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| PREDICTIVE ANALYTICS AND BUS FORECAST PROJECT |
| ANALYSE THE FACTORS THAT AFFECT PRICE OF GOLD IN INDIA |
| USING SPLUS |

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| PREETI USHA  5-10-2016 |

**PREDICT THE PRICE OF GOLD IN INDIA**

**Title**

The model analyse the factors that affect price of gold in India.

**I. Introduction**

This research will analyse the factors that affect price of gold in India. This project will be of interest to the government reserves, gold producers, jewellery sellers, gold investors.

**II. Previous Research**

No research has been done in past.

**III. Methodology**

The research is time series and is based on three hundred and nine observations. The model will use graphical techniques (histogram, scatterplots) and analytical techniques including descriptive statistics, correlation and regression. TIBCO Spotfire S+ will be the statistical program used to complete the analysis.

The functional specifications are provided in the equation below:

+ + -

Eqn.1 Price of gold in Rupees = f (Observation, Price of Gold in Dollars, Interest rate,

* +

Inflation rate, Exchange Rate)

Eqn.2 Price = + obersvation + inflation rate + interest rate+ price in dollar+ exchange rate

Eqn3 Price = a + b1\*observation+ b2\*inflation rate+ b3\*interest rate+ b4\*price in dollar + b5\*exchange rate

Price of gold is defined as a function of the inflation rate, interest rate, exchange rate, price in dollar and the number of observations. It is predicted that the overall trend price of gold is increasing: it will increase as number of observation, exchange rate and Price of gold in Dollars increases. However, price of gold would decrease as the interest rate and inflation rate would increase.

**IV. Results**

a) Histograms: Below display the histogram of Interest Rate, Exchange Rate, Price of gold in dollars, year, observation and inflation rate.



b) Scatterplot

The scatterplot of Price of gold in Rupees with Price of gold in Dollars displayed below is Consistent with the hypothesis, the relationship is strong and linear. There is no evidence of heteroscedasticity.

The scatterplot of Price of gold in Rupees with Observation displayed below is Consistent with the hypothesis, the relationship is strong and somewhat linear. There is no evidence of heteroscedasticity.

The scatterplot of Price of gold in Rupees with Inflation Rate displayed below is consistent with the hypothesis, the relationship is negatively correlated, somewhat weak and slightly non- linear. There is heteroscedasticity.

The scatterplot of Price of gold in Rupees with Interest rate displayed below is consistent with the hypothesis, the relationship is negatively correlated, somewhat weak and slightly non- linear. There is heteroscedasticity. ­­

The scatterplot of price of gold in rupees with exchange rate displayed below is steep up to a certain point and then is constant which means increase or decrease in exchange rate doesn’t significantly affect the price of gold.



c) Table 1, a Table of Descriptive Statistics

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | mean | Med | stdev | skew | Kurt | n |
| ER | 0.00 | 0.00 | 0.03 | 3.53 | 26.45 | 308 |
| Obs | 154.50 | 154.50 | 89.06 | 0.00 | -1.20 | 308 |
| IR | 7.88 | 7.78 | 3.53 | 0.44 | -0.20 | 308 |
| PD | 659.40 | 390.93 | 447.15 | 1.06 | -0.27 | 308 |
| InR | 8.41 | 8.00 | 2.34 | 0.42 | -1.34 | 308 |
| PR | 31106.02 | 16223.74 | 26631.86 | 1.08 | -0.37 | 308 |

d) Table 2, Correlation Matrix Table,

Table 2 displays Correlation Matrix. Notice there is a strong correlation between Price of gold in rupees, price of gold in dollars and observation, there is a weak and negative correlation between Price of gold in rupees and interest rate. As expected, correlation results are in agreement with hypothesis. But, there is a weak correlation between Price of gold in Rupees and Inflation rate and exchange rate. Which is opposite to our hypothesis.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Obs | ER | IR | PD | InR | PR |
| Obs | 1.00 | -0.11 | -0.18 | 0.82 | -0.64 | 0.871 |
| ER | -0.11 | 1.00 | 0.13 | -0.01 | 0.12 | -0.015 |
| IR | -0.18 | 0.13 | 1.00 | 0.20 | 0.41 | 0.117 |
| PD | 0.82 | -0.01 | 0.20 | 1.00 | -0.28 | 0.975 |
| InR | -0.64 | 0.12 | 0.41 | -0.28 | 1.00 | -0.283 |
| PR | 0.87 | -0.02 | 0.12 | 0.98 | -0.28 | 1 |

e) Table 3, Regression Results

Coefficients of Determination

Equation 4 P = 35868.44 + 0.1802\*Observation -153.84\*Inflation Rate+2440.40\*Interest Rate+20216.26\*Exchange Rate+38.81\*Price of Gold in Dollars

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Coefficients | Value | Std. Error | t value | Pr(>|t|) |
| (Intercept) | -35868.44 | 1449.29 | -24.75 | 0.00 |
| Obs | 142.25 | 5.80 | 24.51 | 0.00 |
| IR | -153.84 | 66.32 | -2.32 | 0.02 |
| InR | 2440.40 | 121.18 | 20.14 | 0.00 |
| PD | 38.81 | 0.98 | 39.53 | 0.00 |
| ER | 20216.26 | 7240.29 | 2.79 | 0.01 |

