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1 ARMA model

1.a

the result of 1.a

Data_mean =

1.059510964912281

Data_variance =

31.360269533945456

Data_median =

1.4945000000000000

Data_kurtosis =

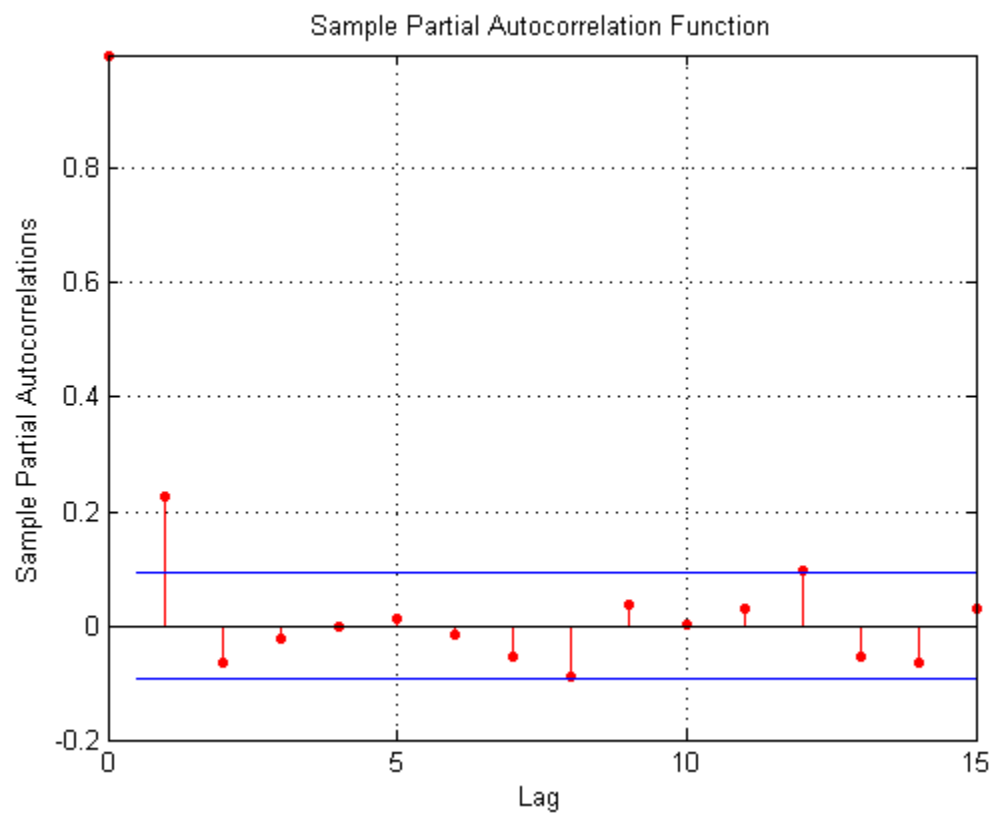
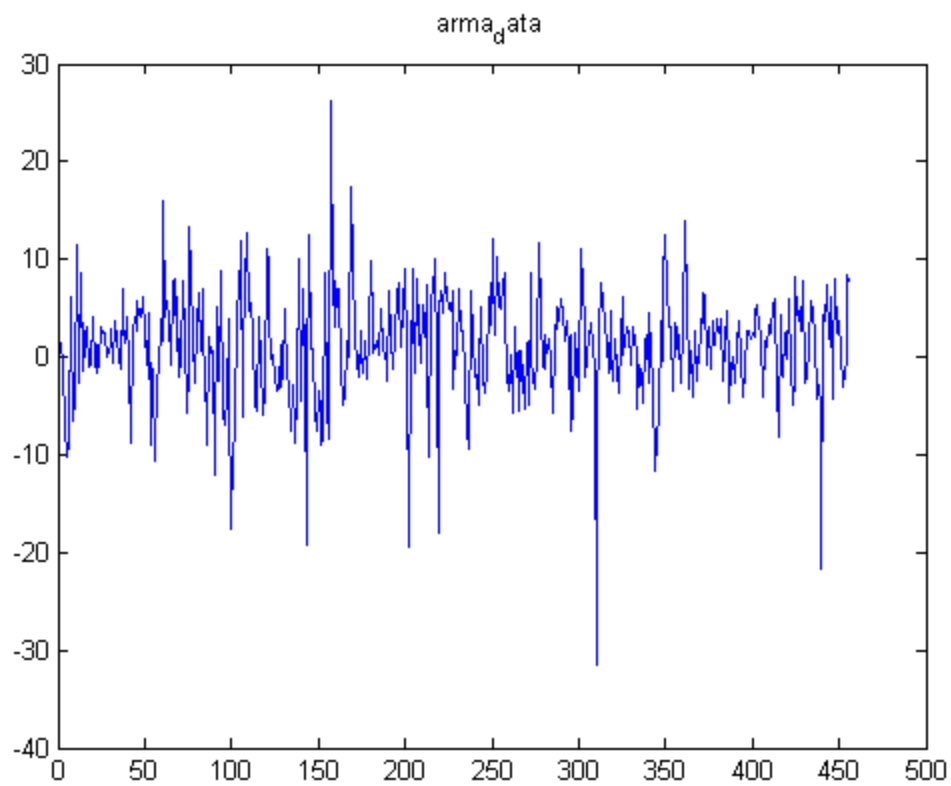
7.154228266875846

