Name: Nguyen Thi Cam Hoang
Student ID: 20165327

Date: June 7th, 2017

Assignment 3

1. Merging Trade and Quote Data

– Date of analysis: **August 26, 2015**
– Information of stock for analysis:

No	Cusip number (8 digit)	Cusip number (9 digit)	Stock Market	Symbol	Company name
1	62671710	302491303	N	FMC	FMC Corp
2	56584910	565849106		MRO	Marathon Oil Corporation
3	62671710	626717102		MUR	Murphy Oil Corporation
4	88250810	882508104		TXN	Texas Instruments Incorporated
5	91301710	913017109		UTX	United Technologies Corporation
6	11132010	111320107	Q	BRCM	Broadcom Ltd
7	63110310	631103108		NDAQ	Nasdaq Inc
8	70339510	703395103		PDCO	Patterson Companies, Inc.
9	98313410	983134107		WYNN	Wynn Resorts, Limited
10	98970110	989701107		ZION	Zions Bancorp

To compute the liquidity variables, these steps were performed:

- **Step 1**: Clean the NBBO, Trade, Quote data.
- **Step 2**: Create the merged data: OfficialCompleteNBBO, TradesandCorrespondingNBBO, BuySellIndicators.
- **Step 3**: Compute the spreads

a) Report the effective spreads of selected stocks.

- The effective spreads were derived from **step 11** in the provided code.
- The data was used: **BuySellIndicators**.

SYM_ROOT	DATE	sumdollar	sumsize	EffectiveSpread_Dollar_Ave	EffectiveSpread_Percent_Ave	EffectiveSpread_Dollar_DW	EffectiveSpread_Dollar_SW	EffectiveSpread_Percent_DW	EffectiveSpread_Percent_SW
BRCM	26-Aug-15	407182159.7	8295301	0.012275618	0.000250542	0.019424895	0.019518123	0.000397625	0.000399576
FMC	26-Aug-15	134740469.8	3374155	0.016367061	0.000409573	0.0882809	0.088776165	0.002209145	0.002221561
MRO	26-Aug-15	171016018.4	11893678	0.009431241	0.000656046	0.012335145	0.012425825	0.000859122	0.000865541
MUR	26-Aug-15	57085655.29	2084397	0.013911331	0.000508126	0.013770176	0.013777299	0.000503026	0.000503302
NDAQ	26-Aug-15	268729782.3	5481433	0.017372876	0.000353403	0.039651869	0.039219671	0.000793055	0.000784618
PDCO	26-Aug-15	66585981.95	1382089	0.019253721	0.000400306	0.039855755	0.039996724	0.000829015	0.000832007
TXN	26-Aug-15	724175260.8	16276823	0.011291965	0.000253971	0.038127348	0.03810515	0.000855612	0.000855241
UTX	26-Aug-15	592203877.9	6577123	0.027456447	0.000305229	0.027258328	0.027278729	0.00030296	0.000303208
WYNN	26-Aug-15	325504248.3	4424354	0.056605885	0.000767188	0.066199345	0.065507971	0.000889967	0.000881199
ZION	26-Aug-15	87672669.2	3216115	0.010498453	0.000385232	0.014737142	0.014727644	0.000539921	0.000539602

b) Report the quoted spreads of selected stocks.

- The quoted spreads were derived from **step 12** in the provided code.
- The data was used: **OfficialCompleteNBBO** and **QSpread**.

SYM_ROOT	DATE	sumtime	QuotedSpread_Dollar	QuotedSpread_Percent	BestOfcDepth_Dollar	BestBidDepth_Dollar	BestOfcDepth_Share	BestBidDepth_Share
BRCM	26-Aug-15	23362.60868	0.01609655	0.00032971	22577.61218	24333.54723	460.6450701	496.6792515
FMC	26-Aug-15	23374.70708	0.036597954	0.000912346	9951.270513	9784.698402	248.9217339	244.9425936
MRO	26-Aug-15	23335.07182	0.01027877	0.000717416	32293.10314	29328.37447	2245.911799	2041.382614
MUR	26-Aug-15	23396.88977	0.020821143	0.000761716	13266.66672	12070.20581	484.7934321	441.4471545
NDAQ	26-Aug-15	23388.88161	0.031371918	0.000638757	11766.61018	13894.49651	239.933062	283.6092007
PDCO	26-Aug-15	23387.92503	0.034839018	0.000726926	11149.36707	12128.64678	232.1441192	252.8266555
TXN	26-Aug-15	23304.05658	0.01320656	0.0002981	22589.58345	23506.76799	509.026191	529.4514039
UTX	26-Aug-15	23391.59608	0.042950001	0.000478067	32647.47287	33663.71617	363.071857	374.9225893
WYNN	26-Aug-15	23399.90003	0.090240633	0.001223768	17490.88222	16984.63931	237.8152844	231.5745046
ZION	26-Aug-15	23376.28106	0.011806786	0.000434285	17296.95608	17221.10299	634.9247662	633.1220366

c) Report the realized spreads of selected stocks.

- The realized spreads were derived from **step 12** in the provided code.
- The data was used: **BuySellIndicators** and **QSpread**.

SYM_ROOT	DATE	sumdollar	sumsize	DollarRealizedSpread_LR_Ave	DollarRealizedSpread_EMO_Ave	DollarRealizedSpread_CLNV_Ave	PercentRealizedSpread_LR_Ave	PercentRealizedSpread_EMO_Ave	PercentRealizedSpread_CLNV_Ave
BRCM	26-Aug-15	453055895.8	9229454	0.006339436	0.005147926	0.005265193	0.000128554	0.000104082	0.000106519
FMC	26-Aug-15	141849713.5	3552133	0.010352814	0.010118967	0.009745057	0.000259925	0.000254273	0.000244754
MRO	26-Aug-15	186934463.4	13002588	-0.001554325	-0.001484823	-0.001247388	-0.00010859	-0.000104064	-8.75406E-05
MUR	26-Aug-15	59899825.74	2187097	-0.002230059	-0.000927641	-0.000618088	-8.17888E-05	-3.42021E-05	-2.29895E-05
NDAQ	26-Aug-15	279520201.9	5701712	0.008681306	0.005145828	0.006045698	0.000177203	0.000105327	0.000123621
PDCO	26-Aug-15	68537023.82	1422377	0.007942171	0.005537581	0.006324007	0.000165581	0.000115397	0.000131739
TXN	26-Aug-15	780163765	17535078	-0.001989805	-0.001372694	-0.001343708	-4.60769E-05	-3.21544E-05	-3.15973E-05
UTX	26-Aug-15	601874441.1	6684219	0.005686812	0.004556969	0.003969901	6.29302E-05	5.04948E-05	4.40111E-05
WYNN	26-Aug-15	325760631.3	4427843	0.016712443	0.007853065	0.012040373	0.000222203	0.000102052	0.000158576
ZION	26-Aug-15	98354707.75	3607921	-0.003503174	-0.003884518	-0.003618221	-0.000128793	-0.000142703	-0.000132983