Residual standard error: 3177 on 302 degrees of freedom

Multiple R-Squared: 0.986 Adjusted R-squared: 0.9858

F-statistic: 4253 on 5 and 302 degrees of freedom, the p-value is 0

Durbin-Watson Statistic: 0.2097413

Number of observations: 308

f) Residual Analysis



Scatterplot



**LOG MODEL RESULTS**

Notice that Explanatory power increases from 0.98 to 0.99 when Log model is used

Coefficients of Determination

Equation 4 P = 8.24 + 140\*Observation+148.1\*Inflation Rate+168.80\*Interest Rate+0.6\*Exchange Rate+37.6\*Price of Gold in Dollars

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Coefficients: | Value | Std. Error | t value | Pr(>|t|) |
| (Intercept) | 8.24 | 0.03 | 241.10 | 0.00 |
| Obs | 140.0 | 0.00 | 45.07 | 0.00 |
| IR | 148.1 | 0.00 | 4.20 | 0.00 |
| InR | 160.8 | 0.00 | 12.59 | 0.00 |
| PD | 37.6 | 0.00 | 30.79 | 0.00 |
| ER | 0.6 | 0.17 | 0.36 | 0.72 |

Residual standard error: 0.0749 on 302 degrees of freedom

Multiple R-Squared: 0.9912 Adjusted R-squared: 0.9911

F-statistic: 6803 on 5 and 302 degrees of freedom, the p-value is 0

> durbinWatson(lmFit)

Durbin-Watson Statistic: 0.1876766

Number of observations: 308

mean(pctResid)

[1] 0.002764828





**GAM MODEL RESULTS**



After Removing over fitting



**V. Discussion**

As predicted, the regression result indicates that the four variable unemployment rate, year, inflation rate, observation can explain 99.12% variation in Price of Gold in Rupees. The F statistic is 6803 is well above the minimum level.

**VI. Conclusion**

The research created model that explains the factors that affects the Price of Gold in Rupees. The explanatory power was quite high. The correlation between observation, interest rate and Price of gold in Dollars were as expected. Observations, Price of gold in Dollars, inflation rate and interest rate were significant indicators. This model can be used by Gold Sellers, Gold Producers,Investers

