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ECO 5375
Eco. & Bus. Forecasting

Prof. Tom Fomby
Fall 2014

IN-CLASS
MID-TERM EXAM

Instructions: Write in your name and student ID above. You have 1 hour and 20 minutes to complete this exam. This is the in-class portion of your mid-term and represents 65% of your total mid-term grade. This exam is worth a total of 83 points. The points for the separate question are broken out as follows:

Questions 1 – 10 are worth 2 points each.
Q11 = (2, 2, 2) = 6 points
Q12 = (2, 2, 2) = 6 points
Q13 = 3 points
Q14 = 3 points
Q15 = 3 points
Q16 = 3 points
Q17 = 3 points
Q18 = 3 points
Q19 = 5 points
Q20 = 5 points
Q21 = (4, 6) = 10 points
Q22 = (4, 4, 2) =10 points
Q23 = 3 points

② 1. SAS programs have two basic steps. They are the Proc step and the data step.

② 2. The basic punctuation following each executable statement in SAS is
- a. Quotation mark (")
- b. Period (".")
- [✓ c.] Semicolon (";")
- d. Dash ("-")

② 3. To put comments in a SAS program
- a. Enclose the comments between quotation marks as in: "content"
- [✓ b.] Enclose the comments between /* and */ as in /*content*/
- c. Enclose the comments between (and) as in (content)
- d. Enclose the comments between # and # as in #content#

② 4. [✓ True] or False. If a time series is slow-turning around a mean, it is probably a nonstationary time series and needs to be differenced before analyzing it.

② 5. If a time series y_t exhibits an exponential growth pattern, it can be transformed to stationarity by the transformation
- a. Δy_t
- [✓ b.] $\Delta \log_e(y_t)$
- c. $\exp(y_t)$
- d. $\tan^{-1}(y_t)$

② 6. True or [✓ False] If some time series data, say x, data needs to be differenced to be made stationary, then the identify statement in the SAS Procedure ARIMA should read "identify var = x;" should be "identify var = x(1);"

② 7. Consider the following AR(1) Box-Jenkins model: $y_t = 20 + 0.8y_{t-1} + a_t$. This model implies that the mean of the y_t series is 100. Suppose the last observation you have on the series is 95. The one-period ahead forecast for this model should be 96. mean $= \bar{y} = \frac{20}{1-.8} = 100$ $\hat{y}_{T+h} = \bar{y} + (y_T - \bar{y})\phi_1^h$

$\hat{y}_{T+1} = 100 + (95-100) \cdot (0.8) = 100 - 4 = 96$

② 8. [✓ True] or False. The "Damping" and "Cutting Off" patterns of the ACF and PACF of the stationary form of a time series provide a way to identify the orders of pure Box-Jenkins processes.

② 9. If the ACF has 2 spikes in it and then cuts off and if the PACF tails off, the ARMA model that is appropriate for the data is ARMA(0 , 2).

② 10. Consider the model: $y_t = y_{t-1} + a_t$. The stationary form of this model is $y_t - y_{t-1} = \Delta y_t = a_t$.

11. Define the following terms:

② Stock Out – the case where the store runs out of product to sell

② Let p = the optimal service level in the optimal inventory model. What is the meaning of 1 – p?

$1-p$ = the probability of a stock out

② Lead time forecast – The forecast of total sales over the time period required to replenish inventories.

12. Suppose you have applied ordinary least squares model to a DTDS model that produces the following table.

OLS regression to get the DW statistic

The REG Procedure
Model: MODEL1
Dependent Variable: TOT

Durbin-Watson D	0.432
Pr < DW	<.0001
Pr > DW	1.0000
Number of Observations	312
1st Order Autocorrelation	0.783

$p < .0001$
reject
no autocorrelation

Note: Pr<DW is the p-value for testing positive autocorrelation, and Pr>DW is the p-value for testing negative autocorrelation

② (a) What are the null and alternative hypotheses of this test?

$\varepsilon_t = \rho\,\varepsilon_{t-1} + v_t$

$H_0: \rho = 0$ (no autocorrelation in the errors)

$H_1: \rho > 0$ (positive autocorrelation in the errors)

② (b) Given the above result, what is the conclusion of this test?

we reject H_0 and accept H_1 that the errors of the regression model are positively correlated.

② (c) In further testing of the DTDS model that you are investigating, would you be inclined to use Ordinary Least Squares Output (Proc Reg) or Generlaized Least Squares Output (Proc Autoreg)? Explain your answer.

Use Generalized Least Squares since the errors of the regression model are autocorrelated.

③

13. Suppose you have been given the output displayed in Computer Output # 1. Does it appear that the DTDS model has autocorrelated errors? Explain your reasoning.

yes. The AR1, AR4, and AR12 coefficients are statistically significant. Their p-values are less than 0.05. These are the coefficients for the autocorrelated error process.

Computer Output # 1

Parameter Estimates

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	108160	28166	3.84	0.0002
t	1	2197	380.0081	5.78	<.0001
t2	1	-2.3581	1.1592	-2.03	0.0428
d2	1	-13603	5248	-2.59	0.0100
d3	1	26528	6700	3.96	<.0001
d4	1	-19559	7308	-2.68	0.0079
d5	1	-27417	7317	-3.75	0.0002
d6	1	23676	7454	3.18	0.0016
d7	1	49498	7512	6.59	<.0001
d8	1	68258	7465	9.14	<.0001
d9	1	-38426	7336	-5.24	<.0001
d10	1	-22235	7331	-3.03	0.0026
d11	1	-27777	6744	-4.12	<.0001
d12	1	11731	5325	2.20	0.0284
AR1	1	-0.5884	0.0444	-13.24	<.0001
AR4	1	-0.1216	0.0429	-2.83	0.0049
AR12	1	-0.2234	0.0415	-5.38	<.0001

Indicates Auto correlated errors.

14. Given Computer Output # 1, does it appear that the trend in the DTDS model has curvature? Explain your answer.

The t2 variable is statistically in that the t-value's p-value is less than 0.05 (p=0.0428). This implies that there is curvature in the trend.

setting $\frac{d}{dt}(\cdot)=0$ implies $0 = 2197-4.7162t^*$

and the peak of the trend is determined at $t^* = \frac{2197}{4.7162}$

Therefore, the peak should occur around $\boxed{t=466}$ $=465.8$

15. Do you expect the trend in this model to reach a peak and then decline thereafter? If so explain why you expect this to be the case. If there is a peak at what time period do you expect the peak to be reached? Show me how you get your answer.

③ yes, it should achieve a peak as compared to a trough because the sign of the t^2 coefficient is negative.

$\frac{d}{dt}(108160 + 2197t - 2.3581t^2) = 2197 - (2)(2.3581)t$

16. Given Computer Output # 2 that accompanies Computer Output # 1, does it look like there is significant seasonality in the data? Explain your answer. What are the null and alternative hypotheses of the test result reported in this output?

③ $H_0: \delta_2 = \delta_3 = \cdots = \delta_{12} = 0$ and there is no seasonality in the data.

H_1: not H_0. (There is some seasonality in the data.

Since the F-statistic has a p-value less than 0.05 we accept H_1, there is seasonality in the data.

Computer Output # 2

Test				
Source	**DF**	**Mean Square**	**F Value**	**Pr > F**
Numerator	11	29317586854	24.37	<.0001
Denominator	298	1202946247		

17. Consider Computer Output # 3 below. Suppose that the data so analyzed has the following output. Which months of the year are weak? Which months are strong? Which is the weakest month? Which is the strongest month? Thoroughly explain your answer.

③ weak months: Jan., Feb., Apr., May, Sept., Oct., Nov.

weakest month = Sept. It has most negative standardized coefficient

strong months: March, June, July, Aug., Dec.

strongest month = Aug. It has the largest positive standardized coefficient.