Data_skewness =

-0.675491315279429

h_adf =

1



1.b

the result of 1.b

Mean: ARMAX(1,0,0); Variance: GARCH(0,0)

Conditional Probability Distribution: Gaussian
Number of Model Parameters Estimated: 3

Parameter	Value	Standard Error	T Statistic
-----	-----	-----	-----
C	0.82229	0.26496	3.1035
AR(1)	0.22709	0.047546	4.7762
K	29.681	1.1017	26.9414

$h_{LB} =$

0

we fail to reject the null autocorrelation of the series

1.c

the result of 1.c

Mean: ARMAX(2,3,0); Variance: GARCH(0,0)

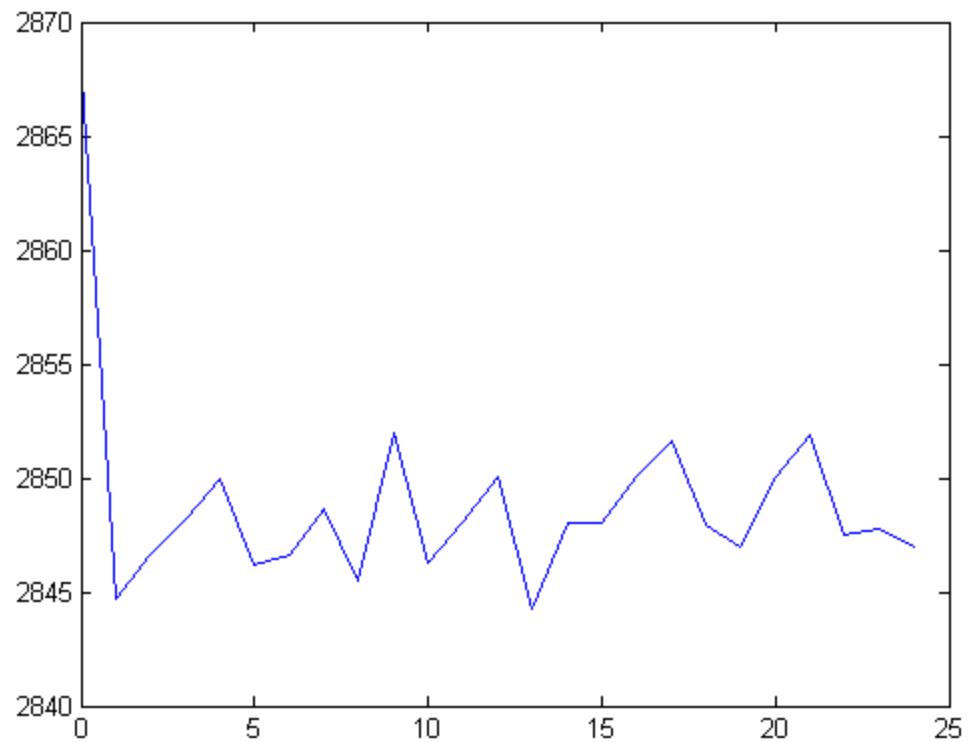
Conditional Probability Distribution: Gaussian
Number of Model Parameters Estimated: 7