**VII. Appendix 1: Dataset used**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Obs | PR | PD | IR | InR | ER |
| 1 | 6295.47 | 363.05 | 7.69 | 10.00 | 0.45% |
| 2 | 6140.54 | 352.2 | 8.82 | 10.00 | 0.64% |
| 3 | 6457.20 | 372.3 | 9.88 | 10.00 | -0.55% |
| 4 | 6783.83 | 387.75 | 9.20 | 10.00 | 0.91% |
| 5 | 7333.11 | 408.4 | 8.52 | 10.00 | 3.01% |
| 6 | 6895.03 | 379.5 | 10.80 | 10.00 | 0.43% |
| 7 | 6999.61 | 384.85 | 12.50 | 10.00 | 0.17% |
| 8 | 6948.86 | 386.2 | 13.71 | 10.00 | -0.28% |
| 9 | 6810.58 | 366 | 16.09 | 10.00 | 2.86% |
| 10 | 6917.02 | 362.7 | 15.43 | 10.00 | 2.25% |
| 11 | 6942.23 | 355.65 | 13.56 | 10.00 | 2.84% |
| 12 | 7226.59 | 357.75 | 12.22 | 10.00 | 3.03% |
| 13 | 7527.25 | 360.4 | 12.09 | 10.00 | 3.45% |
| 14 | 7785.63 | 368.35 | 12.97 | 10.00 | 1.40% |
| 15 | 9347.97 | 362.85 | 13.23 | 11.00 | 22.06% |
| 16 | 8953.66 | 347.4 | 14.21 | 11.00 | -0.31% |
| 17 | 9120.51 | 354.9 | 15.71 | 11.00 | 0.01% |
| 18 | 9241.39 | 357.45 | 14.36 | 12.00 | -0.01% |
| 19 | 9466.73 | 366.3 | 13.64 | 12.00 | 0.04% |
| 20 | 9080.55 | 353.15 | 13.07 | 12.00 | -0.06% |
| 21 | 9182.86 | 354.1 | 12.87 | 12.00 | 0.80% |
| 22 | 9210.34 | 353.1 | 13.37 | 12.00 | 1.10% |
| 23 | 9913.34 | 341.7 | 13.93 | 12.00 | 19.25% |
| 24 | 9615.68 | 336.35 | 14.36 | 12.00 | -2.46% |
| 25 | 9669.22 | 337.5 | 14.71 | 12.00 | 0.09% |
| 26 | 9838.49 | 343.4 | 12.92 | 12.00 | 0.77% |
| 27 | 10174.50 | 357.85 | 13.08 | 12.00 | -2.41% |
| 28 | 9699.96 | 340 | 11.52 | 12.00 | 0.83% |
| 29 | 9903.84 | 349 | 9.95 | 12.00 | -0.99% |
| 30 | 9632.52 | 339.25 | 9.42 | 12.00 | 0.05% |
| 31 | 9425.57 | 334.2 | 8.44 | 12.00 | 0.76% |
| 32 | 9639.30 | 332.9 | 8.00 | 12.00 | 1.79% |
| 33 | 9642.39 | 330.45 | 5.70 | 12.00 | 1.77% |
| 34 | 9885.56 | 327.6 | 5.24 | 12.00 | 4.75% |
| 35 | 10539.89 | 337.8 | 6.11 | 12.00 | -5.07% |
| 36 | 11114.50 | 354.3 | 6.06 | 12.00 | 0.46% |
| 37 | 11780.25 | 377.45 | 5.13 | 12.00 | 0.11% |
| 38 | 11869.92 | 378.45 | 5.93 | 12.00 | -0.04% |
| 39 | 12585.46 | 401.75 | 4.55 | 12.00 | 0.01% |
| 40 | 11702.27 | 371.55 | 5.79 | 12.00 | 0.03% |
| 41 | 11158.97 | 355.5 | 6.58 | 12.00 | -0.02% |
| 42 | 11602.67 | 369.6 | 7.38 | 12.00 | 0.00% |
| 43 | 11630.44 | 370.9 | 8.61 | 12.00 | 0.00% |
| 44 | 12252.64 | 391.75 | 8.64 | 12.00 | -0.01% |
| 45 | 11853.70 | 377.9 | 9.13 | 12.00 | -0.01% |
| 46 | 11967.32 | 381.55 | 9.96 | 12.00 | 0.00% |
| 47 | 12209.60 | 389.2 | 9.88 | 12.00 | 0.02% |
| 48 | 11808.30 | 376.45 | 9.80 | 12.00 | -0.01% |
| 49 | 12159.41 | 387.6 | 10.57 | 12.00 | 0.01% |
| 50 | 12085.70 | 388.25 | 10.80 | 12.00 | 0.00% |
| 51 | 12046.48 | 384 | 11.07 | 12.00 | 0.00% |
| 52 | 12100.50 | 385.75 | 10.94 | 12.00 | 0.00% |
| 53 | 12383.17 | 394.85 | 11.20 | 12.00 | -0.02% |
| 54 | 12044.15 | 383.85 | 10.31 | 12.00 | 0.04% |
| 55 | 12027.80 | 383.1 | 9.81 | 12.00 | 0.06% |
| 56 | 12022.09 | 383.25 | 9.47 | 12.00 | -0.08% |
| 57 | 11762.48 | 374.9 | 9.89 | 12.00 | 0.02% |
| 58 | 11828.84 | 376.4 | 9.81 | 12.00 | 0.16% |
| 59 | 12314.67 | 392 | 9.74 | 12.00 | -0.04% |
| 60 | 12250.82 | 389.75 | 9.67 | 12.00 | 0.06% |