Computer Output # 3

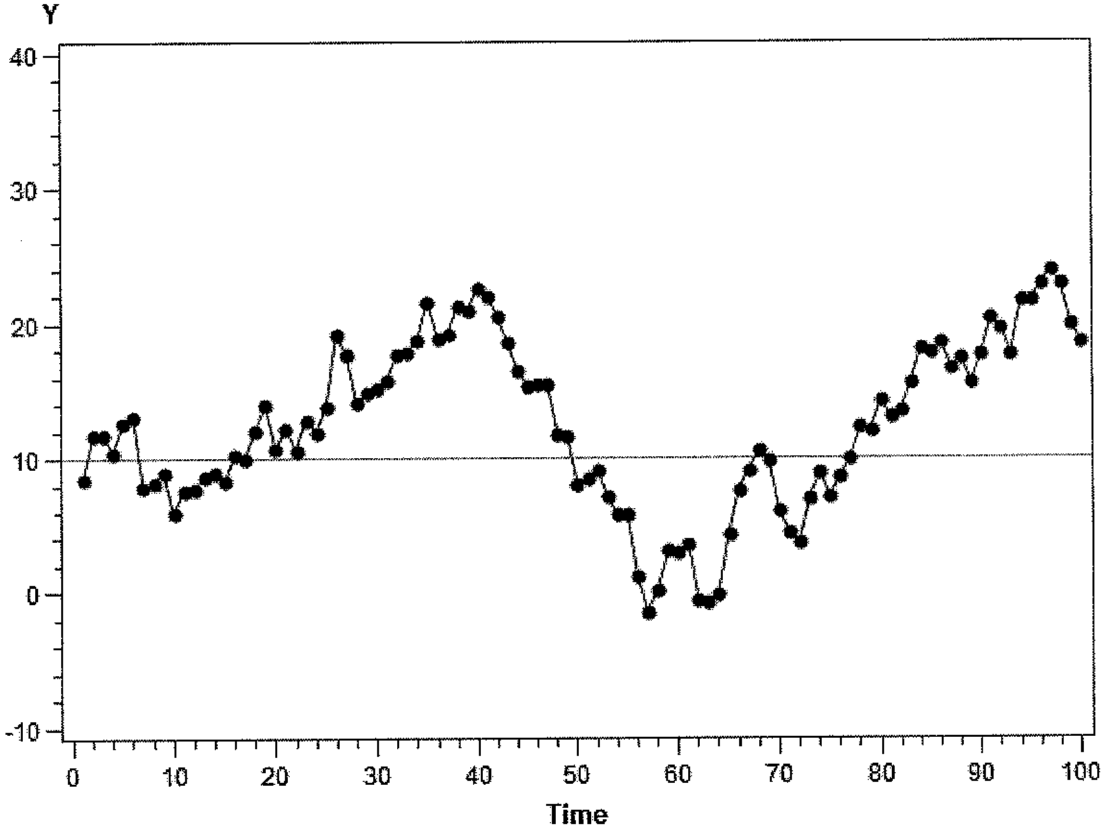
```
Obs      sum        d1a      d2a       d3a       d4a       d5a       d6a
 1    1.97E-15   -0.0231   -0.146   0.21651   -0.1997   -0.2707   0.19076

  d7a        d8a        d9a        d10a       d11a        d12a
0.42398    0.59343   -0.37016   -0.22391   -0.27397    0.082865
```

18. Does the following data in Figure 1 look stationary to you? Why or why not? If you were to conduct an augmented Dickey-Fuller test of this data which case would you use? Does the test equation of this data have an intercept? A trend variable?

③ No, the data does not look stationary. It is too slowly turning around its starting level (=10). In terms of the ADF test, one would use case 2 (the non-zero mean/intercept only case). The test equation would have only an intercept.

Figure 1



⑤

19. Given the below three EVIEWS outputs, which would you choose to test the time series in Figure 1 for a unit root? Which statistic did you focus on? What is its p-value? What is the null hypothesis of the test? What is the alternative hypothesis of the test? What is the outcome of your test? We should use Output # 2, The Dickey-Fuller tau statistic is 0.82 with p-value of 0.99 > 0.05. We accept the null hypothesis that the data is non-stationery (has a unit root) and needs to be differenced to make the data stationary.

EVIEWS OUTPUT # 1

Null Hypothesis: Y has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.250726	0.5935
Test critical values:	1% level	-2.588530	
	5% level	-1.944105	
	10% level	-1.614596	

*MacKinnon (1996) one-sided p-values.

```
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(Y)
Method: Least Squares
Date: 10/16/14   Time: 00:59
Sample (adjusted): 2 100
Included observations: 99 after adjustments
=====================================================================
      Variable        Coefficient    Std. Error    t-Statistic    Prob.
=====================================================================
       Y(-1)           -0.003749     0.014954      -0.250726     0.8026
=====================================================================
R-squared              -0.001831   Mean dependent var          0.101922
Adjusted R-squared     -0.001831   S.D. dependent var          2.059557
S.E. of regression      2.061442   Akaike info criterion       4.294738
Sum squared resid       416.4551   Schwarz criterion           4.320951
Log likelihood         -211.5895   Hannan-Quinn criter.        4.305344
Durbin-Watson stat      1.847336
=====================================================================
```

EVIEWS OUTPUT # 2

```
Null Hypothesis: Y has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)
=====================================================================
                                               t-Statistic    Prob.*
=====================================================================
Augmented Dickey-Fuller test statistic          0.820061      0.9939
Test critical values:        1% level          -3.503049
                             5% level          -2.893230
                             10% level         -2.583740
=====================================================================
*MacKinnon (1996) one-sided p-values.
```

Accept Ho
of need to
difference the
data.

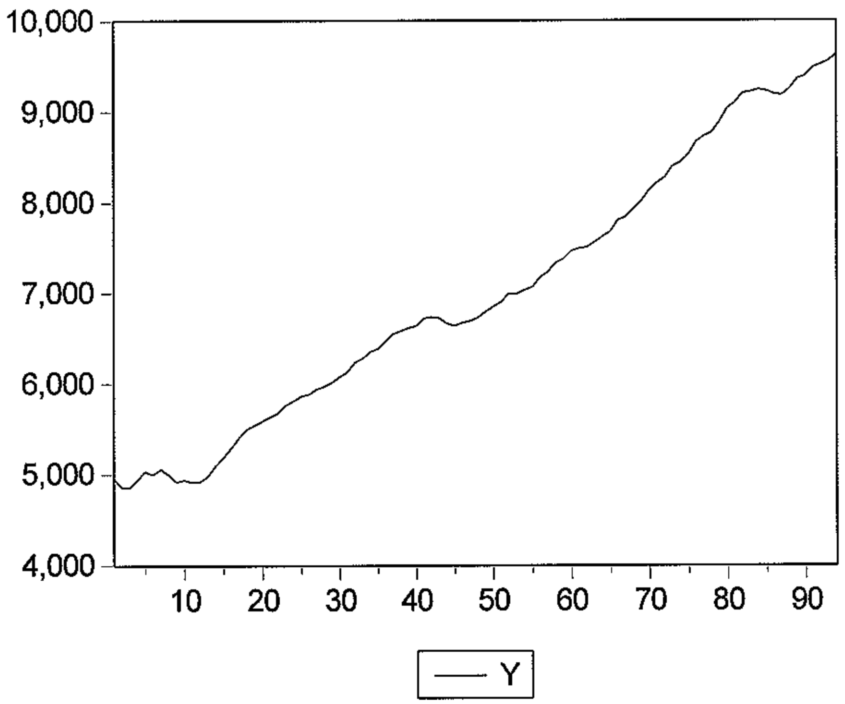
```
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(Y)
Method: Least Squares
Date: 10/16/14   Time: 01:02
Sample (adjusted): 3 94
Included observations: 92 after adjustments
=====================================================================
      Variable        Coefficient    Std. Error    t-Statistic    Prob.
=====================================================================
       Y(-1)            0.002599     0.003170       0.820061     0.4144
      D(Y(-1))          0.343837     0.094727       3.629753     0.0005
          C             16.49044     22.01721       0.748979     0.4558
=====================================================================
R-squared               0.152767   Mean dependent var          51.82283
Adjusted R-squared      0.133728   S.D. dependent var          45.59209
S.E. of regression      42.43425   Akaike info criterion       10.36585
Sum squared resid       160259.3   Schwarz criterion           10.44809
Log likelihood         -473.8293   Hannan-Quinn criter.        10.39904
F-statistic             8.023939   Durbin-Watson stat          2.107897
Prob(F-statistic)       0.000625
=====================================================================
```

EVIEWS OUTPUT # 3

```
Null Hypothesis: Y has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=11)
==========================================================================
                                                  t-Statistic    Prob.*
==========================================================================
Augmented Dickey-Fuller test statistic            -1.983249      0.6023
Test critical values:         1% level            -4.062040
                              5% level            -3.459950
                              10% level           -3.156109
==========================================================================
*MacKinnon (1996) one-sided p-values.


Augmented Dickey-Fuller Test Equation
Dependent Variable: D(Y)
Method: Least Squares
Date: 10/16/14   Time: 01:04
Sample (adjusted): 4 94
Included observations: 91 after adjustments
==========================================================================
      Variable         Coefficient    Std. Error    t-Statistic    Prob.
==========================================================================
       Y(-1)           -0.047957      0.024181      -1.983249      0.0505
      D(Y(-1))          0.293021      0.104490       2.804304      0.0062
      D(Y(-2))          0.157670      0.100263       1.572572      0.1195
         C              235.8543      107.2270       2.199580      0.0305
    @TREND("1")         2.705673      1.306515       2.070909      0.0414
==========================================================================
R-squared               0.196223    Mean dependent var          52.47473
Adjusted R-squared      0.158838    S.D. dependent var          45.41148
S.E. of regression      41.64909    Akaike info criterion       10.34981
Sum squared resid       149179.6    Schwarz criterion           10.48777
Log likelihood         -465.9165    Hannan-Quinn criter.        10.40547
F-statistic             5.248705    Durbin-Watson stat          1.958721
Prob(F-statistic)       0.000786
==========================================================================
```

Now consider the **SAS Computer Output # 4 that is provided as an insert to this exam**. Use them to answer the following 4 questions. We wish to determine the best Box-Jenkins model for this data. **Assume that the time series is observed <u>monthly</u>**. Here is a picture of the series:



20. Using the sample ACF and sample PACF that is provided by **Computer Output # 4**, give me a tentative identification of the d, p, and q values for the Y(1) series. Explain your answer.

⑤

d = 1, p = 1, q = 0.   i.e. p d q ARIMA(1,1,0)

Explanation: The ACF has a damping out behavior while the PACF has one spike in it and then cuts off. Then after differencing the data appears to be an AR(1) process.

