DSCI 5340-001– Predictive Analytics and Business Forecasting

Spring 2020

FIRM NAME - WOMEN AVENGERS GROUP

PROJECT NAME – US RAILTRAFFIC PREDICTION

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PEOPLE – Ugochi Madumere, Charitha Velamala, Madhu Latha Pasumarthy, Rojakrishna Moparthi, Sreya Mamillapalli, Vidhya Ramamurthy

Introduction

Predictions of future events and conditions are called forecasts and the act of making such events are called Forecasting, Bowerman et al (2005). Forecasting is critical to any organization as it helps determines the future events proactively and avoid risks of downfall or anticipate the demand for a supply. Business forecasting is the process of making predictions of future data with the help of past data. The prediction can be done with the help of different models. Among the various models utilized, we would produce the model which best fits the data to achieve a desired solution. In this project, we have multiple data sets with diversified data available. In this project, we, women avengers group have worked on data exploration and analysis of US rail traffic data to help predict future load for American Railroad Association which will assist them to be prepared for the next 7 months. This project although focuses on US Railroad data, we have also analysed observations of various files and data. Due to time constraint, we are focusing only on US Railroad for this assignment.

DATA EXPLORATION

Women avengers group analysed all the files and the observations are as below.

The Variables present across US and Canada are the same and listed hereunder.

- Farm Products Excluding Grain
- Metallic Ores
- Coal
- Crushed Stone, Sand & Gravel
- Nonmetallic Minerals
- Grain Mill Products
- Food Products
- Primary Forest Products
- Lumber & Wood
- Pulp & Paper
- Chemicals
- Petroleum Products
- Stone, Clay & Glass Products
- Coke
- Primary Metal Products
- Motor Vehicles & Parts
- Iron and Steel Scrap1
- Waste & Nonferrous Scrap
- All Other Carloads
- Total Carloads
- Trailers
- Containers
- Total Intermodal

Variables for the railroad data yearly and weekly was analyzed. From the observation, we have drawn the below conclusions for US, Canada, Mexico and North America Railroad Traffic as follows:

US Railroad traffic observations

- Current year data available from Jan 1988 until May 2020 apart from Iron and steel scrap which starts the rail traffic from Jan 2008 until May 2020.
- Previous year observations start from Jan 89 to May 20 with an exception of Iron and steel scrap initiating from Jan 2009 until May 20.
- Similarly, the weekly data is represented in a file for the same data observations however the US traffic rail observations for weekly contains only 12 variables listed below.
  - Total carloads
  - Chemicals
  - Coal
  - Farm and Food Products, Excluding Grain
  - Forest Products
  - Grain
  - Metallic Ores and Metals
  - Motor Vehicles and parts
  - Nonmetallic Minerals and Products
  - Petroleum and Petroleum Products
  - Other
  - Intermodal

Canada Railroad traffic observations, Mexico Railroad traffic observations and North America Railroad observations:

- Current year data available from Jan 1996 until Jan 2016 apart from Iron and steel scrap which starts the rail traffic from Jan 2008 until Jan 2016.
- Previous year observations start from Jan ‘97 to Jan 2016 with an exception of Iron and steel scrap initiating from Jan 2009 until Jan 2016.
- Similarly the weekly data is represented in a file for the same data observations however the US traffic rail observations for weekly contains only 12 variables as specified above in US railroad.

Freight Summary observations:

In Freight summary observation noticed were as follows.

Freight volumes of different ports on a monthly and quarterly basis available from year Jan 2000 until 2020. However the data is available only for variables carloads and intermodal. Data represented for observations are provided in Appendix A and C.

DATA EXPLORATION SUMMARY

Post exploration of data, we determined the correlation with freight summary is deemed limited. Weekly rail data has less variables in comparison to the railtraffic data monthly which has 24 variables. Railtraffic data monthly had two countries listed which were USA and Canada. Canada had ceased values post Jan 2016. Hence upon observation for this project due to time constraint we concluded to analyse the US railtraffic data of monthly to predict the June until Dec 2020 US railtraffic carload across 24 variables. We also identified that there were missing values and outliers hence we addressed the same by transforming the data.

DATA ANALYSIS

SUMMARY

We proceeded with the data analysis post the research of observations. As discussed above, the use of US railroad data was analysed to forecast the carload from June until Dec 2020. These are predictions based on the past data available. Although the volumes are predicted it may have an impact due to COVID'19 scenario.

MODEL DETECTION AND EVALUATION

Box-Jenkins model requires 4 steps procedure.

1. Tentative identification of the model – Based on the past values, the better Box-Jenkins model is identified.
2. Estimation – Based on the model and the past data, an estimation is derived
3. Diagnostic checking – Validation of adequacy of the model
4. Forecasting – Once model is finalized then future time series is executed to uncover the forecasts.

Below is a summary of the steps conducted for this project:

1. We plotted the variables against time to identify the pattern of the time series with 'proc gplot'
2. All plots have seasonality
3. Removed outliers and applied pre-differencing transformation where there was extreme variability respectively
4. Applied Dickey fuller test to check for stationarity. First regular differencing y(1), first seasonal differencing y(12), first regular and seasonal differencing y(1,12) were done using 'proc arima'
5. Checked the lags on ACF and PACF in the trend correlation analysis and for each variable, first regular differencing y(1), first seasonal differencing y(12) showed timeseries is not stationary across board
6. First regular and seasonal differencing y(1,12) was appropriate as SAC dies down quickly or cut offs after lag (q) and SPAC also does the same at the seasonal and nonseasonal level hence the time series is stationary.

7. Checked to ensure Pvalue related to Chisq for all lags are less that alpha = 0.001 to authenticate the significance of the parameters
8. Used spikes at ACF and PACF (seasonal and non-seasonal level) and 'scan' to estimate the right model for each variable using the rules below:
   Rules to Interpret Non-seasonal ACF and PACF plots:

   Non - Seasonal:

	AR(p)	MA(q)	ARMA(p,q)
ACF	Dies Down	Cuts off after lag q	Dies Down
PACF	Cuts off after lag p	Dies Down	Dies Down

   Seasonal:

	AR(P)	MA(Q)	ARMA(P,Q)
ACF	Dies Down	Cuts off after lag q	Dies Down
PACF	Cuts off after lag p	Dies Down	Dies Down

9. Iterated and applied the best model (using proc arima) with the following characteristics using Ljung Box test:
   - Residuals are white noise
   - Pr<Chisq is greater than alpha(0.05) for each lag
   - **Lowest standard error**
   - Lowest AIC and BIC
10. Moving Average (q,Q) worked generally although ARMA(p,P),(q,Q) worked in some cases
11. QQ plot showed normal distribution across all residuals
12. Used 'proc forecast' to predict the next 7 lags of the values (June 2020 – Dec 2020). Note that transformed variables were re-transformed back to y.