| 61 | 12076.62 | 384.3 | 10.29 | 12.00 | -0.03% |
| 62 | 12153.36 | 387.05 | 10.47 | 12.00 | -0.08% |
| 63 | 12042.93 | 383.35 | 11.39 | 12.00 | 0.05% |
| 64 | 12179.75 | 382.35 | 10.92 | 12.00 | 1.40% |
| 65 | 13027.20 | 384 | 10.07 | 12.00 | 6.50% |
| 66 | 13086.63 | 382.65 | 10.38 | 12.00 | 0.81% |
| 67 | 13532.27 | 387.8 | 10.31 | 12.00 | 2.03% |
| 68 | 13608.85 | 387 | 9.69 | 12.00 | 0.77% |
| 69 | 14776.21 | 405.55 | 9.00 | 12.00 | 3.65% |
| 70 | 13892.53 | 400.65 | 8.59 | 12.00 | -4.84% |
| 71 | 13515.52 | 396.35 | 8.87 | 12.00 | -1.69% |
| 72 | 13597.67 | 391.3 | 9.83 | 12.00 | 1.61% |
| 73 | 13680.96 | 390.55 | 9.33 | 12.00 | 0.87% |
| 74 | 13457.86 | 382 | 8.82 | 12.00 | 0.00% |
| 75 | 13697.40 | 385.3 | 8.31 | 12.00 | 1.72% |
| 76 | 13784.67 | 386.45 | 8.89 | 12.00 | 0.28% |
| 77 | 13511.34 | 379 | 8.52 | 12.00 | 0.00% |
| 78 | 13510.19 | 379.5 | 8.46 | 12.00 | 0.14% |
| 79 | 13262.82 | 371.3 | 8.72 | 12.00 | 0.06% |
| 80 | 13228.38 | 369.25 | 10.41 | 12.00 | 0.36% |
| 81 | 12394.81 | 345.5 | 11.11 | 12.00 | 0.00% |
| 82 | 12866.56 | 358.6 | 10.76 | 12.00 | 0.03% |
| 83 | 12489.88 | 348.15 | 10.03 | 12.00 | 0.04% |
| 84 | 12162.06 | 340.15 | 9.26 | 11.00 | -0.32% |
| 85 | 12363.83 | 345.6 | 7.32 | 11.00 | 0.03% |
| 86 | 11976.88 | 334.55 | 6.61 | 10.00 | 0.08% |
| 87 | 11649.05 | 326.35 | 5.60 | 10.00 | -0.28% |
| 88 | 11819.96 | 325.35 | 4.66 | 10.00 | 1.97% |
| 89 | 12012.05 | 332.1 | 4.94 | 10.00 | -0.63% |
| 90 | 11324.05 | 311.4 | 5.49 | 9.00 | 0.48% |
| 91 | 11452.01 | 296.8 | 4.87 | 9.00 | 6.74% |
| 92 | 11378.73 | 290.2 | 6.29 | 9.00 | 1.03% |
| 93 | 11834.26 | 304.85 | 9.71 | 11.00 | -1.40% |
| 94 | 11702.68 | 297.4 | 9.14 | 11.00 | 1.81% |
| 95 | 11884.23 | 301 | 8.26 | 10.50 | 0.39% |
| 96 | 12339.45 | 310.7 | 8.19 | 10.00 | 0.53% |
| 97 | 12235.77 | 293.6 | 10.51 | 9.00 | 4.87% |
| 98 | 12555.70 | 296.3 | 12.39 | 9.00 | 1.80% |
| 99 | 12287.67 | 288.85 | 14.80 | 9.00 | 0.35% |
| 100 | 11624.96 | 273.4 | 15.04 | 9.00 | -0.06% |
| 101 | 12460.05 | 293.85 | 16.34 | 9.00 | -0.22% |
| 102 | 12381.82 | 292.3 | 18.63 | 9.00 | -0.13% |
| 103 | 12548.32 | 294.7 | 19.67 | 9.00 | 0.44% |
| 104 | 12230.42 | 287.8 | 15.32 | 9.00 | -0.21% |
| 105 | 12130.92 | 285.4 | 9.38 | 9.00 | 0.05% |
| 106 | 12249.85 | 287.05 | 8.64 | 9.00 | 0.45% |
| 107 | 11857.06 | 279.45 | 8.95 | 8.00 | -0.64% |
| 108 | 12260.74 | 286.6 | 8.36 | 8.00 | 0.96% |
| 109 | 11509.50 | 268.6 | 7.71 | 8.00 | 0.09% |
| 110 | 11317.30 | 261 | 5.26 | 8.00 | 1.24% |
| 111 | 11070.04 | 255.6 | 3.16 | 8.00 | -0.07% |
| 112 | 11075.52 | 254.8 | 3.15 | 8.00 | 0.33% |
| 113 | 13034.90 | 299 | 2.14 | 8.00 | 0.31% |
| 114 | 12977.94 | 299.1 | 0.92 | 8.00 | -0.48% |
| 115 | 12649.68 | 291.35 | 0.00 | 8.00 | -0.03% |
| 116 | 12630.95 | 290.25 | 0.47 | 8.00 | 0.22% |
| 117 | 12360.03 | 283.3 | 2.62 | 8.00 | 0.29% |
| 118 | 12806.45 | 293.65 | 3.61 | 8.00 | -0.03% |
| 119 | 12067.68 | 276.75 | 4.83 | 8.00 | -0.03% |
| 120 | 12007.98 | 275.05 | 5.54 | 7.00 | 0.11% |
| 121 | 12135.81 | 272.25 | 5.01 | 7.00 | 2.12% |
| 122 | 12872.37 | 288.15 | 5.24 | 7.00 | 0.17% |
