Forecast: U.S. Treasury Constant Maturity Rate

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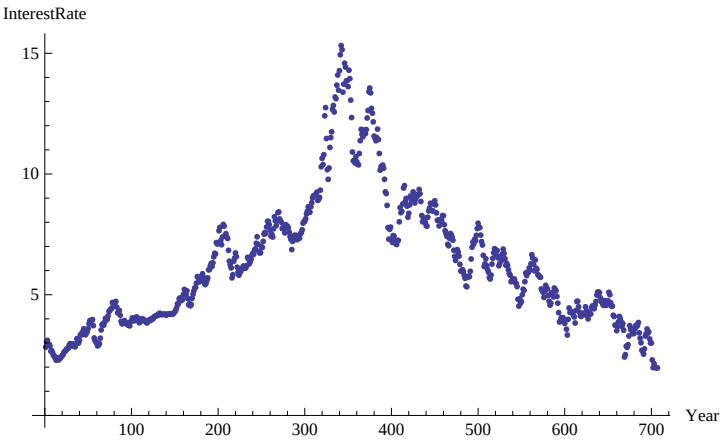
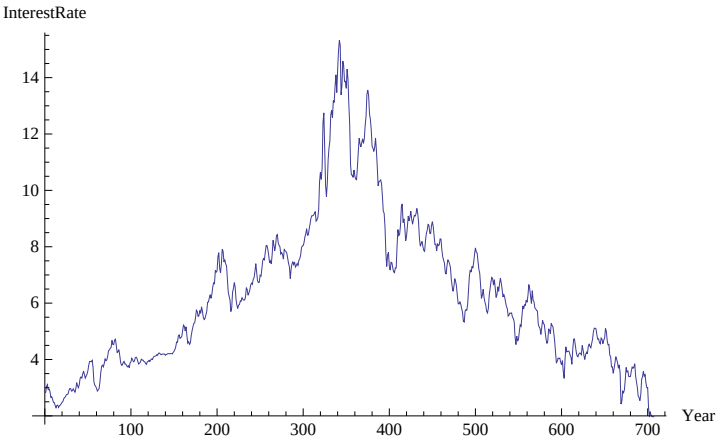
Visualization: Data

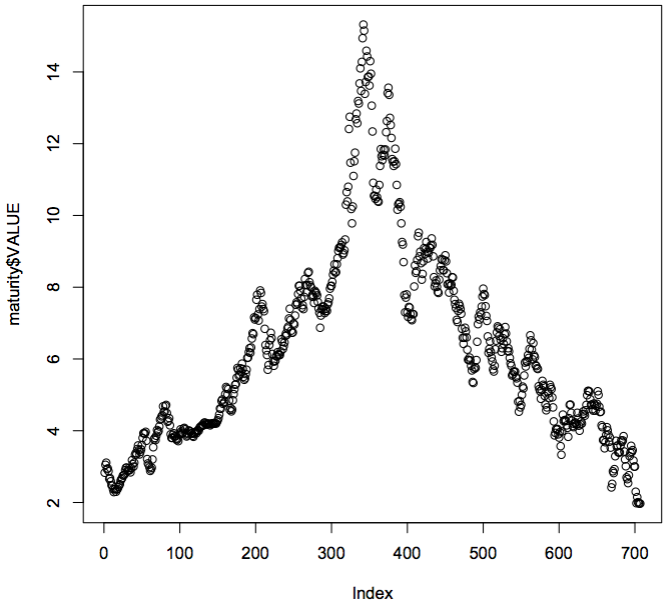
There are three identical graphs. two graphs above are drawn by *Mathematica* using listplot and listlineplot functions. The first graph is just the dotted graph and the second one is line-connected dots. To double check if my plots are correct, I used R to plot another data plot. As a result, we came up with three identical shaped graphs.