21. Using **Computer Output # 4**, fill in the following P-Q box. Be sure to tell me what the entries of the cells of your box are. Which model is indicated to be the best model in the P-Q box? Explain your reasoning.

④

Reasoning: There is a split decision between the AR(1) and AR(2) models. The AR(1) model has the smallest SBC measure while the AR(2) model has the smallest AIC measure. However, the AR1,2 coefficient in the AR(2) model is statistically insignificant ($p = 0.14 > 0.05$). Also the PACF does not support the AR(2) model. The PACF has only one spike in it, not two. Therefore, the P-Q Box suggests the AR(1) as a good preliminary choice. We will follow up with the overfitting exercise to confirm this choice. Also the AR(1) model has white noise residuals.

Legend for P-Q Box:
AIC
SBC
Q_{24}
(p-value)

Q_{24} is for testing residuals of model to be white noise. H_0: residuals are white noise H_1: residuals are not white noise

Q

P

⑥

	0	1	2
0	985.1017 987.6343 30.39 (0.1723)	977.6966 982.7618 18.01 (0.7568)	976.0719 983.6697 15.89 (0.8214)
1	974.0883 979.1535 16.23 (0.8452)	974.1618 981.7596 14.96 (0.8641)	
2	973.9127 981.5105 15.05 (0.8602)		

22. Use **Computer Output #4** to conduct an overfitting exercise on the model you chose from the P-Q box. Below, report the overfitting coefficient of each overfitting model and its corresponding t-statistic. What conclusion do you draw from the overfitting exercise? Explain your answer.

④

Overfitting Model 1 is ARMA(2 , 0).
The overfitting coefficient is 0.15330.
The T-statistic of the overfitting coefficient is 1.47.
Therefore the overfitting coefficient from this model is
statistically (significant/[✓ insignificant]). Circle one alternative.

④

Overfitting Model 2 is ARMA(1 , 1).
The overfitting coefficient is 0.32538.
The T-statistic of the overfitting coefficient is 1.32.
Therefore the overfitting coefficient from this model is
statistically (significant/[✓ insignificant]). Circle one alternative.

②

My conclusion is since both overfitting coefficients are statistically insignificant we choose the AR(1) model as our final choice.

③

23. In the below space write out the final model that you have chosen for the Y time series in **Computer Output # 4** with accompanying t-statistics, standard errors, goodness-of-fit measures, and a test statistic for white noise residuals with accompanying p-value. (You can report your estimated model either in the intercept-form or the deviation-from-mean form.)

Intercept Form:

$$\Delta y_t = 31.15 + \underset{(0.097)}{0.36}\,\Delta y_{t-1} + \hat{a}_t$$

$AIC = 974.08$, $SBC = 979.15$, $Q_{24} = \underset{(0.84)}{16.23}$

Deviation-from-mean form:

$$\Delta y_t - \underset{(7.27)}{48.88} = \underset{(0.097)}{0.36}(\Delta y_{t-1} - 48.88) + \hat{a}_t$$

Same AIC, SBC, etc.

COMPUTER OUTPUT # 4

```
data MT;
input y;
datalines;
4958.900
4857.800
4850.300
4936.600
.
.
.
9485.600
9518.200
9552.000
9625.500
;

proc arima data = MT;
  identify var = y(1);
  e p = 0 q = 0;
  e p = 1 q = 0;
  e p = 2 q = 0;
  e p = 0 q = 1;
  e p = 0 q = 2;
  e p = 1 q = 1;
  run;
```

The SAS System

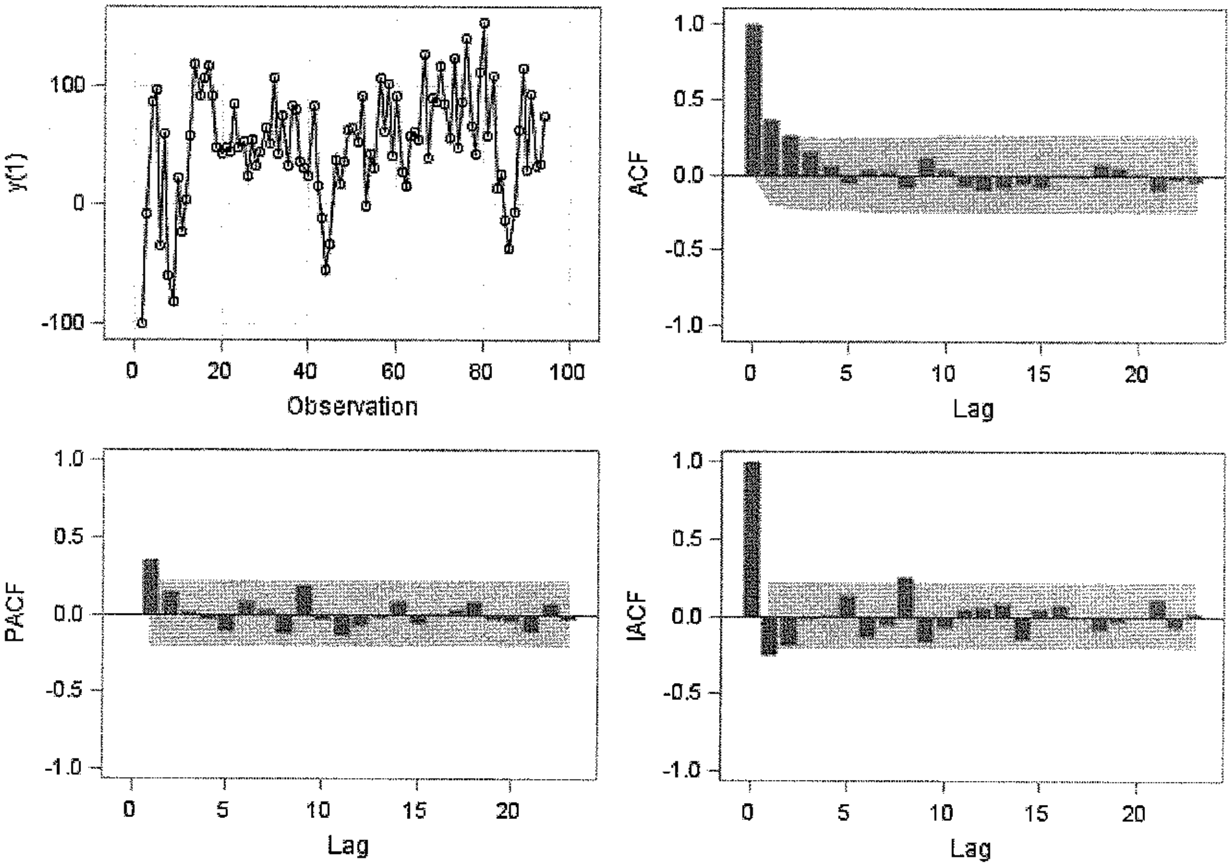
The ARIMA Procedure

Name of Variable = y	
Period(s) of Differencing	1
Mean of Working Series	50.17849
Standard Deviation	47.77749
Number of Observations	93
Observation(s) eliminated by differencing	1

Autocorrelation Check for White Noise

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	22.15	6	0.0011	0.360	0.261	0.153	0.061	-0.053	0.029
12	26.08	12	0.0105	0.027	-0.082	0.112	0.038	-0.069	-0.103
18	28.50	18	0.0548	-0.079	-0.055	-0.078	0.004	-0.019	0.075

Trend and Correlation Analysis for y(1)



