```
MTB > info
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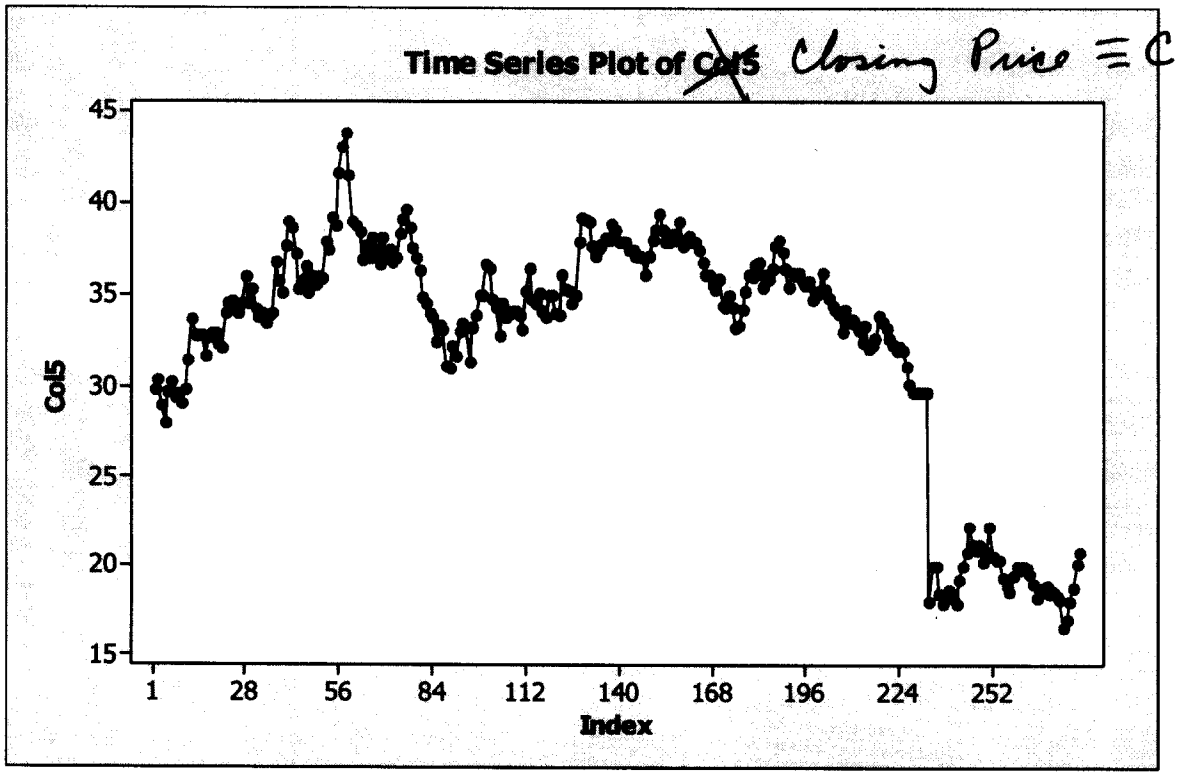
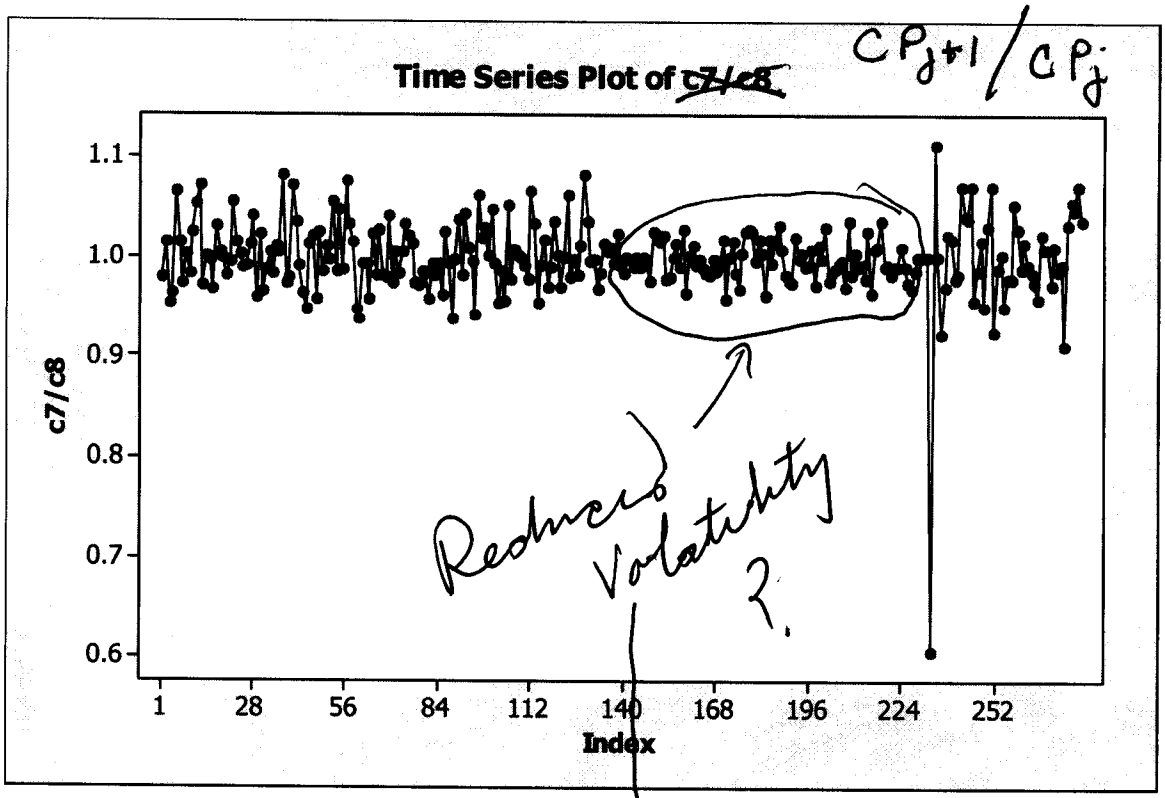
Information on the Worksheet

	Column	Count	Missing	Name	
D	C1	279	0	date	
	C2	279	0	open	
	C3	279	0	high	
	C4	279	0	low	
	C5	279	0	close	
	C6	279	4	volume	
	C7	278	0	Col5	(Closing Price Days 2-279)
	C8	278	0	Col5Also	(Closing Price Days 1-278)
	C9	278	0	c7/c8	(Price day i/Price day i-1)
	C10	278	0	logc9	(log(Price day i/Price day i-1))
	C11	274	0	col6	(Vol Days2-279 wo days NYSE closed)
	C12	274	0	col6Also	(Vol Days1-278 wo days NYSE closed)
