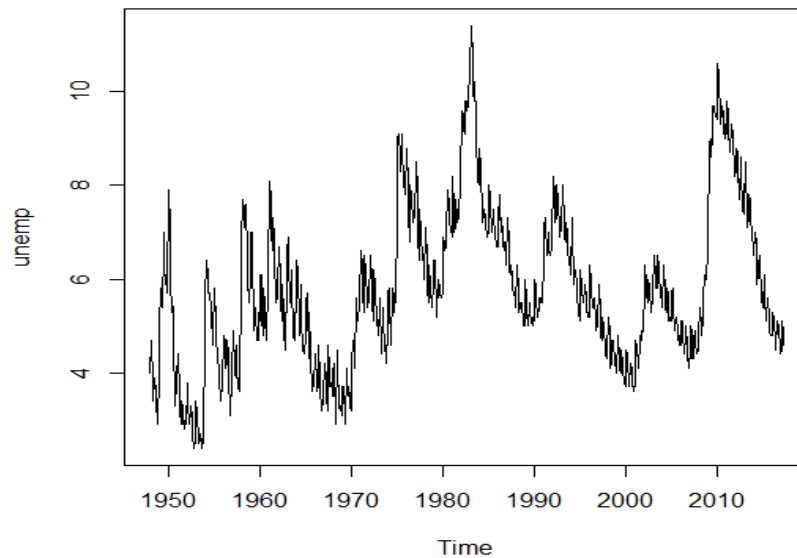


Forecast on Civilian Unemployment Rate

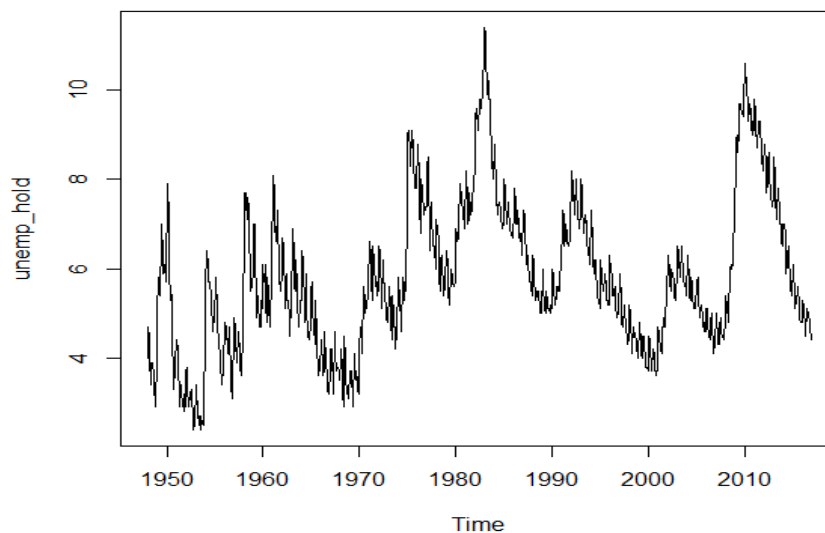
By Sandeep Ramesh

R Programming Code

```
> urnsa = read.csv("UNRATENSA.csv")  
> unemp = ts(urnsa[,2],start=c(1948,1),frequency=12)  
> plot(unemp)
```



```
> unemp_hold = ts(urnsa[,2],start=c(1948,1),end=c(2016,11),frequency=12)  
> plot(unemp_hold)
```



```

> library(urca)
> library(forecast)
> ur_test = ur.df(unemp_hold,type="drift",lags=20,selectlags="AIC")
> summary(ur_test)

#####
# Augmented Dickey-Fuller Test Unit Root Test #
#####

Test regression drift

Call:
lm(formula = z.diff ~ z.lag.1 + 1 + z.diff.lag)

Residuals:
    Min       1Q   Median       3Q      Max
-0.82859 -0.17677 -0.00286  0.14985  1.29507

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.109786   0.038568   2.847  0.00453 **
z.lag.1     -0.019009   0.006411  -2.965  0.00312 **
z.diff.lag1  0.055514   0.035506   1.564  0.11833
z.diff.lag2  0.163767   0.035281   4.642  4.05e-06 ***
z.diff.lag3  0.033004   0.035614   0.927  0.35437
z.diff.lag4  0.033809   0.035514   0.952  0.34140
z.diff.lag5  0.111840   0.034930   3.202  0.00142 **
z.diff.lag6 -0.035682   0.034398  -1.037  0.29990