First data set analyzed was "Total Carloads" under the railtraffic US with the Box-Jenkins model to identify the tentative model to forecast the future 7 months. The Total carloads has current year, previous year data and the percentage change. The data is available from Jan 1988 to May 2020. Hence, we interpreted the prediction to be done for the following seven months commencing from June 2020 to Dec 2020.

To predict the future values based on past data, we have transported the data of total carloads and written a SAS program. We noticed the "Total carload" input variable had 396 observations. We had plotted the timeseries through gplot and identified that the data is random time series. In addition, the variance and mean are not constant and the original time series was dying down slowly. Hence, we concluded that data is not stationary. To make the time series stationary we applied the first differencing to the data and found that it is also not stationary but seasonal since we noticed the spikes at 1, 12, and 24. After this we applied the ARIMA model and executed the 1st, 2nd and 3rd differencing for the seasonal and non-stationary time series. To discover the suitable model, we applied scan and noticed that two models were appropriate. The models were

1. ARMA model with values as p+d=(1) and q=(5).
2. ARMA model with values as p+d=(5) and q=(3).
3. Moving average model with values as q=(1) (12)

In the first model, p value at 0.129 was greater than alpha wherein Alpha set at 0.05 and hence the model seemed to be adequate at ARMA model p+d=(1) and q(5) however did not yield the best standard error, AIC and BIC.

In the second model, p value at 0.001 wherein Alpha set at 0.05 and hence the model seemed to be not adequate at ARMA model p+d=(5) and q=(3).

In the first model, p value at 0.2023 which was greater than alpha wherein Alpha set at 0.05 and hence the model seemed to be adequate at MA model q=(1)(12) and yielded the low standard error, AIC and BIC compared to model 1 and 2.

MODEL CONCLUSION

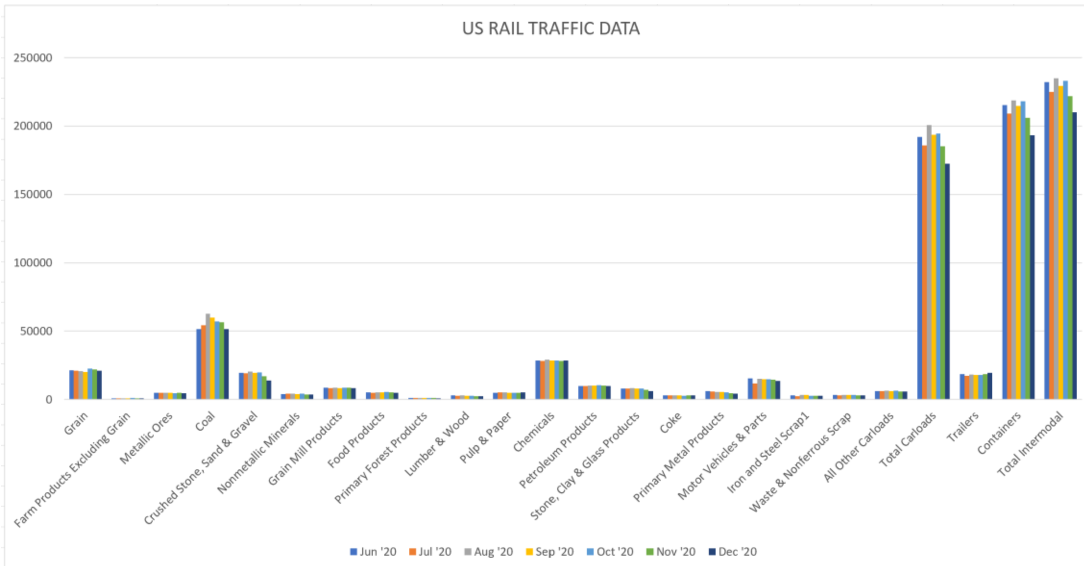
Since the time series found to be seasonal and non-stationary and when both the model were compared, the first model (p+d=(1) and q=(5)) seemed to be appropriate as the standard error, Akaike information criterion (AIC) and Bayesian information criterion (BIC) was less for the first model in comparison to the second model. Hence by identifying and applying the proper model the next 7 months data was forecasted.

FURTHER ANALYSIS ACROSS 24 VARIABLES

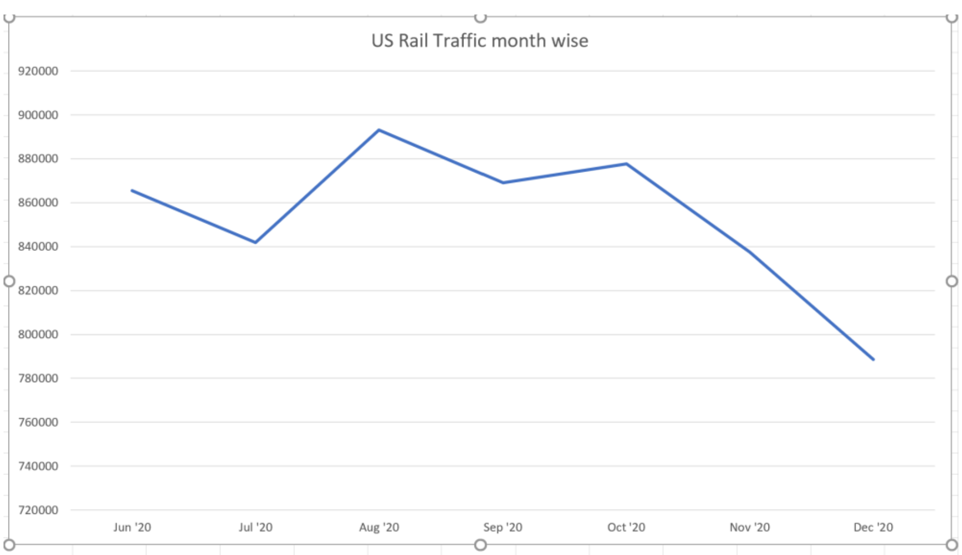
Importantly, once accomplished the total carload data, this series of process was then further applied across 24 variables.