SYM_ROOT	DATE	sumdollar	sumsize	DollarPriceImpact_LR_Ave	DollarPriceImpact_EMO_Ave	DollarPriceImpact_CLNV_Ave	PercentPriceImpact_LR_Ave	PercentPriceImpact_EMO_Ave	PercentPriceImpact_CLNV_Ave
BRCM	26-Aug-15	453055895.8	9229454	0.004841289	0.005551158	0.005660089	9.96356E-05	0.000114236	0.000116443
FMC	26-Aug-15	141849713.5	3552133	0.005245942	0.00392305	0.005290914	0.000130419	9.71711E-05	0.000131517
MRO	26-Aug-15	186934463.4	13002588	0.009976666	0.009696654	0.009630474	0.000694461	0.00067526	0.000670677
MUR	26-Aug-15	59899825.74	2187097	0.015516465	0.013721148	0.013739563	0.000567081	0.000501511	0.000502253
NDAQ	26-Aug-15	279520201.9	5701712	0.007744454	0.010012408	0.00987259	0.00015694	0.000203129	0.000200214
PDCO	26-Aug-15	68537023.82	1422377	0.010784286	0.011586877	0.011610814	0.000223762	0.0002406	0.000241122
TXN	26-Aug-15	780163765	17535078	0.012507864	0.01151418	0.011612531	0.000282637	0.000260253	0.000262556
UTX	26-Aug-15	601874441.1	6684219	0.021413365	0.019721324	0.022342975	0.000238337	0.000219398	0.000248513
WYNN	26-Aug-15	325760631.3	4427843	0.0398581	0.039766128	0.042468532	0.000544506	0.000543629	0.000580254
ZION	26-Aug-15	98354707.75	3607921	0.012897632	0.01303769	0.012988141	0.000473519	0.00047856	0.000476807

SYM_ROOT	DATE	sumdollar	sumsize	DollarRealizedSpread_LR_SW	DollarRealizedSpread_LR_DW	PercentRealizedSpread_LR_SW	PercentRealizedSpread_LR_DW	DollarPriceImpact_LR_SW	DollarPriceImpact_LR_DW
BRCM	26-Aug-15	453055895.8	9229454	0.019208464	0.019116917	0.000393141	0.00039124	-0.001432033	-0.001425342
FMC	26-Aug-15	141849713.5	3552133	0.032382431	0.032109642	0.000815546	0.000808701	0.052138954	0.051940424
MRO	26-Aug-15	186934463.4	13002588	0.006856169	0.006762248	0.000478874	0.000472295	0.00452255	0.004535328
MUR	26-Aug-15	59899825.74	2187097	-0.004357827	-0.004416315	-0.000158756	-0.000160895	0.017550685	0.017602129
NDAQ	26-Aug-15	279520201.9	5701712	0.005144701	0.005589383	9.75522E-05	0.000106716	0.032612933	0.032584967
PDCO	26-Aug-15	68537023.82	1422377	0.023347897	0.023169388	0.000488634	0.000484877	0.015536043	0.015571905
TXN	26-Aug-15	780163765	17535078	0.0377271	0.037659076	0.000844996	0.000843379	-0.002192891	-0.002104448
UTX	26-Aug-15	601874441.1	6684219	0.032899263	0.033028502	0.000364566	0.000365986	-0.00594405	-0.006094766
WYNN	26-Aug-15	325760631.3	4427843	-0.007738248	-0.008280116	-9.91856E-05	-0.000106	0.073201579	0.074434347
ZION	26-Aug-15	98354707.75	3607921	-0.005901702	-0.005909294	-0.000216274	-0.000216547	0.01908358	0.019099441

SYM_ROOT	DATE	sumdollar	sumsize	PercentPriceImpact_LR_SW	PercentPriceImpact_LR_DW	DollarRealizedSpread_EMO_SW	DollarRealizedSpread_EMO_DW	PercentRealizedSpread_EMO_SW	PercentRealizedSpread_EMO_DW
BRCM	26-Aug-15	453055895.8	9229454	-2.92375E-05	-2.91129E-05	0.018602802	0.018518687	0.000380637	0.000378889
FMC	26-Aug-15	141849713.5	3552133	0.001299536	0.001294566	0.036825332	0.036647127	0.000924719	0.0009202
MRO	26-Aug-15	186934463.4	13002588	0.000313713	0.000314547	0.007382882	0.007285335	0.000515594	0.000508751
MUR	26-Aug-15	59899825.74	2187097	0.000640704	0.00064257	-0.002812837	-0.002865416	-0.000102593	-0.000104516
NDAQ	26-Aug-15	279520201.9	5701712	0.000657837	0.000656809	0.003266202	0.003697135	5.95126E-05	6.83952E-05
PDCO	26-Aug-15	68537023.82	1422377	0.000320224	0.000320956	0.022114655	0.021921052	0.000463336	0.000459267
TXN	26-Aug-15	780163765	17535078	-4.74553E-05	-4.54987E-05	0.036107662	0.03603363	0.000808674	0.000806924
UTX	26-Aug-15	601874441.1	6684219	-6.49532E-05	-6.66329E-05	0.02768433	0.027798942	0.000306752	0.000308012
WYNN	26-Aug-15	325760631.3	4427843	0.000979785	0.000995362	-0.015145494	-0.015707981	-0.000199853	-0.000206956
ZION	26-Aug-15	98354707.75	3607921	0.000699245	0.000699795	-0.005511215	-0.005524042	-0.000201672	-0.000202138

SYM_ROOT	DATE	sumdollar	sumsize	DollarPriceImpact_EMO_SW	DollarPriceImpact_EMO_DW	PercentPriceImpact_EMO_SW	PercentPriceImpact_EMO_DW	DollarRealizedSpread_CLNV_SW	DollarRealizedSpread_CLNV_DW
BRCM	26-Aug-15	453055895.8	9229454	-0.001449267	-0.001445079	-2.9528E-05	-2.94536E-05	0.01862363	0.01853584
FMC	26-Aug-15	141849713.5	3552133	0.045554663	0.045252736	0.001136967	0.001129455	0.037536649	0.037357859
MRO	26-Aug-15	186934463.4	13002588	0.003618976	0.003637086	0.000250658	0.000251877	0.007366585	0.007274168
MUR	26-Aug-15	59899825.74	2187097	0.015506075	0.01555183	0.00056629	0.000567949	-0.003591535	-0.003640402
NDAQ	26-Aug-15	279520201.9	5701712	0.033525655	0.033505629	0.000676293	0.00067543	0.003175829	0.003612609
PDCO	26-Aug-15	68537023.82	1422377	0.015291298	0.015348174	0.000314724	0.000315893	0.022104059	0.021931634
TXN	26-Aug-15	780163765	17535078	-0.000956763	-0.000862938	-1.97356E-05	-1.76585E-05	0.037259408	0.037190432
UTX	26-Aug-15	601874441.1	6684219	-0.003227014	-0.003361011	-3.49038E-05	-3.63992E-05	0.030592403	0.030715004
WYNN	26-Aug-15	325760631.3	4427843	0.071261402	0.072470178	0.000953975	0.000969274	-0.008480163	-0.009021681
ZION	26-Aug-15	98354707.75	3607921	0.018465463	0.01848701	0.000676275	0.000677036	-0.006338449	-0.006345767

SYM_ROOT	DATE	sumdollar	sumsize	PercentRealizedSpread_CLNV_SW	PercentRealizedSpread_CLNV_DW	DollarPriceImpact_CLNV_SW	DollarPriceImpact_CLNV_DW	PercentPriceImpact_CLNV_SW	PercentPriceImpact_CLNV_DW
BRCM	26-Aug-15	453055895.8	9229454	0.00038113	0.000379307	-0.001154699	-0.001149231	-2.35458E-05	-2.34467E-05
FMC	26-Aug-15	141849713.5	3552133	0.000942562	0.000938026	0.045970553	0.045671334	0.001147297	0.001139853
MRO	26-Aug-15	186934463.4	13002588	0.000514181	0.000507698	0.003954399	0.00396583	0.00027438	0.000275128
MUR	26-Aug-15	59899825.74	2187097	-0.000131029	-0.000132817	0.016629006	0.016671133	0.000607292	0.000608819
NDAQ	26-Aug-15	279520201.9	5701712	5.74961E-05	6.65007E-05	0.034266362	0.034244777	0.000691489	0.000690589
PDCO	26-Aug-15	68537023.82	1422377	0.000462687	0.000459059	0.016049254	0.016081697	0.000330951	0.000331611
TXN	26-Aug-15	780163765	17535078	0.000834354	0.000832715	-0.001953964	-0.001864748	-4.19518E-05	-3.99762E-05
UTX	26-Aug-15	601874441.1	6684219	0.000339028	0.000340376	-0.004278572	-0.004422839	-4.65364E-05	-4.8146E-05
WYNN	26-Aug-15	325760631.3	4427843	-0.000109272	-0.000116091	0.071590967	0.072814695	0.000958005	0.000973477
ZION	26-Aug-15	98354707.75	3607921	-0.000232326	-0.000232588	0.019496383	0.019511992	0.000714418	0.000714957

2. Time-Series Analysis

a) For each return series, test the null hypothesis that the first 12 lags of autocorrelations are zero at 5% level.

