**The Time Analysis of Platinum Price**
NEAS Time Series Student Project
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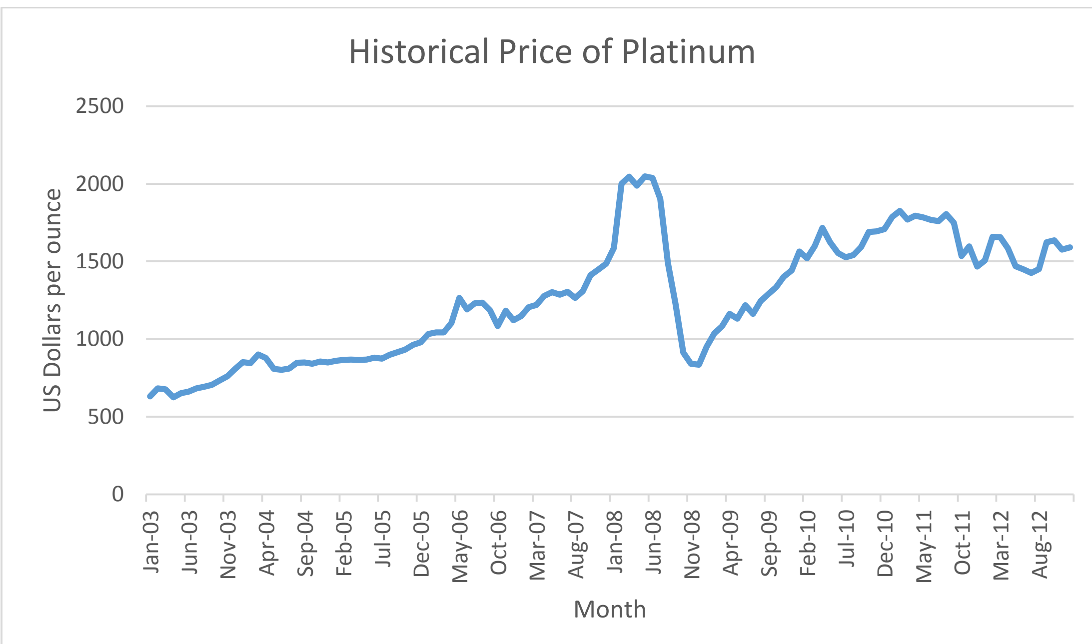
## Introduction

I chose platinum for my wife's engagement ring and wedding band. During each of those purchases, the jewelry store owner spoke about the huge changes in the price of platinum. This made me wonder how the price of platinum has changed over the last ten years and how least squares regression might be able to predict its patterns.

## Data

Presented in US dollars per ounce, per month. The data was pulled from the following website: http://www.kitco.com/scripts/hist_charts/yearly_graphs.plx

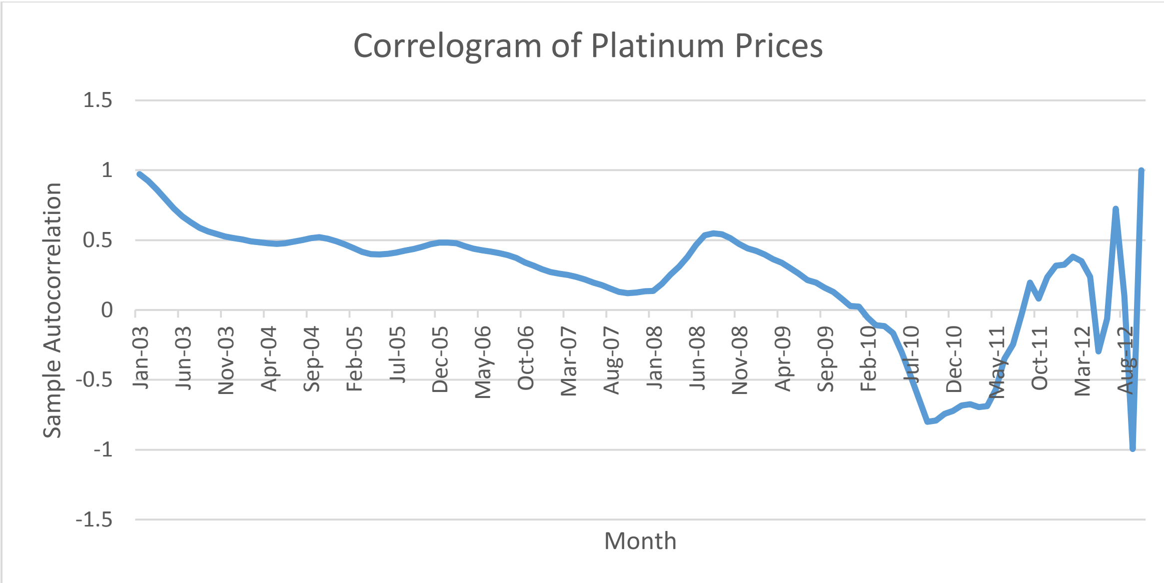
Here is a graph showing the movement in price over the past ten years.