Conditional Least Squares Estimation

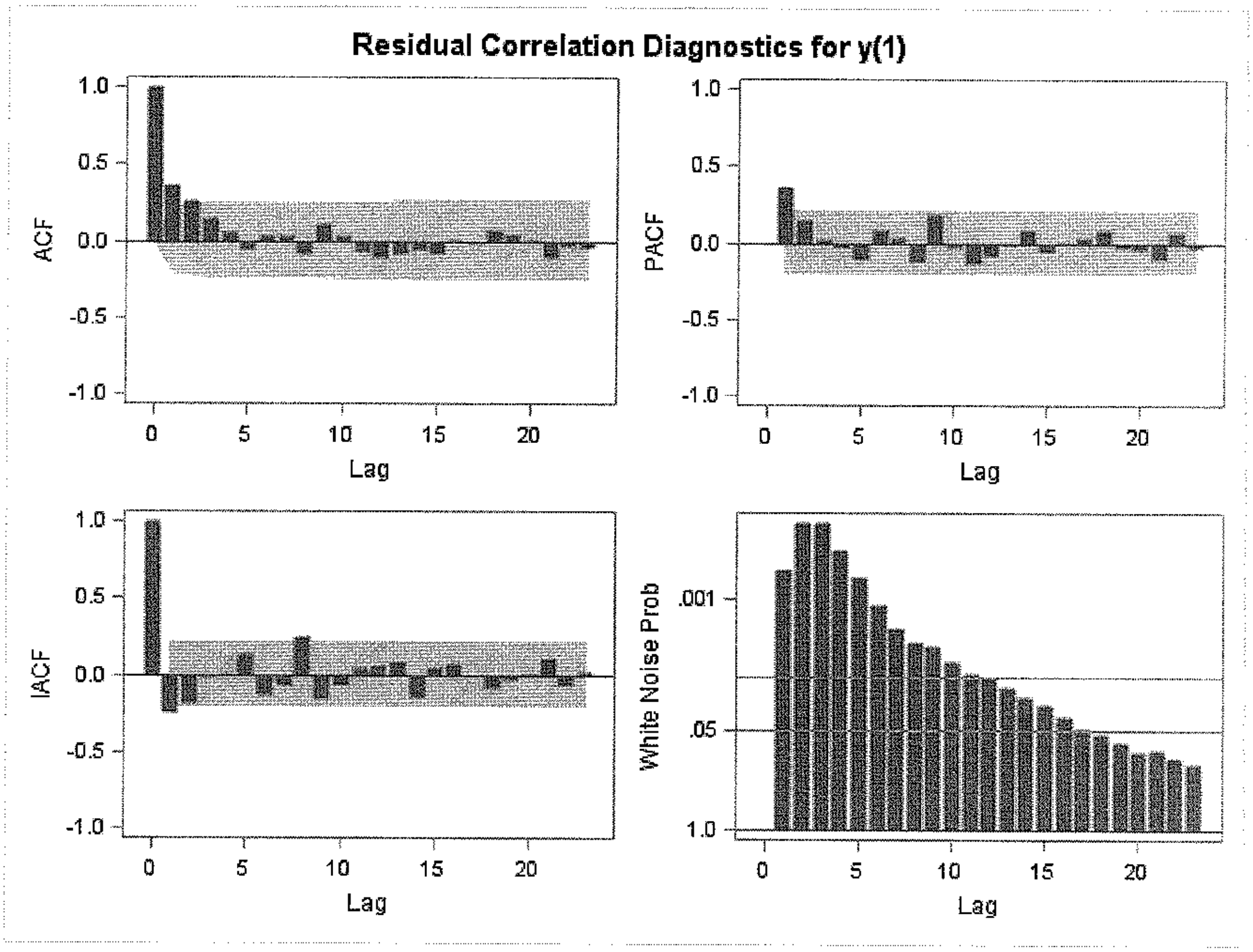
Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	50.17849	4.98115	10.07	<.0001	0

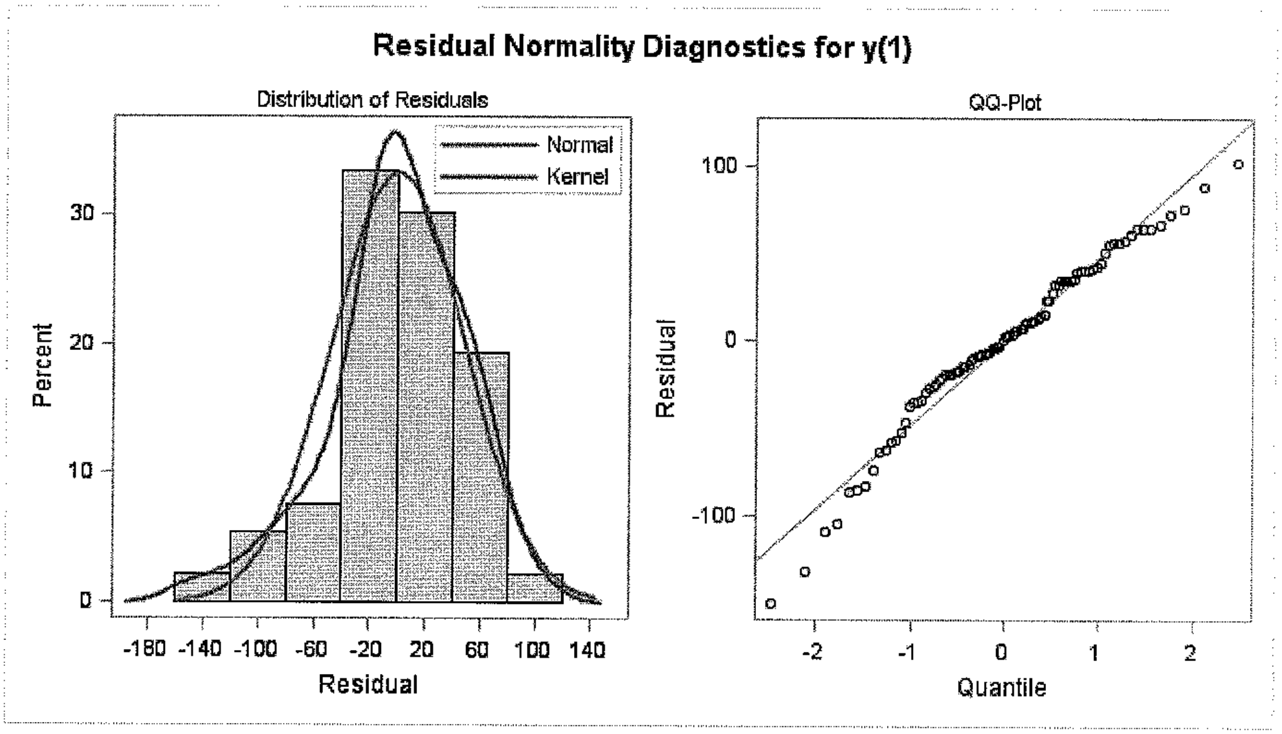
Constant Estimate	50.17849
Variance Estimate	2307.501
Std Error Estimate	48.03645
AIC	985.1017
SBC	987.6343
Number of Residuals	93

*** AIC and SBC do not include log determinant.**

Autocorrelation Check of Residuals

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	22.15	6	0.0011	0.360	0.261	0.153	0.061	-0.053	0.029
12	26.08	12	0.0105	0.027	-0.082	0.112	0.038	-0.069	-0.103
18	28.50	18	0.0548	-0.079	-0.055	-0.078	0.004	-0.019	0.075
24	30.39	24	0.1723	0.045	0.012	-0.102	-0.028	-0.045	0.002





Model for variable y

Estimated Mean	50.17849
Period(s) of Differencing	1

Conditional Least Squares Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	48.88861	7.27282	6.72	<.0001	0
AR1,1	0.36274	0.09787	3.71	0.0004	1

Constant Estimate	31.15467
Variance Estimate	2028.233
Std Error Estimate	45.03591
AIC	974.0883
SBC	979.1535
Number of Residuals	93

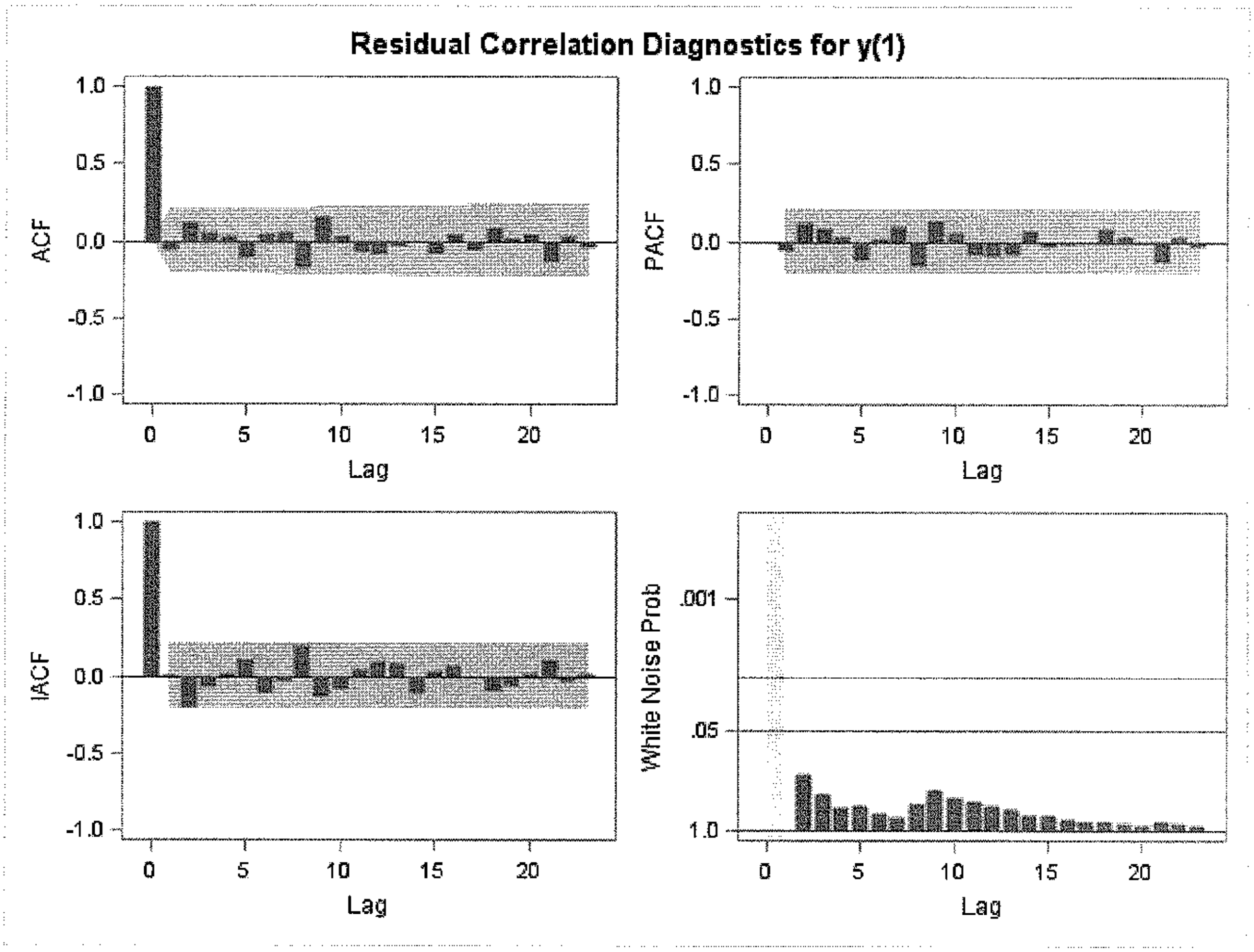
*** AIC and SBC do not include log determinant.**

