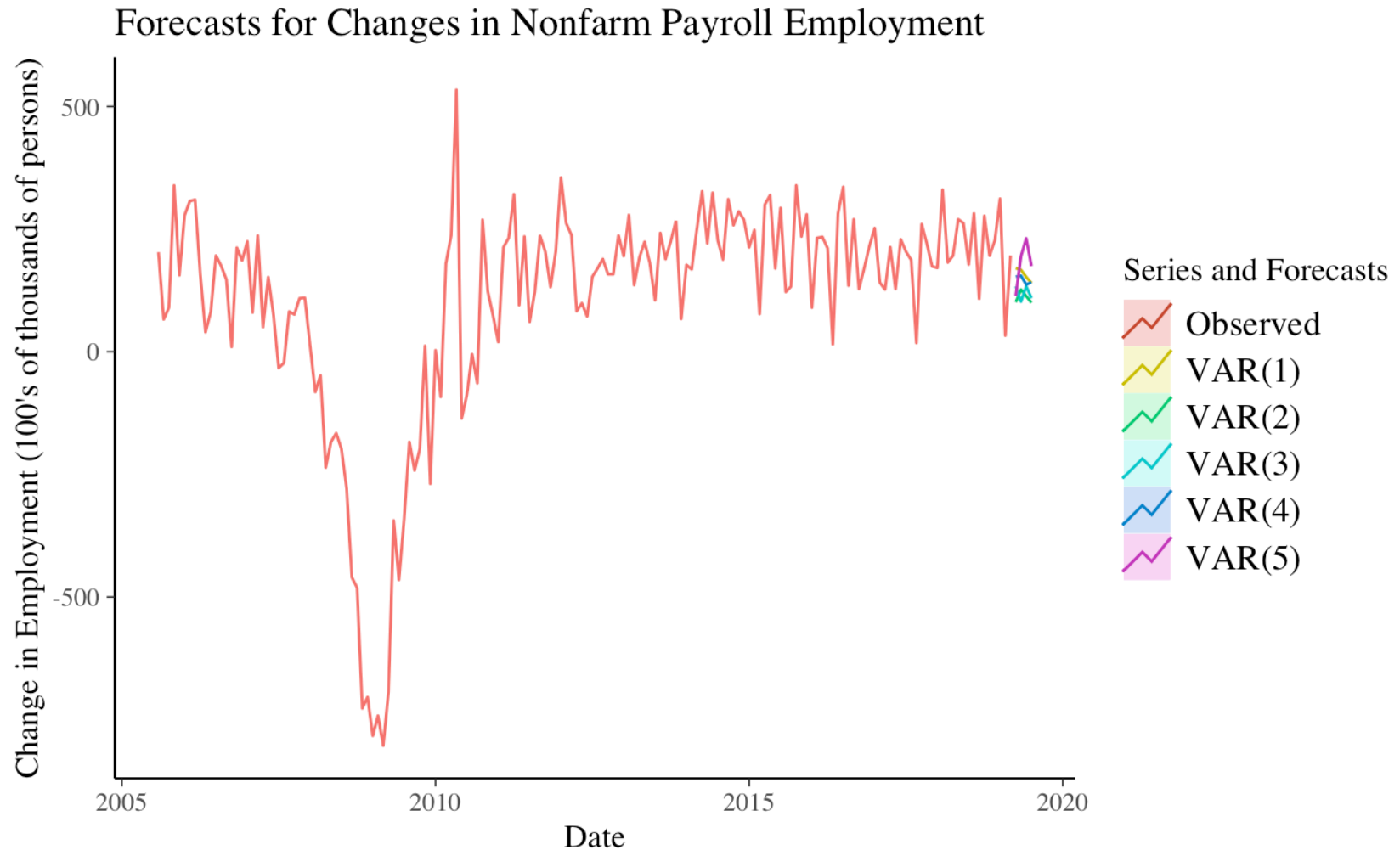| Method	AR(1)	AR(2)	AR(3)	AR(4)	AR(5)
RMSE	**198.1784**	**181.5567**	177.6057	176.6125	175.7327
AIC	**12910.92**	**12744.72**	12704.52	12695.78	12688.22