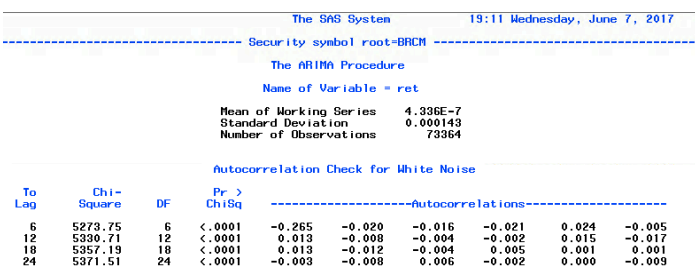
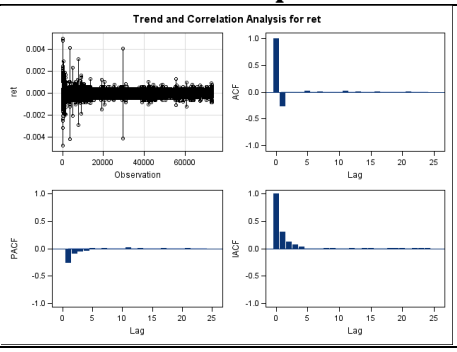
- This is done by using the following statement in sas:

```
proc arima data=trade;
by sym_root;
identify var=ret;
run;
quit;
```

- Significant level: $\alpha = 0.05$
- Hypothesis:
  - Null hypothesis: lags of autocorrelations are zero
  - Alternative hypothesis: at least one lag is not zero

  Or:
  - H_0: $\rho_l = 0$ for all l
  - H_1: $\rho_l \neq 0$ for at least one l

Result

	Autocorrelation check	Correlation panel
BRCM		

FMC

Security symbol root=FMC

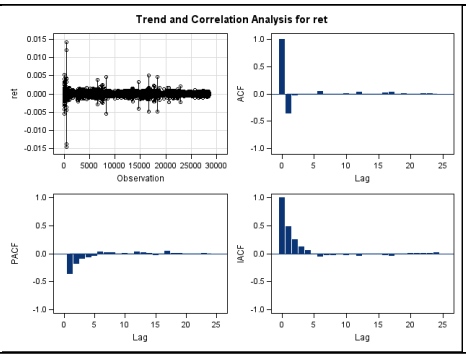
The ARIMA Procedure

Name of Variable = ret

Mean of Working Series	-5.79E-7
Standard Deviation	0.000316
Number of Observations	28511

Autocorrelation Check for White Noise

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	3899.57	6	<.0001	-0.365	-0.031	0.000	-0.016	0.001	0.051
12	3950.26	12	<.0001	-0.015	-0.001	-0.011	0.014	-0.013	0.033
18	4034.85	18	<.0001	-0.003	-0.012	-0.021	0.015	0.039	-0.025
24	4053.72	24	<.0001	0.003	-0.004	-0.008	0.008	0.007	-0.021



MRO

Security symbol root=MRO

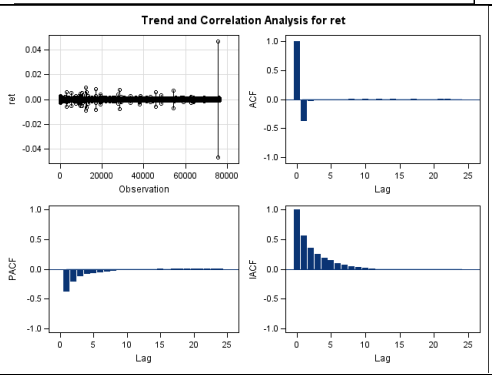
The ARIMA Procedure

Name of Variable = ret

Mean of Working Series	2.99E-7
Standard Deviation	0.000343
Number of Observations	76186

Autocorrelation Check for White Noise

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	9999.99	6	<.0001	-0.380	-0.035	-0.003	-0.013	-0.010	-0.003
12	9999.99	12	<.0001	-0.000	0.002	-0.002	0.002	-0.002	0.002
18	9999.99	18	<.0001	-0.000	0.003	0.001	-0.003	0.005	0.001
24	9999.99	24	<.0001	-0.001	0.000	0.002	0.006	-0.002	-0.002



MUR

Security symbol root=MUR

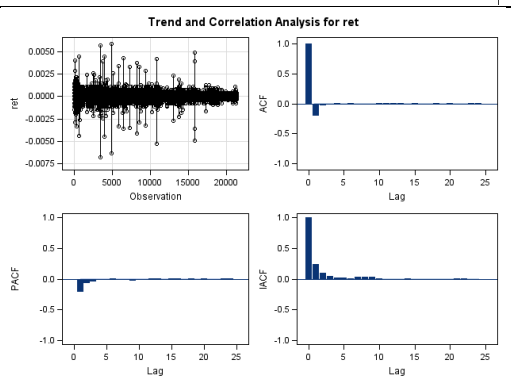
The ARIMA Procedure

Name of Variable = ret

Mean of Working Series	1.359E-7
Standard Deviation	0.000306
Number of Observations	21320

Autocorrelation Check for White Noise

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	942.12	6	<.0001	-0.207	-0.029	-0.014	0.003	-0.005	0.006
12	964.84	12	<.0001	-0.018	-0.007	-0.023	0.009	0.003	0.009
18	972.73	18	<.0001	0.003	-0.013	0.013	-0.000	-0.003	0.004
24	987.64	24	<.0001	-0.005	0.012	-0.008	-0.016	0.014	0.002



NDAQ

Security symbol root=NDAQ

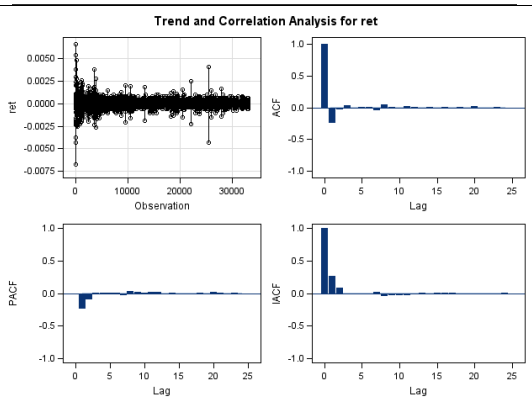
The ARIMA Procedure

Name of Variable = ret

Mean of Working Series	-2.67E-7
Standard Deviation	0.000208
Number of Observations	33057