***Mathematica* Plot**



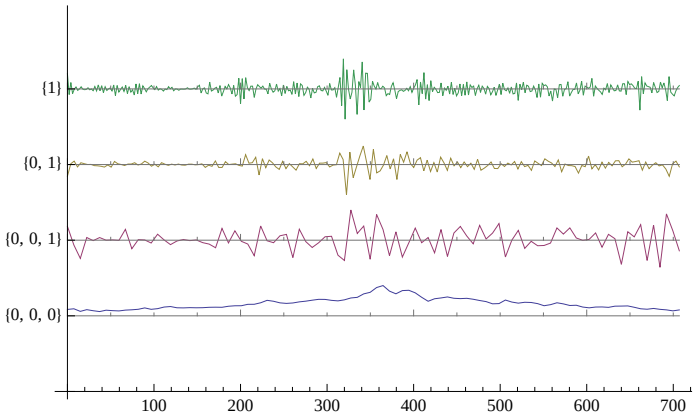


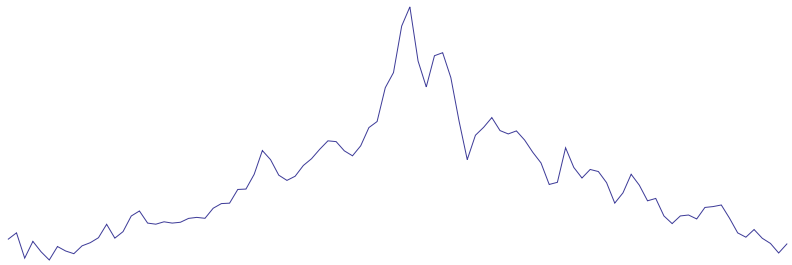
R Plot



Decomposition: Wavelets

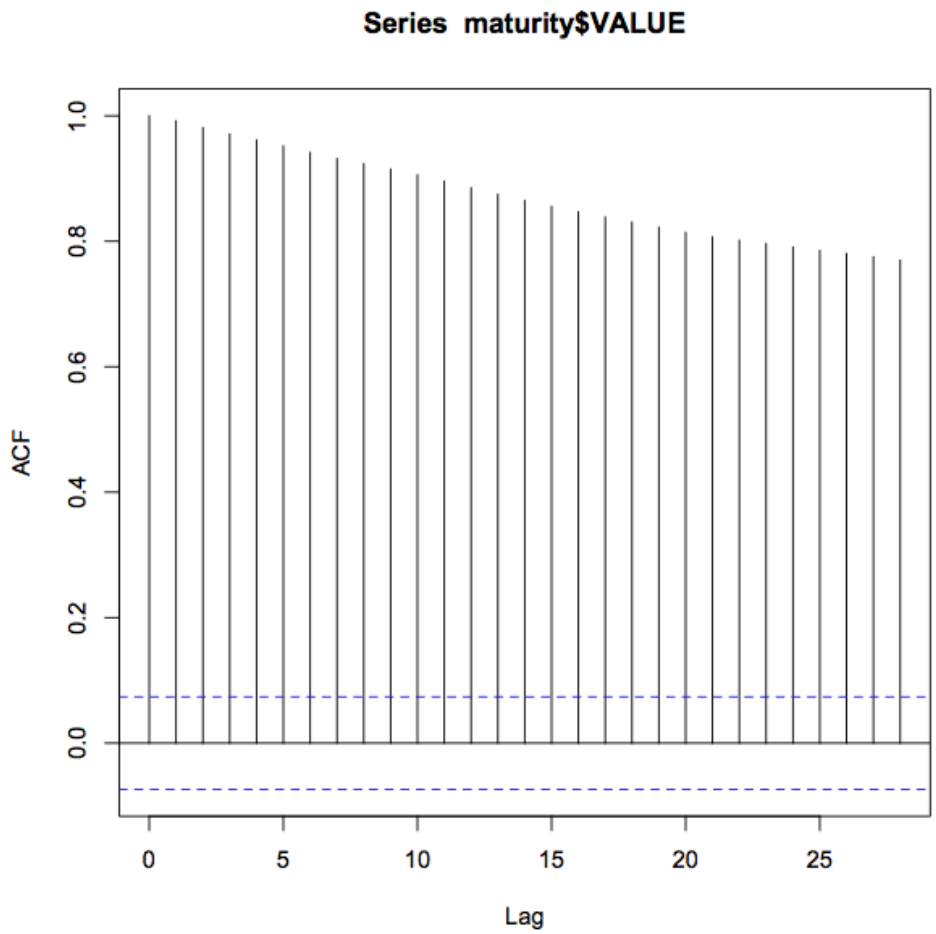
Now that we plotted the data, I want to find out the trend and noise of the data. First, I used the Wavelet package from Mathematica to have an idea what's going on. For the first image below, {1}, {0,1}, {0,0,1} are different types of noises. {0, 0, 0} is the detrended graph which the noises are removed. Then, I just separated them and zoomed in the trend graph.