z.diff.lag7 -0.051921   0.034342  -1.512  0.13096
z.diff.lag8 -0.013089   0.025134  -0.521  0.60269
z.diff.lag9 -0.101075   0.025017  -4.040  5.86e-05 ***
z.diff.lag10 -0.072058   0.025097  -2.871  0.00420 **
z.diff.lag11  0.014629   0.024823   0.589  0.55580
z.diff.lag12  0.677500   0.024792  27.327 < 2e-16 ***
z.diff.lag13 -0.054403   0.034528  -1.576  0.11551
z.diff.lag14 -0.188553   0.034498  -5.466  6.20e-08 ***
z.diff.lag15 -0.143070   0.034939  -4.095  4.66e-05 ***
z.diff.lag16 -0.064827   0.035341  -1.834  0.06699 .
z.diff.lag17 -0.043500   0.035290  -1.233  0.21808
z.diff.lag18 -0.084428   0.034959  -2.415  0.01596 *
z.diff.lag19  0.097829   0.035035   2.792  0.00536 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2643 on 785 degrees of freedom
Multiple R-squared:  0.6863,    Adjusted R-squared:  0.6783
F-statistic: 85.87 on 20 and 785 DF,  p-value: < 2.2e-16

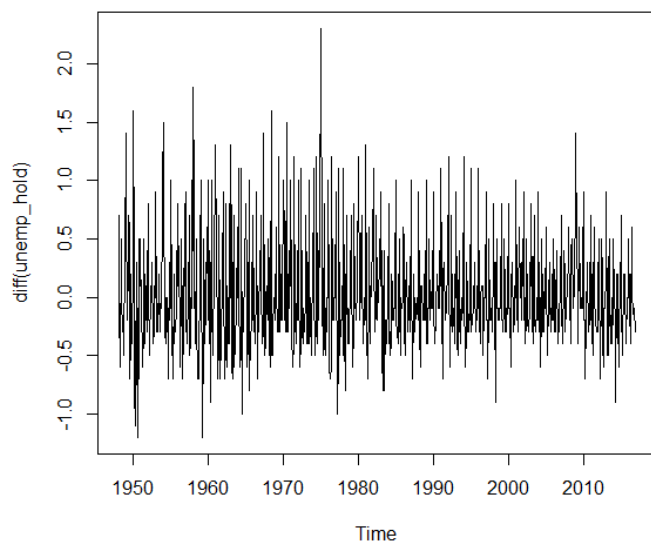
Value of test-statistic is: -2.965 4.4036

Critical values for test statistics:
      1pct   5pct  10pct
tau2  -3.43  -2.86  -2.57
phi1   6.43   4.59   3.78

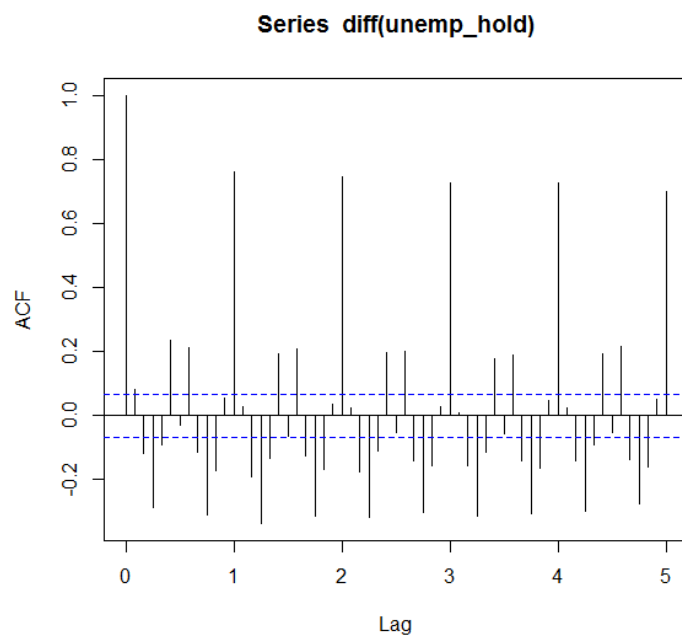
> ur_test = ur.df(diff(unemp_hold),type="drift",lags=20,selectlags="AIC")
> summary(ur_test)