Autocorrelation Check for White Noise

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	1976.77	6	<.0001	-0.240	-0.028	0.038	-0.008	0.005	0.008
12	2117.93	12	<.0001	-0.040	0.045	0.009	-0.002	0.022	0.008
18	2131.28	18	<.0001	-0.014	0.008	-0.006	0.003	-0.008	0.006
24	2163.08	24	<.0001	-0.005	0.022	-0.001	-0.007	0.013	-0.015



PDCO

The SAS System 19:11 Wednesday, June 7, 2017

Security symbol root=PDCO

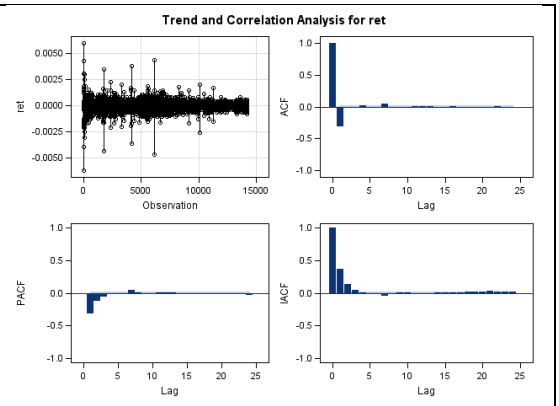
The ARIMA Procedure

Name of Variable = ret

Mean of Working Series	1.186E-6
Standard Deviation	0.000281
Number of Observations	14213

Autocorrelation Check for White Noise

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	1422.40	6	<.0001	-0.315	-0.007	-0.009	0.021	-0.014	-0.001
12	1455.36	12	<.0001	0.041	-0.015	-0.013	-0.005	0.013	0.003
18	1457.61	18	<.0001	0.003	-0.004	-0.009	0.003	-0.006	0.001
24	1467.39	24	<.0001	-0.002	-0.006	-0.014	0.009	-0.007	-0.018



TXN

The SAS System 19:11 Wednesday, June 7, 2017 7

Security symbol root=TXN

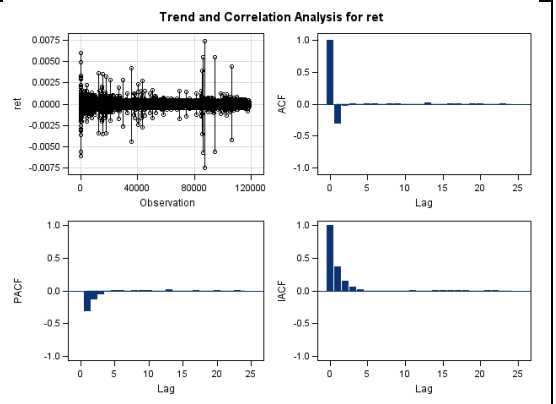
The ARIMA Procedure

Name of Variable = ret

Mean of Working Series	1.047E-7
Standard Deviation	0.000145
Number of Observations	118525

Autocorrelation Check for White Noise

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	9999.99	6	<.0001	-0.309	-0.025	0.004	-0.001	0.009	0.002
12	9999.99	12	<.0001	-0.003	0.007	0.004	0.000	-0.007	-0.008
18	9999.99	18	<.0001	0.026	-0.013	-0.005	0.002	0.003	-0.010
24	9999.99	24	<.0001	0.005	0.002	-0.004	-0.003	0.007	-0.005



UTX

The SAS System 19:11 Wednesday, June 7, 2017

Security symbol root=UTX

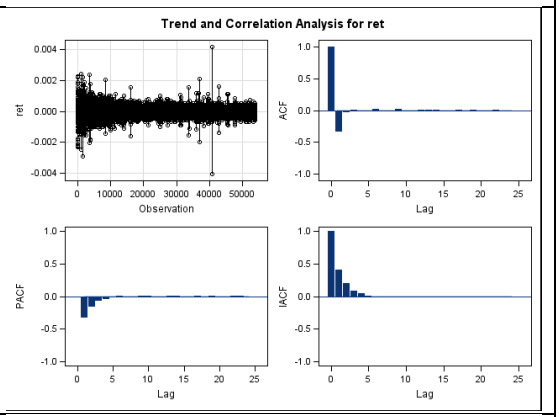
The ARIMA Procedure

Name of Variable = ret

Mean of Working Series	1.61E-7
Standard Deviation	0.000174
Number of Observations	53829

Autocorrelation Check for White Noise

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	5985.10	6	<.0001	-0.331	-0.032	0.009	-0.012	0.000	0.021
12	6010.52	12	<.0001	-0.013	-0.002	0.015	-0.008	-0.003	0.001
18	6020.14	18	<.0001	0.010	0.002	-0.008	0.001	0.005	-0.002
24	6040.66	24	<.0001	0.010	-0.010	0.000	0.012	-0.005	-0.003



WYNN

The SAS System 19:11 Wednesday, June 7, 2017

Security symbol root=WYNN

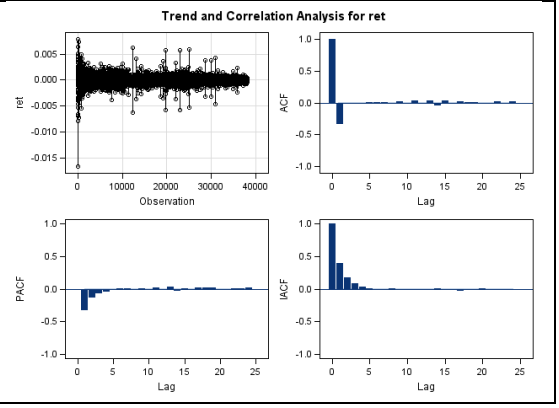
The ARIMA Procedure

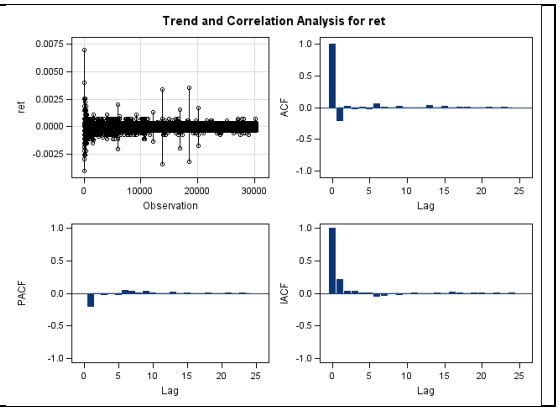
Name of Variable = ret

Mean of Working Series	-1.59E-6
Standard Deviation	0.000409
Number of Observations	38054

Autocorrelation Check for White Noise

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	4241.84	6	<.0001	-0.333	-0.011	-0.015	-0.002	0.011	0.005
12	4323.65	12	<.0001	0.004	-0.015	0.015	-0.019	0.029	-0.022
18	4477.11	18	<.0001	0.031	-0.042	0.030	-0.011	0.016	0.003
24	4523.64	24	<.0001	0.008	-0.021	-0.001	0.019	-0.005	0.018



ZION	The SAS System 19:11 Wednesday, June 7, 2017 Security symbol root=ZION The ARIMA Procedure Name of Variable = ret Mean of Working Series 4.31E-7 Standard Deviation 0.000177 Number of Observations 30301 Autocorrelation Check for White Noise	

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	1549.89	6	<.0001	-0.212	0.026	-0.034	0.010	-0.032	0.057
12	1578.03	12	<.0001	0.011	-0.002	0.024	-0.007	-0.013	-0.002
18	1646.43	18	<.0001	0.023	-0.020	0.022	-0.022	0.003	0.002
24	1659.15	24	<.0001	-0.001	-0.009	0.011	-0.008	0.009	-0.007

Interpretation:

- We only consider to the lag from 1 to 12.
- As can be seen from all tables and figures above, there is a common trend across all stocks. The p-value is smaller than the significant level of 0.05. Hence, there is a strong evidence against the null hypothesis. In another words, we can reject the null hypothesis under the significant level of 0.05.
- Besides, from the figures, we can observe that the original variables are not stationary. Look at the ACF and PACF, the ACF tails off and PACF cuts off after lag 1, this may suggest us to use AR(1) model. However, the optimize p value for AR can be estimated later.