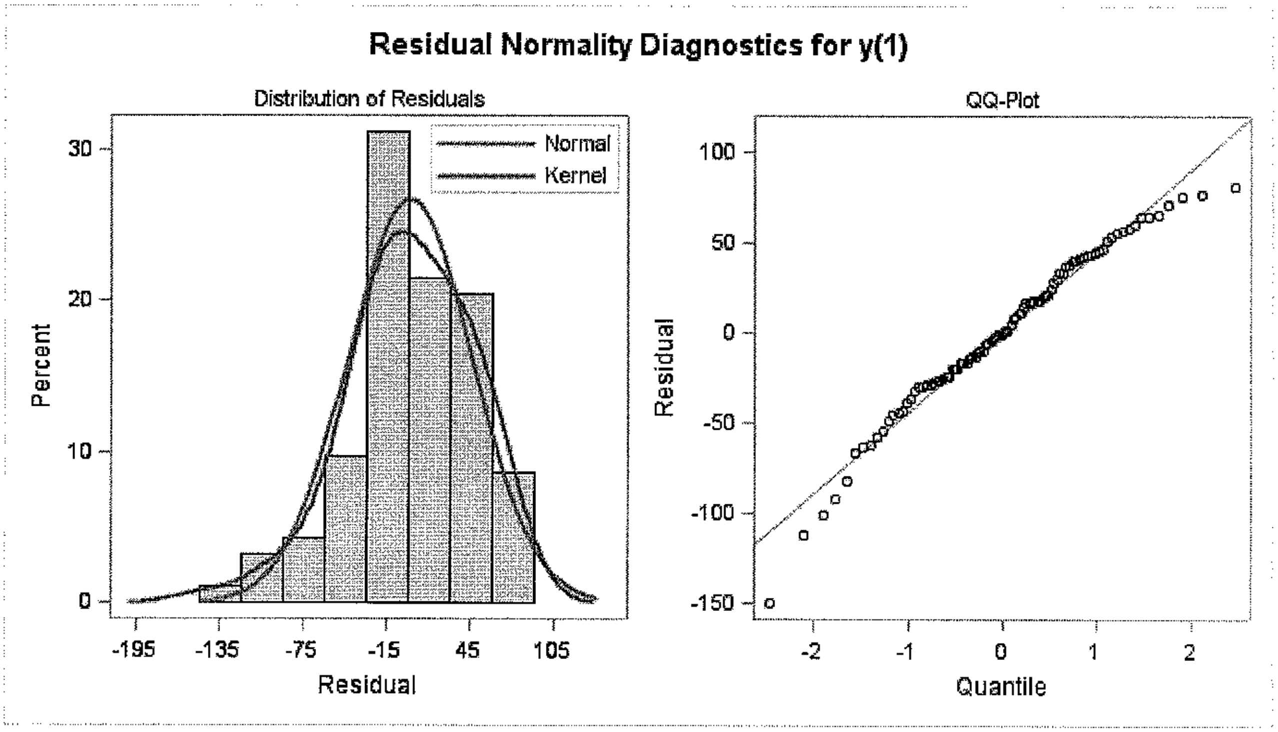
Correlations of Parameter Estimates

Parameter	MU	AR1,1
MU	1.000	-0.021
AR1,1	-0.021	1.000

Autocorrelation Check of Residuals

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	3.83	5	0.5741	-0.055	0.126	0.064	0.040	-0.107	0.052
12	10.88	11	0.4532	0.060	-0.164	0.163	0.032	-0.061	-0.072
18	13.21	17	0.7222	-0.032	-0.006	-0.075	0.050	-0.058	0.088
24	16.23	23	0.8452	0.026	0.041	-0.126	0.028	-0.047	0.056





Model for variable y

Estimated Mean	48.88861
Period(s) of Differencing	1

Autoregressive Factors	
Factor 1:	1 - 0.36274 B**(1)

Conditional Least Squares Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	47.76943	8.49179	5.63	<.0001	0
AR1,1	0.30844	0.10446	2.95	0.0040	1
AR1,2	0.15330	0.10456	1.47	0.1461	2

Constant Estimate	25.71258
Variance Estimate	2003.35
Std Error Estimate	44.7588
AIC	973.9127
SBC	981.5105
Number of Residuals	93

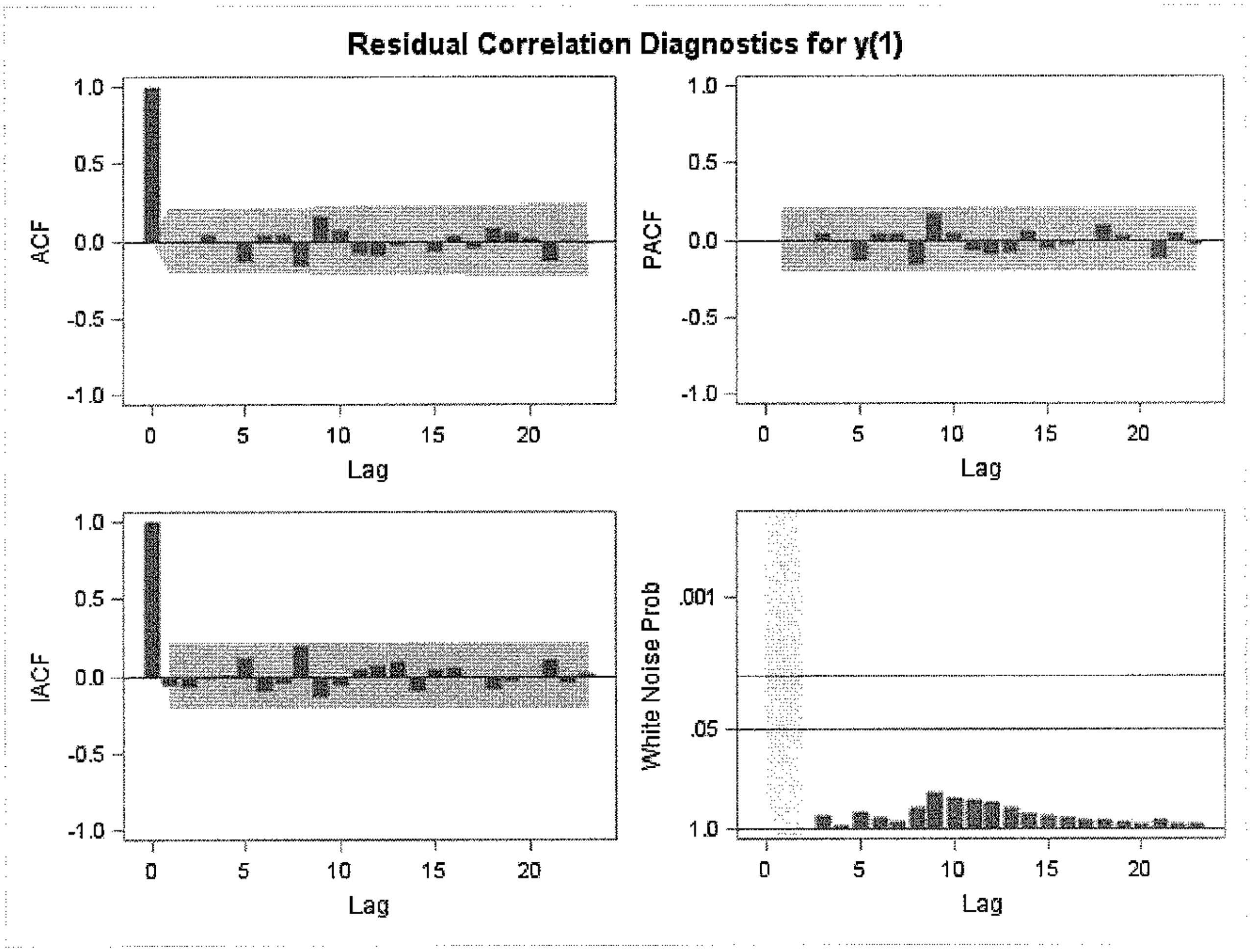
*** AIC and SBC do not include log determinant.**

