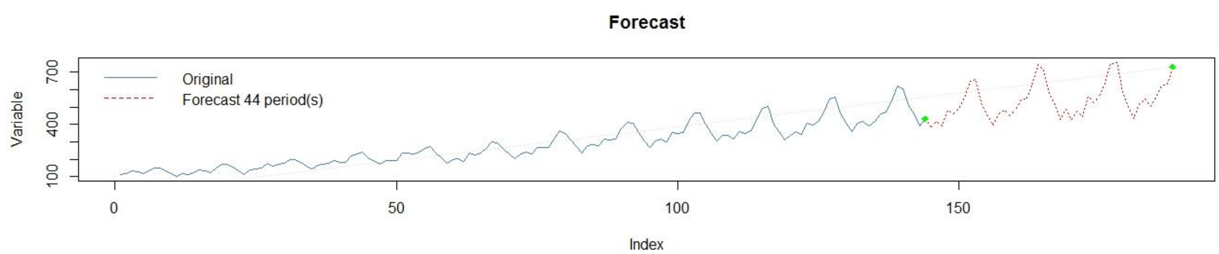
ARMA Method

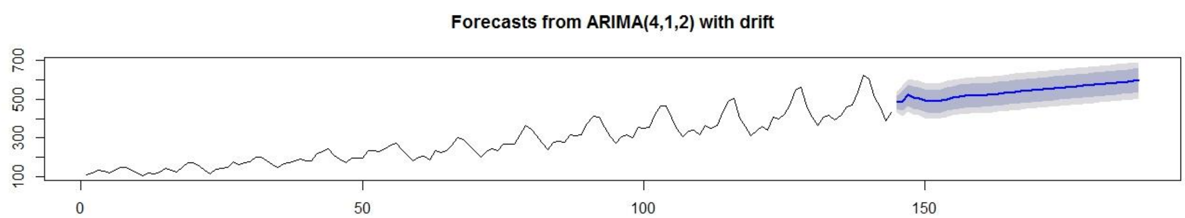
https://github.com/OVVO-Financial/NNS

Data: AirPassengers

The classic Box & Jenkins airline data. Monthly totals of international airline passengers, 1949 to 1960.

Seasonal test yields a periodicity of 25. Using just a lag of 25 yields the following out of sample estimates:

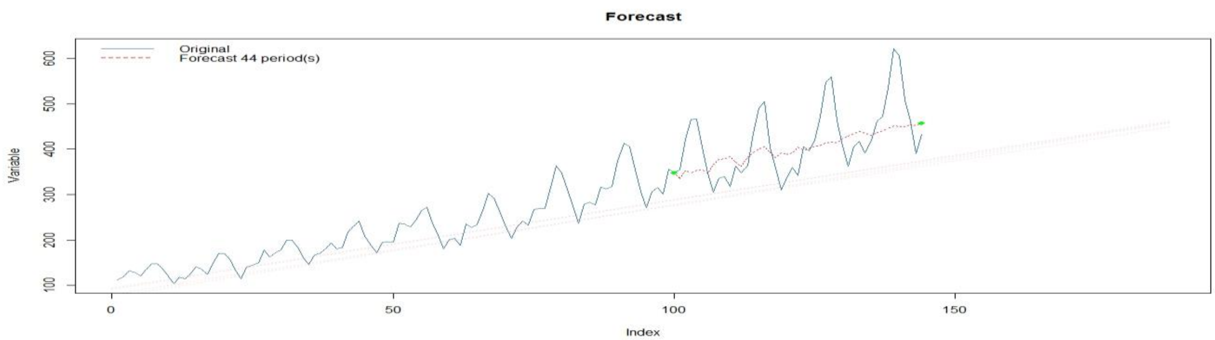


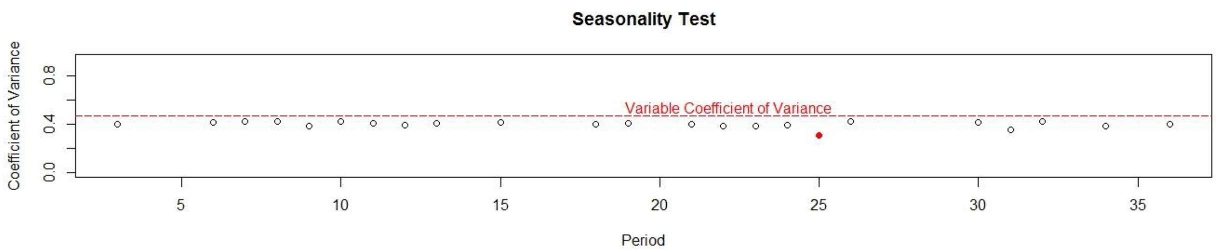



```
> sum((VN.ARMA(AirPassengers[1:144],h=44,Linear = FALSE,Training_set = 100)-A
irPassengers[101:144])^2)
[1] 461546.1
> fit=auto.arima(AirPassengers[1:100])
> sum(((forecast(fit,h=44)$mean)-AirPassengers[101:144])^2)
[1] 655153.3
```

Using the weighted average of **all** seasonal factors yields the following reduction of the sum of squared errors:

```
> sum((VN.ARMA(AirPassengers[1:144],h=44,Linear = FALSE,Training_set = 100,Seasonal_Factor = FALSE)-AirPassengers[101:144])^2)
[1] 205267
```





***Note the seasonal lags are weighted by:

1) coefficient of variance (Column 2).
2) number of observations (Column 1).

```
 Period                        Weights
 [1,]  3 0.3997134 0.4279947 0.11338353
 [2,]  6 0.4177093 0.4279947 0.06655730
 [3,]  7 0.4253993 0.4279947 0.05962723
 [4,]  8 0.4256049 0.4279947 0.05469999
 [5,]  9 0.3810549 0.4279947 0.05324607
 [6,] 10 0.4223298 0.4279947 0.04797285
 [7,] 11 0.4070272 0.4279947 0.04623771
 [8,] 12 0.3937383 0.4279947 0.04486716
 [9,] 13 0.4086634 0.4279947 0.04230140
[10,] 15 0.4161916 0.4279947 0.03909503
[11,] 18 0.4038333 0.4279947 0.03666989
[12,] 19 0.4115440 0.4279947 0.03546428
[13,] 21 0.4001555 0.4279947 0.03468078
[14,] 22 0.3879518 0.4279947 0.03476318
[15,] 23 0.3811338 0.4279947 0.03461691
[16,] 24 0.3888033 0.4279947 0.03367137
[17,] 25 0.3059293 0.4279947 0.03922552
[18,] 26 0.4226966 0.4279947 0.03100889
[19,] 30 0.4165706 0.4279947 0.02989696
[20,] 31 0.3512198 0.4279947 0.03345577
[21,] 32 0.4206233 0.4279947 0.02912364
[22,] 34 0.3866862 0.4279947 0.03041819
[23,] 36 0.4039125 0.4279947 0.02901636
```