CONCLUSION

Thus, in all the 24 variables we identified the differencing and whichever model seemed to have less white noise, less standard error and AIC and BIC was identified and applied. We recognized from the results that Intermodal variable has more volume than all the variables for US railtraffic data. In addition the overall volumes in

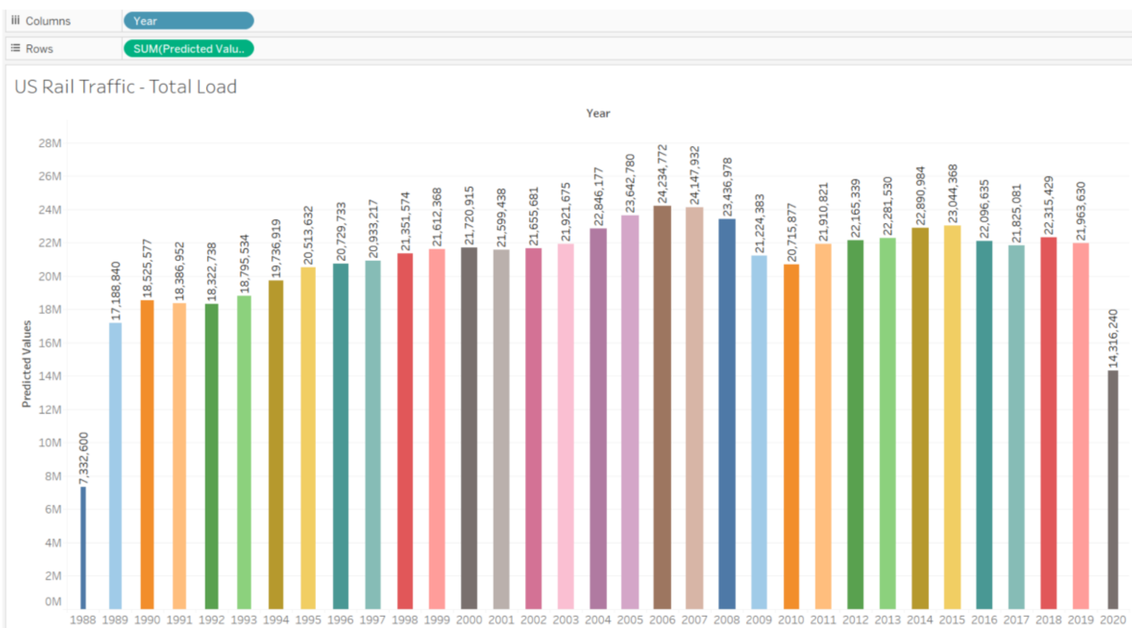


In addition the overall volumes have spike in August with a decrease in trend for December. Although the abnormalities could not be predicted with example of continuing COVID'19 scenario, we have taken into consideration January until May 2020 rail traffic load. The American railroads authority can take precaution to eliminate such adversities.



In addition to the above, we performed an analysis to represent the data in Tableau with the overall volume of Railtraffic car load from the year 1988 January until May 2020 and in addition

with the data predicted of June 2020 until December 2020 across all 24 variables. Hereunder the prediction provided wherein we could see that year 1988 had less railroad traffic data and post which it is happening in the year 2020. We infer that due to external aspect like Corona virus from January of 2020 and the US transportation shut down could be the factor of less volume. For the month of June until Dec 2020, Railtraffic of US can be better determined with our prediction by American railroads association although external factors not inclusive of the data.



Thus Box-Jenkins model identifies the tentatively better model to predict future and forecast the upcoming events based on the past data.

SAS CODE AND RESULT OF TOTAL CAR LOAD VARIABLE

SAS CODE - Total Carload

```
data raildata;
input y;
time=_n_;
Lny=log(y);
Sqrty=y**.5;
QtRooty=y**.25;
datalines;
295906.5
298504
303894.4
312908.5
312043.75
303028.2
291270.5
313627.6
313486.5
321212
309133.4
291284.5
299758.75
293216.5
306034.6
318582
308893.2
299452.5
269887.75
```

309463

304484

316036.5

305956.4

269901

294673.4

304579.25

309923.5

310197.5

310725.8

315141

292591.25

307852.4

307123.25

312509.6

294641.25

271069.5

272090.6

291283.5

286572.5

285031.5

285876.2

298425.25

280286

308388.25

303855.5

309932.8

289959.75

280689

279156.4

293030.5

294533.5

294957.8

295606

289108.25

286616.8

304905.5

299810.6

309441.5

296078

277026.4

293916.25

287493.75

290894.4

302889.75

304745.25

296229.4

276320.5

288350.75

299765.6

311674.25

297738.75

285506.6

284296.5

299040.75

310351.8

314487.5

319152.75

308931.2

295594.75

325822.4

320352.5

326858.25

318984

306869.5

309330.75

320802

322219.4

322432.75

316840.6

319978

303963

326417.2

331981

329275.25

320368

300519.25

286489.2

311596.25

318555.75

322623.75

320595.2

323460.25

306776.6

330040

319411.5

331768.6

315705.5

301422.75

297578.4

321924

321411

318270.4

319006.75

323417

307491.4

328145

321566.75

326816

312832

303953.8

325568.25

320610

320812.5

325919.2

326627.25

328644.75

309798.4

332848

335869.2

338717

322603.25

301547

314867.25

329430.5

319531.6

326363

331744

313953.4

308484.75

330585.25

331021.6

335402.25

323252.75

310307

319480.5

321686.25

328546.4

323069

323848.2

326453

308934

333055.2

332347.5

335755.5

317964.6

291105

310916

318220.25

329607.25

324208.5

323489.6

324032.5

298846.25

325803

322700.5

336856.2

319099.25

301763

304152.4

312993.75

309928.25

316713.25

317716.8

327976.5

308398.6

331830.75

325547.5

329718

316733

303429.75

301105.2

308181.5

316209

318706.8

315972.25

323211.75

305599.6

328340.25

327780

336557.8

320755

302968

318569

318222

330106.6

331658.75

334523.5

328385

315802

333471.5

329761

341369.75

327668

310525.8

315969

335191

337317.6

340551

333188.75

328383.8

315590.25

335317

335569

331475.25

326305.8

308221.25

329550.25

328545

337465.2

336948.75

341697.8

343914

321180.75

339159.4

336588.25

337389

323432.8

315580.25

309389

314536

326118

330006.5

326242.6

334730.75

311661

335746.8

333736

336010

329505.75

307590

311298.4

323070.25

326014.25

332166.6

327114

322843.25

319945.4

333687.25

318490

326756.2

296544

258954.4

266125.75

276499

270477

255992.8

249005

259711.25

263771.2

279046.5

276167.4

275358.5

272120

248185.6

264372.5

272335.5

288900.6

294775

288342

283069.6

280679.75

295455

297376.8

298881.25

285083.25

271970.4

285924.25

284139

298895.8

294360

289799.5

285800.6

277880

296546

298980

304211.25

295338.4

283765.25

286336.25

282172.6

280849

278340.5

278406.6

285134.5

275965.75

292349

288047.25

284510

282605.5

272220.25

268000.2

278229.75

279517.25

277212.25

280350

284086.25

277003.8

294612.25

289898.5

288807.2

286356

269706.5

269235

275234.25

289205.5

296351.2

296456

294520.5

294341.2

303015.25

297609.25

301591.6

290466

288984

290197.25

272302.75

279257.25

280608.8

268344

271766.5

275282.2

288989.25

283550

281117.5

260401.25

243888.6

242010.5

244760.5

239233.4

236092.25

240642.75

249005

254809.75

269597.8

267161

266748.5

263801.6

243410.5

249143.25

261010

256697.8

255825

257215

266494

254809.75

268681

261140.75

266444.25

261504.2

249542

243481

257035.25

262663.25

262756.5

263884

270192.25

262073.25

```
277205.2
266706.5
267607.4
258016.75
255494.5
247697.4
249994.5
239286
260386
258334.2
255848.5
252820
263846.5
248135.5
244895.4
238894.75
232025.5
233146.6
231771
224918.25
196107
185042.75
run;
proc print data = raildata;
run;
proc gplot data=raildata;
plot y*time;
plot z*time;
symbol1 i =j v = dot c = blue;
```

```
symbol2 i=j v=dot c=red;
proc arima data=raildata;
identify var= y scan;
identify var= y(1);
identify var= y(12);
identify var= y(1,12);
run;
proc arima data=raildata;
identify var=y(1,12) scan;
estimate q=(1)(12) printall plot;
forecast lead =12 out=fcast1;
run;
```