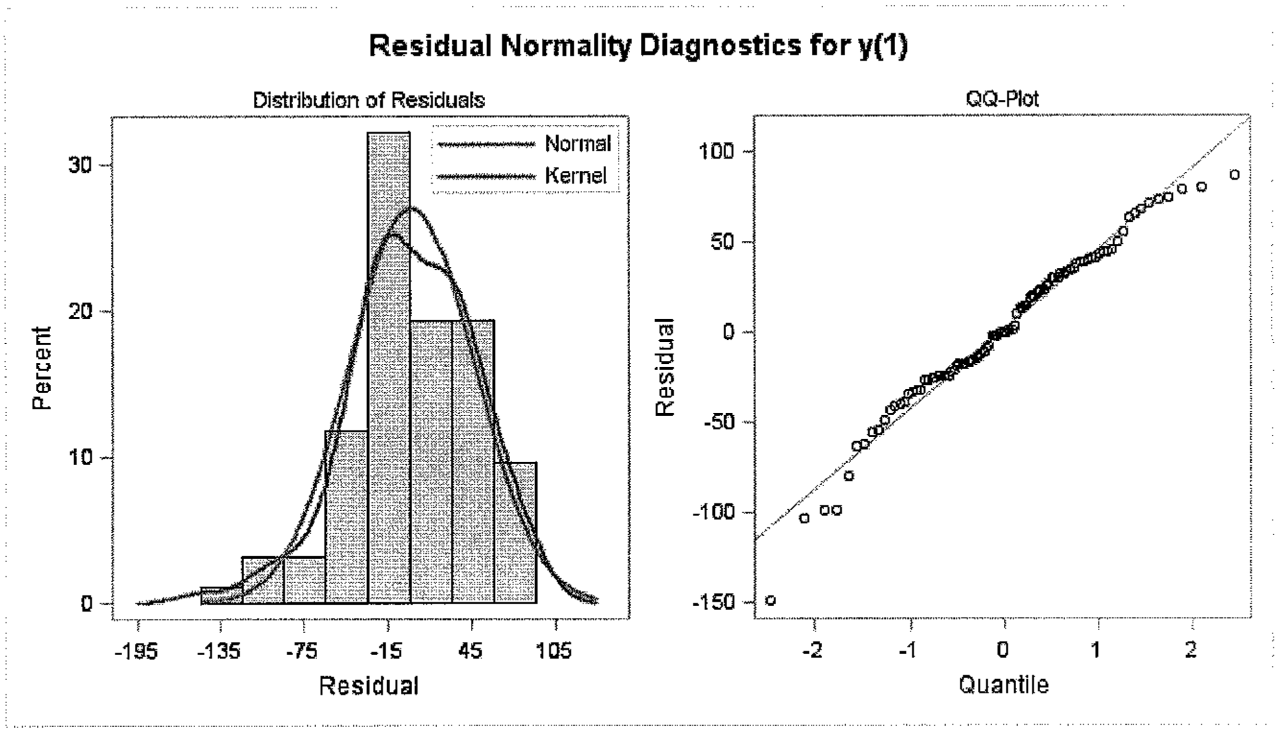
Correlations of Parameter Estimates

Parameter	MU	AR1,1	AR1,2
MU	1.000	-0.018	-0.036
AR1,1	-0.018	1.000	-0.365
AR1,2	-0.036	-0.365	1.000

Autocorrelation Check of Residuals

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	2.14	4	0.7095	-0.003	-0.003	0.048	-0.002	-0.128	0.052
12	9.96	10	0.4438	0.045	-0.160	0.169	0.072	-0.075	-0.085
18	11.81	16	0.7570	-0.025	-0.003	-0.065	0.037	-0.041	0.089
24	15.05	22	0.8602	0.057	0.028	-0.128	0.008	-0.016	0.075





Model for variable y

Estimated Mean	47.76943
Period(s) of Differencing	1

Autoregressive Factors

Factor 1:	1 - 0.30844 B**(1) - 0.1533 B**(2)

Conditional Least Squares Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	49.71299	6.04443	8.22	<.0001	0
MA1,1	-0.27289	0.10104	-2.70	0.0082	1

Constant Estimate	49.71299
Variance Estimate	2108.473
Std Error Estimate	45.91811
AIC	977.6966
SBC	982.7618
Number of Residuals	93

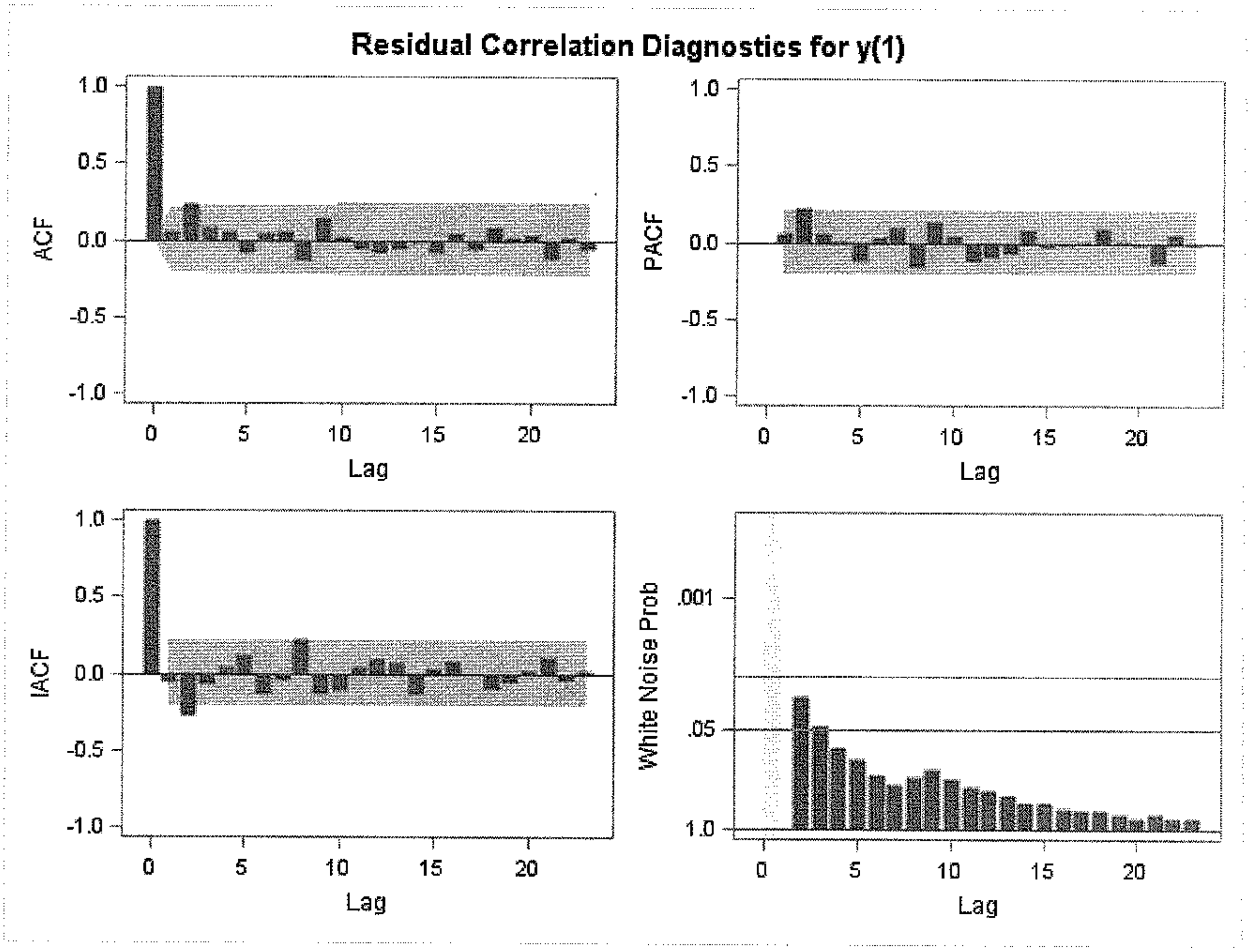
*** AIC and SBC do not include log determinant.**