<u>For problem (b) and (c), I will analyse each stock one by one</u>

b) Choose the appropriate lags for building ARIMA model based on the SCAN and ESACF methods.

- Data trade used for this analysis is already processed from problem 1, this data satisfies all the conditions of trading.
- SCAN is done by using:

```
proc arima data=trade;
by sym_root;
identify var=ret scan minic; *option scan minic;
run;
quit;
```

- ESACF is done by using:

```
proc arima data=trade;
by sym_root;
identify var=ret esacf minic; *option esacf minic;
run;
quit;
```

c) Build an ARIMA model for the series:

- For simplicity, I hereby only consider the model to the difference of 1. In order to compare the performance of SCAN and ESACF method, the values of p and q smaller than 5 will be shown. This is because in some model, the the SCAN and ESACF report the optimal value of (p+d) is between the interval (5, 10).

- **ARIMA(p,0,q)**

```
proc arima data=trade;
by sym_root;
identify var=ret;
estimate p=0 q=3 method=ml;
 *using maximum likelihood method and
setting value for p and q depends on each instance;
run;quit;
```

- **ARIMA(p,1,q)**

```
proc arima data=trade;
by sym_root;
identify var=dret; *dret is the first order difference of ret
estimate p=4 q=5 method=ml; *maximum likelihood;
*using maximum likelihood method and
setting value for p and q depends on each instance;
run;quit;
```

BRCM

SCAN Chi-Square[1] Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	<.0001	<.0001	<.0001	<.0001	0.2024
AR 1	<.0001	0.0006	0.5260	<.0001	0.0001	0.0009
AR 2	<.0001	0.0030	<.0001	<.0001	<.0001	0.1361
AR 3	<.0001	<.0001	<.0001	<.0001	0.0153	0.0290
AR 4	0.4597	0.6677	0.0014	0.8573	0.0447	0.2844
AR 5	0.6355	0.5568	0.0128	0.0382	0.1506	0.0426

SCAN does not output the ARMA result within the value of 5

ESACF Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	<.0001	<.0001	<.0001	<.0001	0.2026
AR 1	<.0001	<.0001	0.5833	<.0001	<.0001	0.0179
AR 2	<.0001	<.0001	0.0001	<.0001	<.0001	0.0076
AR 3	<.0001	<.0001	<.0001	<.0001	<.0001	0.0088
AR 4	<.0001	<.0001	<.0001	0.0184	<.0001	0.0030
AR 5	<.0001	0.0674	<.0001	<.0001	<.0001	<.0001

ARMA(p+d,q) Tentative Order Selection Tests

--------ESACF--------		
p+d	q	BIC
0	5	-17.7995

(5% Significance Level)

Use p+d = 0 and q=5

ARIMA model

ARIMA(0,0,5)

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	4.35304E-7	3.34978E-7	1.30	0.1938	0
MA1,1	0.29780	0.0036912	80.68	<.0001	1
MA1,2	0.02792	0.0038528	7.25	<.0001	2
MA1,3	0.02057	0.0038523	5.34	<.0001	3
MA1,4	0.01482	0.0038519	3.85	0.0001	4
MA1,5	-0.02465	0.0036922	-6.68	<.0001	5

Constant Estimate	4.353E-7
Variance Estimate	1.87E-8
Std Error Estimate	0.000137
AIC	-1097302
SBC	-1097247
Number of Residuals	73364

Final model:

ARIMA(0,0,5)

Moving Average Factors

Factor 1: 1 - 0.2978 B**(1) - 0.02792 B**(2) - 0.02057 B**(3) - 0.01482 B**(4) + 0.02465 B**(5)

FMC

SCAN Chi-Square[1] Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	<.0001	0.9586	0.0157	0.8787	<.0001
AR 1	<.0001	0.6919	0.0495	0.1211	0.0102	<.0001
AR 2	<.0001	0.0281	0.1092	0.0480	0.9495	<.0001
AR 3	<.0001	0.4655	0.0250	0.7153	<.0001	0.0001
AR 4	<.0001	<.0001	<.0001	<.0001	0.0003	0.0003
AR 5	<.0001	<.0001	0.0001	0.1190	0.0013	0.9287

ARMA(p+d,q) Tentative Order Selection Tests

---------SCAN---------

p+d	q	BIC
5	5	-16.332

(5% Significance Level)

ESACF Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	<.0001	0.9586	0.0157	0.8794	<.0001
AR 1	<.0001	<.0001	0.9240	0.0099	0.9663	<.0001
AR 2	<.0001	<.0001	<.0001	0.1453	0.9811	<.0001
AR 3	<.0001	<.0001	<.0001	0.1990	0.9633	<.0001
AR 4	<.0001	<.0001	<.0001	0.0017	<.0001	<.0001
AR 5	<.0001	<.0001	<.0001	<.0001	<.0001	0.5381

ARMA(p+d,q) Tentative Order Selection Tests

--------ESACF--------

p+d	q	BIC
5	5	-16.332

(5% Significance Level)

Use p+d = 5 and q=5 for further analysis

ARIMA model

ARIMA(5,0,5)

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	-5.8363E-7	9.59036E-7	-0.61	0.5428	0
MA1,1	0.06996	0.08252	0.85	0.3965	1
MA1,2	0.07666	0.08563	0.90	0.3706	2
MA1,3	0.28396	0.07410	3.83	0.0001	3
MA1,4	0.33973	0.08396	4.05	<.0001	4
MA1,5	-0.36832	0.04051	-9.09	<.0001	5
AR1,1	-0.39187	0.08244	-4.75	<.0001	1
AR1,2	-0.14015	0.07340	-1.91	0.0562	2
AR1,3	0.20141	0.07283	2.77	0.0057	3
AR1,4	0.42366	0.07732	5.48	<.0001	4
AR1,5	-0.14954	0.01320	-11.33	<.0001	5

Constant Estimate	-6.17E-7
Variance Estimate	8.184E-8
Std Error Estimate	0.000286
AIC	-384336
SBC	-384245
Number of Residuals	28511

ARIMA(4,1,5)

The ARIMA Procedure

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	2.7744E-10	4.5409E-10	0.61	0.5412	0
MA1,1	3.18936	0.01721	185.33	<.0001	1
MA1,2	4.71936	0.03529	133.72	<.0001	2
MA1,3	4.23661	0.04071	104.07	<.0001	3
MA1,4	2.16956	0.03050	71.13	<.0001	4
MA1,5	0.46294	0.01003	46.16	<.0001	5
AR1,1	1.72575	0.01854	93.10	<.0001	1
AR1,2	-1.76432	0.02044	-86.30	<.0001	2
AR1,3	0.94100	0.02062	45.64	<.0001	3
AR1,4	-0.06857	0.01350	-5.08	<.0001	4

Constant Estimate	4.61E-11
Variance Estimate	8.175E-8
Std Error Estimate	0.000286
AIC	-384343
SBC	-384260
Number of Residuals	28510

Final model: The model is chosen based on the lowest AIC
ARIMA(4,1,5)

Autoregressive Factors

Factor 1: 1 - 1.72575 B**(1) + 1.76432 B**(2) - 0.941 B**(3) + 0.06857 B**(4)