Parameter	Value	Standard Error	T Statistic
-----	-----	-----	-----
C	1.7635	0.39383	4.4778
AR(1)	0.76564	0.0080525	95.0808
AR(2)	-0.99708	0.0068798	-144.9293
MA(1)	-0.53168	0.04944	-10.7540
MA(2)	0.82849	0.037218	22.2604
MA(3)	0.22339	0.048923	4.5663
K	29.041	1.1733	24.7517

$h_{arch} =$

0

fail to reject null of no arch effect



GARCH model

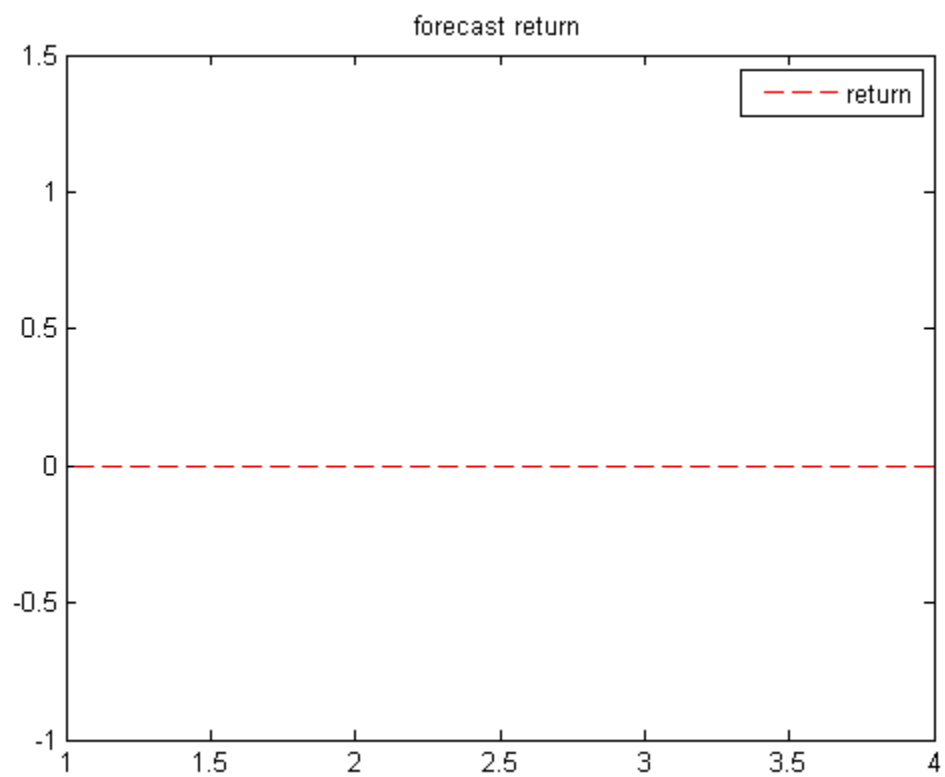
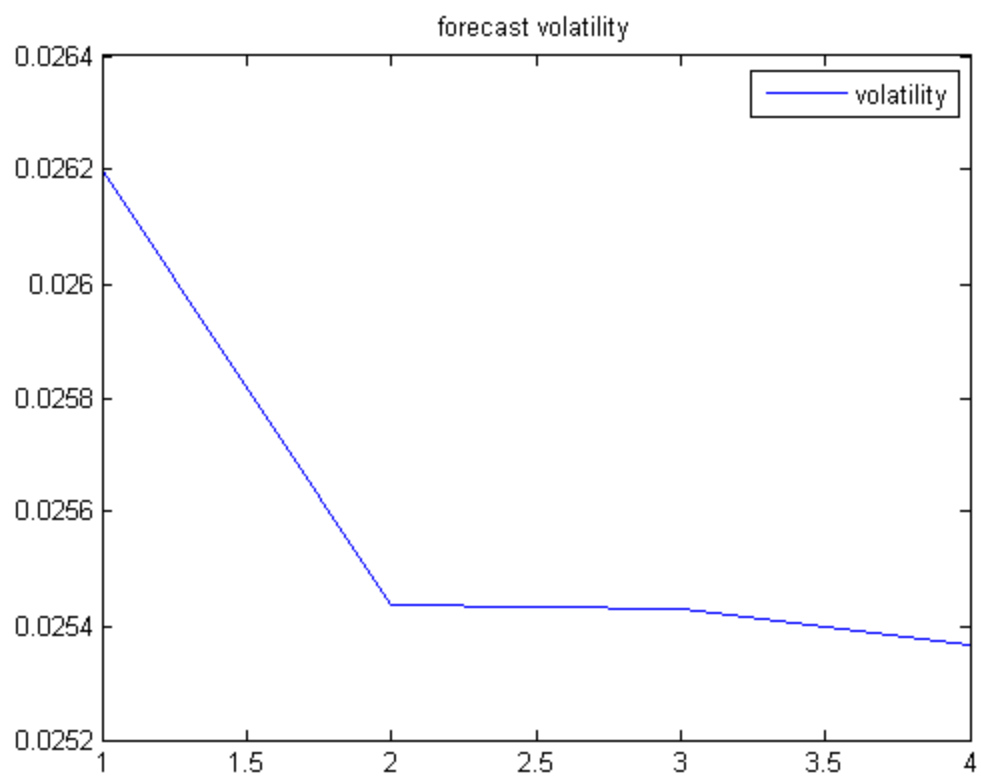
2.a