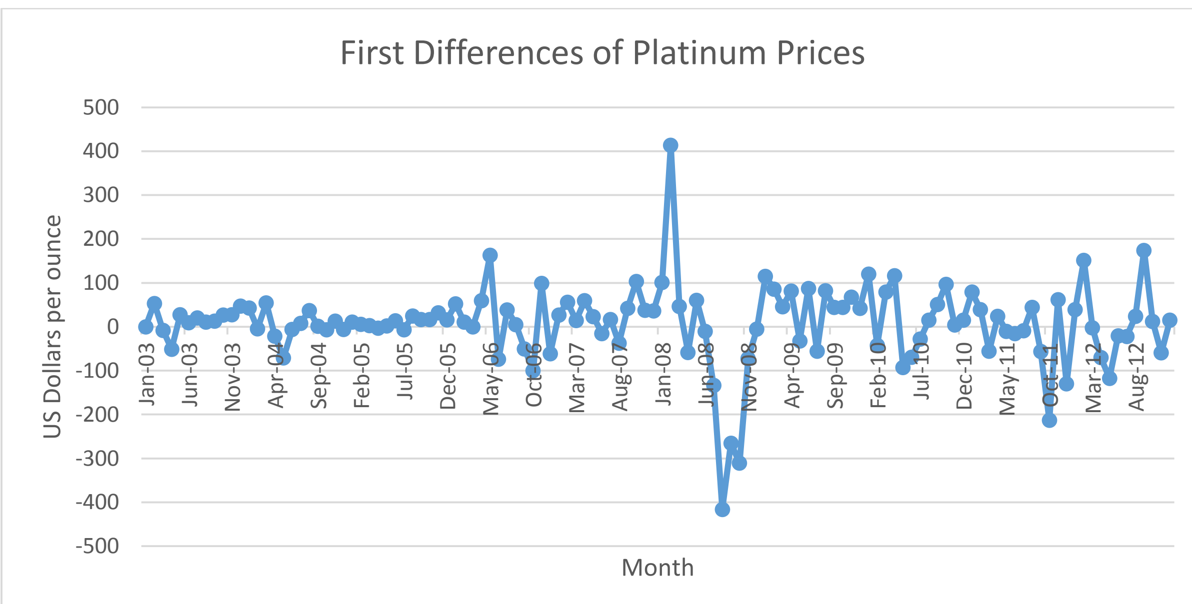

The prices appear to be trending upward, with a dramatic increase and decrease around 2008. Since there does not appear to be any seasonal patterns in the price movements, no effort will be made for a seasonal adjustment.

## Stationarity

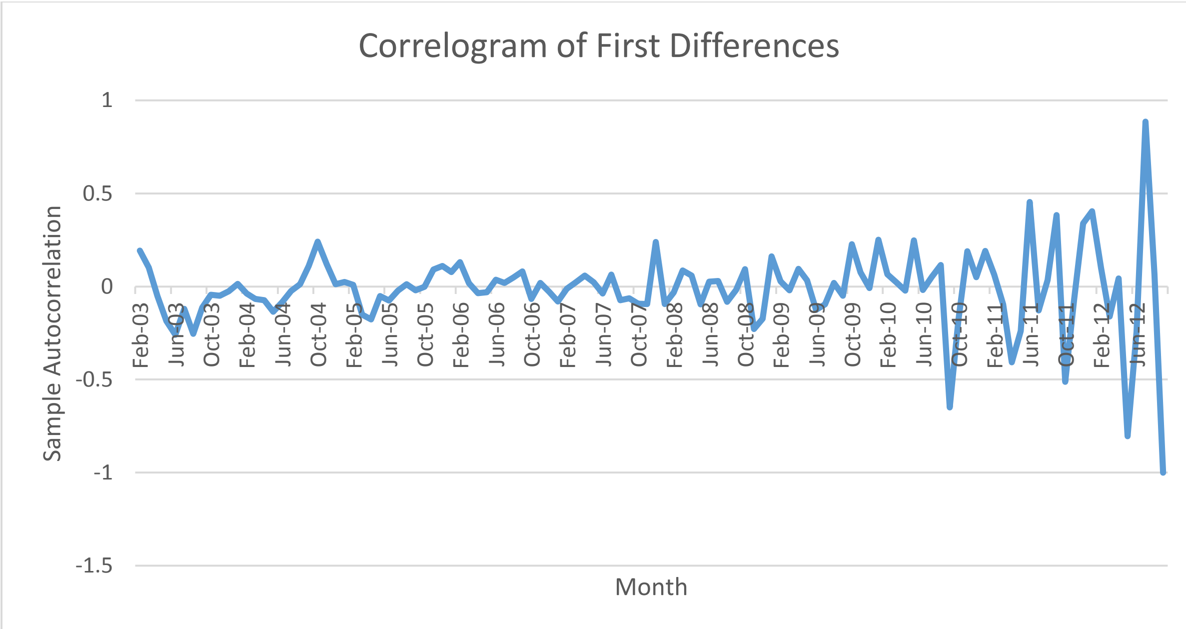
If the data can be found to be stationary, then we can use an autoregressive (AR) process to predict its behavior. A sign of being stationary would be a correlogram converging to zero. Below is a correlogram on the data itself.




