

(a) Dickey-Fuller Tests

(i) No, the ACF is not decaying that fast to zero

(ii) Null hypothesis is the time series can be represented by a unit root, that it is not stationary. It cannot be rejected.(p-value=0.63) It is non-stationary

ADF Statistic: -0.146679

p-value: 0.633396

Critical Values:

1%: -2.569

5%: -1.941

10%: -1.616

(iv) We cannot reject the null hypothesis(p-value=0.63) which means it is not stationary

ADF Statistic: -1.289240

p-value: 0.634081

Critical Values:

1%: -3.440

5%: -2.866

10%: -2.569

(v) We will reject the null hypothesis (p-value=0) which means that it is stationary when we try the first differences.

ADF Statistic: -6.130658

p-value: 0.000000

Critical Values:

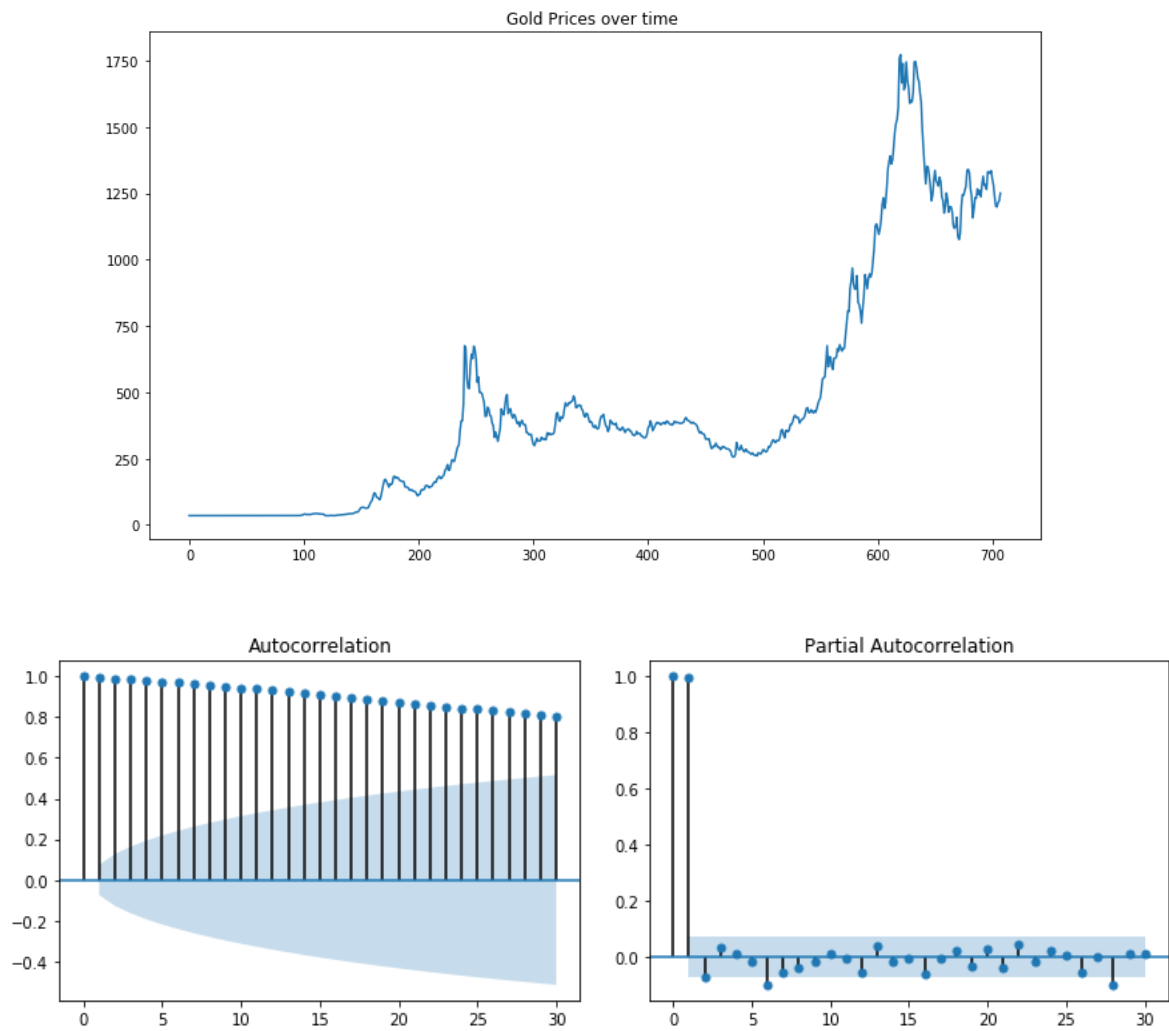
1%: -3.447

5%: -2.869

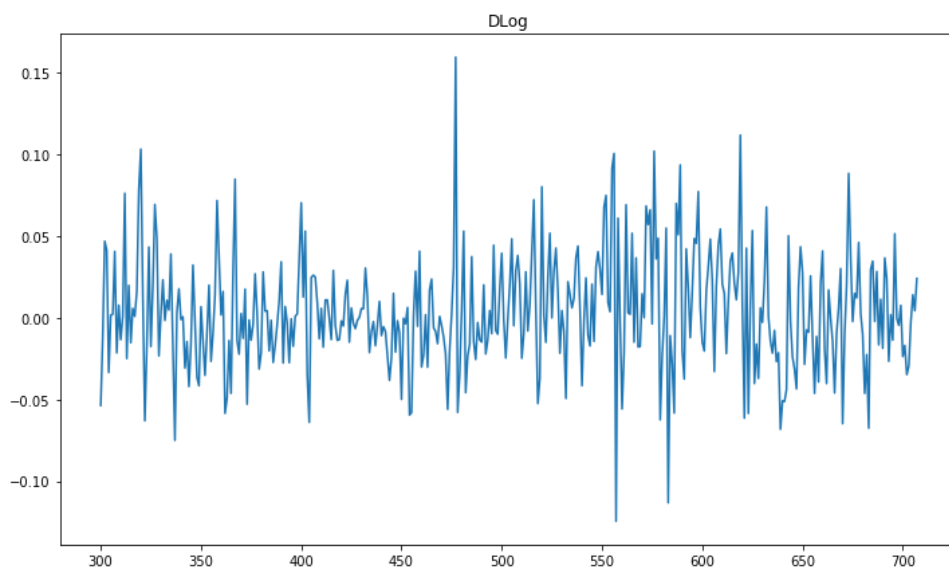
10%: -2.571

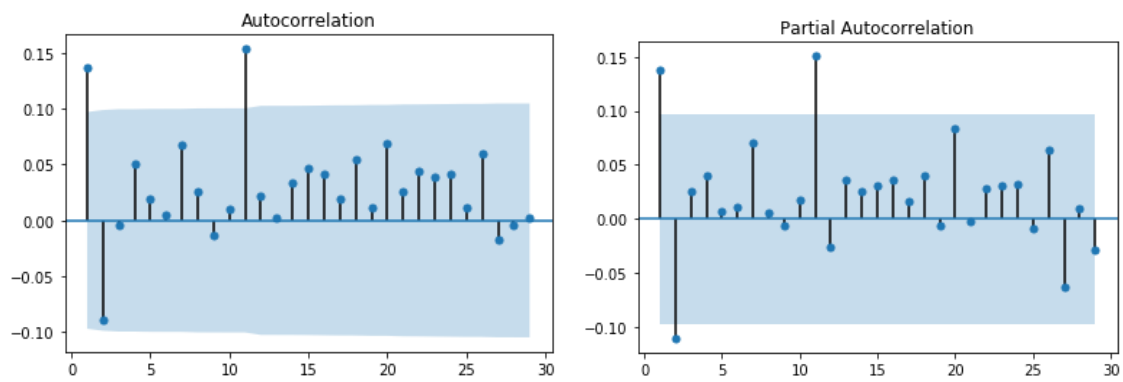
(b) ARIMA Modelling

1. Gold - ACF and PACF



2. DLOG - ACF and PACF





3. Estimations using Different Models :

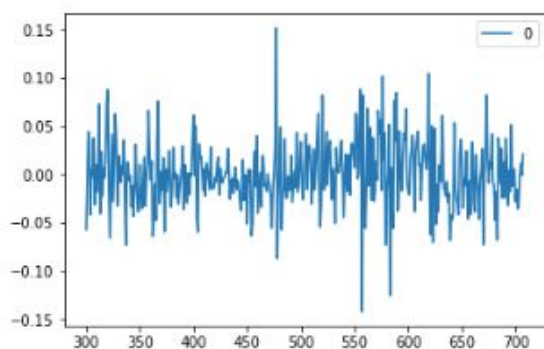
3.1 MA(1)

```
Model 1 : MA1
=====
                        ARMA Model Results
=====
Dep. Variable:          Gold      No. Observations:          408
Model:                  ARMA(0, 1)  Log Likelihood              793.846