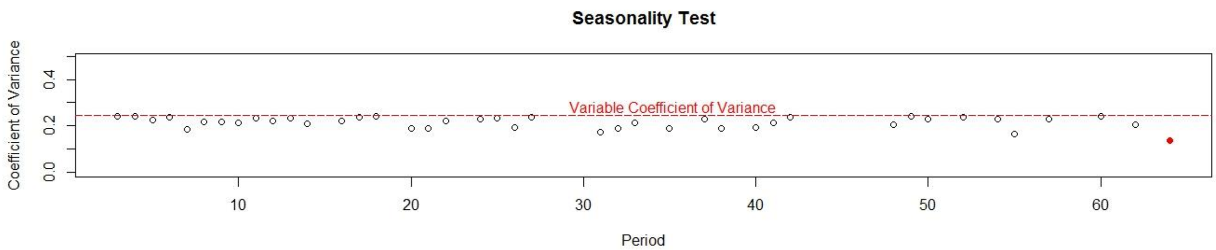
Data: pageviews

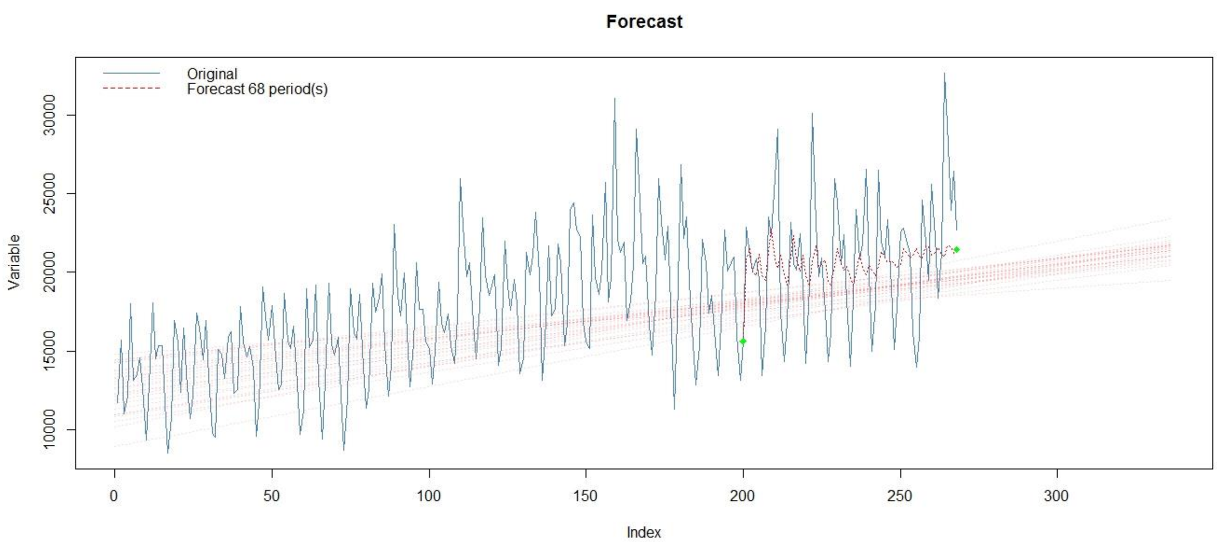
http://www.datasciencecentral.com/forum/topics/challenge-of-the-week-identifying-patterns-in-complex-time-series

https://github.com/OVVO-Financial/NNS/blob/master/pageviews.RData

Another example versus auto.arima & a simple linear regression:

```
> sum((VN.ARMA(pageviews,h=68,Linear = FALSE,Training_set = 200,Seasonal_Fact
or = FALSE)-pageviews[201:268])^2)
[1] 1052489096
> fit2=auto.arima(pageviews[1:200])
> sum((forecast(fit2,h=68)$mean-pageviews[201:268])^2)
[1] 1617146490
```





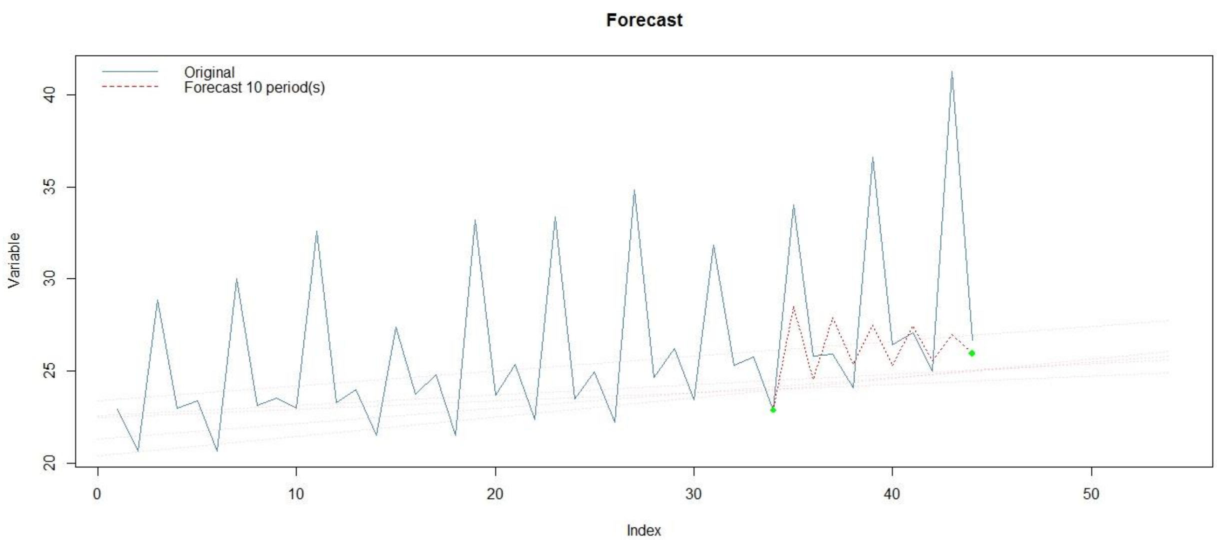

```
> pageviews.estimate=numeric()
> pageviews.index=1:200
> for(i in 201:268) {pageviews.estimate[i]=(coef(lm(pageviews[1:200]~pageview
s.index))[1]+ coef(lm(pageviews[1:200]~pageviews.index))[2]*i)}
> sum((na.omit(pageviews.estimate)- pageviews[201:268])^2)
[1] 1216028478
```