| 123 | 12459.28 | 276.75 | 4.95 | 8.00 | 0.90% |
| 124 | 12678.29 | 277 | 3.99 | 8.00 | 1.68% |
| 125 | 12597.47 | 273.65 | 3.50 | 8.00 | 0.38% |
| 126 | 12387.86 | 264.5 | 2.75 | 8.00 | 1.88% |
| 127 | 12608.67 | 269.1 | 2.74 | 8.00 | 0.05% |
| 128 | 12811.32 | 274.45 | 3.48 | 8.00 | -0.41% |
| 129 | 12271.47 | 264.5 | 3.25 | 8.00 | -0.62% |
| 130 | 12416.21 | 266.7 | 3.02 | 7.50 | 0.32% |
| 131 | 12015.26 | 257.7 | 2.53 | 7.00 | 0.37% |
| 132 | 12323.31 | 263.15 | 2.28 | 7.00 | 0.28% |
| 133 | 12575.17 | 267.5 | 2.50 | 7.00 | 0.34% |
| 134 | 12729.02 | 270.6 | 3.39 | 7.00 | 0.09% |
| 135 | 12531.86 | 265.9 | 4.04 | 7.00 | 0.19% |
| 136 | 12869.22 | 273 | 5.19 | 7.00 | -0.02% |
| 137 | 14024.83 | 293.1 | 4.73 | 7.00 | 1.55% |
| 138 | 13377.21 | 278.75 | 4.23 | 6.50 | 0.29% |
| 139 | 13204.71 | 275.5 | 4.89 | 6.50 | -0.13% |
| 140 | 13332.83 | 276.5 | 5.16 | 6.50 | 0.61% |
| 141 | 13694.36 | 282.3 | 4.94 | 6.50 | 0.60% |
| 142 | 14465.49 | 296.85 | 5.19 | 6.50 | 0.41% |
| 143 | 14702.29 | 301.4 | 5.17 | 6.50 | 0.14% |
| 144 | 15080.22 | 308.2 | 4.69 | 6.50 | 0.31% |
| 145 | 16006.66 | 326.6 | 4.66 | 6.50 | 0.16% |
| 146 | 15561.91 | 318.5 | 4.16 | 6.50 | -0.31% |
| 147 | 14818.17 | 304.65 | 3.89 | 6.50 | -0.45% |
| 148 | 15161.40 | 312.8 | 3.86 | 6.50 | -0.35% |
| 149 | 15650.89 | 323.7 | 4.30 | 6.50 | -0.25% |
| 150 | 15318.94 | 316.9 | 4.06 | 6.50 | -0.02% |
| 151 | 15413.30 | 319.05 | 3.60 | 6.25 | -0.06% |
| 152 | 16648.24 | 347.2 | 3.20 | 6.25 | -0.75% |
| 153 | 17567.79 | 367.5 | 3.43 | 6.25 | -0.31% |
| 154 | 16561.20 | 347.45 | 3.86 | 6.25 | -0.40% |
| 155 | 15891.97 | 334.85 | 4.06 | 6.25 | -0.27% |
| 156 | 15943.42 | 336.75 | 5.12 | 6.25 | -0.34% |
| 157 | 16993.02 | 361.4 | 4.66 | 6.00 | -0.63% |
| 158 | 16078.62 | 346 | 4.41 | 6.00 | -1.30% |
| 159 | 16368.87 | 354.75 | 4.16 | 6.00 | -0.53% |
| 160 | 17217.50 | 375.6 | 3.10 | 6.00 | -0.66% |
| 161 | 17754.88 | 388 | 2.89 | 6.00 | -0.46% |
| 162 | 17504.85 | 386.25 | 3.29 | 6.00 | -0.72% |
| 163 | 18232.47 | 398.35 | 3.07 | 6.00 | 0.99% |
| 164 | 18991.41 | 416.25 | 3.72 | 6.00 | -0.32% |
| 165 | 18106.68 | 399.75 | 4.35 | 6.00 | -0.78% |
| 166 | 17906.26 | 395.85 | 4.13 | 6.00 | -0.14% |
| 167 | 18397.05 | 423.7 | 3.49 | 6.00 | -4.10% |
| 168 | 17276.59 | 388.5 | 2.23 | 6.00 | 2.58% |
| 169 | 17849.62 | 393.25 | 2.83 | 6.00 | 2.27% |
| 170 | 18196.89 | 395.8 | 3.02 | 6.00 | 1.09% |
| 171 | 18151.17 | 391.4 | 3.19 | 6.00 | 0.87% |
| 172 | 18874.00 | 407.25 | 4.61 | 6.00 | -0.13% |
| 173 | 19119.90 | 415.65 | 4.81 | 6.00 | -0.84% |
| 174 | 19305.06 | 425.55 | 4.57 | 6.00 | -1.28% |
| 175 | 20171.76 | 453.4 | 4.17 | 6.00 | -1.84% |
| 176 | 18935.52 | 435.6 | 3.78 | 6.00 | -2.81% |
| 177 | 18428.95 | 422.15 | 4.37 | 6.00 | 0.91% |
| 178 | 18985.61 | 435.45 | 4.17 | 6.00 | -0.02% |
| 179 | 18666.78 | 427.5 | 4.17 | 6.00 | 0.09% |
| 180 | 18966.02 | 435.7 | 4.96 | 6.00 | -0.56% |
| 181 | 18130.11 | 414.45 | 3.74 | 6.00 | 0.62% |
| 182 | 19005.10 | 437.1 | 3.32 | 6.00 | -0.49% |
| 183 | 18635.75 | 429 | 4.06 | 6.00 | -0.10% |
| 184 | 19101.99 | 433.25 | 3.45 | 6.00 | 1.32% |