Method:                  css-mle    S.D. of innovations         0.035
Date:                    Wed, 13 Feb 2019  AIC                  -1581.692
Time:                    20:54:21    BIC                       -1569.658
Sample:                  0          HQIC                     -1576.930
=====
```

```
=====
                        coef      std err          z      P>|z|      [0.025      0.975]
-----
const                0.0033      0.002         1.659     0.098     -0.001      0.007
ma.L1.Gold            0.1710      0.053         3.205     0.001      0.066      0.276
=====
```

```
Roots
=====
                        Real      Imaginary      Modulus      Frequency
-----
MA.1                   -5.8473      +0.0000j         5.8473         0.5000
=====
```

Residual Plot



```
RSS 0.4877778915736305
AIC
```

3.2 ARMA (2,0)

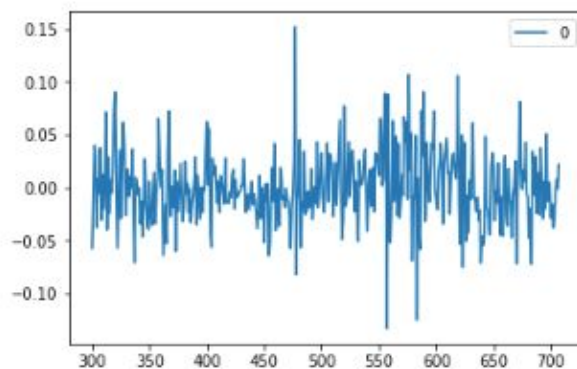
```
Model 1 : ARMA(2, 0)
                        ARMA Model Results
=====
Dep. Variable:          Gold      No. Observations:          408
Model:                  ARMA(2, 0)  Log Likelihood           795.369
Method:                 css-mle    S.D. of innovations         0.034
Date:                   Wed, 13 Feb 2019  AIC                  -1582.739