	C13	274	0	c11/c12	(Vol day i/Vol day i-1)
	C14	274	0	logc13	(log(Vol day i/Vol day i-1))

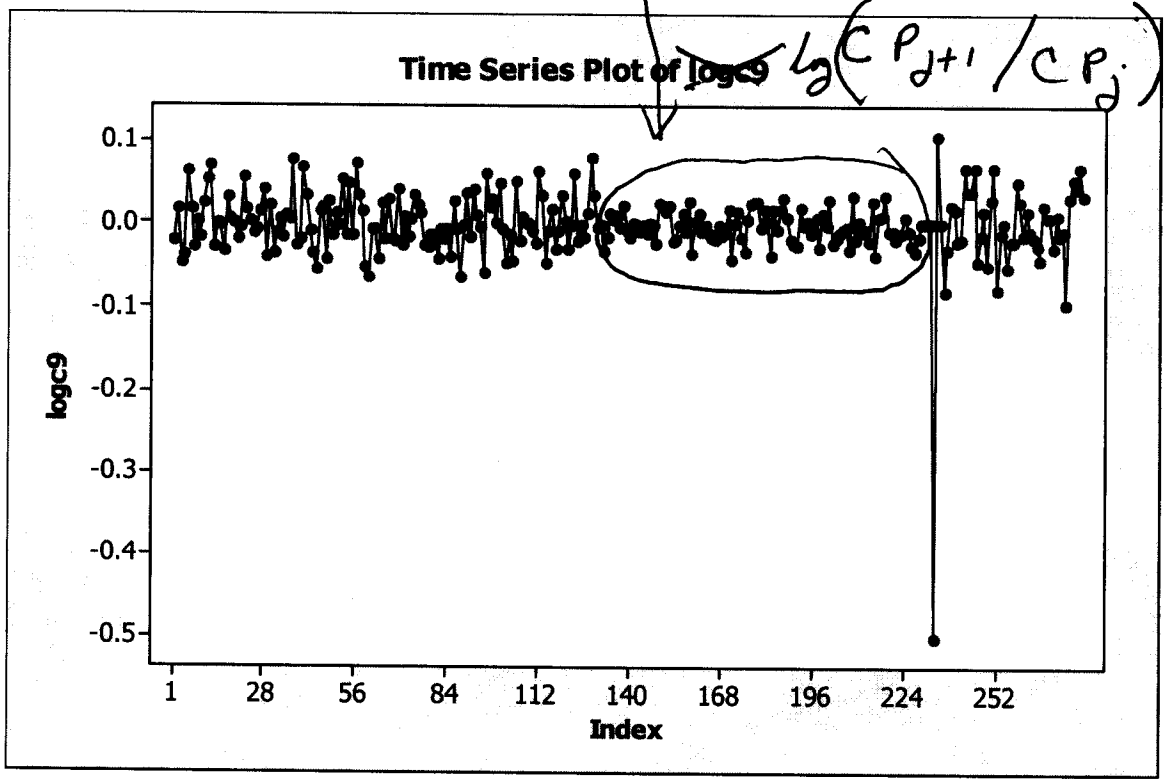
1. Modeling Price at Close (Closing Price)





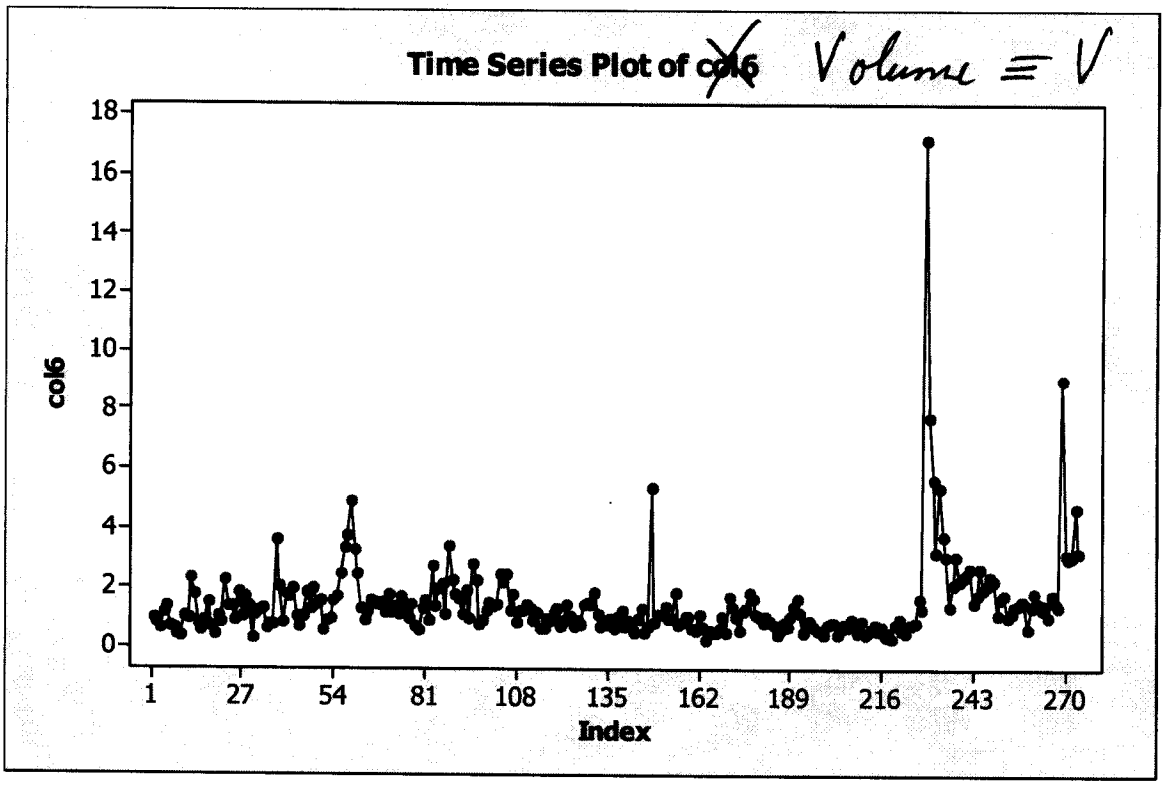
CP_{j+1} / CP_j

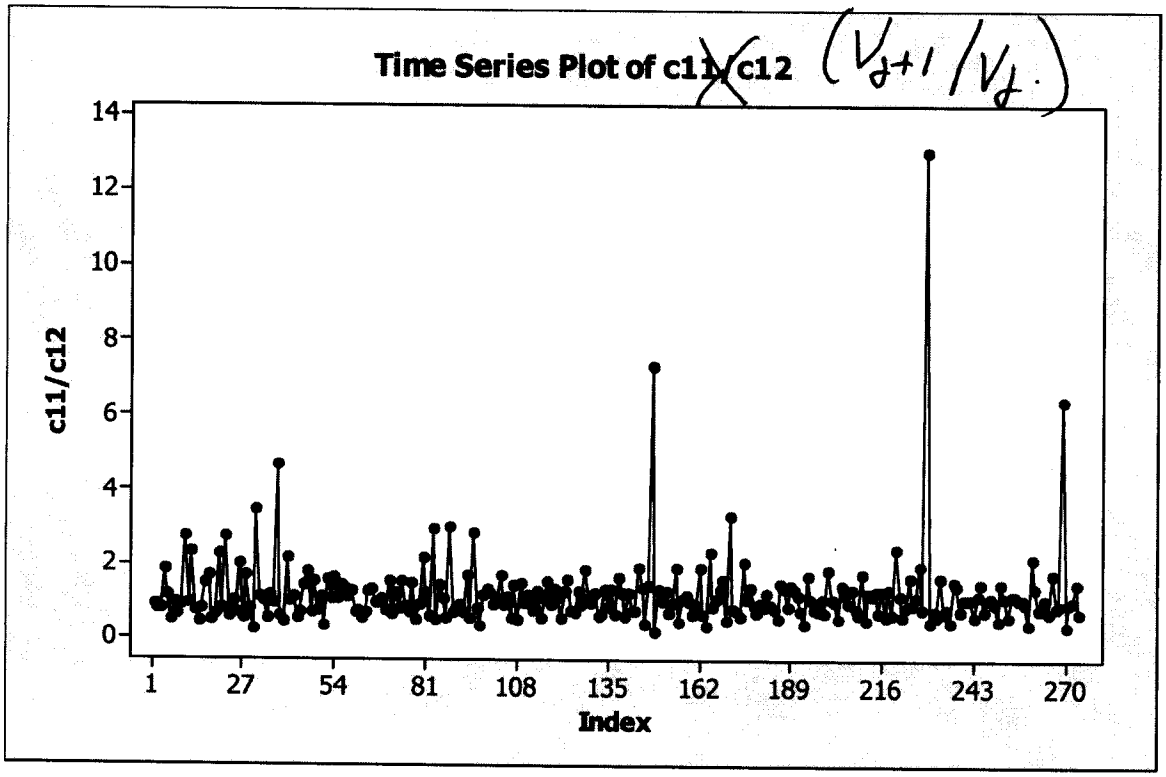
Reduced Volatility ?

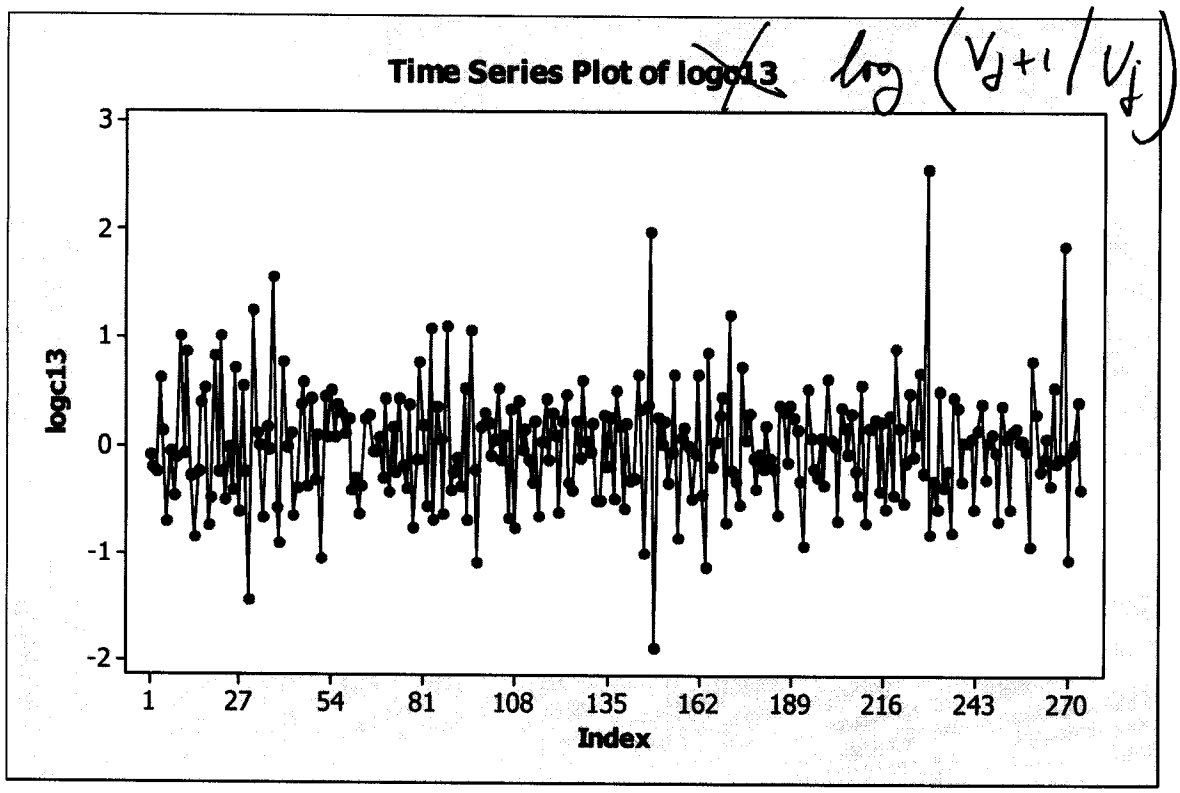


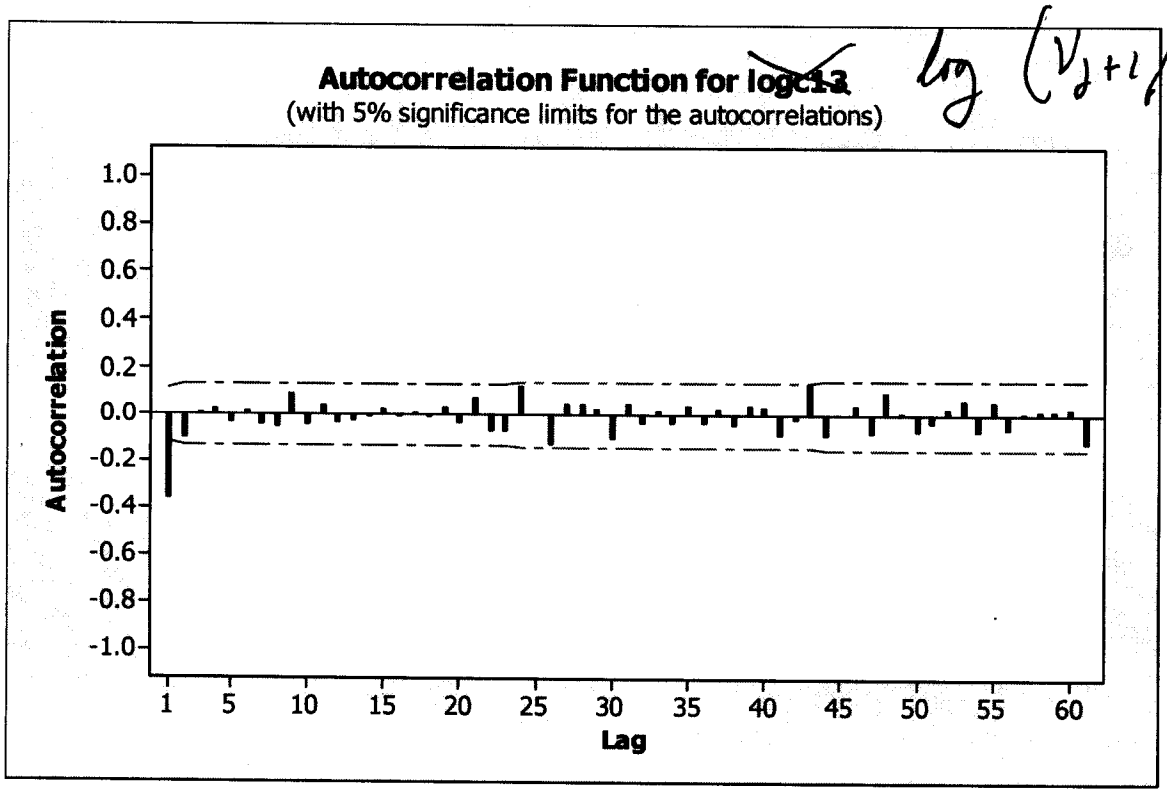
$\ln(CP_{j+1} / CP_j)$

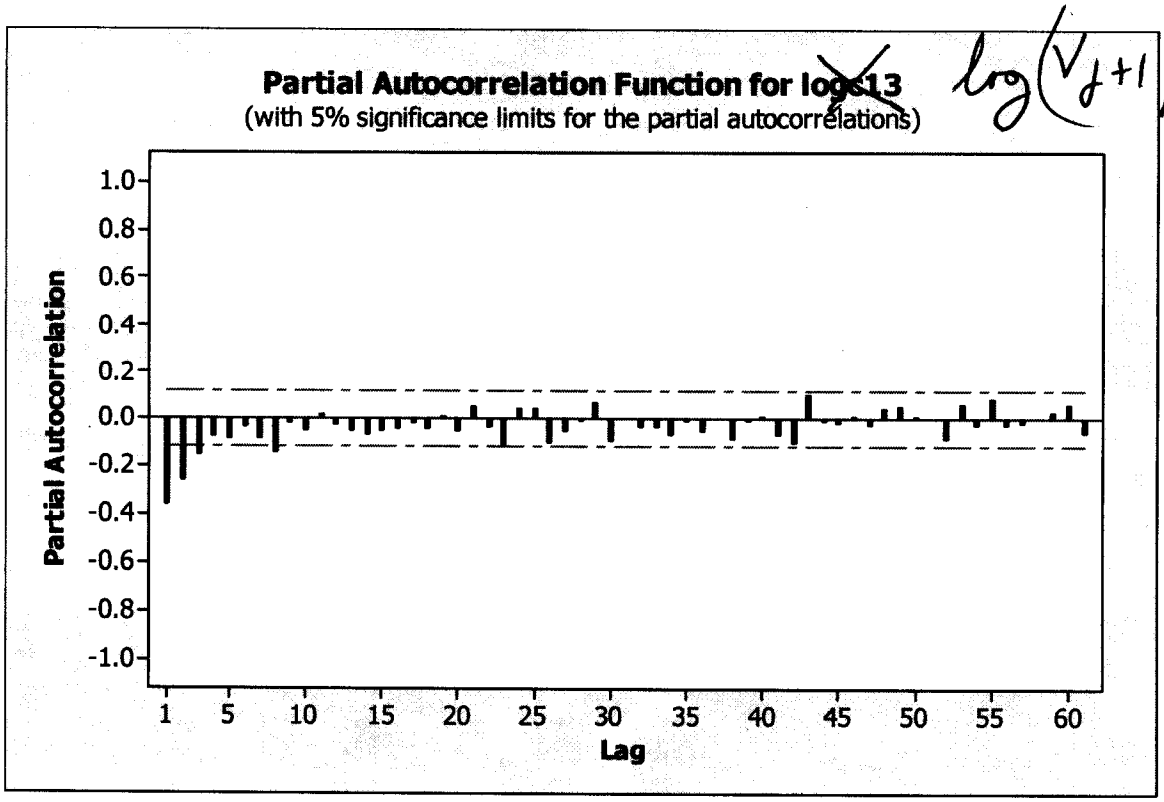
2. Modeling Volume



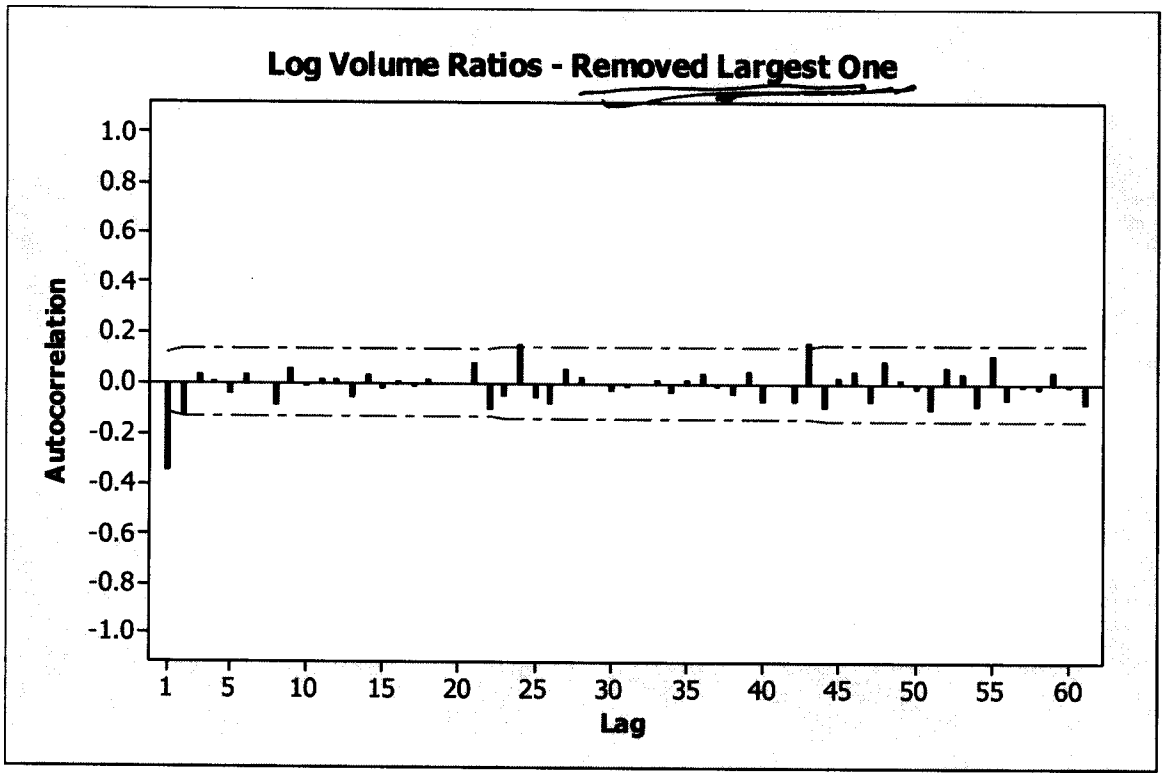


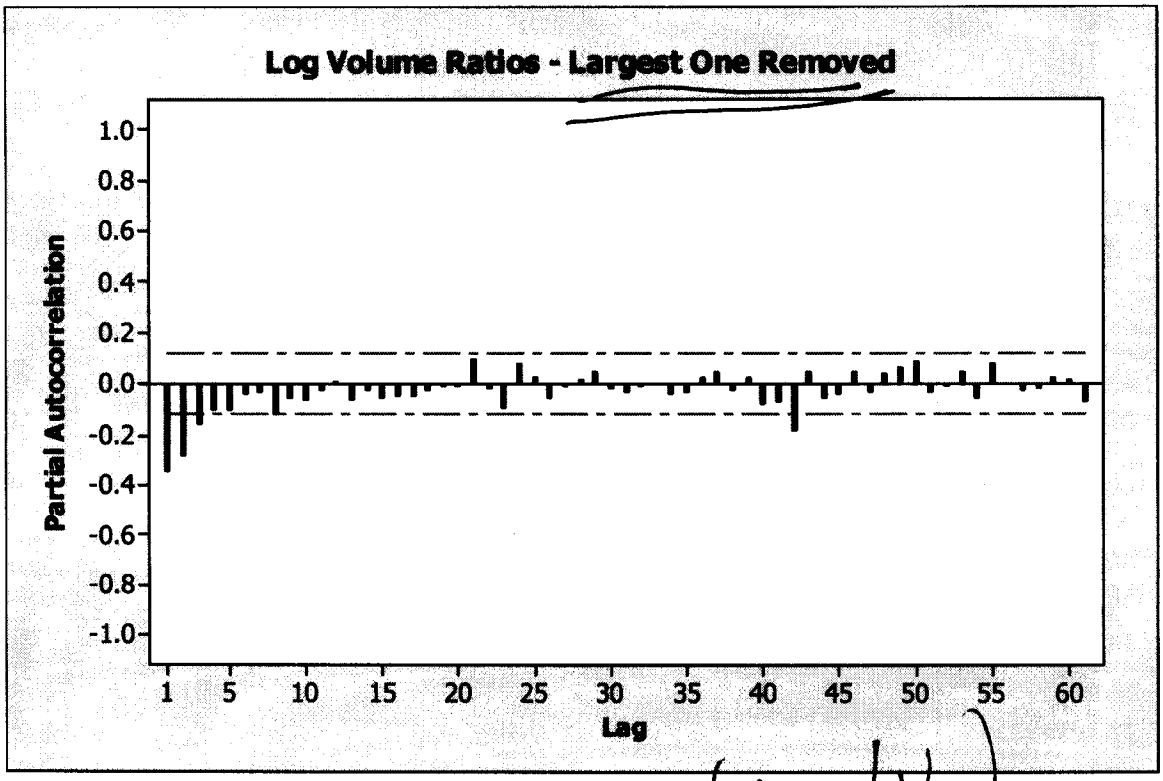