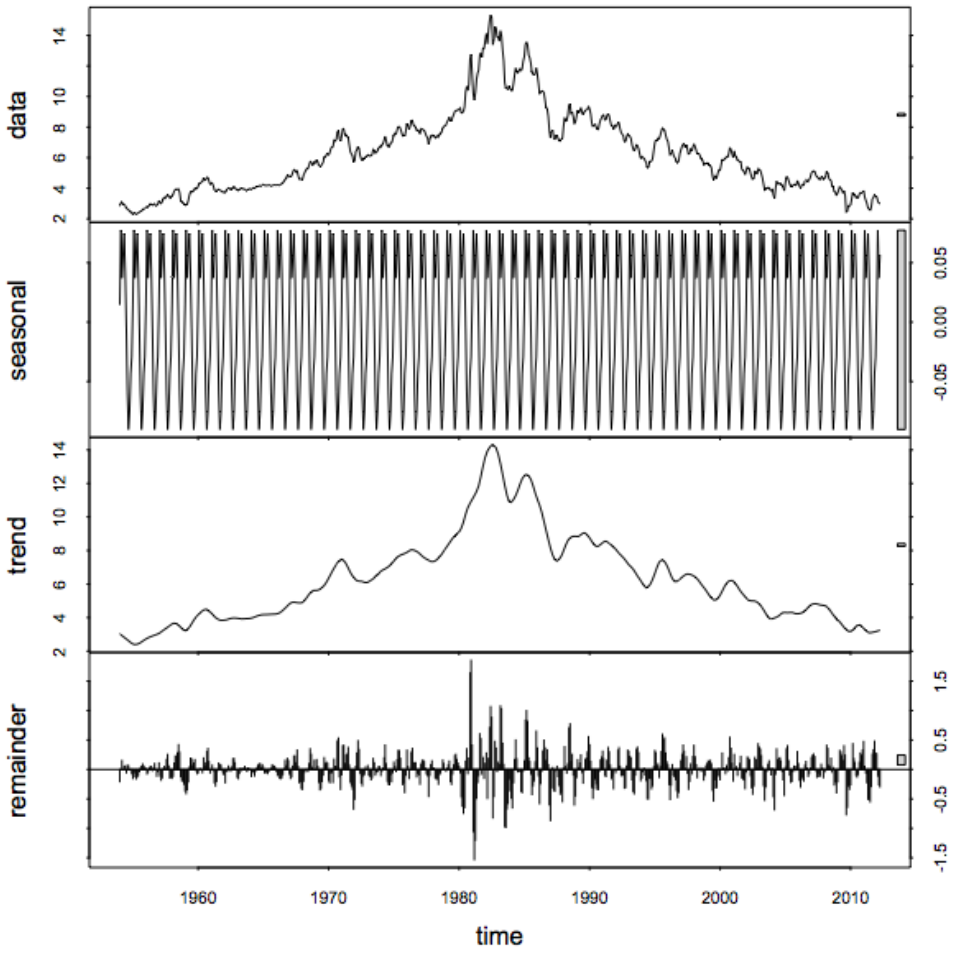




With Wavelet decomposition, I got some senses about what has happened in the past more precisely. Then, with R, I drew the ACF graph and the trend and noise graphs.