Obs	y	time	Lny	Sqrty	QtRooty
1	295906.50	1	12.5978	543.973	23.3232
2	298504.00	2	12.6065	546.355	23.3742
3	303894.40	3	12.6244	551.266	23.4791
4	312908.50	4	12.6537	559.382	23.6513
5	312043.75	5	12.6509	558.609	23.6349
6	303028.20	6	12.6216	550.480	23.4623
7	291270.50	7	12.5820	539.695	23.2313
8	313627.60	8	12.6560	560.025	23.6648
9	313486.50	9	12.6555	559.899	23.6622
10	321212.00	10	12.6799	566.756	23.8066
11	309133.40	11	12.6415	555.998	23.5796
12	291284.50	12	12.5821	539.708	23.2316
13	299758.75	13	12.6107	547.502	23.3988
14	293216.50	14	12.5887	541.495	23.2700
15	306034.60	15	12.6315	553.204	23.5203
16	318582.00	16	12.6716	564.431	23.7578
17	308893.20	17	12.6408	555.782	23.5750
18	299452.50	18	12.6097	547.223	23.3928

Obs	y	time	Lny	Sqrty	QtRooty
19	269887.75	19	12.5058	519.507	22.7927
20	309463.00	20	12.6426	556.294	23.5859
21	304484.00	21	12.6264	551.801	23.4904
22	316036.50	22	12.6636	562.171	23.7102
23	305956.40	23	12.6312	553.133	23.5188
24	269901.00	24	12.5058	519.520	22.7930
25	294673.40	25	12.5936	542.838	23.2989
26	304579.25	26	12.6267	551.887	23.4923
27	309923.50	27	12.6441	556.708	23.5947
28	310197.50	28	12.6450	556.954	23.5999
29	310725.80	29	12.6467	557.428	23.6099
30	315141.00	30	12.6608	561.374	23.6933
31	292591.25	31	12.5865	540.917	23.2576
32	307852.40	32	12.6374	554.844	23.5551
33	307123.25	33	12.6350	554.187	23.5412
34	312509.60	34	12.6524	559.026	23.6437
35	294641.25	35	12.5935	542.809	23.2983
36	271069.50	36	12.5101	520.643	22.8176

Obs	y	time	Lny	Sqrty	QtRooty
37	272090.60	37	12.5139	521.623	22.8391
38	291283.50	38	12.5821	539.707	23.2316
39	286572.50	39	12.5657	535.325	23.1371
40	285031.50	40	12.5604	533.883	23.1059
41	285876.20	41	12.5633	534.674	23.1230
42	298425.25	42	12.6063	546.283	23.3727
43	280286.00	43	12.5436	529.420	23.0091
44	308388.25	44	12.6391	555.327	23.5654
45	303855.50	45	12.6243	551.231	23.4783
46	309932.80	46	12.6441	556.716	23.5948
47	289959.75	47	12.5775	538.479	23.2052
48	280689.00	48	12.5450	529.801	23.0174
49	279156.40	49	12.5395	528.353	22.9859
50	293030.50	50	12.5880	541.323	23.2663
51	294533.50	51	12.5931	542.709	23.2961
52	294957.80	52	12.5946	543.100	23.3045
53	295606.00	53	12.5968	543.697	23.3173
54	289108.25	54	12.5746	537.688	23.1881

Obs	y	time	Lny	Sqrty	QtRooty
55	286616.80	55	12.5659	535.366	23.1380
56	304905.50	56	12.6278	552.182	23.4986
57	299810.60	57	12.6109	547.550	23.3998
58	309441.50	58	12.6425	556.275	23.5855
59	296078.00	59	12.5984	544.130	23.3266
60	277026.40	60	12.5319	526.333	22.9419
61	293916.25	61	12.5911	542.140	23.2839
62	287493.75	62	12.5690	536.184	23.1557
63	290894.40	63	12.5807	539.346	23.2238
64	302889.75	64	12.6211	550.354	23.4596
65	304745.25	65	12.6272	552.037	23.4955
66	296229.40	66	12.5989	544.270	23.3296
67	276320.50	67	12.5293	525.662	22.9273
68	288350.75	68	12.5719	536.983	23.1729
69	299765.60	69	12.6108	547.509	23.3989
70	311674.25	70	12.6497	558.278	23.6279
71	297738.75	71	12.6040	545.654	23.3592
72	285506.60	72	12.5620	534.328	23.1155

Obs	y	time	Lny	Sqrty	QtRooty
73	284296.50	73	12.5578	533.195	23.0910
74	299040.75	74	12.6083	546.846	23.3847
75	310351.80	75	12.6455	557.092	23.6028
76	314487.50	76	12.6587	560.792	23.6810
77	319152.75	77	12.6734	564.936	23.7684
78	308931.20	78	12.6409	555.816	23.5757
79	295594.75	79	12.5967	543.686	23.3171
80	325822.40	80	12.6941	570.809	23.8916
81	320352.50	81	12.6772	565.997	23.7907
82	326858.25	82	12.6973	571.715	23.9106
83	318984.00	83	12.6729	564.787	23.7652
84	306869.50	84	12.6342	553.958	23.5363
85	309330.75	85	12.6422	556.175	23.5834
86	320802.00	86	12.6786	566.394	23.7990
87	322219.40	87	12.6830	567.644	23.8253
88	322432.75	88	12.6836	567.832	23.8292
89	316840.60	89	12.6662	562.886	23.7252
90	319978.00	90	12.6760	565.666	23.7837