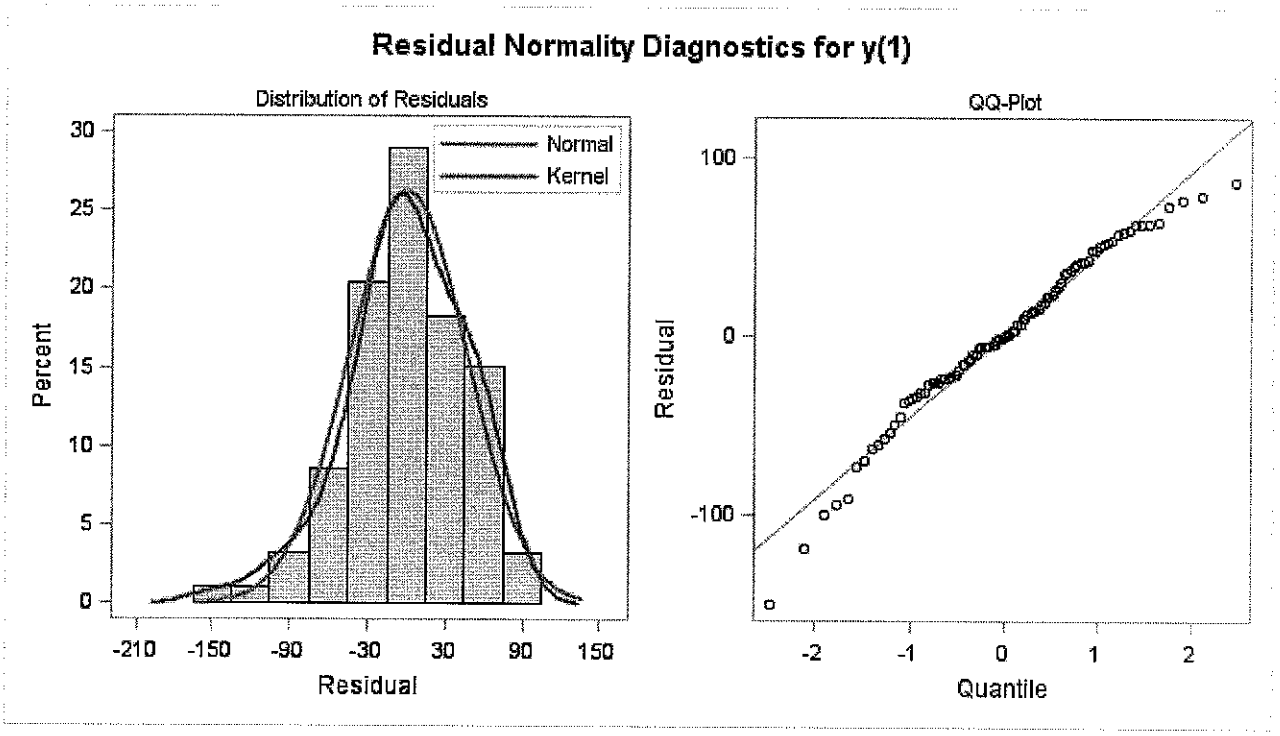
Correlations of Parameter Estimates

Parameter	MU	MA1,1
MU	1.000	0.005
MA1,1	0.005	1.000

Autocorrelation Check of Residuals

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	7.50	5	0.1859	0.059	0.233	0.082	0.064	-0.081	0.040
12	12.91	11	0.2991	0.053	-0.135	0.144	0.016	-0.055	-0.079
18	15.40	17	0.5665	-0.052	-0.021	-0.081	0.041	-0.052	0.087
24	18.01	23	0.7568	0.017	0.040	-0.120	0.019	-0.059	0.034





Model for variable y	

Estimated Mean	49.71299
Period(s) of Differencing	1

Moving Average Factors	
Factor 1:	1 + 0.27289 B**(1)

Conditional Least Squares Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	49.09344	6.83021	7.19	<.0001	0
MA1,1	-0.28720	0.10419	-2.76	0.0071	1
MA1,2	-0.17595	0.10429	-1.69	0.0950	2

Constant Estimate	49.09344
Variance Estimate	2050.408
Std Error Estimate	45.28143
AIC	976.0719
SBC	983.6697
Number of Residuals	93

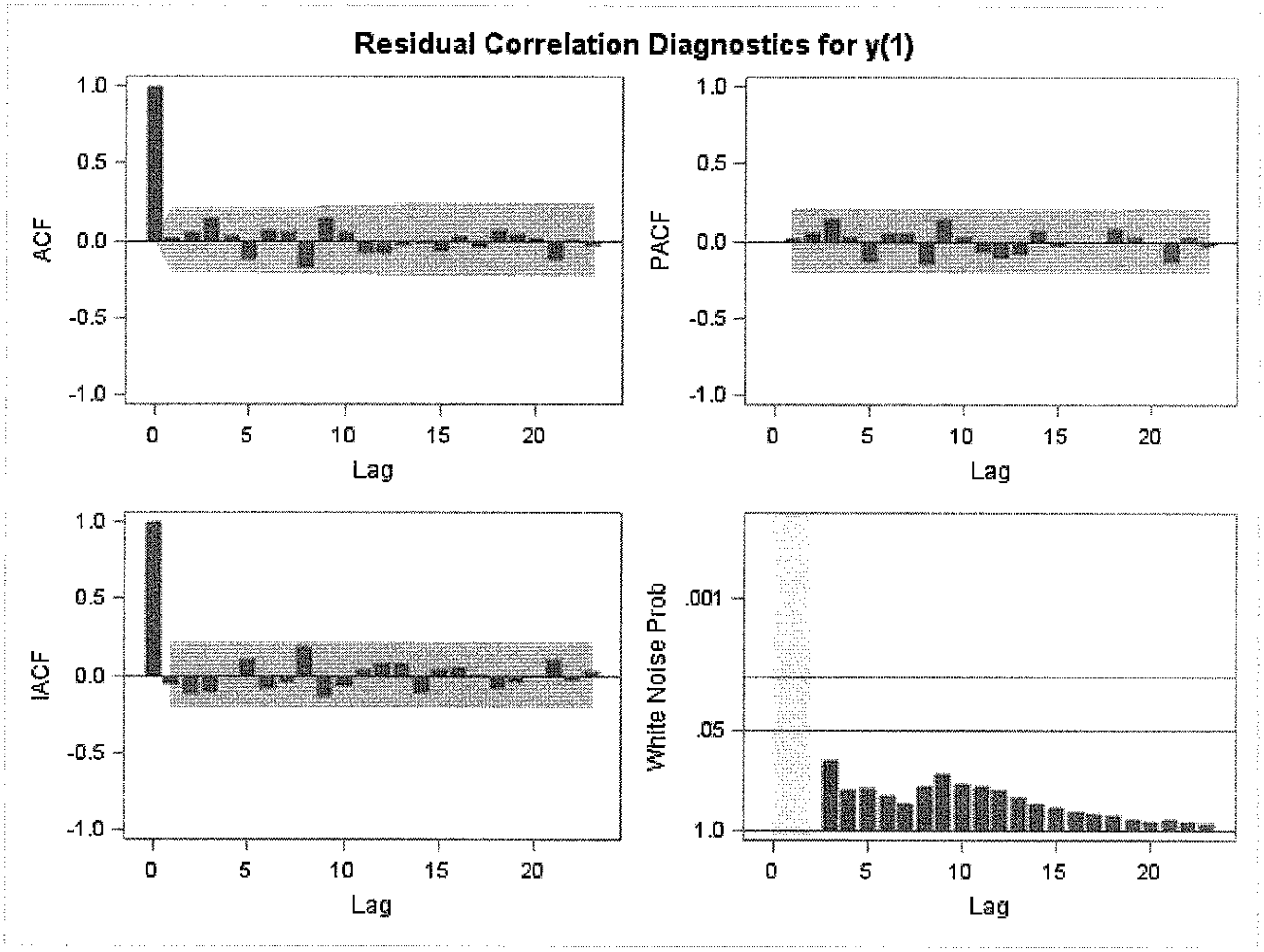
*** AIC and SBC do not include log determinant.**

Correlations of Parameter Estimates

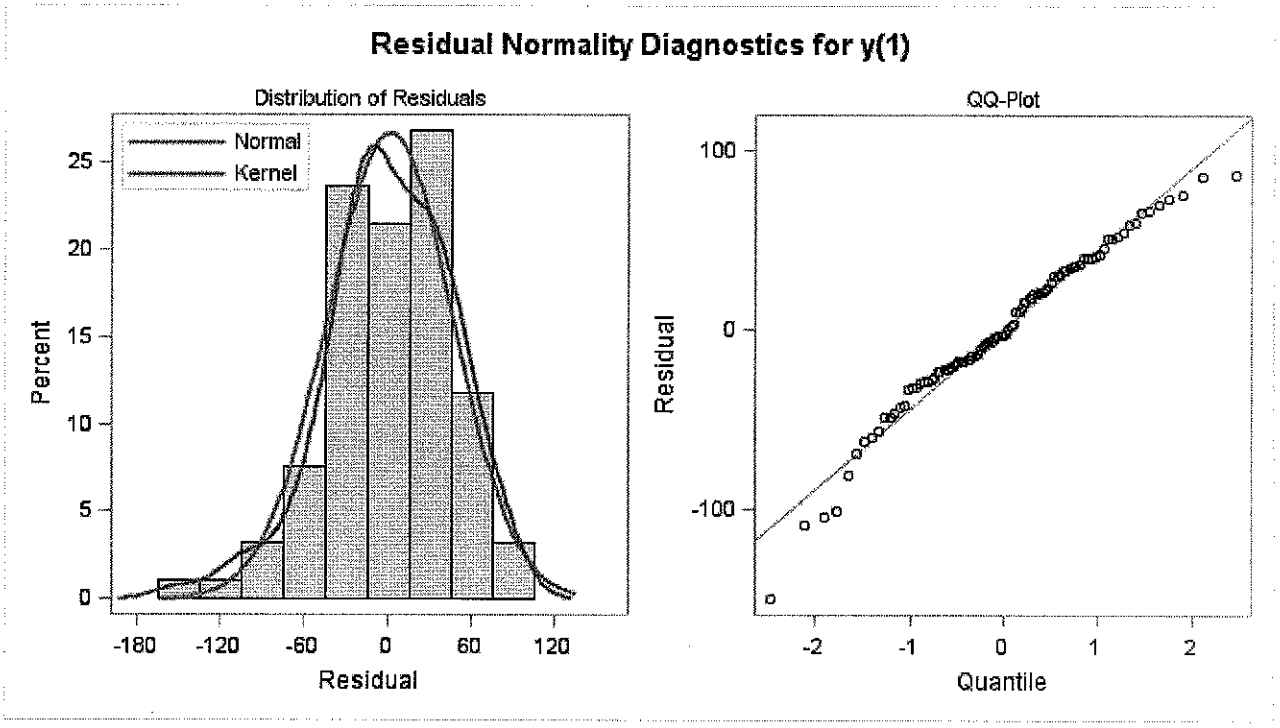
Parameter	MU	MA1,1	MA1,2
MU	1.000	0.007	0.014
MA1,1	0.007	1.000	0.240
MA1,2	0.014	0.240	1.000