VAR(1 – 5) by minimizing additive square loss

- Created Vector Autoregressions jointly in unrate, payems, NASDAQ prices, US Retail Gas Prices, CPI, and effective Federal Funds Rate

# VAR(1 – 5) by minimizing additive square loss – *Unrate*
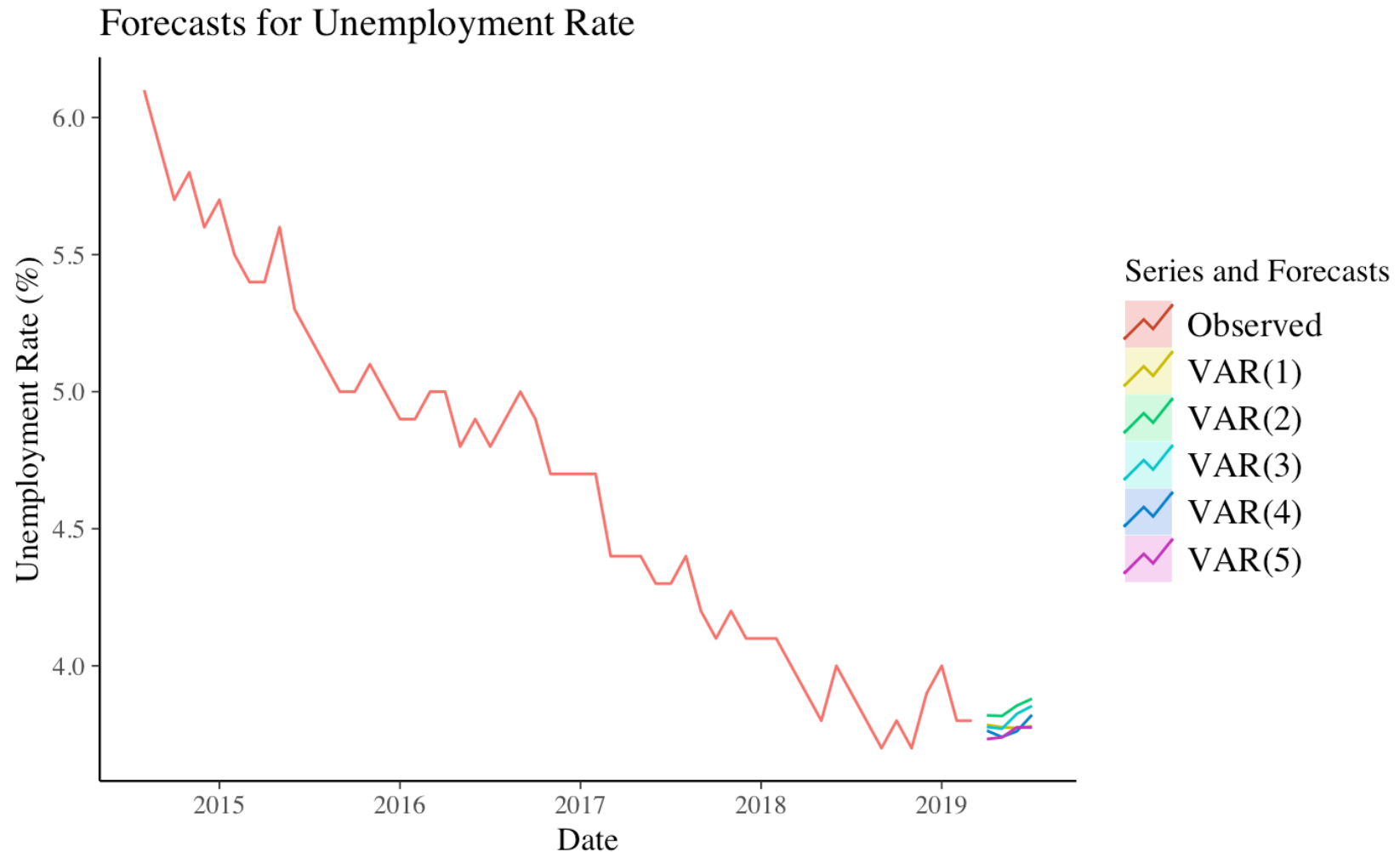
Forecasts for Unemployment Rate