Obs	y	time	Lny	Sqrty	QtRooty
91	303963.00	91	12.6247	551.328	23.4804
92	326417.20	92	12.6959	571.329	23.9025
93	331981.00	93	12.7128	576.178	24.0037
94	329275.25	94	12.7046	573.825	23.9546
95	320368.00	95	12.6772	566.011	23.7910
96	300519.25	96	12.6133	548.196	23.4136
97	286489.20	97	12.5655	535.247	23.1354
98	311596.25	98	12.6495	558.208	23.6264
99	318555.75	99	12.6716	564.407	23.7573
100	322623.75	100	12.6842	568.000	23.8327
101	320595.20	101	12.6779	566.211	23.7952
102	323460.25	102	12.6868	568.736	23.8482
103	306776.60	103	12.6339	553.874	23.5345
104	330040.00	104	12.7070	574.491	23.9685
105	319411.50	105	12.6742	565.165	23.7732
106	331768.60	106	12.7122	575.994	23.9999
107	315705.50	107	12.6626	561.877	23.7039
108	301422.75	108	12.6163	549.020	23.4312

Obs	y	time	Lny	Sqrty	QtRooty
109	297578.40	109	12.6034	545.507	23.3561
110	321924.00	110	12.6821	567.383	23.8198
111	321411.00	111	12.6805	566.931	23.8103
112	318270.40	112	12.6707	564.155	23.7519
113	319006.75	113	12.6730	564.807	23.7657
114	323417.00	114	12.6867	568.698	23.8474
115	307491.40	115	12.6362	554.519	23.5482
116	328145.00	116	12.7012	572.839	23.9341
117	321566.75	117	12.6810	567.069	23.8132
118	326816.00	118	12.6972	571.678	23.9098
119	312832.00	119	12.6534	559.314	23.6498
120	303953.80	120	12.6246	551.320	23.4802
121	325568.25	121	12.6933	570.586	23.8869
122	320610.00	122	12.6780	566.224	23.7955
123	320812.50	123	12.6786	566.403	23.7992
124	325919.20	124	12.6944	570.893	23.8934
125	326627.25	125	12.6966	571.513	23.9063
126	328644.75	126	12.7027	573.275	23.9432

Obs	y	time	Lny	Sqrty	QtRooty
127	309798.40	127	12.6437	556.595	23.5923
128	332848.00	128	12.7154	576.930	24.0194
129	335869.20	129	12.7245	579.542	24.0737
130	338717.00	130	12.7329	581.994	24.1246
131	322603.25	131	12.6842	567.982	23.8324
132	301547.00	132	12.6167	549.133	23.4336
133	314867.25	133	12.6599	561.130	23.6882
134	329430.50	134	12.7051	573.960	23.9575
135	319531.60	135	12.6746	565.271	23.7754
136	326363.00	136	12.6958	571.282	23.9015
137	331744.00	137	12.7121	575.972	23.9994
138	313953.40	138	12.6570	560.315	23.6710
139	308484.75	139	12.6394	555.414	23.5672
140	330585.25	140	12.7086	574.965	23.9784
141	331021.60	141	12.7099	575.345	23.9863
142	335402.25	142	12.7231	579.139	24.0653
143	323252.75	143	12.6862	568.553	23.8444
144	310307.00	144	12.6453	557.052	23.6020

Obs	y	time	Lny	Sqrty	QtRooty
145	319480.50	145	12.6745	565.226	23.7745
146	321686.25	146	12.6813	567.174	23.8154
147	328546.40	147	12.7024	573.190	23.9414
148	323069.00	148	12.6856	568.392	23.8410
149	323848.20	149	12.6880	569.077	23.8553
150	326453.00	150	12.6960	571.361	23.9032
151	308934.00	151	12.6409	555.818	23.5758
152	333055.20	152	12.7161	577.109	24.0231
153	332347.50	153	12.7139	576.496	24.0103
154	335755.50	154	12.7241	579.444	24.0716
155	317964.60	155	12.6697	563.883	23.7462
156	291105.00	156	12.5814	539.541	23.2280
157	310916.00	157	12.6473	557.598	23.6135
158	318220.25	158	12.6705	564.110	23.7510
159	329607.25	159	12.7057	574.114	23.9607
160	324208.50	160	12.6891	569.393	23.8620
161	323489.60	161	12.6869	568.761	23.8487
162	324032.50	162	12.6886	569.239	23.8587

Obs	y	time	Lny	Sqrty	QtRooty
163	298846.25	163	12.6077	546.668	23.3809
164	325803.00	164	12.6940	570.792	23.8912
165	322700.50	165	12.6845	568.067	23.8342
166	336856.20	166	12.7274	580.393	24.0913
167	319099.25	167	12.6733	564.889	23.7674
168	301763.00	168	12.6174	549.330	23.4378
169	304152.40	169	12.6253	551.500	23.4840
170	312993.75	170	12.6539	559.458	23.6529
171	309928.25	171	12.6441	556.712	23.5947
172	316713.25	172	12.6658	562.773	23.7228
173	317716.80	173	12.6689	563.664	23.7416
174	327976.50	174	12.7007	572.692	23.9310
175	308398.60	175	12.6391	555.336	23.5656
176	331830.75	176	12.7124	576.048	24.0010
177	325547.50	177	12.6933	570.568	23.8866
178	329718.00	178	12.7060	574.211	23.9627
179	316733.00	179	12.6658	562.790	23.7232
180	303429.75	180	12.6229	550.845	23.4701

Obs	y	time	Lny	Sqrty	QtRooty
181	301105.20	181	12.6152	548.731	23.4250
182	308181.50	182	12.6384	555.141	23.5614
183	316209.00	183	12.6642	562.325	23.7134
184	318706.80	184	12.6720	564.541	23.7601
185	315972.25	185	12.6634	562.114	23.7089
186	323211.75	186	12.6861	568.517	23.8436
187	305599.60	187	12.6300	552.811	23.5119
188	328340.25	188	12.7018	573.010	23.9376
189	327780.00	189	12.7001	572.521	23.9274
190	336557.80	190	12.7265	580.136	24.0860
191	320755.00	191	12.6784	566.352	23.7982
192	302968.00	192	12.6214	550.425	23.4611
193	318569.00	193	12.6716	564.419	23.7575
194	318222.00	194	12.6705	564.112	23.7510
195	330106.60	195	12.7072	574.549	23.9698
196	331658.75	196	12.7119	575.898	23.9979
197	334523.50	197	12.7205	578.380	24.0495
198	328385.00	198	12.7019	573.049	23.9384

Obs	y	time	Lny	Sqrty	QtRooty
199	315802.00	199	12.6629	561.963	23.7058
200	333471.50	200	12.7173	577.470	24.0306
201	329761.00	201	12.7061	574.248	23.9635
202	341369.75	202	12.7407	584.269	24.1716
203	327668.00	203	12.6998	572.423	23.9254
204	310525.80	204	12.6460	557.248	23.6061
205	315969.00	205	12.6634	562.111	23.7089
206	335191.00	206	12.7225	578.957	24.0615
207	337317.60	207	12.7288	580.790	24.0996
208	340551.00	208	12.7383	583.567	24.1571
209	333188.75	209	12.7165	577.225	24.0255
210	328383.80	210	12.7019	573.048	23.9384
211	315590.25	211	12.6622	561.774	23.7018
212	335317.00	212	12.7228	579.066	24.0638
213	335569.00	213	12.7236	579.283	24.0683
214	331475.25	214	12.7113	575.739	23.9946
215	326305.80	215	12.6956	571.232	23.9005
216	308221.25	216	12.6386	555.177	23.5622