Time Series Plot of logc13
log (Vj+1 / Vj)
logc13
3
2
1
0
-1
-2
1
27
54
81
108
135
162
189
216
243
270
Index


Autocorrelation Function for logc13
(with 5% significance limits for the autocorrelations)
log (Vj+1 / Vj)
Autocorrelation
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
1
5
10
15
20
25
30
35
40
45
50
55
60
Lag


Partial Autocorrelation Function for logs13
(with 5% significance limits for the partial autocorrelations)
Partial Autocorrelation
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
1 5 10 15 20 25 30 35 40 45 50 55 60
Lag

$\log(V_{t+1}/V_t)$


Log Volume Ratios - Removed Largest One
Autocorrelation
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
1 5 10 15 20 25 30 35 40 45 50 55 60
Lag



ACF + PACF of $\log(V_{t+1}/V_t)$ suggest MA(1) model for $\log(V_{t+1}/V_t)$

(If I remember my time series diagnostics correctly)

or an IMA(1) for $\log V_{t+1}$

Fit a MA(1) Model to Log Volume Ratio with Largest Log Volume Ratio Removed

ARIMA Model: logc13

Estimates at each iteration

Iteration	SSE	Parameters	
0	69.8447	0.100	0.095
1	61.9638	0.250	0.031
2	57.7496	0.400	0.002
3	55.6022	0.550	-0.006