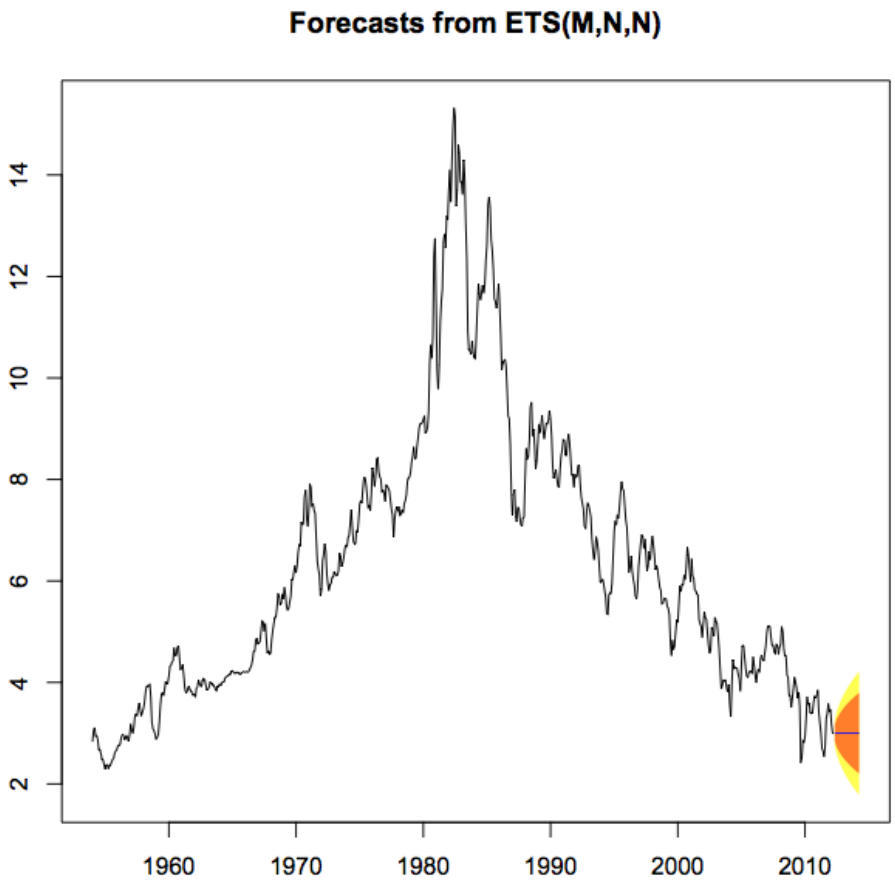
Decomposition: R



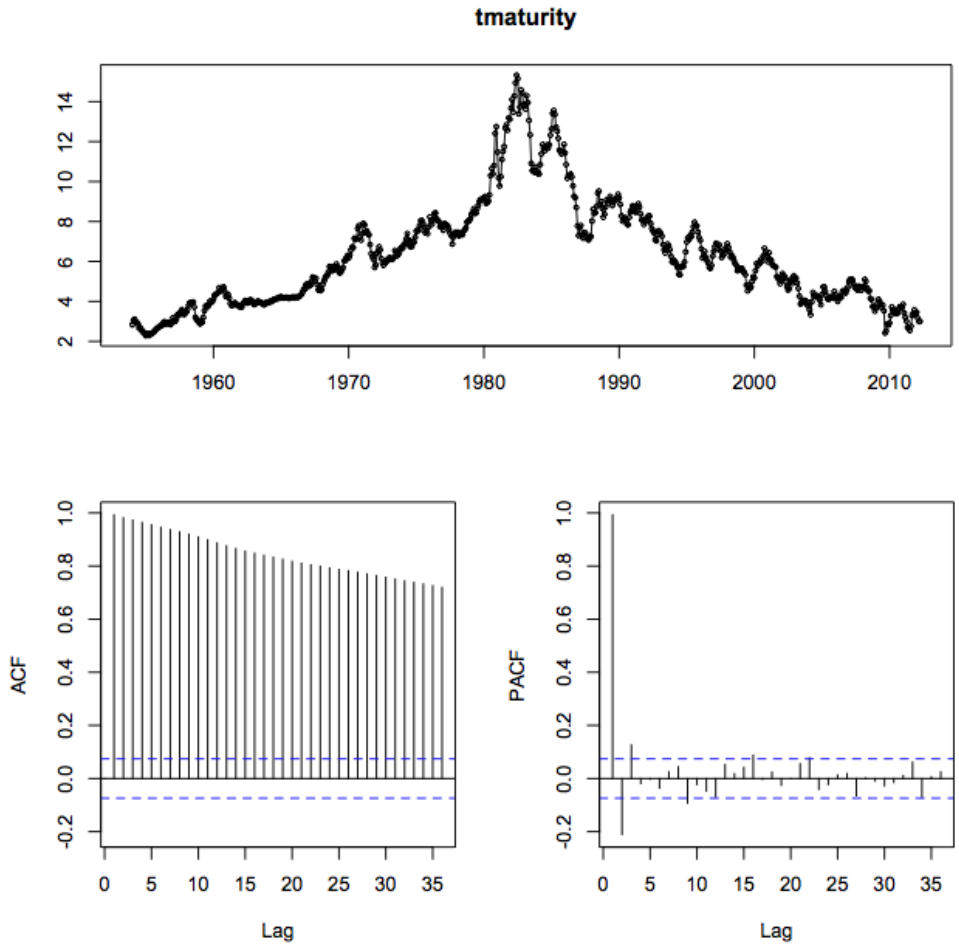