Mean: $ARMAX(0,0,0)$; Variance: $GARCH(1,2)$

Conditional Probability Distribution: Gaussian

Number of Model Parameters Estimated: 5

Parameter	Value	Standard Error	T Statistic
<i>C</i>	0.00032358	0.00018583	1.7412
<i>K</i>	1.2906e-06	2.3361e-07	5.5248
<i>GARCH</i> (1)	0.90767	0.0093076	97.5194
<i>ARCH</i> (1)	0.012487	0.013844	0.9020
<i>ARCH</i> (2)	0.072915	0.015283	4.7709



b

ar5 garch(1,1)

Mean: ARMAX(5,0,0); Variance: GARCH(1,1)

Conditional Probability Distribution: T

Number of Model Parameters Estimated: 6

Parameter	Value	Standard Error	T Statistic
-----	-----	-----	-----
C	0	Fixed	Fixed
AR(1)	0	Fixed	Fixed
AR(2)	0	Fixed	Fixed
AR(3)	-0.010767	0.020159	-0.5341
AR(4)	0	Fixed	Fixed
AR(5)	-0.042019	0.020268	-2.0731
K	6.1291e-07	2.794e-07	2.1937
GARCH(1)	0.92806	0.0098329	94.3835
ARCH(1)	0.070814	0.0098912	7.1594
DoF	10.109	1.5831	6.3853

c

Mean: ARMAX(2,0,0); Variance: EGARCH(0,2)