Moving Average Factors

Factor 1: 1 - 3.18936 B**(1) + 4.71936 B**(2) - 4.23661 B**(3) + 2.16956 B**(4) - 0.46294 B**(5)

MRO

SCAN Chi-Square[1] Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	<.0001	0.4377	0.0015	0.0111	0.5238
AR 1	<.0001	0.9995	0.0173	0.3068	0.5483	0.9107
AR 2	<.0001	0.0065	0.2115	0.2359	0.8319	0.8524
AR 3	<.0001	0.2342	0.5485	0.9112	0.8493	0.8205
AR 4	<.0001	0.6580	0.4796	0.8514	0.9890	0.9290
AR 5	<.0001	0.7320	0.9706	0.7217	0.9274	0.9409

ARMA(p+d,q) Tentative Order Selection Tests

---------SCAN---------

p+d	q	BIC
2	2	-16.1862
3	1	-16.1866
1	3	-16.1863
0	5	-16.1866

(5% Significance Level)

ESACF Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	<.0001	0.4377	0.0015	0.0111	0.5238
AR 1	<.0001	0.9907	0.1360	0.3349	0.2027	0.5579
AR 2	<.0001	0.9758	<.0001	0.1029	0.3744	0.7857
AR 3	<.0001	<.0001	<.0001	0.0386	0.0006	0.6450
AR 4	<.0001	<.0001	<.0001	<.0001	0.8680	0.5261
AR 5	<.0001	<.0001	0.0160	<.0001	0.0006	0.6244

ARMA(p+d,q) Tentative Order Selection Tests

--------ESACF--------

p+d	q	BIC
1	3	-16.1863
4	4	-16.1861
0	5	-16.1866

(5% Significance Level)

p+d=3 and q=1/p+d=0 and q=5 for further analysis (lowest BIC)

ARIMA model

ARIMA(3,0,1)

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	2.95855E-7	4.20786E-7	0.70	0.4820	0
MA1,1	0.74499	0.0090432	82.38	<.0001	1
AR1,1	0.23549	0.0098047	24.02	<.0001	1
AR1,2	0.06535	0.0060885	10.73	<.0001	2
AR1,3	0.02823	0.0050902	5.55	<.0001	3

Constant Estimate	1.985E-7
Variance Estimate	9.337E-8
Std Error Estimate	0.000306
AIC	-1016986
SBC	-1016940
Number of Residuals	76186

ARIMA(2,1,1)

The ARIMA Procedure

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	2.2293E-11	3.9846E-11	0.56	0.5758	0
MA1,1	1.00000	0.01951	51.25	<.0001	1
AR1,1	-0.32000	0.0035809	-89.36	<.0001	1
AR1,2	-0.13200	0.0035805	-36.86	<.0001	2

Constant Estimate	3.24E-11
Variance Estimate	9.855E-8
Std Error Estimate	0.000314
AIC	-1012952
SBC	-1012815
Number of Residuals	76185

ARIMA(0,0,5)

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	2.96005E-7	4.22511E-7	0.70	0.4836	0
MA1,1	0.50949	0.0036228	140.64	<.0001	1
MA1,2	0.05424	0.0040669	13.34	<.0001	2
MA1,3	0.01685	0.0040695	4.14	<.0001	3
MA1,4	0.02373	0.0040653	5.84	<.0001	4
MA1,5	0.01403	0.0036230	3.87	0.0001	5

Constant Estimate	2.96E-7
Variance Estimate	9.336E-8
Std Error Estimate	0.000306
AIC	-1016992
SBC	-1016936
Number of Residuals	76186

Final model: The model is chosen based on the lowest AIC
ARIMA(0,0,5)

Moving Average Factors

Factor 1: 1 - 0.50949 B**(1) - 0.05424 B**(2) - 0.01685 B**(3) - 0.02373 B**(4) - 0.01403 B**(5)

MUR

SCAN Chi-Square[1] Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	<.0001	0.0502	0.6278	0.4521	0.4367
AR 1	<.0001	0.2312	0.3463	0.4968	0.8766	0.5872
AR 2	<.0001	0.3696	0.8747	0.9131	0.6020	0.9492
AR 3	0.1214	0.4094	0.9184	0.8867	0.6516	0.2914
AR 4	0.1580	0.3766	0.5388	0.6684	0.5843	0.7705
AR 5	0.7978	0.1874	0.0940	0.3136	0.7375	0.8731

ARMA(p+d,q) Tentative Order Selection Tests

---------SCAN---------

p+d	q	BIC
1	1	-16.2365
0	2	-16.2364
3	0	-16.2359

(5% Significance Level)

ESACF Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	<.0001	0.0503	0.6279	0.4522	0.4368
AR 1	<.0001	<.0001	0.0013	0.3834	0.8894	0.8676
AR 2	<.0001	<.0001	0.3398	0.6588	0.8374	0.9908
AR 3	<.0001	<.0001	<.0001	0.9351	0.7581	0.9637
AR 4	<.0001	<.0001	0.0026	0.0348	0.4797	0.6876
AR 5	<.0001	<.0001	<.0001	<.0001	<.0001	0.2553

ARMA(p+d,q) Tentative Order Selection Tests

--------ESACF--------

p+d	q	BIC
0	2	-16.2364
2	2	-16.2357

(5% Significance Level)

Use p+d = 1 and q=1 for further analysis (lowest BIC)

ARIMA model

ARIMA(1,0,1)

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	1.29929E-7	1.48354E-6	0.09	0.9302	0
MA1,1	0.39892	0.02573	15.50	<.0001	1
AR1,1	0.17282	0.02765	6.25	<.0001	1

Constant Estimate	1.075E-7
Variance Estimate	8.886E-8
Std Error Estimate	0.000298
AIC	-285648
SBC	-285624
Number of Residuals	21320

ARIMA(0,1,1)

The ARIMA Procedure

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	7.5239E-11	5.5754E-10	0.13	0.8927	0
MA1,1	1.00000	0.09560	10.46	<.0001	1

Constant Estimate	7.52E-11
Variance Estimate	9.355E-8
Std Error Estimate	0.000306
AIC	-284531
SBC	-284516
Number of Residuals	21319

Final model: The model is chosen based on the lowest AIC

ARIMA(1,0,1)

Autoregressive Factors

Factor 1: 1 - 0.17282 B**(1)

Moving Average Factors

Factor 1: 1 - 0.39892 B**(1)

NDAQ

SCAN Chi-Square[1] Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	<.0001	<.0001	0.1492	0.3472	0.1448
AR 1	<.0001	<.0001	<.0001	0.4823	0.1551	0.1648
AR 2	0.0892	0.6539	0.1443	0.0842	0.2320	0.4859
AR 3	0.7808	0.2866	0.7434	0.0523	0.0009	0.2639
AR 4	0.1498	0.6827	0.2885	0.1961	0.6459	0.0082
AR 5	0.0331	0.0609	0.2150	0.0955	0.3465	<.0001

SCAN does not output the ARMA result within the value of 5

ESACF Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	<.0001	<.0001	0.1556	0.3523	0.1490
AR 1	<.0001	<.0001	<.0001	0.0129	0.5325	0.7758
AR 2	<.0001	<.0001	<.0001	0.0961	0.2675	0.8734
AR 3	<.0001	<.0001	0.0768	0.0004	0.2340	0.1848
AR 4	<.0001	<.0001	0.3315	<.0001	0.1124	0.4917
AR 5	<.0001	<.0001	<.0001	<.0001	0.4043	<.0001

ARMA(p+d,q) Tentative Order Selection Tests

--------ESACF--------		
p+d	q	BIC
0	3	-17.1218
2	3	-17.1212

(5% Significance Level)