| 185 | 20806.43 | 473.25 | 3.63 | 6.00 | -0.14% |
| 186 | 21233.18 | 470.75 | 4.18 | 6.00 | 2.54% |
| 187 | 22750.33 | 495.65 | 5.33 | 6.00 | 1.82% |
| 188 | 23090.13 | 513 | 5.57 | 6.00 | -1.95% |
| 189 | 25096.09 | 568.75 | 4.37 | 6.00 | -2.38% |
| 190 | 24669.72 | 556 | 4.57 | 6.00 | 0.80% |
| 191 | 25936.82 | 582 | 4.57 | 6.00 | 0.51% |
| 192 | 28925.26 | 644 | 4.65 | 6.00 | 0.90% |
| 193 | 30233.89 | 653 | 5.93 | 6.00 | 3.13% |
| 194 | 28245.54 | 613.5 | 7.27 | 6.00 | -0.92% |
| 195 | 29449.20 | 632.5 | 6.33 | 6.00 | 1.35% |
| 196 | 29014.57 | 623.5 | 5.94 | 6.00 | -0.04% |
| 197 | 27520.55 | 599.25 | 6.40 | 6.00 | -1.23% |
| 198 | 27186.86 | 603.75 | 6.92 | 6.00 | -2.16% |
| 199 | 28928.18 | 646.7 | 5.95 | 6.00 | -0.71% |
| 200 | 27972.32 | 632 | 6.53 | 6.00 | -1.09% |
| 201 | 28727.37 | 650.5 | 6.72 | 6.00 | -0.08% |
| 202 | 29407.45 | 664.2 | 7.56 | 6.00 | 0.02% |
| 203 | 28762.96 | 661.75 | 6.72 | 6.00 | -2.20% |
| 204 | 27885.62 | 677 | 6.67 | 6.00 | -4.81% |
| 205 | 26762.75 | 659.1 | 6.61 | 6.00 | -1.63% |
| 206 | 26493.23 | 650.5 | 5.69 | 6.00 | 0.37% |
| 207 | 26874.55 | 665.5 | 6.45 | 6.00 | -0.83% |
| 208 | 27468.00 | 672 | 7.26 | 6.00 | 1.12% |
| 209 | 29606.68 | 743 | 6.40 | 6.00 | -2.41% |
| 210 | 31045.89 | 789.5 | 5.51 | 6.00 | -1.17% |
| 211 | 31046.19 | 783.5 | 5.51 | 6.00 | 0.83% |
| 212 | 32862.25 | 833.75 | 5.51 | 6.00 | -0.29% |
| 213 | 36352.97 | 923.25 | 5.51 | 6.00 | -0.32% |
| 214 | 38874.57 | 971.5 | 5.47 | 6.00 | 1.63% |
| 215 | 37452.02 | 933.5 | 7.87 | 6.00 | 0.28% |
| 216 | 35288.56 | 871 | 7.81 | 6.00 | 1.07% |
| 217 | 37604.50 | 885.75 | 7.75 | 6.00 | 4.20% |
| 218 | 40024.00 | 930.25 | 7.69 | 6.00 | 1.83% |
| 219 | 39083.85 | 918 | 8.33 | 6.00 | -1.04% |
| 220 | 36597.85 | 833 | 9.02 | 6.00 | 3.26% |
| 221 | 41540.54 | 884.5 | 9.77 | 6.00 | 6.71% |
| 222 | 36135.59 | 730.75 | 10.45 | 6.00 | 5.36% |
| 223 | 40794.23 | 814.5 | 10.45 | 6.00 | 0.51% |
| 224 | 42374.21 | 869.75 | 9.70 | 6.00 | -1.93% |
| 225 | 44945.15 | 919.5 | 10.45 | 6.00 | 0.47% |
| 226 | 48685.28 | 952 | 9.63 | 6.00 | 4.41% |
| 227 | 46498.61 | 916.5 | 8.03 | 6.00 | -0.85% |
| 228 | 44193.40 | 883.25 | 8.70 | 6.00 | -1.67% |
| 229 | 45960.67 | 975.5 | 8.63 | 6.00 | -5.24% |
| 230 | 44767.22 | 934.5 | 9.29 | 6.00 | 1.34% |
| 231 | 45025.05 | 939 | 11.89 | 6.00 | 0.16% |
| 232 | 46652.28 | 955.5 | 11.72 | 6.00 | 1.81% |
| 233 | 47900.55 | 995.75 | 11.64 | 6.00 | -1.96% |
| 234 | 48843.60 | 1040 | 11.49 | 6.00 | -1.70% |
| 235 | 54690.01 | 1175.75 | 13.51 | 6.00 | -0.83% |
| 236 | 50606.80 | 1087.5 | 14.97 | 6.00 | -0.27% |
| 237 | 49794.34 | 1078.5 | 16.22 | 6.00 | -0.61% |
| 238 | 51095.86 | 1108.25 | 14.86 | 6.00 | -0.04% |
| 239 | 50080.36 | 1115.5 | 14.86 | 6.00 | -2.78% |
| 240 | 52311.51 | 1179.25 | 13.33 | 6.00 | -1.23% |
| 241 | 55985.73 | 1207.5 | 13.91 | 6.00 | 4.72% |
| 242 | 57777.57 | 1244 | 13.73 | 6.00 | 0.17% |
| 243 | 54247.44 | 1169 | 11.25 | 6.00 | -0.09% |
| 244 | 58611.83 | 1246 | 9.88 | 6.00 | 1.42% |
| 245 | 58730.04 | 1307 | 9.82 | 6.00 | -5.30% |
| 246 | 59829.35 | 1346.75 | 9.70 | 6.00 | -0.55% |