VAR(1 – 5) by minimizing additive square loss – *Payems*

Forecasts for Changes in Nonfarm Payroll Employment

VAR(1 – 5) by minimizing additive square loss

Method	VAR(1)	VAR(2)	VAR(3)	VAR(4)	VAR(5)
AIC	5062.369	4950.203	4925.694	4906.418	4863.024
BIC	5205.281	5215.259	5312.568	5414.778	5492.54

Bayesian: AR(6) with Laplace priors - *Unrate*

Forecast for Unemployment Rate
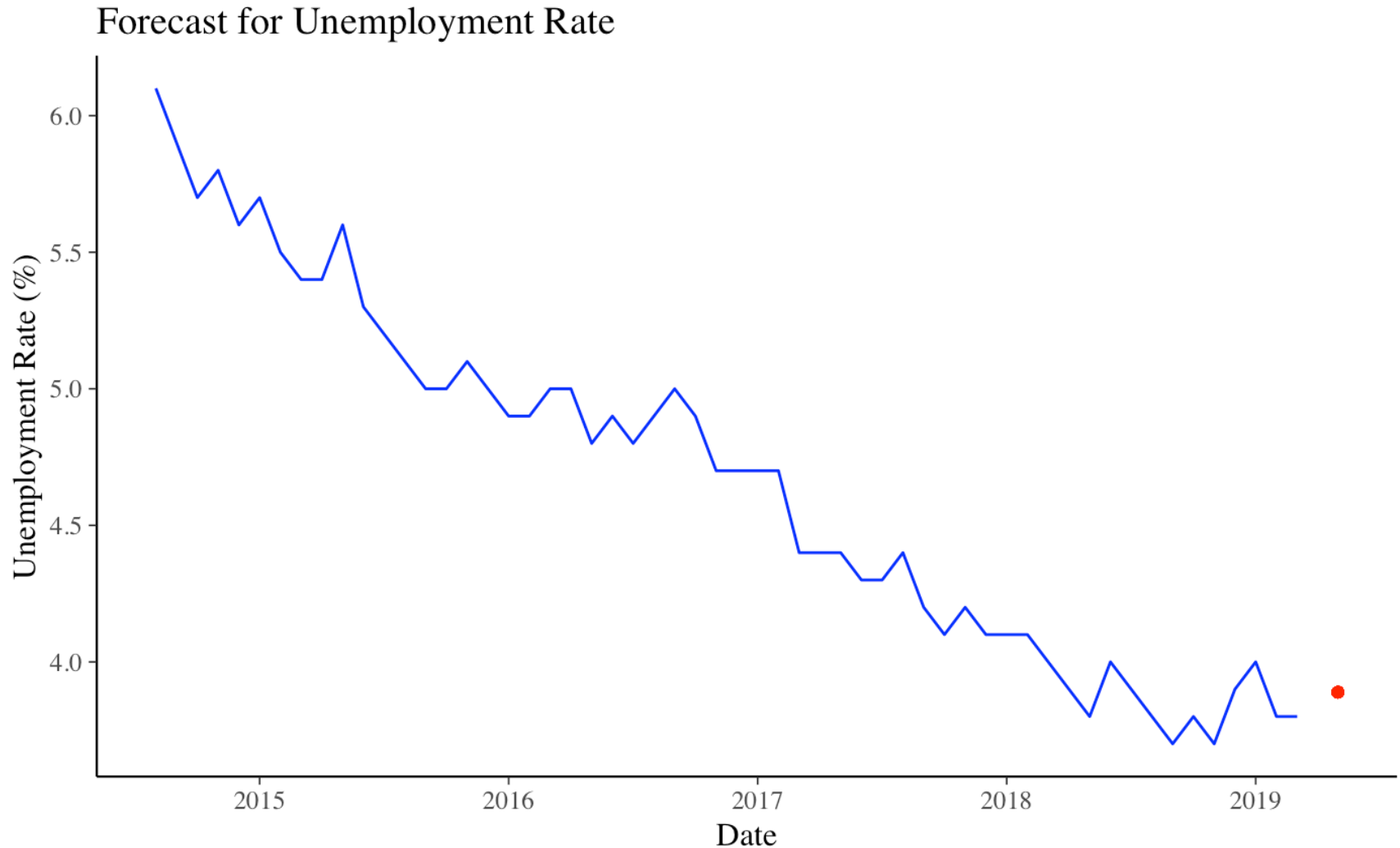
Bayesian: AR(6) with Laplace priors - *Payems*