Time:                   20:25:08    BIC                      -1566.694
Sample:                 0          HQIC                     -1576.390
=====
```

	coef	std err	z	P> z	[0.025	0.975]
const	0.0033	0.002	1.874	0.062	-0.000	0.007
ar.L1.Gold	0.1529	0.049	3.100	0.002	0.056	0.250
ar.L2.Gold	-0.1104	0.049	-2.241	0.026	-0.207	-0.014

Roots

	Real	Imaginary	Modulus	Frequency
AR.1	0.6923	-2.9286j	3.0093	-0.2131
AR.2	0.6923	+2.9286j	3.0093	0.2131

Residual Plot



RSS 0.48414199711977257
ACP

3.3 ARMA (0,2)

Model 1 : ARMA(0, 2)

ARMA Model Results

```

=====
Dep. Variable:      Gold      No. Observations:      408
Model:              ARMA(0, 2)  Log Likelihood      795.257
Method:             css-mle    S.D. of innovations      0.034
Date:              Wed, 13 Feb 2019  AIC      -1582.513
Time:              20:25:09    BIC      -1566.468
Sample:            0          HQIC      -1576.164
=====

```

```

=====
              coef      std err          z      P>|z|      [0.025      0.975]
-----
const          0.0033      0.002        1.824      0.069      -0.000      0.007
ma.L1.Gold      0.1533      0.049        3.102      0.002       0.056      0.250
ma.L2.Gold     -0.0809      0.048       -1.688      0.092     -0.175     0.013
=====