Conditional Probability Distribution: Gaussian

Number of Model Parameters Estimated: 8

Parameter	Value	Standard Error	T Statistic
-----	-----	-----	-----
C	-0.00060919	0.00052954	-1.1504
AR(1)	0.046761	0.014681	3.1851
AR(2)	-0.097694	0.012614	-7.7448
K	-6.8778	0.027816	-247.2602
ARCH(1)	0.5302	0.030395	17.4433
ARCH(2)	0.6282	0.022719	27.6507
Leverage(1)	-0.023715	0.018974	-1.2499
Leverage(2)	-0.053014	0.01562	-3.3939

Mean: ARMAX(2,0,0); Variance: EGARCH(0,2)

Conditional Probability Distribution: Gaussian

Number of Model Parameters Estimated: 6

Parameter	Value	Standard Error	T Statistic
-----	-----	-----	-----

C	-0.00026344	0.00049541	-0.5318
AR(1)	0.045298	0.014269	3.1747
AR(2)	-0.086127	0.012662	-6.8021
K	-6.8767	0.027685	-248.3885
ARCH(1)	0.53183	0.030605	17.3775
ARCH(2)	0.62898	0.023389	26.8927
Leverage(1)	0	Fixed	Fixed
Leverage(2)	0	Fixed	Fixed

2.c result

$H_{LR_2C} =$

0

leverage effect is not significant at the 5% level

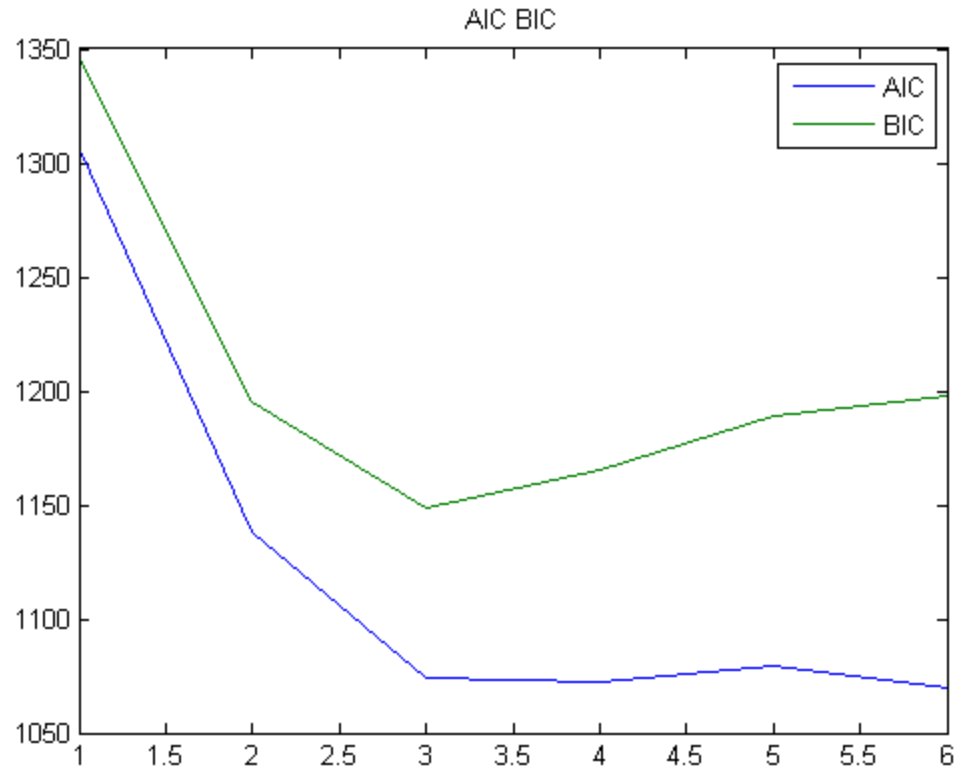
VAR model

Model : 2-D VAR(3) with Additive Constant

Conditional mean is AR-stable and is MA-invertible

Standard errors without DoF adjustment (maximum likelihood)