Visualization Forecast

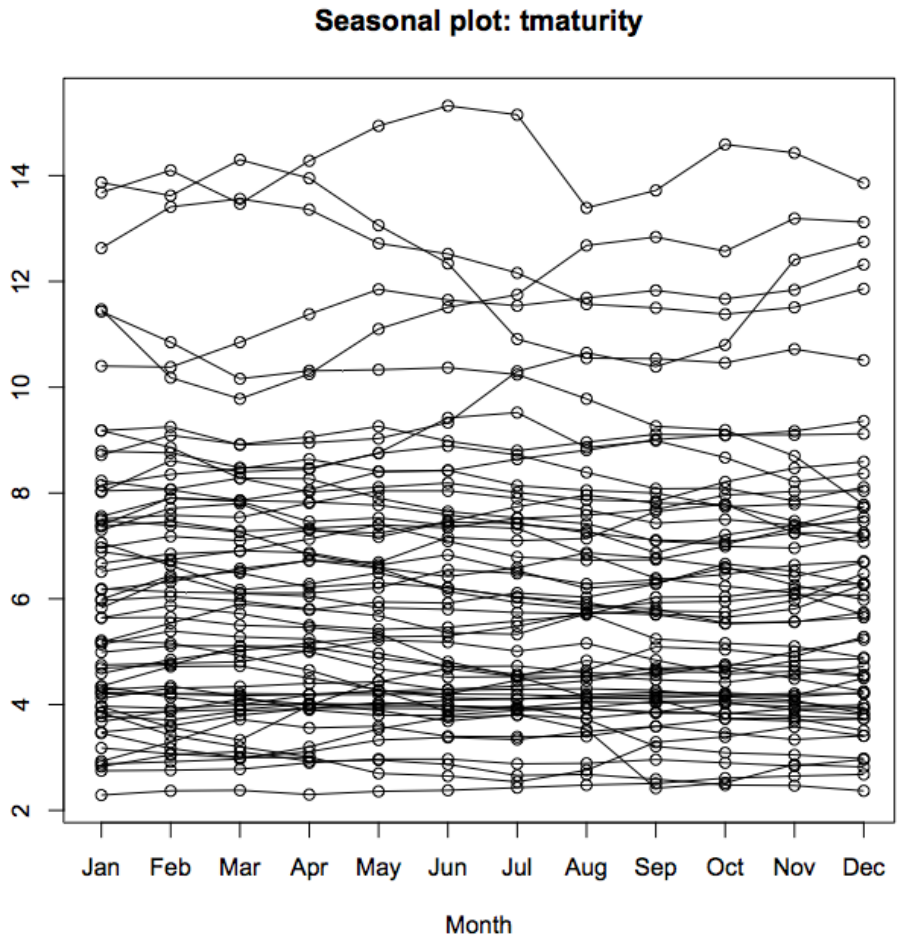
This is the plot for the forecasting.