Obs	y	time	Lny	Sqrty	QtRooty
217	329550.25	217	12.7055	574.065	23.9596
218	328545.00	218	12.7024	573.188	23.9414
219	337465.20	219	12.7292	580.918	24.1022
220	336948.75	220	12.7277	580.473	24.0930
221	341697.80	221	12.7417	584.549	24.1775
222	343914.00	222	12.7481	586.442	24.2166
223	321180.75	223	12.6798	566.728	23.8061
224	339159.40	224	12.7342	582.374	24.1324
225	336588.25	225	12.7266	580.162	24.0866
226	337389.00	226	12.7290	580.852	24.1009
227	323432.80	227	12.6867	568.712	23.8477
228	315580.25	228	12.6622	561.765	23.7016
229	309389.00	229	12.6424	556.227	23.5845
230	314536.00	230	12.6589	560.835	23.6820
231	326118.00	231	12.6950	571.067	23.8970
232	330006.50	232	12.7069	574.462	23.9679
233	326242.60	233	12.6954	571.177	23.8993
234	334730.75	234	12.7211	578.559	24.0533

Obs	y	time	Lny	Sqrty	QtRooty
235	311661.00	235	12.6497	558.266	23.6277
236	335746.80	236	12.7241	579.437	24.0715
237	333736.00	237	12.7181	577.699	24.0354
238	336010.00	238	12.7249	579.664	24.0762
239	329505.75	239	12.7053	574.026	23.9588
240	307590.00	240	12.6365	554.608	23.5501
241	311298.40	241	12.6485	557.941	23.6208
242	323070.25	242	12.6856	568.393	23.8410
243	326014.25	243	12.6947	570.977	23.8951
244	332166.60	244	12.7134	576.339	24.0071
245	327114.00	245	12.6981	571.939	23.9152
246	322843.25	246	12.6849	568.193	23.8368
247	319945.40	247	12.6759	565.637	23.7831
248	333687.25	248	12.7180	577.657	24.0345
249	318490.00	249	12.6713	564.349	23.7560
250	326756.20	250	12.6970	571.626	23.9087
251	296544.00	251	12.6000	544.559	23.3358
252	258954.40	252	12.4644	508.876	22.5583

Obs	y	time	Lny	Sqrty	QtRooty
253	266125.75	253	12.4917	515.874	22.7129
254	276499.00	254	12.5300	525.832	22.9310
255	270477.00	255	12.5079	520.074	22.8051
256	255992.80	256	12.4529	505.957	22.4935
257	249005.00	257	12.4252	499.004	22.3384
258	259711.25	258	12.4673	509.619	22.5747
259	263771.20	259	12.4828	513.587	22.6624
260	279046.50	260	12.5391	528.249	22.9837
261	276167.40	261	12.5288	525.516	22.9241
262	275358.50	262	12.5258	524.746	22.9073
263	272120.00	263	12.5140	521.651	22.8397
264	248185.60	264	12.4219	498.182	22.3200
265	264372.50	265	12.4851	514.172	22.6754
266	272335.50	266	12.5148	521.858	22.8442
267	288900.60	267	12.5738	537.495	23.1839
268	294775.00	268	12.5940	542.932	23.3009
269	288342.00	269	12.5719	536.975	23.1727
270	283069.60	270	12.5534	532.043	23.0661

Obs	y	time	Lny	Sqrty	QtRooty
271	280679.75	271	12.5450	529.792	23.0172
272	295455.00	272	12.5963	543.558	23.3143
273	297376.80	273	12.6028	545.323	23.3521
274	298881.25	274	12.6078	546.700	23.3816
275	285083.25	275	12.5605	533.932	23.1070
276	271970.40	276	12.5134	521.508	22.8365
277	285924.25	277	12.5635	534.719	23.1240
278	284139.00	278	12.5572	533.047	23.0878
279	298895.80	279	12.6079	546.714	23.3819
280	294360.00	280	12.5926	542.550	23.2927
281	289799.50	281	12.5769	538.330	23.2019
282	285800.60	282	12.5630	534.603	23.1215
283	277880.00	283	12.5349	527.143	22.9596
284	296546.00	284	12.6000	544.560	23.3358
285	298980.00	285	12.6081	546.791	23.3836
286	304211.25	286	12.6255	551.553	23.4852
287	295338.40	287	12.5959	543.450	23.3120
288	283765.25	288	12.5559	532.696	23.0802

Obs	y	time	Lny	Sqrty	QtRooty
289	286336.25	289	12.5649	535.104	23.1323
290	282172.60	290	12.5503	531.199	23.0478
291	280849.00	291	12.5456	529.952	23.0207
292	278340.50	292	12.5366	527.580	22.9691
293	278406.60	293	12.5368	527.642	22.9705
294	285134.50	294	12.5607	533.980	23.1080
295	275965.75	295	12.5280	525.324	22.9200
296	292349.00	296	12.5857	540.693	23.2528
297	288047.25	297	12.5709	536.700	23.1668
298	284510.00	298	12.5585	533.395	23.0953
299	282605.50	299	12.5518	531.607	23.0566
300	272220.25	300	12.5144	521.747	22.8418
301	268000.20	301	12.4987	517.687	22.7527
302	278229.75	302	12.5362	527.475	22.9668
303	279517.25	303	12.5408	528.694	22.9933
304	277212.25	304	12.5325	526.509	22.9458
305	280350.00	305	12.5438	529.481	23.0105
306	284086.25	306	12.5570	532.997	23.0867