```

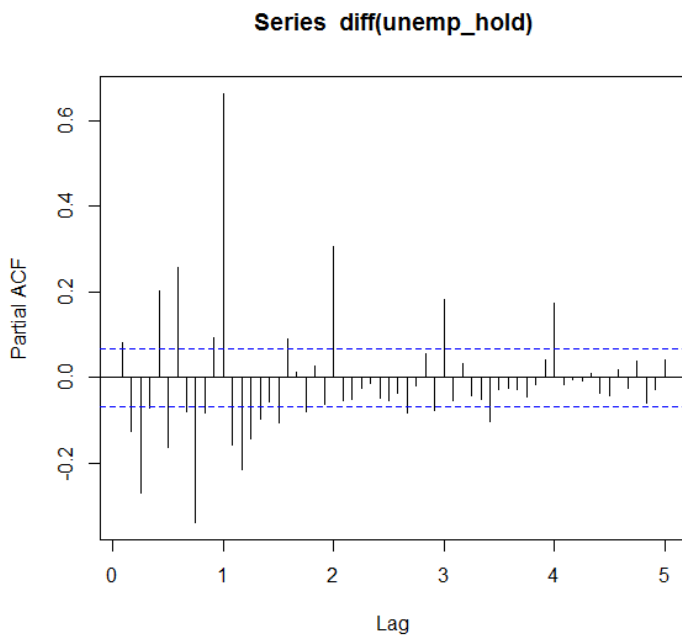
```
> plot(diff(unemp_hold))
```



```
> acf(diff(unemp_hold), 60)
```



```
> pacf(diff(unemp_hold), 60)
```



```
> rho = acf(diff(unemp_hold), 36)
> rho
```

Autocorrelations of series 'diff(unemp_hold)', by lag

[illegible]

MODEL GUESSES

```
> Arima(unemp_hold,order=c(1,1,1),seasonal=c(1,0,1))
Series: unemp_hold
ARIMA(1,1,1) (1,0,1) [12]
```

Coefficients:

	ar1	ma1	sar1	sma1
	0.8188	-0.6572	0.9911	-0.7608
s.e.	0.0448	0.0566	0.0034	0.0259

sigma^2 estimated as 0.05615: log likelihood=6.71
AIC=-3.41 AICc=-3.34 BIC=20.17

```
> Arima(unemp_hold,order=c(1,1,1),seasonal=c(2,0,1))
Series: unemp_hold
ARIMA(1,1,1) (2,0,1) [12]
```

Coefficients:

	ar1	ma1	sar1	sar2	sma1
	0.8217	-0.660	0.9576	0.0326	-0.7443
s.e.	0.0449	0.057	0.0501	0.0486	0.0370

sigma^2 estimated as 0.05618: log likelihood=6.93
AIC=-1.86 AICc=-1.76 BIC=26.44

```
> Arima(unemp_hold,order=c(2,1,1),seasonal=c(1,0,1))
Series: unemp_hold
ARIMA(2,1,1) (1,0,1) [12]
```

Coefficients:

	ar1	ar2	ma1	sar1	sma1
	0.5995	0.1239	-0.4889	0.9918	-0.7612
s.e.	0.1131	0.0471	0.1114	0.0032	0.0264