Forecast for Changes in Nonfarm Payroll Employment
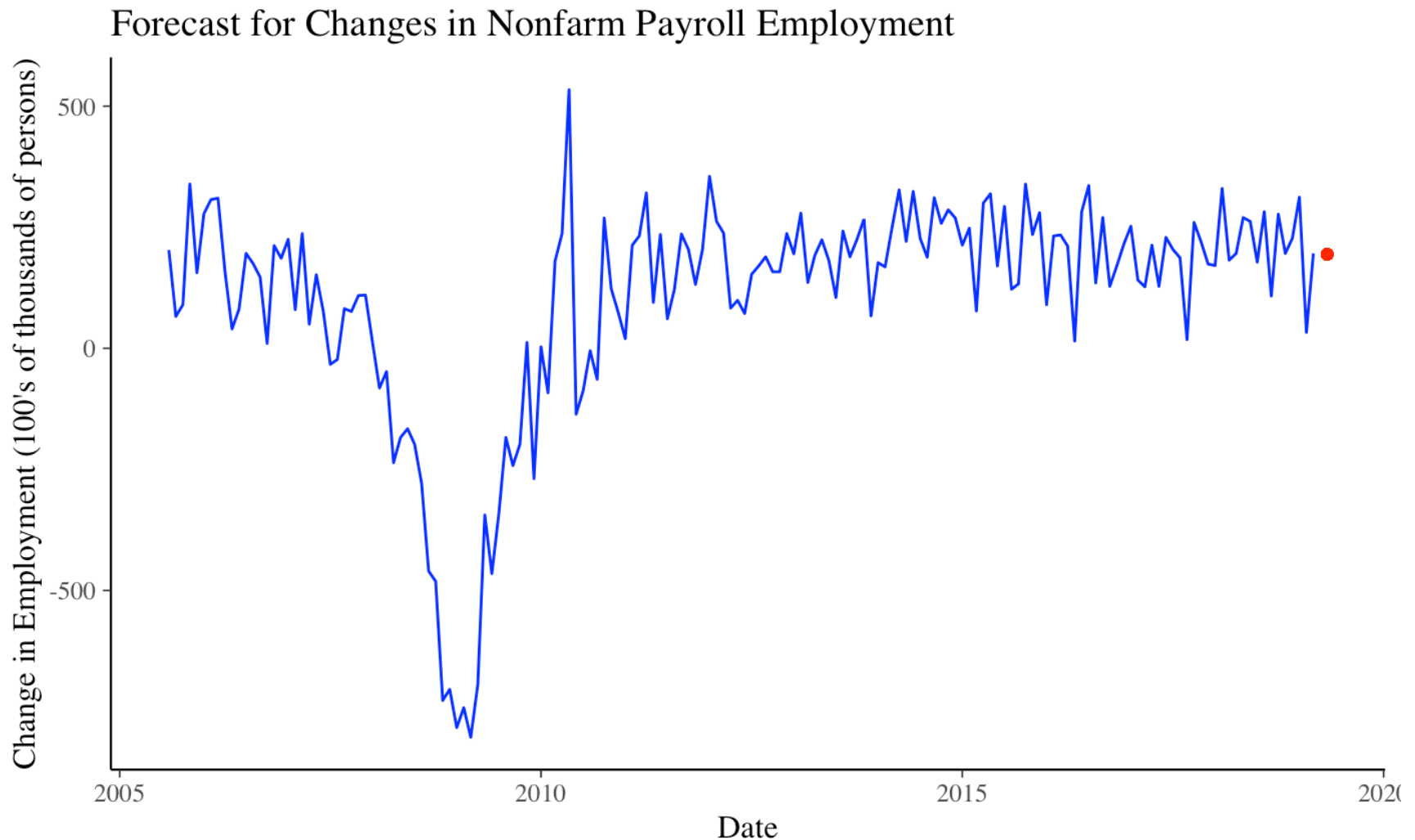
Bayesian: AR(6) with Laplace priors