Use p+d = 2 and q=3 for further analysis (lowest BIC)

ARIMA model

ARIMA(0,0,3)

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	-2.6355E-7	8.37541E-7	-0.31	0.7530	0
MA1,1	0.26036	0.0054965	47.37	<.0001	1
MA1,2	0.02074	0.0056802	3.65	0.0003	2
MA1,3	-0.03773	0.0054970	-6.86	<.0001	3

Constant Estimate	-2.64E-7
Variance Estimate	4.051E-8
Std Error Estimate	0.000201
AIC	-468875
SBC	-468841
Number of Residuals	33057

Final model:

ARIMA(0,0,3)

Moving Average Factors

Factor 1: 1 - 0.26036 B**(1) - 0.02074 B**(2) + 0.03773 B**(3)

PDCO

SCAN Chi-Square[1] Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	0.4733	0.3056	0.0206	0.1316	0.9061
AR 1	<.0001	0.3262	0.1656	0.1305	0.2359	0.0971
AR 2	<.0001	0.0214	0.1171	0.8860	0.0564	0.0426
AR 3	0.7346	0.2119	0.2730	0.0511	0.2463	0.8793
AR 4	0.1947	0.6979	0.2565	0.0518	0.9359	0.1520
AR 5	0.3546	0.2450	0.6513	<.0001	0.0148	0.0107

SCAN does not output the ARMA result within the value of 5

ESACF Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	0.4752	0.3068	0.0220	0.1348	0.9069
AR 1	<.0001	<.0001	0.5463	0.1060	0.1248	0.9680
AR 2	<.0001	<.0001	<.0001	0.8268	0.6057	0.5060
AR 3	<.0001	<.0001	<.0001	0.3980	0.5762	0.9511
AR 4	<.0001	<.0001	0.0002	<.0001	0.5915	0.9680
AR 5	<.0001	<.0001	0.0713	<.0001	0.6488	<.0001

ARMA(p+d,q) Tentative Order Selection Tests

--------ESACF--------		
p+d	q	BIC
1	2	-16.5823
0	4	-16.5852

(5% Significance Level)

Use p+d = 0 and q=4 for further analysis (lowest BIC)

ARIMA model

ARIMA(0,0,4)

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	1.15948E-6	1.4313E-6	0.81	0.4179	0
MA1,1	0.35947	0.0083899	42.85	<.0001	1
MA1,2	0.01115	0.0089148	1.25	0.2112	2
MA1,3	0.0049941	0.0089136	0.56	0.5753	3
MA1,4	-0.01973	0.0083883	-2.35	0.0187	4

Constant Estimate	1.159E-6
Variance Estimate	7.018E-8
Std Error Estimate	0.000265
AIC	-193780
SBC	-193743
Number of Residuals	14213

Final model:

ARIMA(0,0,4)

Moving Average Factors

Factor 1: 1 - 0.35947 B**(1) - 0.01115 B**(2) - 0.00499 B**(3) + 0.01973 B**(4)

TXN

SCAN Chi-Square[1] Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	<.0001	0.2577	0.8107	0.0029	0.5730
AR 1	<.0001	0.0996	0.9287	0.2622	0.0670	0.3273
AR 2	<.0001	0.7043	0.1183	0.0615	0.1055	0.0329
AR 3	<.0001	0.0031	0.0655	0.0756	0.0205	0.6886
AR 4	0.6163	0.0442	0.7369	0.0214	0.4336	0.6012
AR 5	0.0456	0.1938	0.0863	0.1899	0.7806	0.1552

ARMA(p+d,q) Tentative Order Selection Tests

---------SCAN---------

p+d	q	BIC
5	1	-17.8034
4	4	-17.8033
3	5	-17.8033

(5% Significance Level)

ESACF Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	<.0001	0.2578	0.8107	0.0029	0.5735
AR 1	<.0001	<.0001	0.5119	0.9236	0.0146	0.0481
AR 2	<.0001	<.0001	0.4980	0.0175	0.0252	0.1044
AR 3	<.0001	<.0001	<.0001	<.0001	<.0001	0.6900
AR 4	<.0001	<.0001	<.0001	<.0001	<.0001	0.2721
AR 5	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001

ARMA(p+d,q) Tentative Order Selection Tests

--------ESACF--------

p+d	q	BIC
0	5	-17.8035
2	5	-17.8034
3	5	-17.8033
4	5	-17.8033

(5% Significance Level)

Use p+d = 0 and q=5 for further analysis (lowest BIC)

ARIMA model

ARIMA(0,0,5)

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	1.04499E-7	2.52135E-7	0.41	0.6785	0
MA1,1	0.35846	0.0029045	123.42	<.0001	1
MA1,2	0.02682	0.0030864	8.69	<.0001	2
MA1,3	-0.0052304	0.0030865	-1.69	0.0901	3
MA1,4	-0.0032353	0.0030856	-1.05	0.2944	4
MA1,5	-0.01282	0.0029046	-4.41	<.0001	5

Constant Estimate	1.045E-7
Variance Estimate	1.863E-8
Std Error Estimate	0.000136
AIC	-1773219
SBC	-1773161
Number of Residuals	118525

Final model:

ARIMA(0,0,5)

Moving Average Factors

Factor 1: 1 - 0.35846 B**(1) - 0.02682 B**(2) + 0.00523 B**(3) + 0.00324 B**(4) + 0.01282 B**(5)

UTX

SCAN Chi-Square[1] Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	<.0001	0.0599	0.0111	0.9943	<.0001
AR 1	<.0001	0.0216	0.0158	0.0104	0.0058	0.0001
AR 2	<.0001	0.0083	0.0171	0.0061	0.3126	0.0054
AR 3	<.0001	0.5529	0.0048	0.1058	0.0031	0.1835
AR 4	<.0001	<.0001	0.0005	0.0104	0.3072	0.5112
AR 5	0.0033	0.3476	0.6067	0.0741	0.5587	0.7237

ARMA(p+d,q) Tentative Order Selection Tests

p+d	q	BIC
5	1	-17.4655
4	4	-17.465
3	5	-17.465

(5% Significance Level)

ESACF Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	<.0001	0.0600	0.0111	0.9943	<.0001
AR 1	<.0001	<.0001	0.0002	0.0111	0.9967	<.0001
AR 2	<.0001	<.0001	<.0001	0.0005	0.5912	0.0003
AR 3	<.0001	<.0001	<.0001	<.0001	0.0919	0.0471
AR 4	<.0001	<.0001	<.0001	<.0001	<.0001	0.0016
AR 5	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001

ESACF does not output the ARMA result within the value of 5

Use p+d = 5 and q=1 for further analysis (lowest BIC)

ARIMA model

ARIMA(5,0,1)

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	1.62054E-7	3.99456E-7	0.41	0.6850	0
MA1,1	-0.34016	0.15279	-2.23	0.0260	1
AR1,1	-0.73724	0.15270	-4.83	<.0001	1
AR1,2	-0.32783	0.06079	-5.39	<.0001	2
AR1,3	-0.15020	0.02946	-5.10	<.0001	3
AR1,4	-0.07812	0.01296	-6.03	<.0001	4
AR1,5	-0.03752	0.0065574	-5.72	<.0001	5

Constant Estimate	3.777E-7
Variance Estimate	2.598E-8
Std Error Estimate	0.000161
AIC	-787400
SBC	-787338
Number of Residuals	53829

ARIMA(4,1,1)