4	55.2756	0.604	-0.005
5	55.2294	0.624	-0.005
6	55.2222	0.631	-0.005
7	55.2210	0.634	-0.005
8	55.2208	0.635	-0.005
9	55.2207	0.636	-0.005

Relative change in each estimate less than 0.0010

Final Estimates of Parameters

Type	Coef	SE Coef	T	P
MA 1	0.6359	0.0470	13.54	0.000
Constant	-0.004836	0.009970	-0.49	0.628
Mean	-0.004836	0.009970		

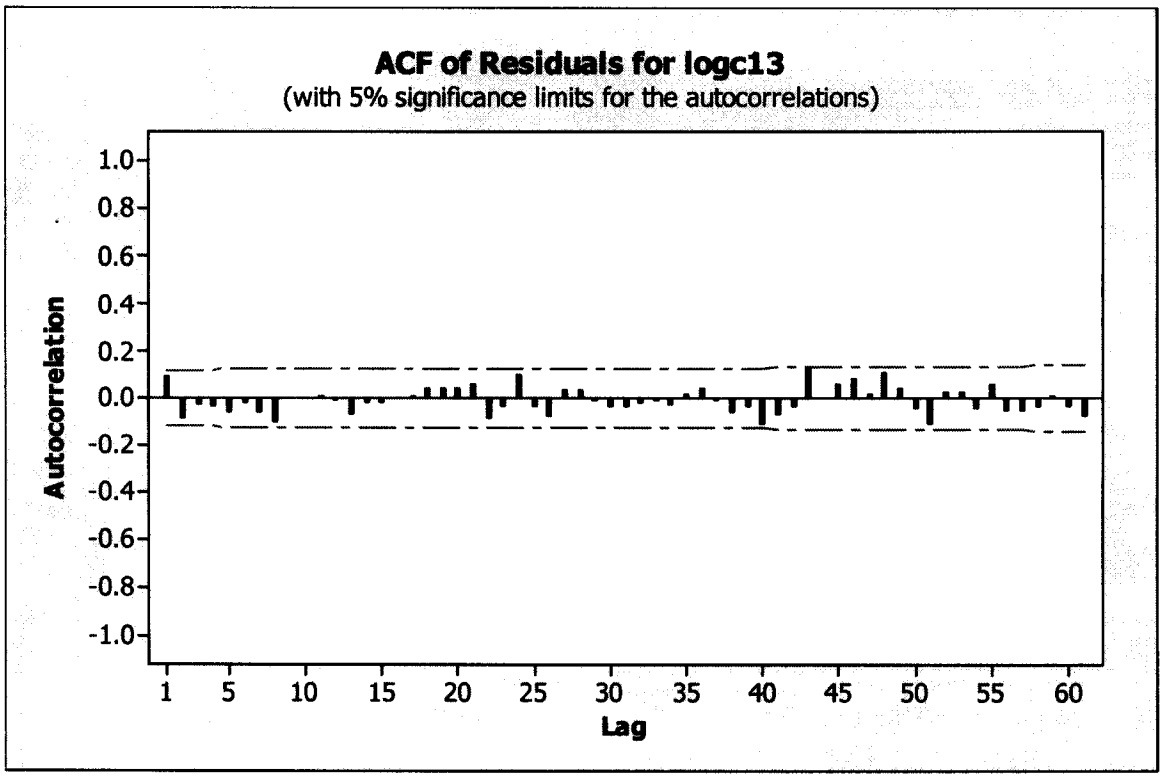
$\hat{\theta} = .635910$

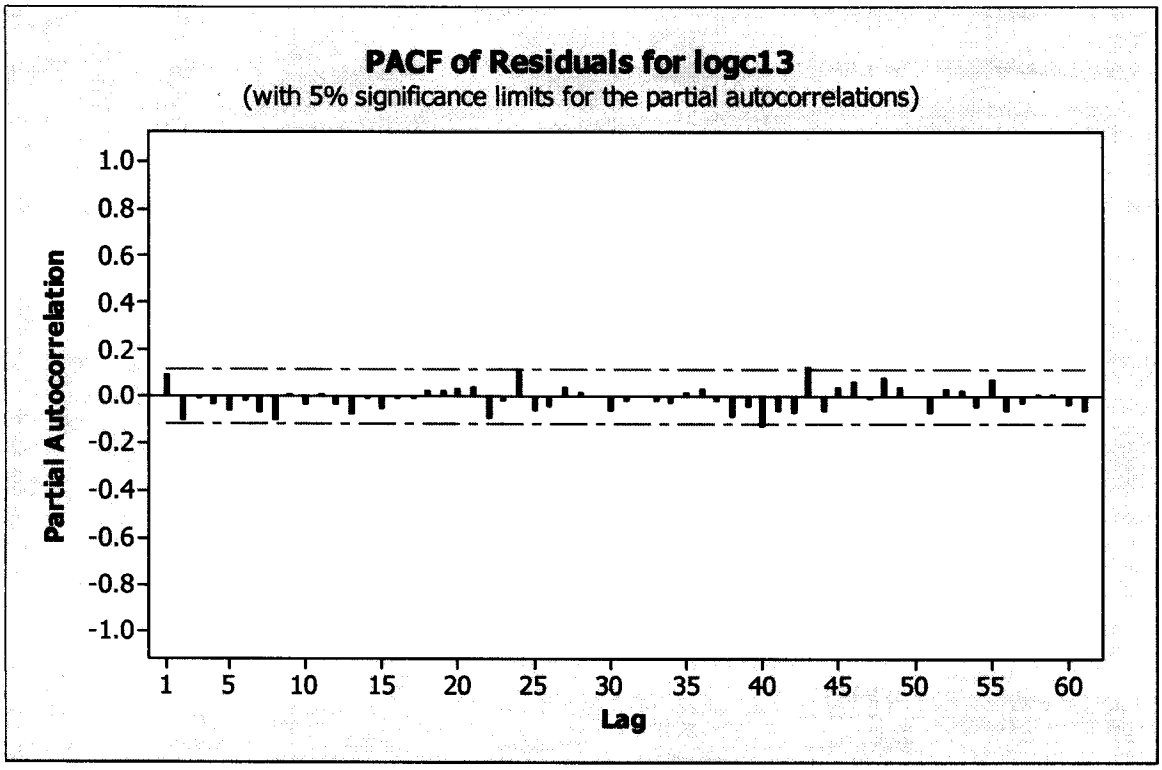
$\hat{\nu} = 0$

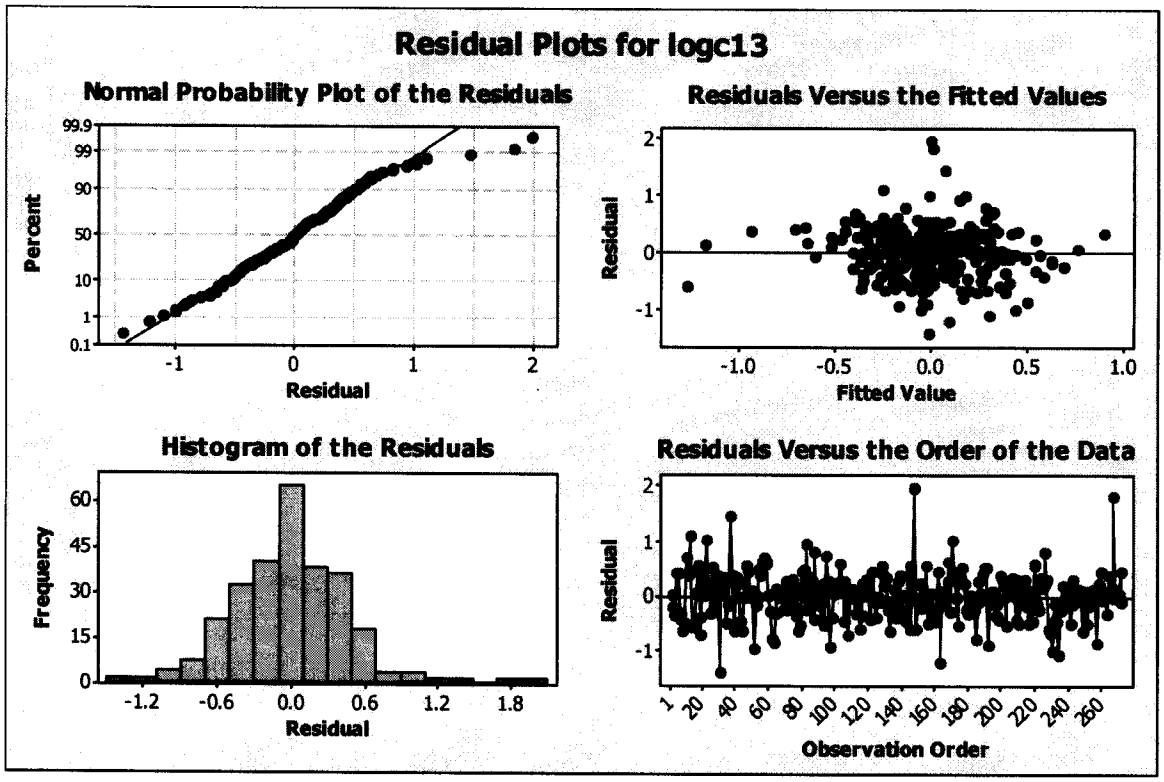
Number of observations: 273
Residuals: SS = 55.2076 (backforecasts excluded)