sigma^2 estimated as 0.0557: log likelihood=10.02
AIC=-8.05 AICc=-7.94 BIC=20.25

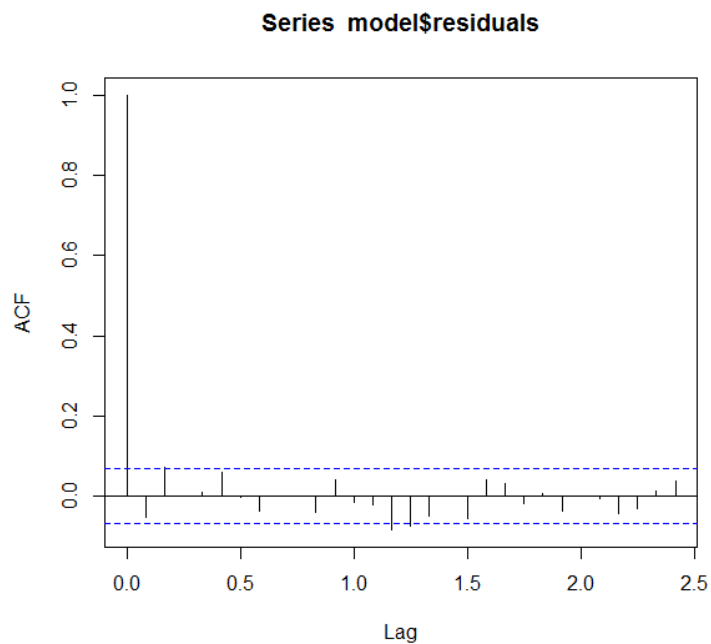
```
> Arima(unemp_hold,order=c(2,1,2),seasonal=c(1,0,1))
Series: unemp_hold
ARIMA(2,1,2) (1,0,1) [12]
```

Coefficients:

	ar1	ar2	ma1	ma2	sar1	sma1
	0.4531	0.2472	-0.3411	-0.1018	0.9918	-0.7614
s.e.	0.2780	0.2306	0.2827	0.1964	0.0032	0.0264

sigma^2 estimated as 0.05576: log likelihood=10.11
AIC=-6.23 AICc=-6.09 BIC=26.79

```
> model=Arima(unemp_hold,order=c(1,1,1),seasonal=c(1,0,1))
> acf(model$residuals)
```



```
> Box.test(model$residuals,30,type="Ljung-Box")
```

Box-Ljung test

```
data: model$residuals
X-squared = 37.545, df = 30, p-value = 0.1618
```

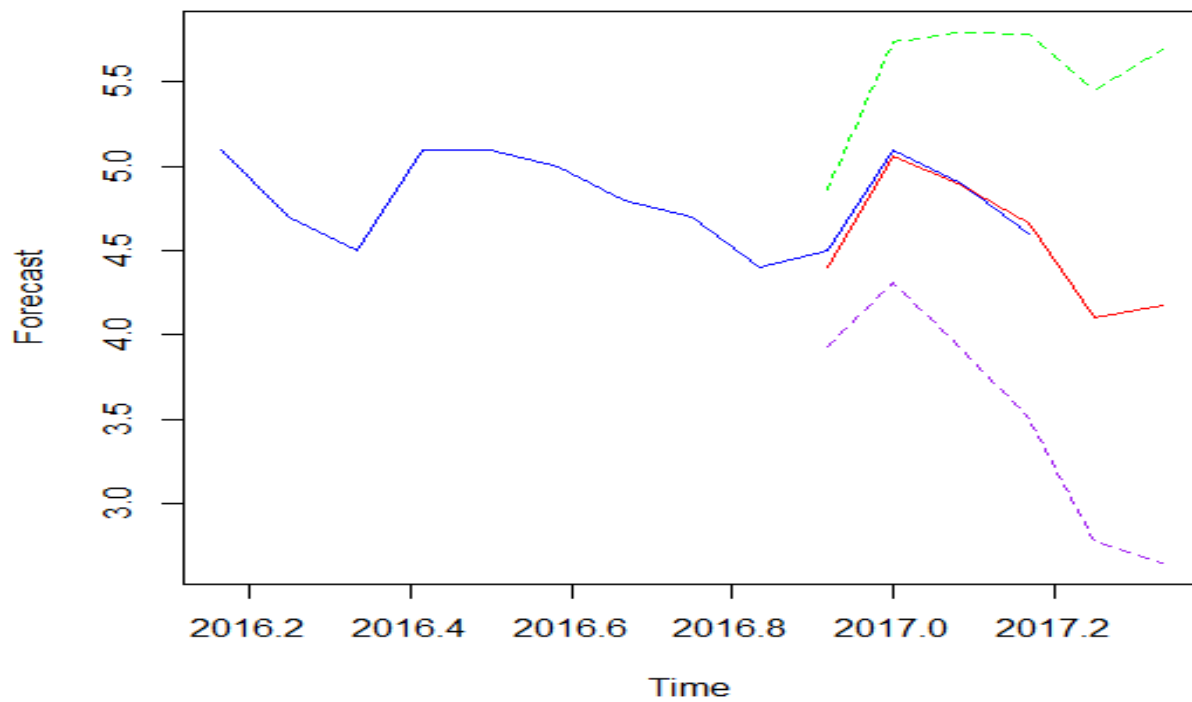
```
> unemp_hold_fore=forecast.Arima(model,h=6)
> unemp_hold_fore
```