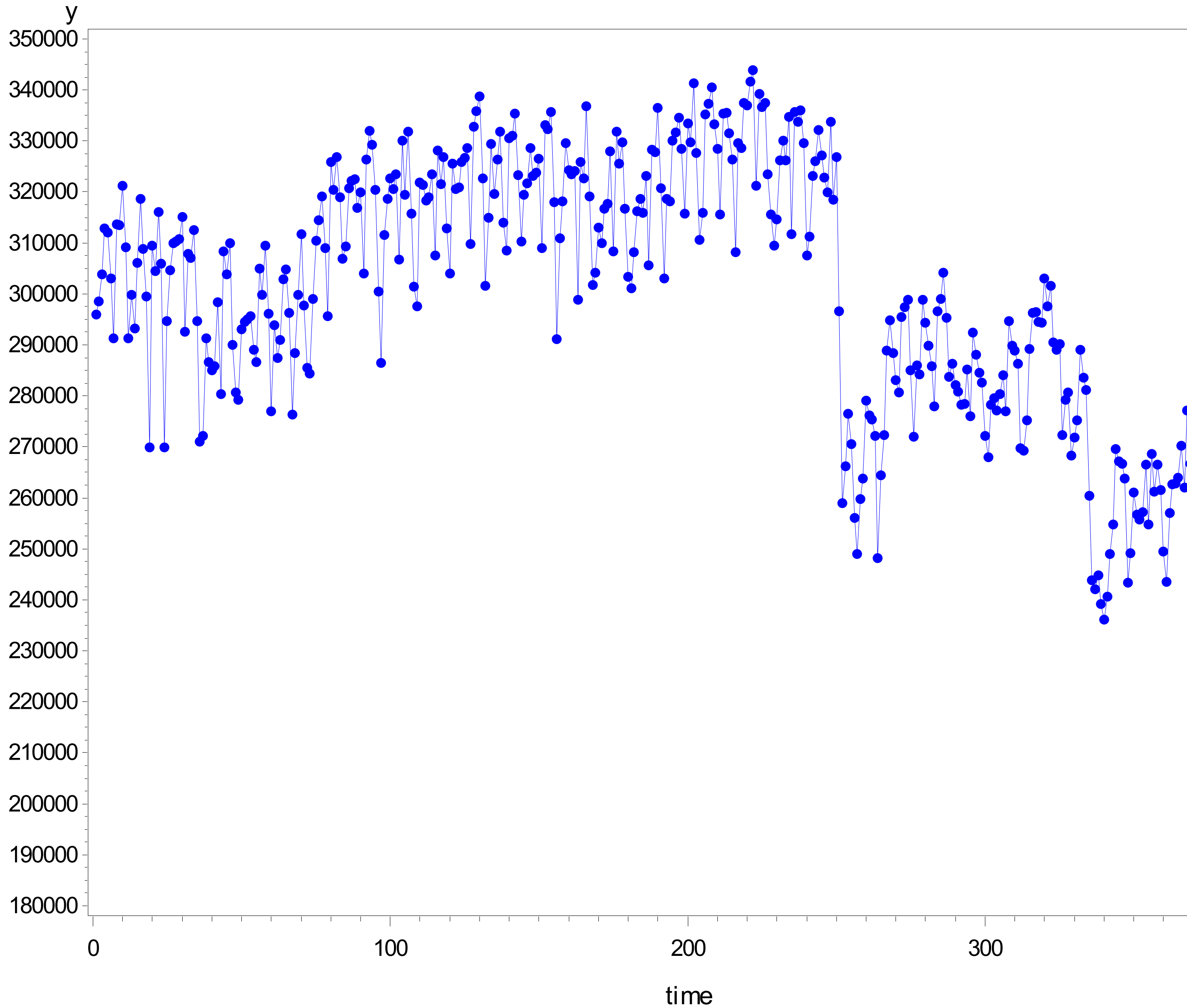
Obs	y	time	Lny	Sqrty	QtRooty
307	277003.80	307	12.5318	526.312	22.9415
308	294612.25	308	12.5934	542.782	23.2977
309	289898.50	309	12.5773	538.422	23.2039
310	288807.20	310	12.5735	537.408	23.1821
311	286356.00	311	12.5650	535.122	23.1327
312	269706.50	312	12.5051	519.333	22.7889
313	269235.00	313	12.5033	518.879	22.7789
314	275234.25	314	12.5254	524.628	22.9048
315	289205.50	315	12.5749	537.778	23.1900
316	296351.20	316	12.5993	544.381	23.3320
317	296456.00	317	12.5997	544.478	23.3340
318	294520.50	318	12.5931	542.697	23.2959
319	294341.20	319	12.5925	542.532	23.2923
320	303015.25	320	12.6215	550.468	23.4621
321	297609.25	321	12.6035	545.536	23.3567
322	301591.60	322	12.6168	549.174	23.4345
323	290466.00	323	12.5792	538.949	23.2153
324	288984.00	324	12.5741	537.572	23.1856

Obs	y	time	Lny	Sqrty	QtRooty
325	290197.25	325	12.5783	538.700	23.2099
326	272302.75	326	12.5147	521.826	22.8435
327	279257.25	327	12.5399	528.448	22.9880
328	280608.80	328	12.5447	529.725	23.0158
329	268344.00	329	12.5000	518.019	22.7600
330	271766.50	330	12.5127	521.312	22.8323
331	275282.20	331	12.5256	524.673	22.9058
332	288989.25	332	12.5741	537.577	23.1857
333	283550.00	333	12.5551	532.494	23.0758
334	281117.50	334	12.5465	530.205	23.0262
335	260401.25	335	12.4700	510.295	22.5897
336	243888.60	336	12.4045	493.851	22.2228
337	242010.50	337	12.3967	491.946	22.1798
338	244760.50	338	12.4080	494.733	22.2426
339	239233.40	339	12.3852	489.115	22.1159
340	236092.25	340	12.3720	485.893	22.0430
341	240642.75	341	12.3911	490.554	22.1484

Obs	y	time	Lny	Sqrty	QtRooty
342	249005.00	342	12.4252	499.004	22.3384
343	254809.75	343	12.4483	504.787	22.4675
344	269597.80	344	12.5047	519.228	22.7866
345	267161.00	345	12.4956	516.876	22.7349
346	266748.50	346	12.4941	516.477	22.7261
347	263801.60	347	12.4830	513.616	22.6631
348	243410.50	348	12.4025	493.366	22.2119
349	249143.25	349	12.4258	499.143	22.3415
350	261010.00	350	12.4723	510.891	22.6029
351	256697.80	351	12.4557	506.654	22.5090
352	255825.00	352	12.4522	505.791	22.4898
353	257215.00	353	12.4577	507.164	22.5203
354	266494.00	354	12.4931	516.231	22.7207
355	254809.75	355	12.4483	504.787	22.4675
356	268681.00	356	12.5013	518.344	22.7672
357	261140.75	357	12.4728	511.019	22.6057
358	266444.25	358	12.4929	516.182	22.7196
359	261504.20	359	12.4742	511.375	22.6136

Obs	y	time	Lny	Sqrty	QtRooty
360	249542.00	360	12.4274	499.542	22.3504
361	243481.00	361	12.4028	493.438	22.2135
362	257035.25	362	12.4570	506.986	22.5164
363	262663.25	363	12.4786	512.507	22.6386
364	262756.50	364	12.4790	512.598	22.6406
365	263884.00	365	12.4833	513.696	22.6649
366	270192.25	366	12.5069	519.800	22.7991
367	262073.25	367	12.4764	511.931	22.6259
368	277205.20	368	12.5325	526.503	22.9456
369	266706.50	369	12.4939	516.436	22.7252
370	267607.40	370	12.4973	517.308	22.7444
371	258016.75	371	12.4608	507.953	22.5378
372	255494.50	372	12.4510	505.465	22.4825
373	247697.40	373	12.4200	497.692	22.3090
374	249994.50	374	12.4292	499.994	22.3606
375	239286.00	375	12.3854	489.169	22.1172
376	260386.00	376	12.4699	510.280	22.5894
377	258334.20	377	12.4620	508.266	22.5448