| 247 | 63481.89 | 1383.5 | 8.33 | 6.00 | 3.33% |
| 248 | 62846.93 | 1405.5 | 9.47 | 6.00 | -2.38% |
| 249 | 60922.55 | 1327 | 9.30 | 6.00 | 2.49% |
| 250 | 63868.91 | 1411 | 8.82 | 6.00 | -1.22% |
| 251 | 64172.18 | 1439 | 8.82 | 6.00 | -1.61% |
| 252 | 67892.13 | 1535.5 | 9.41 | 6.00 | -0.63% |
| 253 | 69211.64 | 1536.5 | 8.72 | 6.00 | 1.82% |
| 254 | 67299.61 | 1505.5 | 8.62 | 6.00 | -0.80% |
| 255 | 71963.39 | 1628.5 | 8.43 | 6.00 | -1.10% |
| 256 | 83511.65 | 1813.5 | 8.99 | 6.00 | 3.60% |
| 257 | 79339.49 | 1620 | 10.06 | 6.00 | 7.03% |
| 258 | 83852.78 | 1722 | 9.39 | 6.00 | -0.66% |
| 259 | 91149.91 | 1746 | 9.34 | 6.00 | 7.05% |
| 260 | 81303.75 | 1531 | 6.49 | 6.00 | 1.70% |
| 261 | 86232.07 | 1744 | 5.32 | 6.00 | -6.60% |
| 262 | 86747.69 | 1770 | 7.57 | 9.50 | -0.82% |
| 263 | 84696.05 | 1662.5 | 8.65 | 9.50 | 3.59% |
| 264 | 87020.87 | 1651.25 | 10.22 | 9.00 | 0.00% |
| 265 | 87493.36 | 1558 | 10.16 | 9.00 | 3.52% |
| 266 | 89252.23 | 1598.5 | 10.05 | 9.00 | -0.28% |
| 267 | 90207.51 | 1622 | 9.84 | 9.00 | 6.41% |
| 268 | 91697.81 | 1648.5 | 10.31 | 9.00 | 0.00% |
| 269 | 93675.11 | 1776 | 9.14 | 9.00 | -0.67% |
| 270 | 92473.60 | 1719 | 9.60 | 9.00 | 0.08% |
| 271 | 93885.75 | 1726 | 9.55 | 9.00 | 0.09% |
| 272 | 90814.41 | 1657.5 | 11.17 | 9.00 | 0.00% |
| 273 | 88548.03 | 1664.75 | 11.62 | 9.00 | -0.14% |
| 274 | 86422.34 | 1588.5 | 12.06 | 8.75 | 0.06% |
| 275 | 86864.87 | 1598.25 | 11.44 | 8.50 | -4.81% |
| 276 | 79142.38 | 1469 | 10.24 | 8.50 | -0.01% |
| 277 | 78768.31 | 1394.5 | 10.68 | 8.25 | 1.74% |
| 278 | 70834.59 | 1192 | 11.06 | 8.25 | 0.04% |
| 279 | 79928.16 | 1314.5 | 10.85 | 10.25 | 0.86% |
| 280 | 92151.12 | 1394.75 | 10.75 | 10.25 | -0.46% |
| 281 | 83045.53 | 1326.5 | 10.70 | 9.50 | 1.31% |
| 282 | 81366.40 | 1324 | 11.06 | 8.75 | 0.03% |
| 283 | 78299.96 | 1253 | 11.47 | 8.75 | -2.68% |
| 284 | 74504.34 | 1204.5 | 9.13 | 8.75 | -0.41% |
| 285 | 78381.40 | 1251 | 7.24 | 9.00 | 2.03% |
| 286 | 82216.46 | 1326.5 | 6.73 | 9.00 | 0.26% |
| 287 | 77146.52 | 1291.75 | 6.70 | 9.00 | -1.11% |
| 288 | 77715.86 | 1288.5 | 7.08 | 9.00 | 5.39% |
| 289 | 73892.04 | 1250.5 | 7.02 | 9.00 | 5.22% |
| 290 | 79090.66 | 1315 | 6.49 | 9.00 | 2.22% |
| 291 | 77786.53 | 1285.25 | 7.23 | 9.00 | 7.97% |
| 292 | 78019.30 | 1285.75 | 6.75 | 9.00 | -4.74% |
| 293 | 75131.03 | 1216.5 | 6.30 | 9.00 | -1.54% |
| 294 | 71484.94 | 1164.25 | 4.98 | 9.00 | 1.26% |
| 295 | 73395.54 | 1182.75 | 4.12 | 9.00 | -0.94% |
| 296 | 76125.73 | 1206 | 5.86 | 9.00 | 1.42% |
| 297 | 78053.58 | 1260.25 | 7.17 | 8.75 | -1.42% |
| 298 | 75031.26 | 1214 | 6.30 | 8.75 | -2.88% |
| 299 | 74283.93 | 1187 | 6.28 | 8.50 | 0.55% |
| 300 | 74963.58 | 1180.25 | 5.79 | 8.50 | -1.91% |
| 301 | 76090.23 | 1191.4 | 5.74 | 8.50 | 1.46% |
| 302 | 74569.27 | 1171 | 6.10 | 8.25 | 0.82% |
| 303 | 70427.42 | 1098.4 | 4.37 | 8.25 | -0.06% |
| 304 | 75449.11 | 1135 | 4.35 | 8.25 | 2.35% |
| 305 | 73122.96 | 1114 | 5.14 | 8.25 | -0.86% |
| 306 | 74646.84 | 1142.35 | 6.32 | 7.75 | 1.31% |
| 307 | 70780.94 | 1061.9 | 6.72 | 7.75 | 1.33% |
| 308 | 70125.63 | 1060 | 6.32 | 7.75 | -1.61% |