Unrate

```
Diagnostics:
                  mcse      Rhat      n_eff
(Intercept)     0.00040   0.99936    4127
unratel1        0.00056   0.99996    3883
unratel2        0.00079   0.99957    3800
unratel3        0.00084   1.00095    3444
unratel4        0.00091   1.00034    2840
unratel5        0.00080   0.99974    3596
unratel6        0.00052   0.99928    4173
sigma           0.00009   1.00000    2675
mean_PPD        0.00015   1.00006    3710
log-posterior   0.20291   1.01494     397
```

Payems

```
Diagnostics:
                  mcse      Rhat      n_eff
(Intercept)     0.11922   0.99979    3369
payemsl1        0.00048   1.00010    4417
payemsl2        0.00052   0.99930    4146
payemsl3        0.00055   0.99985    3916
payemsl4        0.00054   1.00065    4166
payemsl5        0.00049   0.99969    4592
payemsl6        0.00051   0.99955    4162
sigma           0.07774   1.00174    2818
mean_PPD        0.14066   0.99996    3178
log-posterior   0.17968   1.00380     482
```
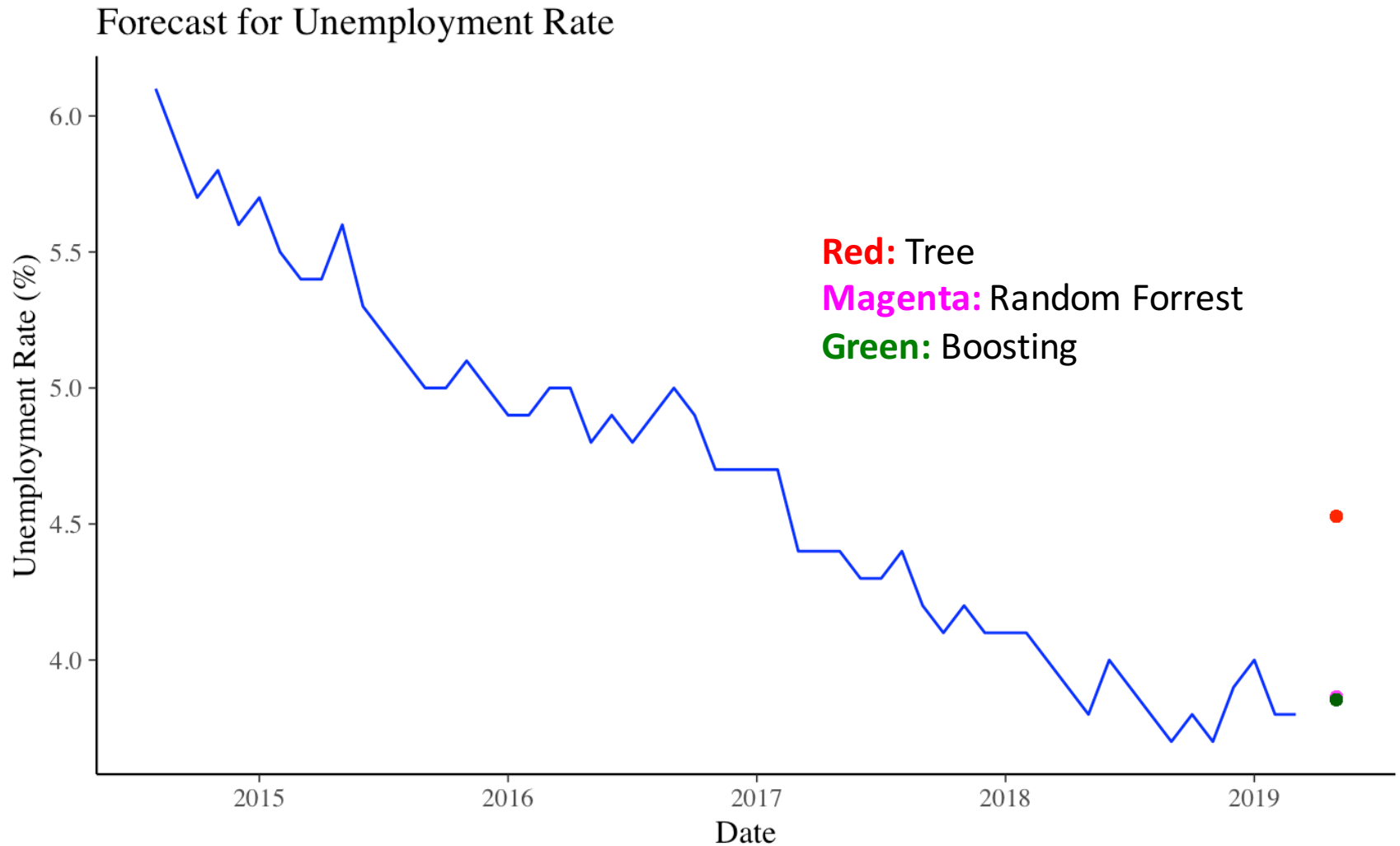
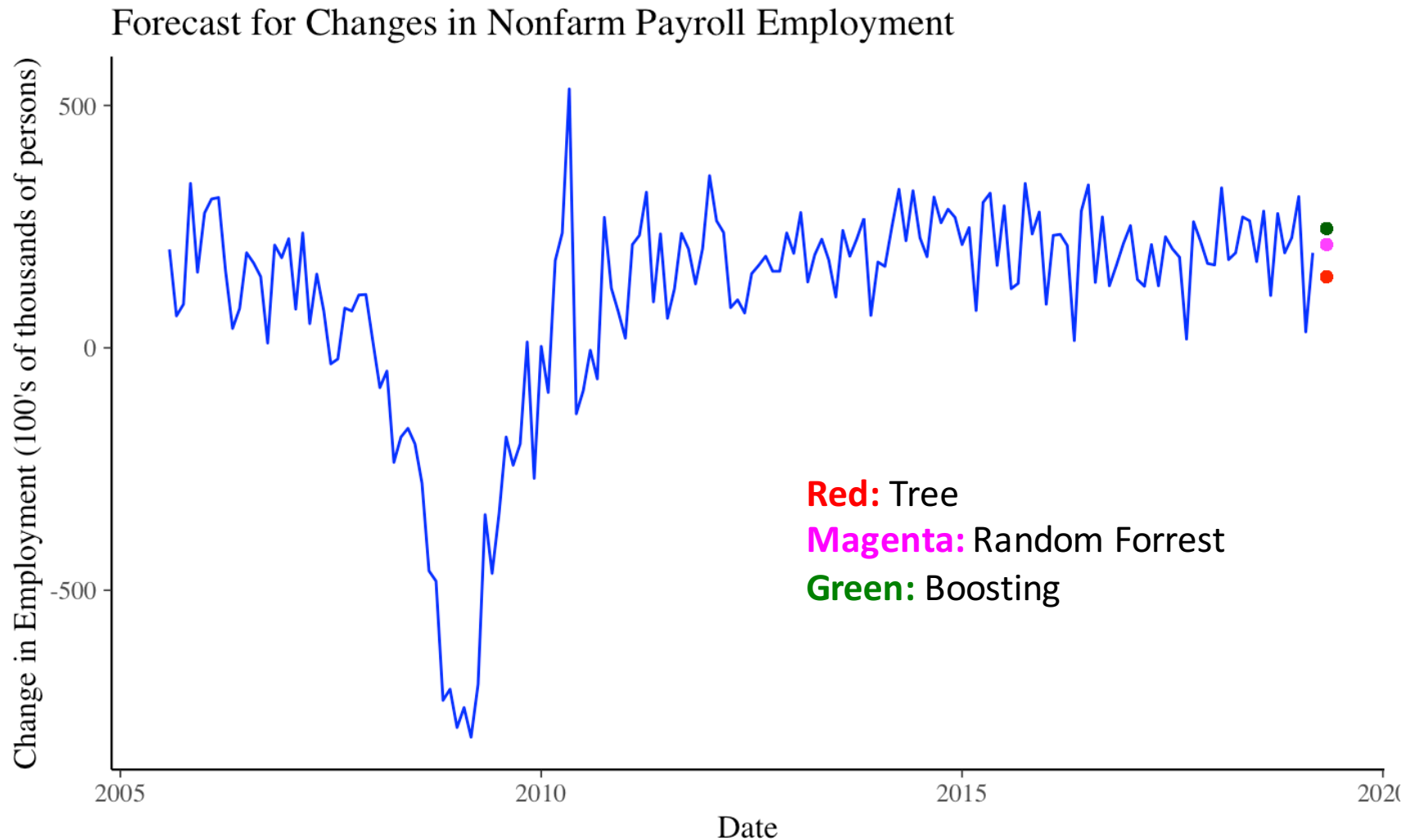# ML Methods: Tree, Random Forrest, Boost