	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Dec 2016	4.399971	4.096307	4.703635	3.935558	4.864385
Jan 2017	5.021205	4.555774	5.486636	4.309390	5.733020
Feb 2017	4.857442	4.248353	5.466532	3.925920	5.788965
Mar 2017	4.642949	3.899795	5.386104	3.506392	5.779506
Apr 2017	4.112765	3.242580	4.982950	2.781931	5.443598
May 2017	4.170644	3.179376	5.161912	2.654630	5.686658

Plot of Forecast using Hold out Data:

```
> upper=ts(unemp_hold_fore$upper[,2],start=c(2016,12),frequency=12)
> lower=ts(unemp_hold_fore$lower[,2],start=c(2016,12),frequency=12)
```

```
plot(cbind(window(unemp,start=c(2016,3),frequency=12),unemp_hold_fore$mean,upper,lower),plot.type="single",ylab='Forecast',lty=c("solid","solid","dashed","dashed"),col=c("blue","red","green","purple"))
```

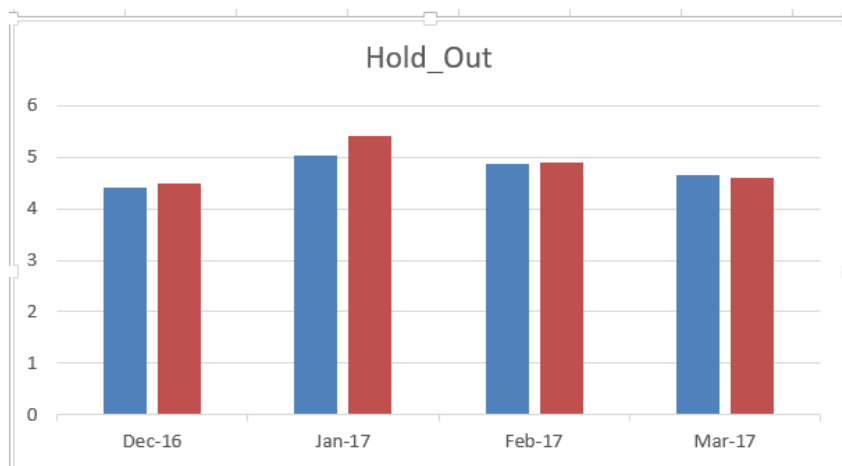


Hold out Period Data:

Series	Point Forecast	Actual Data	Matching_Ratio
Dec-16	4.399971	4.5	98%
Jan-17	5.021205	5.4	93%
Feb-17	4.857442	4.9	99%
Mar-17	4.642949	4.6	101%

Actual Forecast of SARIMA(1,1,1)(1,0,1) model:

```
> unemp_hold_fore
      Point Forecast   Lo 80   Hi 80   Lo 95   Hi 95
Dec 2016      4.399971 4.096307 4.703635 3.935558 4.864385
Jan 2017      5.021205 4.555774 5.486636 4.309390 5.733020
Feb 2017      4.857442 4.248353 5.466532 3.925920 5.788965
Mar 2017      4.642949 3.899795 5.386104 3.506392 5.779506
Apr 2017      4.112765 3.242580 4.982950 2.781931 5.443598
May 2017      4.170644 3.179376 5.161912 2.654630 5.686658
```



The above Bar Chart shows the forecasted value in red and Actual data values in blue which shows that our results for April and May too will be predicted approximately