MS = 0.2037 DF = 271

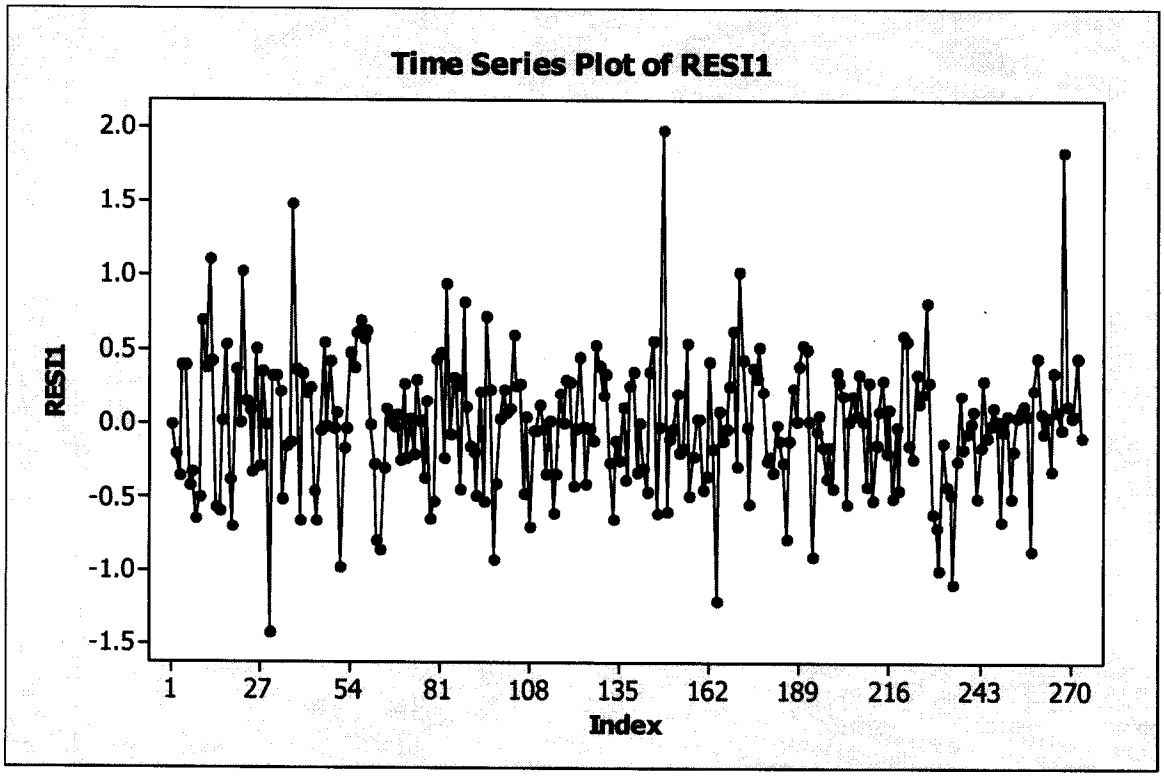
Modified Box-Pierce (Ljung-Box) Chi-Square statistic

Lag	12	24	36	48
Chi-Square	10.0	19.5	24.1	44.3
DF	10	22	34	46
P-Value	0.442	0.613	0.896	0.545

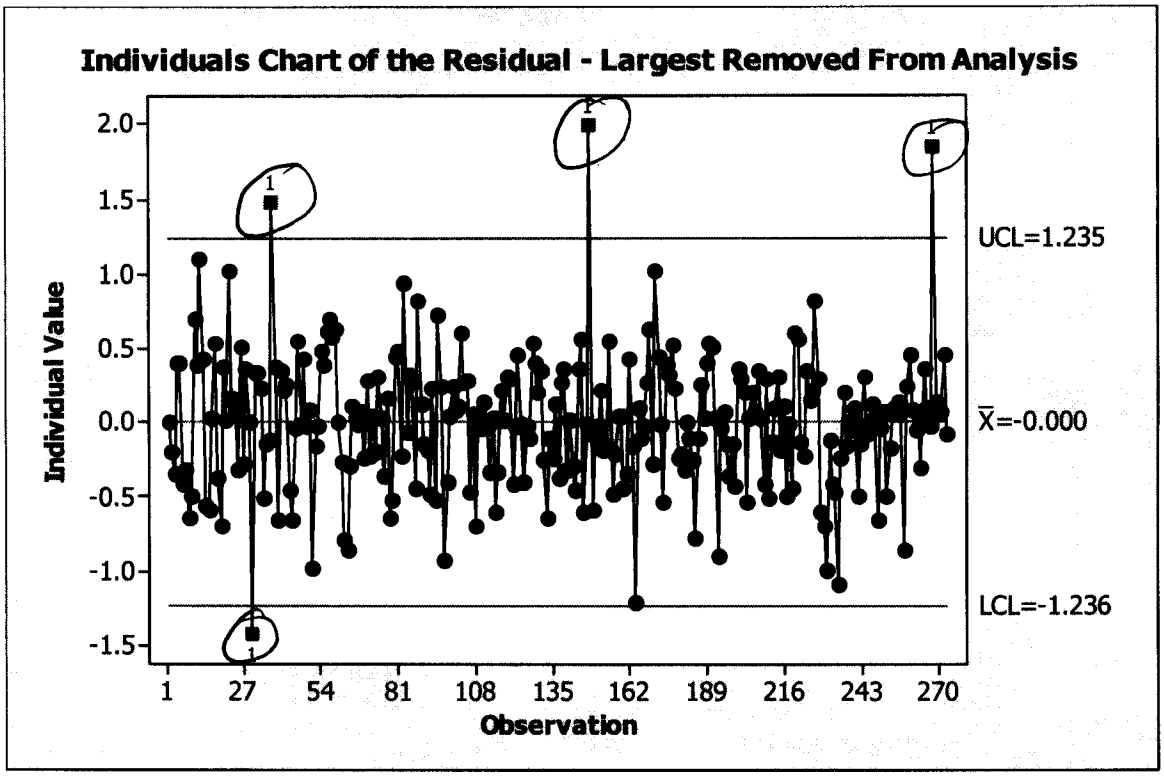

ACF of Residuals for logc13
(with 5% significance limits for the autocorrelations)
Autocorrelation
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
1 5 10 15 20 25 30 35 40 45 50 55 60
Lag


PACF of Residuals for logc13
(with 5% significance limits for the partial autocorrelations)