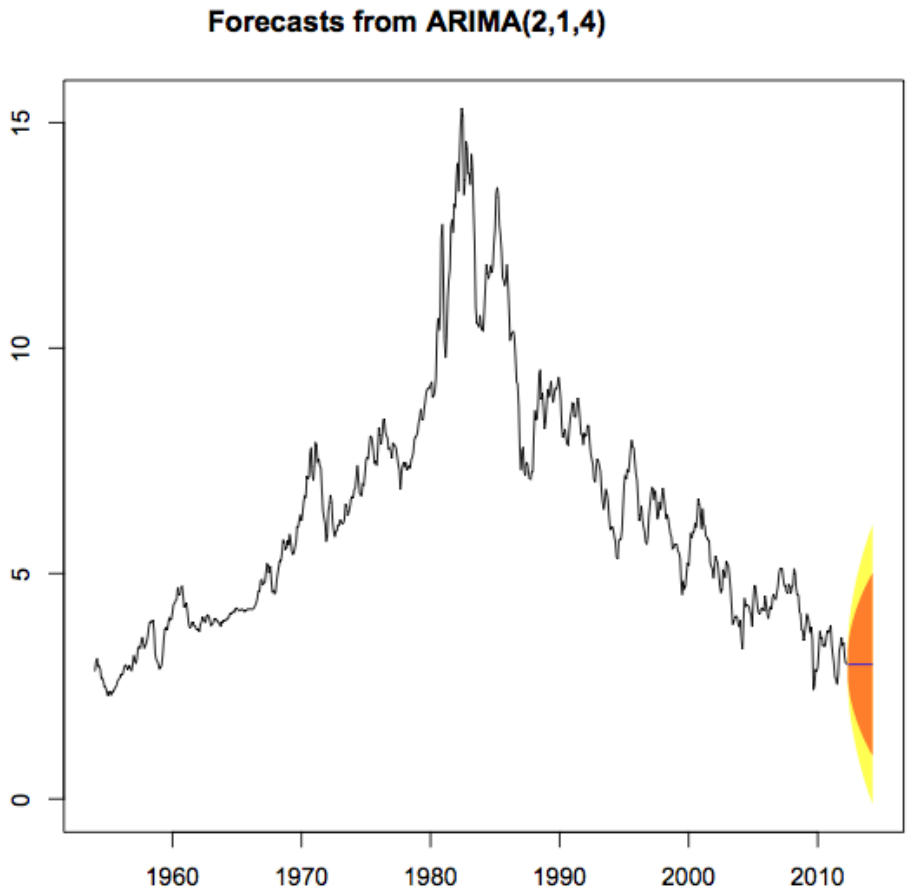
This graph underneath is just the review of the plots of Timeseries containing the dataplot, acf plot, and the PACF plot.



The Seasonal Plot is performed to see when the season is going to end so that it assists to predict the Periodic data.



This is the forecast data using the ARIMA. The forecasts are shown as a blue line, and the orange and yellow shaded areas show 80% and 95% prediction intervals, respectively.