This data clearly does not converge to zero. So we turn to the first difference of the data, which basically means you're looking at the changes in the prices from one month to the next. Below is a graph of the first differences:



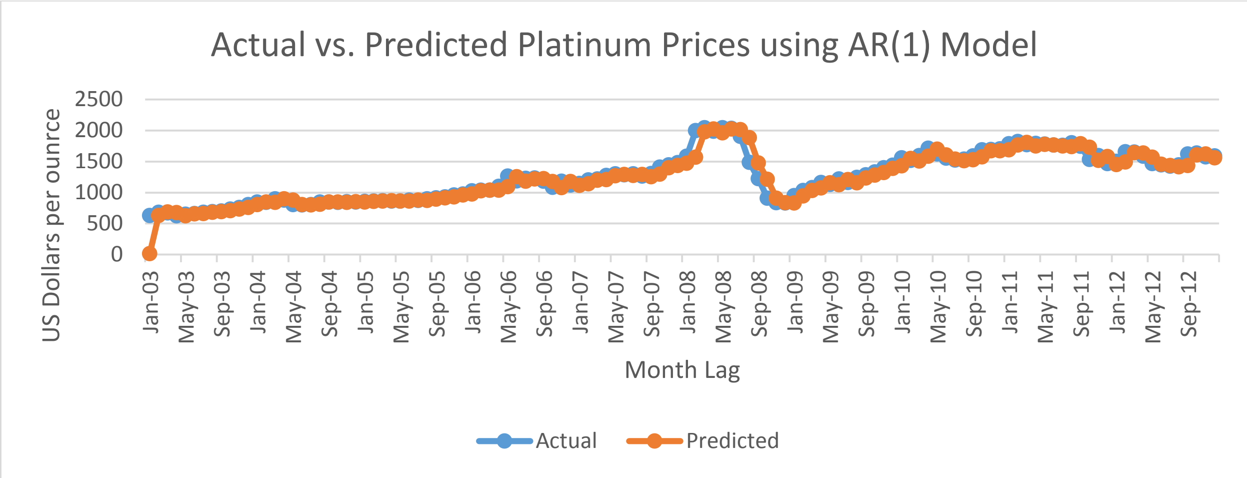

The above graph makes sense, as the raw data appeared to be moving with consistent changes except for the year 2008. Now we will take a look at the correlogram of first differences, hoping that will converge to zero.




While one could argue that the graph above does not converge to zero, it stays around zero the majority of the time. We will next take a look at the AR(1) model to see if we can reasonably use it to model the movement of platinum prices. We will use the regression Excel add-in. Below are the results:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SUMMARY OUTPUT | | | | | | | | |
| | | | | | | | | |
| *Regression Statistics* | | | | | | | | |
| Multiple R | 0.972684331 | | | | | | | |
| R Square | 0.946114807 | | | | | | | |
| Adjusted R Square | 0.94565425 | | | | | | | |
| Standard Error | 89.58726783 | | | | | | | |
| Observations | 119 | | | | | | | |
| | | | | | | | | |
| ANOVA | | | | | | | | |
| | *df* | *SS* | *MS* | *F* | *Significance F* | | | |
| Regression | 1 | 16487425.38 | 16487425 | 2054.283 | 4.67414E-76 | | | |
| Residual | 117 | 939027.7913 | 8025.879 | | | | | |
| Total | 118 | 17426453.17 | | | | | | |
| | | | | | | | | |
| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95.0%* | *Upper 95.0%* |
| Intercept | 16.405306 | 28.45793092 | 0.576476 | 0.565401 | -39.95413495 | 72.76474694 | -39.95413495 | 72.76474694 |
| X Variable 1 | 0.980557895 | 0.021634313 | 45.3242 | 4.67E-76 | 0.937712271 | 1.023403518 | 0.937712271 | 1.023403518 |

The AR(1) model utilizes the following equation: $Y(t) = \Phi Y(t-1) + e(t)$. $\Phi$ pulls from the X variable 1 coefficient and e(t), the error term, pulls from the Intercept coefficient. Now we will go back ten years and predict the next month's price based on the prior month's price, using the AR(1) equation. In the graph below we compare these monthly predictions to the actual prices in an effort to determine if the model is reasonable.