```

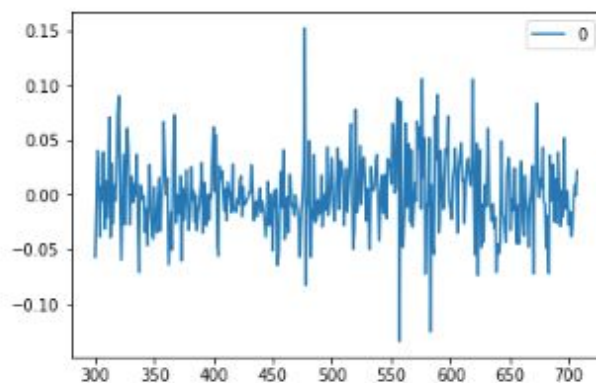
Roots

```

=====
              Real      Imaginary      Modulus      Frequency
-----
MA.1         -2.6942      +0.0000j      2.6942      0.5000
MA.2          4.5896      +0.0000j      4.5896      0.0000
=====

```

Residual Plot



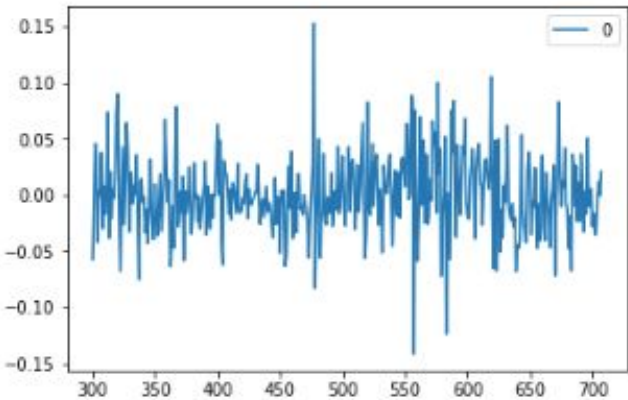
RSS 0.4844080606887626

3.4 ARMA (1,0)

```

Model 1 : ARMA(1, 0)
=====
ARMA Model Results
=====
Dep. Variable:      Gold      No. Observations:      408
Model:              ARMA(1, 0)  Log Likelihood          792.873
Method:             css-mle    S.D. of innovations      0.035
Date:               Wed, 13 Feb 2019  AIC                      -1579.746
Time:               20:25:09          BIC                      -1567.712
Sample:             0              HQIC                     -1574.984
=====
              coef      std err          z      P>|z|      [0.025      0.975]
-----
const          0.0033        0.002        1.671      0.095      -0.001      0.007
ar.L1.Gold      0.1378        0.049        2.803      0.005       0.041      0.234
=====
Roots
=====
              Real      Imaginary      Modulus      Frequency
-----
AR.1          7.2568      +0.0000j        7.2568        0.0000
=====
Residual Plot
=====