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	6.1421E-11	2.6583E-11	2.31	0.0209	0
MA1,1	1.00000	0.02864	34.91	<.0001	1
AR1,1	-0.39497	0.0043068	-91.71	<.0001	1
AR1,2	-0.18959	0.0046206	-41.03	<.0001	2
AR1,3	-0.07923	0.0046204	-17.15	<.0001	3
AR1,4	-0.04035	0.0043066	-9.37	<.0001	4

Constant Estimate	1.05E-10
Variance Estimate	2.6E-8
Std Error Estimate	0.000161
AIC	-787345
SBC	-787291
Number of Residuals	53828

Final model: The model is chosen based on the lowest AIC
ARIMA(5,0,1)

Autoregressive Factors

Factor 1: 1 + 0.73724 B**(1) + 0.32783 B**(2) + 0.1502 B**(3) + 0.07812 B**(4) + 0.03752 B**(5)

Moving Average Factors

Factor 1: 1 + 0.34016 B**(1)

WYNN

SCAN Chi-Square[1] Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	0.0563	0.0060	0.7365	0.0595	0.3327
AR 1	<.0001	0.0111	0.4001	0.0431	0.1994	0.8869
AR 2	<.0001	0.8743	0.0301	0.6302	0.5052	0.3081
AR 3	<.0001	0.0622	0.2930	0.5026	0.6209	0.7631
AR 4	0.0011	0.2545	0.7132	0.3226	0.7583	0.6784
AR 5	0.7393	0.0683	0.0668	0.1690	0.3813	0.5522

ARMA(p+d,q) Tentative Order Selection Tests

p+d	q	BIC
3	1	-15.8202
2	3	-15.8209
0	4	-15.8205
5	0	-15.8223

(5% Significance Level)

ESACF Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	0.0598	0.0067	0.7401	0.0632	0.3396
AR 1	<.0001	<.0001	0.0403	0.5570	0.1769	0.8067
AR 2	<.0001	<.0001	<.0001	0.3993	0.0929	0.8974
AR 3	<.0001	<.0001	<.0001	<.0001	0.6377	0.7896
AR 4	<.0001	<.0001	<.0001	<.0001	<.0001	0.8620
AR 5	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001

ARMA(p+d,q) Tentative Order Selection Tests

p+d	q	BIC
0	3	-15.8207
1	3	-15.8209
2	3	-15.8209

(5% Significance Level)

Use p+d = 5 and q=0 for further analysis (lowest BIC)

ARIMA model

ARIMA(5,0,0)

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	-1.3814E-6	1.06935E-6	-1.29	0.1964	0
AR1,1	-0.42138	0.0051707	-81.49	<.0001	1
AR1,2	-0.19961	0.0055785	-35.78	<.0001	2
AR1,3	-0.11527	0.0056239	-20.50	<.0001	3
AR1,4	-0.05887	0.0055552	-10.60	<.0001	4
AR1,5	-0.01669	0.0051260	-3.26	0.0011	5

Constant Estimate	-2.5E-6
Variance Estimate	1.428E-7
Std Error Estimate	0.000378
AIC	-491792
SBC	-491741
Number of Residuals	38054

ARIMA(4,1,0)

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	1.32853E-7	5.53593E-7	0.24	0.8103	0
AR1,1	-1.12977	0.0049816	-226.79	<.0001	1
AR1,2	-0.92979	0.0069556	-133.67	<.0001	2
AR1,3	-0.61739	0.0069276	-89.12	<.0001	3
AR1,4	-0.27576	0.0049278	-55.96	<.0001	4

Constant Estimate	5.251E-7
Variance Estimate	1.822E-7
Std Error Estimate	0.000427
AIC	-482522
SBC	-482479
Number of Residuals	38053

Final model: The model is chosen based on the lowest AIC

ARIMA(5,0,0)

Autoregressive Factors

Factor 1: 1 + 0.42138 B**(1) + 0.19961 B**(2) + 0.11527 B**(3) + 0.05887 B**(4) + 0.01669 B**(5)

ZION

SCAN Chi-Square[1] Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	<.0001	<.0001	0.1052	<.0001	<.0001
AR 1	0.0005	<.0001	0.0011	<.0001	0.2186	<.0001
AR 2	<.0001	0.0007	<.0001	<.0001	<.0001	<.0001
AR 3	0.4416	<.0001	0.0492	<.0001	0.1532	<.0001
AR 4	<.0001	0.0023	<.0001	<.0001	<.0001	<.0001
AR 5	<.0001	<.0001	<.0001	<.0001	0.0401	0.7948

ARMA(p+d,q) Tentative Order Selection Tests

---------SCAN---------

p+d	q	BIC
5	5	-17.44

(5% Significance Level)

ESACF Probability Values

Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	<.0001	<.0001	<.0001	0.1109	<.0001	<.0001
AR 1	<.0001	<.0001	<.0001	0.0838	0.4870	<.0001
AR 2	<.0001	<.0001	<.0001	0.0035	0.5037	<.0001
AR 3	<.0001	<.0001	<.0001	<.0001	0.5039	<.0001
AR 4	<.0001	<.0001	<.0001	<.0001	<.0001	0.0010
AR 5	<.0001	<.0001	<.0001	<.0001	<.0001	0.4599

ARMA(p+d,q) Tentative Order Selection Tests

--------ESACF--------

p+d	q	BIC
5	5	-17.44

(5% Significance Level)

Use p+d = 5 and q=5 for further analysis

ARIMA model

ARIMA(5,0,5)

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	4.35389E-7	8.1509E-7	0.53	0.5932	0
MA1,1	0.20499	0.06969	2.94	0.0033	1
MA1,2	0.06196	0.06150	1.01	0.3137	2
MA1,3	0.44681	0.06044	7.39	<.0001	3
MA1,4	-0.24018	0.06904	-3.48	0.0005	4
MA1,5	-0.26661	0.02769	-9.63	<.0001	5
AR1,1	-0.01402	0.06937	-0.20	0.8398	1
AR1,2	0.07531	0.06142	1.23	0.2202	2
AR1,3	0.43229	0.06123	7.06	<.0001	3
AR1,4	-0.13678	0.06926	-1.97	0.0483	4
AR1,5	-0.32218	0.02277	-14.15	<.0001	5

Constant Estimate	4.203E-7
Variance Estimate	2.983E-8
Std Error Estimate	0.000173
AIC	-439044
SBC	-438952
Number of Residuals	30301

ARIMA(4,1,5)

The ARIMA Procedure

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	4.1409E-11	3.0135E-10	0.14	0.8907	0
MA1,1	0.11781	0.13050	0.90	0.3667	1
MA1,2	0.28923	0.06591	4.39	<.0001	2
MA1,3	0.76690	0.05648	13.58	<.0001	3
MA1,4	0.04334	0.10677	0.41	0.6848	4
MA1,5	-0.21729	0.02857	-7.61	<.0001	5
AR1,1	-1.09834	0.11921	-9.21	<.0001	1
AR1,2	-0.80896	0.15391	-5.26	<.0001	2
AR1,3	-0.0029221	0.13699	-0.02	0.9830	3
AR1,4	0.21338	0.03601	5.93	<.0001	4

Constant Estimate	1.12E-10
Variance Estimate	2.99E-8
Std Error Estimate	0.000173
AIC	-438949
SBC	-438866
Number of Residuals	30300

Final model: The model is chosen based on the lowest AIC

ARIMA(5,0,5)

Autoregressive Factors

Factor 1: 1 + 0.01402 B**(1) - 0.07531 B**(2) - 0.43229 B**(3) + 0.13678 B**(4) + 0.32218 B**(5)

Moving Average Factors

Factor 1: 1 - 0.20499 B**(1) - 0.06196 B**(2) - 0.44681 B**(3) + 0.24018 B**(4) + 0.26661 B**(5)