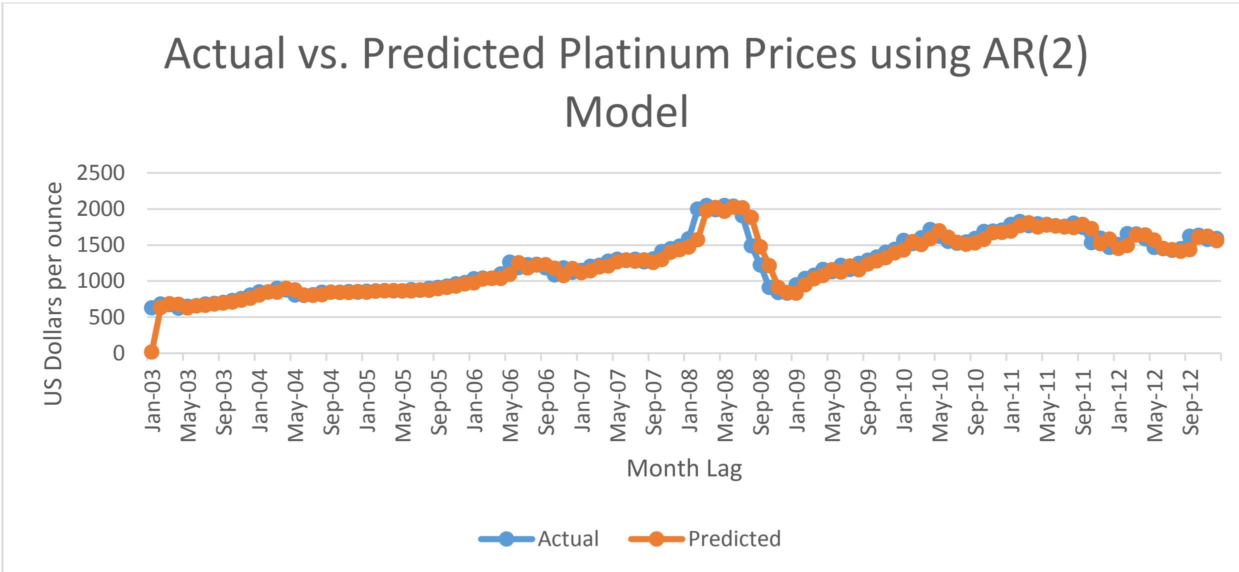



**Conclusion**

As one can see, the AR(1) model does a great job of predicting the next month's platinum price. Additionally, the model has high R values, which verifies the significance of the model.

Below are results of using the AR(2) model, which we will show simply for comparison purposes since it does not appear to offer more value than the AR(1) model.

| SUMMARY OUTPUT | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| *Regression Statistics* | | | | | | | | | |
| Multiple R | 0.976721 | | | | | | | | |
| R Square | 0.953984 | | | | | | | | |
| Adjusted R Square | 0.953184 | | | | | | | | |
| Standard Error | 83.24897 | | | | | | | | |
| Observations | 118 | | | | | | | | |
| | | | | | | | | | |
| ANOVA | | | | | | | | | |
| | *df* | *SS* | *MS* | *F* | *gnificance F* | | | | |
| Regression | 2 | 16522940 | 8261470 | 1192.064 | 1.31E-77 | | | | |
| Residual | 115 | 796994.9 | 6930.39 | | | | | | |
| Total | 117 | 17319935 | | | | | | | |
| | | | | | | | | | |
| | *Coefficients* | *andard Err* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *ower 95.0%* | *pper 95.0%* |
| Intercept | 36.30632 | 26.8411 | 1.352639 | 0.178825 | -16.8607 | 89.47338 | -16.8607 | 89.47338 |
| X Variable 1 | 1.359309 | 0.086059 | 15.79507 | 1.4E-30 | 1.188842 | 1.529775 | 1.188842 | 1.529775 |
| X Variable 2 | -0.39218 | 0.086631 | -4.52705 | 1.47E-05 | -0.56378 | -0.22058 | -0.56378 | -0.22058 |



Actual vs. Predicted Platinum Prices using AR(2) Model
US Dollars per ounce
2500
2000
1500
1000
500
0
Jan-03
May-03
Sep-03
Jan-04
May-04
Sep-04
Jan-05
May-05
Sep-05
Jan-06
May-06
Sep-06
Jan-07
May-07
Sep-07
Jan-08
May-08
Sep-08
Jan-09
May-09
Sep-09
Jan-10
May-10
Sep-10
Jan-11
May-11
Sep-11
Jan-12
May-12
Sep-12
Month Lag
Actual
Predicted