Autocorrelation Check of Residuals

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	4.47	4	0.3459	0.027	0.056	0.145	0.036	-0.117	0.073
12	11.90	10	0.2920	0.055	-0.167	0.153	0.057	-0.084	-0.078
18	13.51	16	0.6351	-0.024	-0.017	-0.070	0.038	-0.045	0.069
24	15.89	22	0.8214	0.048	0.025	-0.116	0.008	-0.034	0.043



Residual Correlation Diagnostics for y(1)



Residual Normality Diagnostics for y(1)

Model for variable y

Estimated Mean	49.09344
Period(s) of Differencing	1

Moving Average Factors	
Factor 1:	1 + 0.2872 B**(1) + 0.17595 B**(2)

Conditional Least Squares Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag
MU	47.70871	8.73031	5.46	<.0001	0
MA1,1	0.32538	0.24581	1.32	0.1890	1
AR1,1	0.64697	0.19839	3.26	0.0016	1

Constant Estimate	16.84271
Variance Estimate	2008.722
Std Error Estimate	44.81877
AIC	974.1618
SBC	981.7596
Number of Residuals	93

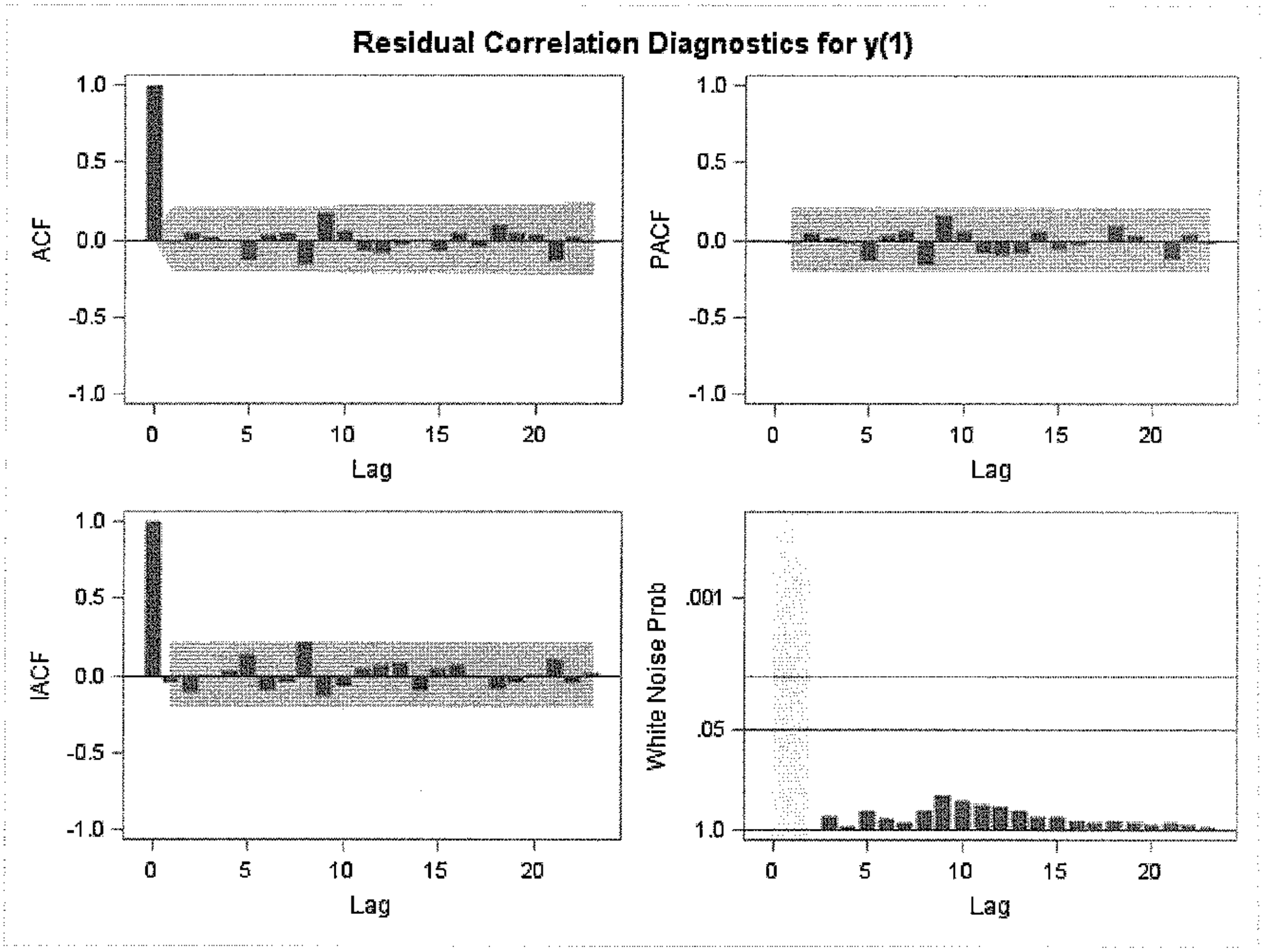
*** AIC and SBC do not include log determinant.**

Correlations of Parameter Estimates

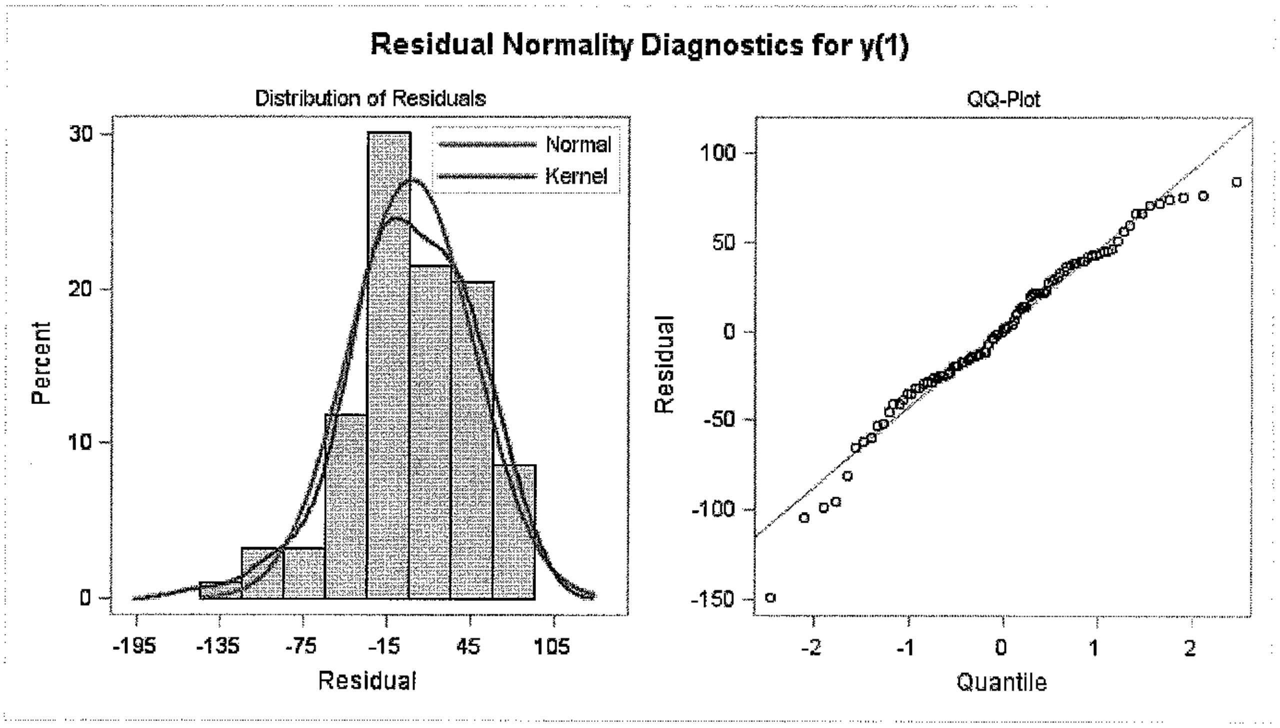
Parameter	MU	MA1,1	AR1,1
MU	1.000	-0.043	-0.059
MA1,1	-0.043	1.000	0.914
AR1,1	-0.059	0.914	1.000

Autocorrelation Check of Residuals

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	2.17	4	0.7036	-0.014	0.043	0.019	-0.010	-0.134	0.037
12	9.49	10	0.4866	0.044	-0.155	0.171	0.060	-0.065	-0.082
18	11.68	16	0.7657	-0.033	-0.005	-0.068	0.043	-0.042	0.098
24	14.96	22	0.8641	0.049	0.035	-0.127	0.016	-0.022	0.077



Residual Correlation Diagnostics for y(1)



Residual Normality Diagnostics for y(1)

Distribution of Residuals

QQ-Plot

Model for variable y

Estimated Mean	47.70871
Period(s) of Differencing	1

Autoregressive Factors	
Factor 1:	1 - 0.64697 B**(1)

Moving Average Factors	
Factor 1:	1 - 0.32538 B**(1)