Partial Autocorrelation
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
1 5 10 15 20 25 30 35 40 45 50 55 60
Lag


Residual Plots for logc13
Normal Probability Plot of the Residuals
Percent
Residual
Residuals Versus the Fitted Values
Residual
Fitted Value
Histogram of the Residuals
Frequency
Residual
Residuals Versus the Order of the Data
Residual
Observation Order


Time Series Plot of RESI1
RESI1
Index

Since Residuals are white noise for an MA(1) an I-chart could be used to determine outliers



Estimated Residual for the Largest log Vol Ratio 2.56986 is (from (5) on MA(1) on David's Handout) 2.56986-Forecast Estimate where the forecast estimate (FE) is

$$\mu - \theta\, e_{t-1} \quad \textit{where } \mu \textit{ is estimated by } 0 \textit{ and } \theta \textit{ by } 0.635910$$

and

$$e_t = \sum_{j=0}^{\infty} \theta^j \left(Y_{t-j} - \mu\right)$$

That is, here

$$FE(t) = -\theta e_{t-1} = -\sum_{j=0}^{\infty} \theta^{j+1} Y_{t-j-1} = -0.176332$$

So the estimated residual for the largest Volume Ratio is 2.56986+0.176332=2.746192. Note that this would be way above the upper control limit in our Individuals control chart above.