**VIII. Appendix 2**

**S+ Script**

tdata <-Projectdata

dim(tdata)

names(tdata)

#Histogram

par(mfcol=c(3,3))

hist(tdata$ER,main="Histogram of Exchange rate",xlab="ER",ylab="PR")

hist(tdata$Obs,main="Histogram of Obs",xlab="Obs",ylab="PR")

hist(tdata$IR,main="Histogram of Inflation rate",xlab="IR",ylab="PR")

hist(tdata$InR,main="Histogram of InterestRate",xlab="InR",ylab="PR")

hist(tdata$PD,main="Histogram of Price in dollars",xlab="PD",ylab="PR")

#Scatter Plot

par(mfcol=c(3,3))

plot(tdata$Obs,tdata$PR, main = "Price of gold in Rs vs Obs")

plot(tdata$IR,tdata$PR, main = "Price of gold in Rs vs Inflationrate")

plot(tdata$InR,tdata$PR, main = "Price of gold in Rs vs Interestrate")

plot(tdata$PR,tdata$PR, main = "Price of gold in Rs vs Price in dollars")

plot(tdata$ER,tdata$PR, main = "Price of gold in Rs vs Exchange rate")

#Time Series plot

par(mfrow=c(3,3))

tsplot(tdata$PR,xlab="Price ruppees vs Time");

tsplot(tdata$ER,xlab="Exchange vs Time");

tsplot(tdata$IR,xlab="Inflation rate rate vs time");

tsplot(tdata$InR,xlab="Intrest rate rate vs time");

tsplot(tdata$PD,xlab="Price dollar vs time");

smdf<-na.omit(tdata)

par(mfcol=c(3,3))

scatter.smooth (smdf$Obs,tdata$PR,main="Obs vs Price of gold in Rs",xlab="Obs",ylab="Price of gold PR")

scatter.smooth( smdf$IR,tdata$PR,main="Inflationrate vs Price of gold in Rs ",xlab="IR",ylab="PR")

scatter.smooth (smdf$InR,tdata$PR,main="InterestRate vs Price of gold in Rs ",xlab="InR",ylab="PR")

scatter.smooth (smdf$PD,tdata$PR,main="Price in dollars vs Price of gold in Rs ",xlab="InR",ylab="PR")

scatter.smooth (smdf$ER,tdata$PR,main="Exchange rate vs Price of gold in Rs",xlab="ER",ylab="PR")

fdesstat<-function(inputDataFrame){

meanVec<-apply(inputDataFrame,2,mean,na.rm=T)

medVec<-apply(inputDataFrame,2,median,na.rm=T)

sdVec<-apply(inputDataFrame,2,stdev,na.rm=T)

skewVec<-apply(inputDataFrame,2,skewness,na.rm=T)

kurtVec<-apply(inputDataFrame,2,kurtosis,na.rm=T)

nVec<-apply(inputDataFrame,2,length)

resultsDF<-data.frame(cbind(meanVec,medVec,sdVec,skewVec,kurtVec,nVec))

names(resultsDF)<-c("mean","med","stdev","skew","kurt","n")

return(resultsDF)}

smdf<-na.omit(tdata)

names(tdata)

round(fdesstat(tdata[,c("ER","Obs","IR","PD","InR","PR")]),3)

round(colMeans(tdata[,c("ER","Obs","IR","PD","InR","PR")],na.rm=T),3)

round(colStdevs(tdata[,c("ER","Obs","IR","PD","InR","PR")],na.rm=T),3)

round(cor(smdf[,c("Obs","ER","IR","PD","InR","PR")],na.method="omit"),3)

lmFit<-lm(PR~PD+Obs+IR+InR+ER,data=smdf,na.action=na.omit)

lmFit

names(lmFit)

summary(lmFit)

durbinWatson(lmFit)

preds<-predict(lmFit)

resids<-resid(lmFit)

rdf<-data.frame(smdf,p=preds,r=resids)

names(rdf)

par(mfcol=c(1,2))

hist(rdf$r, main="Histogram of Residual",xlab="Residual")

pFit<-lm(PR~p,data=rdf)

scatter.smooth(rdf$p,rdf$PR, main="Actual vs Predicted", xlab="Predicted",ylab="Actual")

par(mfcol=c(2,2))

plot(smdf$ER,rdf$r,main="Exchange rate vs Residual",xlab="Residual",ylab="ER")

plot(smdf$Obs,rdf$r,main="Obs vs Residual",xlab="Residual",ylab="Obs")

plot(smdf$IR,rdf$r,main="Inflationrate vs Residual",xlab="Residual",ylab="IR")

plot(smdf$InR,rdf$r,main="Intrestrate vs Residual",xlab="Residual",ylab="InR")

plot(smdf$PD,rdf$r,main="IR vs Residual",xlab="Residual",ylab="PD")

#log model

lmFit<-lm(log(PR)~Obs+IR+InR+PD+ER,data=tdata,na.action=na.omit)

summary(lmFit)

durbinWatson(lmFit)

names(lmFit)

r<-lmFit$residuals

p<-exp(lmFit$fitted.values)

pctResid<-tdata$PR/p-1

mean(pctResid)

par(mfcol=c(2,2))

hist(r);title("Histogram of Residuals")

tsplot(r);title("Time series plot of Residuals")

tsplot(tdata$PR,p);title("Time Series Actual Vs Predicted")

par(mfcol=c(3,3))

plot(tdata$Obs,r);title("Time Series Obs Vs Predicted")

plot(tdata$InR,r); title(" Time Series Interest Rate Vs Predicted")

plot(tdata$IR,r); title(" Time Series Inflation Rate Vs Predicted")

plot(tdata$PD,r); title(" Time Series Price In Dollars Vs Predicted")

plot(tdata$ER,r); title(" Time Series Exchange Rate Vs Predicted")

# Robust MM

lmFit<-lm(log(PR)~Obs+IR+InR+PD+ER,data=tdata,na.action=na.omit)

summary(lmFit)

durbinWatson(lmFit)

names(lmFit)

r<-lmFit$residuals

p<-exp(lmFit$fitted.values)

pctResid<-tdata$PR/p-1

mean(pctResid)

par(mfcol=c(2,2))

hist(r)

tsplot(r)

tsplot(tdata$PR,p)

par(mfcol=c(2,2))

plot(tdata$Obs,r)

plot(tdata$PR,r)

plot(tdata$PD,r)

plot(tdata$Mth,r)

plot(tdata$Yr,r)

plot(tdata$ER,r)

# Do GAM Model

fit<-gam(PR~s(Obs)+s(IR)+s(PD)+s(InR)+s(ER),data=tdata,na.action=na.omit)

summary(fit)

par(mfcol=c(3,3)); plot.gam(fit)

names(fit)

# remove overfitting....change df for each coefficient

fit<-gam(PR~s(Obs,2)+s(IR,2)+s(InR,2)+s(ER,2)+s(PD,2),data=tdata,na.action=na.omit)

summary(fit)

par(mfcol=c(3,3)); plot.gam(fit)

**IX. Bibliography:** Data sourcehttps://research.stlouisfed.org/