Data: Wang Dataset

Quarterly electric demand in New York City from the first quarter of 1995 through the fourth quarter of 2005. Source: Wang[2008]. "A guide to box jenkins modeling." *Journal of Business Forecasting*

https://github.com/OVVO-Financial/NNS/blob/master/Wang_Dataset.RData

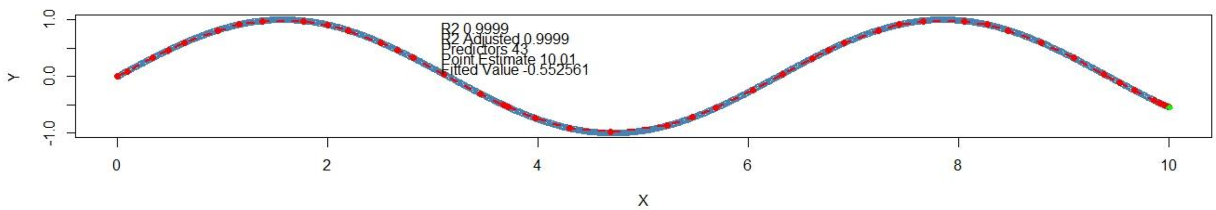
```
> sum((ARMA(Wang_Dataset,h=10,Training_set = 34)-Wang_Dataset[35:44])^2)
[1] 200.9067
> fit3=auto.arima(Wang_Dataset[1:34])
> sum((forecast(fit3,h=10)$mean-Wang_Dataset[35:44])^2)
[1] 445.7394
> Wang.data.index = 1:34
> Wang.lm.estimate = numeric()
> for(i in 35:44) {Wang.lm.estimate[i]=(coef(lm(Wang_Dataset[1:34]~Wang.data.
index))[1]+ coef(lm(Wang_Dataset[1:34]~Wang.data.index))[2]*i)}
> sum((na.omit(Wang.lm.estimate)- Wang_Dataset[35:44])^2)
[1] 350.5229
```



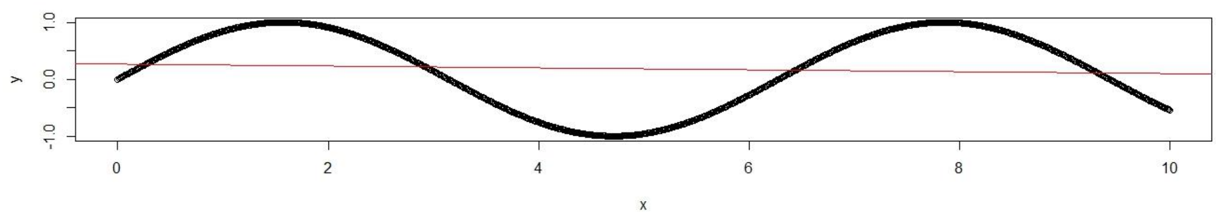
Regression Method

The key to the ARMA method is the use of nonlinear regressions on component series. Below is an example on a sine wave. The linear regression would have an estimate ~ equal to the mean for all forecasts.

```
> VN.reg(x,y,order=5, point.est = 10.01)
 Predictors          R2 R2 Adjusted
 43.0000000   0.9998863   0.9998837
       Point Fitted.value
  10.0100000   -0.5525609
```




```
> reg = lm(y~x)
> plot(x,y)
> abline(reg,col="red")
```




```
> coef(reg)[1]+coef(reg)[2]*10.01
(Intercept)
  0.1017961
```