Software: *Mathematica* & R

Mathematica script
"Plot the data"
ListPlot[maturityvalues,AxesLabel→ {Year,InterestRate}]
ListLinePlot[maturityvalues,AxesLabel→ {Year,InterestRate}]
"Use the Wavelet package"
maturitydwd=DiscreteWaveletTransform[maturityvalues,DaubechiesWavelet[5],3];
WaveletListPlot[maturitydwd,Ticks→Full]
"Plot the trend and noise"
maturitydwd[Automatic,{"ListPlot"}]

R script
"First off, downloaded two packages which are "t series" and "forecast""
>install.packages("tseries",dependencies = TRUE)
>library("tseries")
>install.packages("forecast",dependencies = TRUE)

```
>library("forecast")
READ the data
>maturity=read.table("/Users/matme90/Downloads/maturity2.txt", header=TRUE, row.names = 1)

CHECK DATA
> maturity$VALUE
PLOT DATA
>plot(maturity$VALUE)
ACF function calculations
>acf(maturity$VALUE)
Make a time series out of the data
> tmaturity <- ts(maturity$VALUE, start = c(1954, 1), end = c(2012, 4), frequency = 12)
>dc=decompose(tmaturity, type = c("additive", "multiplicative"), filter = NULL)
Trend and noise
> plot(stl(tmaturity,s.window="periodic"))

These are the numbers for the forecast from ARIMA
> forecast(tmaturity)
Final plot for forecast
> plot(forecast(tmaturity))

Some additional codes for ARIMA
>tsdisplay(tmaturity)
>seasonplot(tmaturity)
fit ARIMA to the data
>fit <- auto.arima(tmaturity)
>fit
PLOT the fit
>plot(forecast(fit))
```

General forecast:

	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
Mar 2012	3.170029	2.999991	3.340067	2.909978	3.430080
Apr 2012	3.170029	2.929465	3.410593	2.802119	3.537939
May 2012	3.170029	2.875276	3.464782	2.719243	3.620815
Jun 2012	3.170029	2.829531	3.510527	2.649282	3.690776
Jul 2012	3.170029	2.789176	3.550882	2.587564	3.752494
Aug 2012	3.170029	2.752644	3.587414	2.531693	3.808365
Sep 2012	3.170029	2.719005	3.621053	2.480247	3.859811
Oct 2012	3.170029	2.687653	3.652405	2.432299	3.907759
Nov 2012	3.170029	2.658169	3.681889	2.387206	3.952852
Dec 2012	3.170029	2.630245	3.709813	2.344500	3.995558
Jan 2013	3.170029	2.603650	3.736408	2.303828	4.036230
Feb 2013	3.170029	2.578207	3.761851	2.264915	4.075143
Mar 2013	3.170029	2.553771	3.786287	2.227543	4.112515
Apr 2013	3.170029	2.530227	3.809831	2.191536	4.148522
May 2013	3.170029	2.507480	3.832578	2.156748	4.183310
Jun 2013	3.170029	2.485451	3.854607	2.123057	4.217001
Jul 2013	3.170029	2.464072	3.875986	2.090361	4.249697
Aug 2013	3.170029	2.443286	3.896772	2.058572	4.281486
Sep 2013	3.170029	2.423043	3.917015	2.027613	4.312445
Oct 2013	3.170029	2.403301	3.936757	1.997419	4.342639
Nov 2013	3.170029	2.384021	3.956037	1.967933	4.372125
Dec 2013	3.170029	2.365170	3.974888	1.939103	4.400955
Jan 2014	3.170029	2.346718	3.993340	1.910884	4.429174
Feb 2014	3.170029	2.328640	4.011418	1.883236	4.456822

ARIMA Forecast:

The forecast was done with ARIMA. This table shows which coefficient and variance that is used for the ARIMA.

Series: tmaturity
ARIMA(2,1,4)

Coefficients:

	ar1	ar2	ma1	ma2	ma3	ma4
	-0.8735	-0.8475	1.2762	1.1165	0.230	-0.1366
s.e.	0.0813	0.0843	0.0859	0.0963	0.071	0.0387

σ^2 estimated as 0.06405: log likelihood = -31.62
AIC=77.23 AICc=77.4 BIC=109.08