```



```

RSS 0.4900916271131731
=====

```

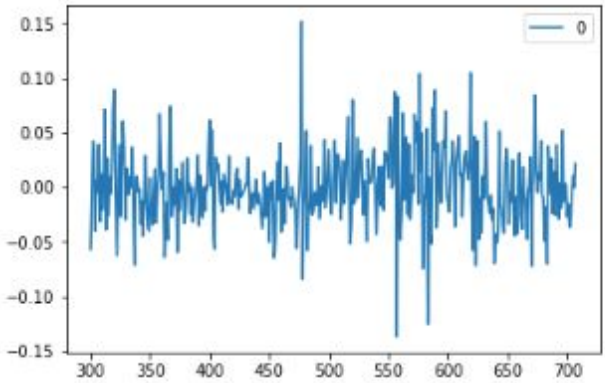
3.5 ARMA (1,1)

```

Model 1 : ARMA(1, 1)

                                ARMA Model Results
=====
Dep. Variable:                  Gold      No. Observations:                  408
Model:                          ARMA(1, 1)  Log Likelihood                  794.852
Method:                        css-mle     S.D. of innovations              0.034
Date:                          Wed, 13 Feb 2019  AIC                  -1581.703
Time:                          20:25:10      BIC                  -1565.658
Sample:                          0          HQIC                  -1575.354
=====

              coef      std err          z      P>|z|      [0.025      0.975]
-----
const          0.0033        0.002        1.737      0.083      -0.000        0.007
ar.L1.Gold     -0.3165        0.221       -1.430      0.153      -0.750        0.117
ma.L1.Gold      0.4788        0.204        2.349      0.019        0.079        0.878
=====
                        Roots
=====
              Real          Imaginary          Modulus          Frequency
-----
AR.1          -3.1599          +0.0000j          3.1599          0.5000
MA.1          -2.0885          +0.0000j          2.0885          0.5000
=====
Residual Plot



RSS 0.4853739591685967

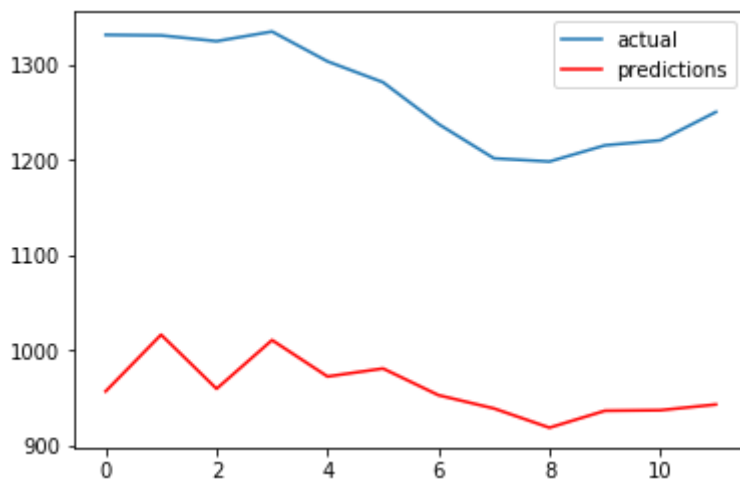
```

Comparisons

	RSS	AIC	HQ
ARMA(0, 1)	0.487	-1581.692	-1576.930
ARMA(2,0)	0.484	-1582.739	-1576.390
ARMA(0,2)	0.484	-1582.513	-1576.164
ARMA(1,0)	0.490	-1579.746	-1574.984
ARMA (1,1)	0.485	-1581.703	-1575.354

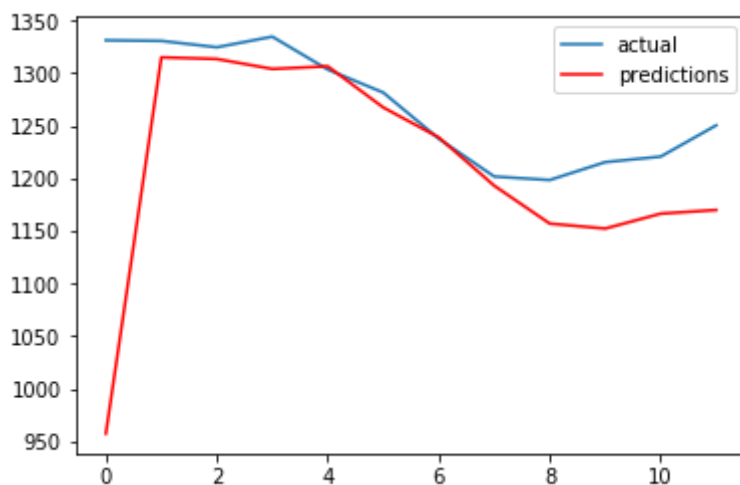
ARMA (2,0) and ARMA(0,2) looks better because of lower RSS, AIC and HQ

Static Forecasts



We expected the price to first fluctuate for a while then drop a little bit.

Dynamic Forecasts



Do you expect gold prices to go up or down in the next 12 months?

By looking at the forecasting results, gold prices are likely to go down in the next 12 months.

Static Forecasts does not take time effect in forecasting the next predictions. In dynamic forecasts, the predicted values for current months are used to predict the values for next month.