Parameter	Value	Std. Error	t-Statistic
a(1)	0.0637785	0.0450303	1.41635
a(2)	0.0787124	0.0377855	2.08314
AR(1)(1,1)	1.15919	0.109481	10.588
(1,2)	0.357914	0.129991	2.75338
(2,1)	0.01686	0.0918671	0.183526
(2,2)	1.40597	0.109077	12.8897
AR(2)(1,1)	-0.287219	0.162183	-1.77096
(1,2)	-0.506112	0.193168	-2.62007
(2,1)	0.0141312	0.136089	0.103838
(2,2)	-0.699753	0.162089	-4.31708
AR(3)(1,1)	0.110005	0.107288	1.02532
(1,2)	0.15471	0.12862	1.20284
(2,1)	0.00824625	0.0900263	0.0915982
(2,2)	0.244512	0.107927	2.26554
Q(1,1)	0.164541	0.00946044	17.3925
Q(2,1)	0		
Q(2,2)	0.115855	0.00666118	17.3925



b

Model : 2-D VAR(3) with Additive Constant
Conditional mean is AR-stable and is MA-invertible
Standard errors without DoF adjustment (maximum likelihood)

Parameter	Value	Std. Error	t-Statistic
a(1)	0.0581032	0.0441289	1.31667
a(2)	0.0508601	0.033019	1.54033
AR(1)(1,1)	1.16257	0.108835	10.6819
(1,2)	0.3542	0.129159	2.74235
(2,1)	0		
(2,2)	1.42545	0.0391895	36.3733
AR(2)(1,1)	-0.290487	0.161176	-1.8023
(1,2)	-0.502106	0.191839	-2.61732
(2,1)	0		
(2,2)	-0.680464	0.0640382	-10.6259
AR(3)(1,1)	0.108677	0.10664	1.0191
(1,2)	0.156257	0.12778	1.22287
(2,1)	0		
(2,2)	0.246694	0.0392032	6.2927
Q(1,1)	0.163088	0.00932315	17.4929
Q(2,1)	0		
Q(2,2)	0.115253	0.00658856	17.4929

$H_{LR_VAR} =$

0

coefficient is not significant
the modified model

Model : 2-D VAR(3) with Additive Constant

Conditional mean is AR-stable and is MA-invertible

Standard errors without DoF adjustment (maximum likelihood)

Parameter	Value	Std. Error	t-Statistic
-----	-----	-----	-----
a(1)	0.0581032	0.0441289	1.31667
a(2)	0.0508601	0.033019	1.54033
AR(1)(1,1)	1.16257	0.108835	10.6819
(1,2)	0.3542	0.129159	2.74235
(2,1)	0		
(2,2)	1.42545	0.0391895	36.3733
AR(2)(1,1)	-0.290487	0.161176	-1.8023
(1,2)	-0.502106	0.191839	-2.61732
(2,1)	0		
(2,2)	-0.680464	0.0640382	-10.6259
AR(3)(1,1)	0.108677	0.10664	1.0191
(1,2)	0.156257	0.12778	1.22287
(2,1)	0		
(2,2)	0.246694	0.0392032	6.2927
Q(1,1)	0.163088	0.00932315	17.4929
Q(2,1)	0		
Q(2,2)	0.115253	0.00658856	17.4929

C

change to MA

Model : 2-D VMA(6) with Additive Constant

Conditional mean is AR-stable and is not MA-invertible

a Constant:

5.67353

6.11358

MA(1) Moving Average Matrix:

1.16257 0.3542

0 1.42545

MA(2) Moving Average Matrix:

1.06108 0.414572

0 1.35145

MA(3) Moving Average Matrix:

1.00455 0.298292

0 1.20315

MA(4) Moving Average Matrix:

0.985968 0.235174

0 1.14707

MA(5) Moving Average Matrix:

0.969763 0.245168

0 1.14978

MA(6) Moving Average Matrix:
0.950177 0.268432
0 1.15523
Q Innovations Covariance:
0.163088 0
0 0.115253

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