- Created dataset with 11 predictors:
    - lagged values for unrate/payems (lag1 … lag6)
    - lag1 values for payems/unrate, NASDAQ prices, US Retail Gas Prices, CPI, and effective Federal Funds Rate

ML Methods: Tree, Random Forrest, Boost - *Unrate*

Forecast for Unemployment Rate

Red: Tree
Magenta: Random Forrest
Green: Boosting

ML Methods: Tree, Random Forrest, Boost - *Payems*

Forecast for Changes in Nonfarm Payroll Employment

Red: Tree
Magenta: Random Forrest
Green: Boosting

ML Methods: Tree, Random Forrest, Boost

Unrate

Method	Tree	Random Forrest	Boosting
Test RMSE	**0.503**	0.270	0.222
Train RMSE	**0.553**	0.241	0.154

Payems

Method	Tree	Random Forrest	Boosting
Test RMSE	**150.650**	121.062	137.800
Train RMSE	**158.877**	119.688	82.916

Equal-Weighted Averaging for UNRATE

	Forecast	25%	95%
AR(1)	**3.79**	3.38	4.20
AR(2)	**3.79**	3.38	4.20
AR(3)	3.74	3.34	4.13
AR(4)	3.76	3.37	4.14
AR(5)	3.78	3.39	4.16
VAR(1)	3.78	3.52	4.04
VAR(2)	3.81	3.56	4.06
VAR(3)	3.77	3.52	4.02
VAR(4)	3.76	3.51	4.01
VAR(5)	3.73	3.48	3.97
Bayesian AR(6) w/ Laplace	3.88	3.50	4.25
Tree	**4.52**		
Random Forrest	3.86		
Boost	3.85		
AVERAGE	**3.79%**		

Equal-Weighted Averaging for PAYEMS

	Forecast	25%	95%
AR(1)	**124.85**	-263.76	513.48
AR(2)	**88.02**	-268.18	444.24
AR(3)	133.81	-214.82	482.45
AR(4)	142.49	-204.38	489.36
AR(5)	144.12	-201.20	489.45
VAR(1)	170.51	-84.40	425.43
VAR(2)	**101.02**	-135.49	337.54
VAR(3)	133.24	-99.33	365.81
VAR(4)	152.97	-78.346	384.29
VAR(5)	**114.50**	-114.67	343.68
Bayesian AR(6) w/ Laplace	194.10	-154.92	540.12
Tree	**146.75**		
Random Forrest	213.27		
Boost	246.33		
AVERAGE	**170K**		