Obs	y	time	Lny	Sqrty	QtRooty
378	255848.50	378	12.4523	505.815	22.4903
379	252820.00	379	12.4404	502.812	22.4235
380	263846.50	380	12.4831	513.660	22.6641
381	248135.50	381	12.4217	498.132	22.3189
382	244895.40	382	12.4086	494.869	22.2457
383	238894.75	383	12.3838	488.769	22.1081
384	232025.50	384	12.3546	481.690	21.9474
385	233146.60	385	12.3594	482.853	21.9739
386	231771.00	386	12.3535	481.426	21.9414
387	224918.25	387	12.3235	474.255	21.7774
388	196107.00	388	12.1864	442.840	21.0438
389	185042.75	389	12.1283	430.166	20.7404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Name of Variable = y	
Mean of Working Series	298743.7
Standard Deviation	27643.34
Number of Observations	389

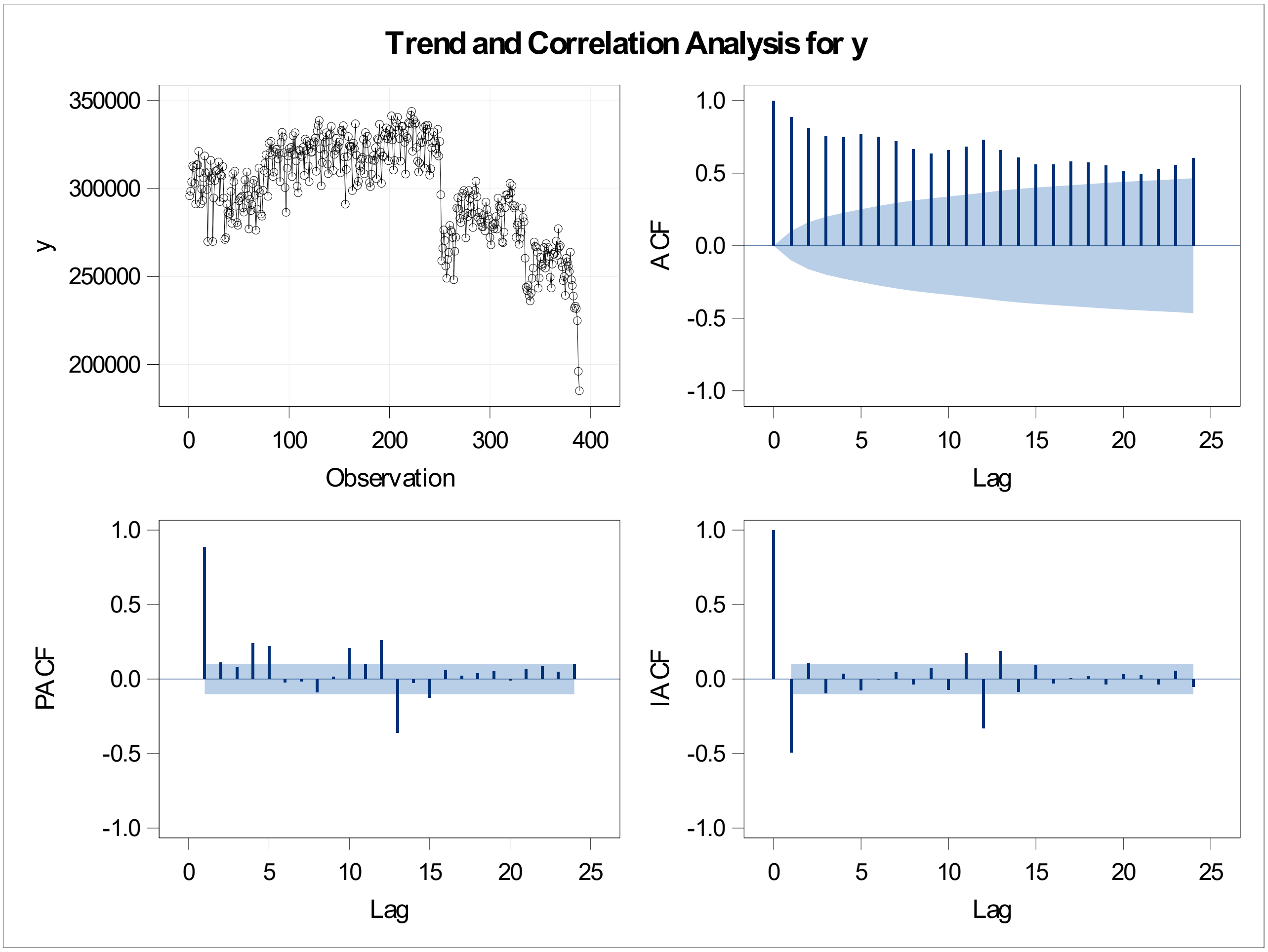
Autocorrelation Check for White Noise									
To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	1466.70	6	<.0001	0.887	0.810	0.754	0.748	0.766	0.750
12	2587.73	12	<.0001	0.718	0.665	0.635	0.659	0.684	0.730
18	3441.03	18	<.0001	0.660	0.608	0.558	0.559	0.581	0.574
24	4173.41	24	<.0001	0.554	0.511	0.495	0.529	0.557	0.604

Squared Canonical Correlation Estimates						
Lags	MA 0	MA 1	MA 2	MA 3	MA 4	MA 5
AR 0	0.8219	0.7119	0.6294	0.6306	0.6728	0.6570
AR 1	0.0195	0.0016	0.0682	0.0161	0.0335	0.0109
AR 2	0.0040	0.0149	0.0218	0.0403	0.0397	0.0022
AR 3	0.0833	0.0199	0.0235	0.0049	0.0190	0.0245
AR 4	0.0830	0.0395	0.0202	0.0220	0.0203	0.0245
AR 5	0.0004	0.0012	0.0115	0.0002	0.0250	0.0157

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	<.0001
AR 1	0.0057	0.4479	<.0001	0.0222	0.0012	0.0732
AR 2	0.2123	0.0407	0.0223	0.0005	0.0018	0.4877
AR 3	<.0001	0.0199	0.0339	0.3868	0.0933	0.0513
AR 4	<.0001	0.0011	0.0510	0.0578	0.0222	0.0755
AR 5	0.7073	0.5058	0.0465	0.8244	0.0619	0.1515

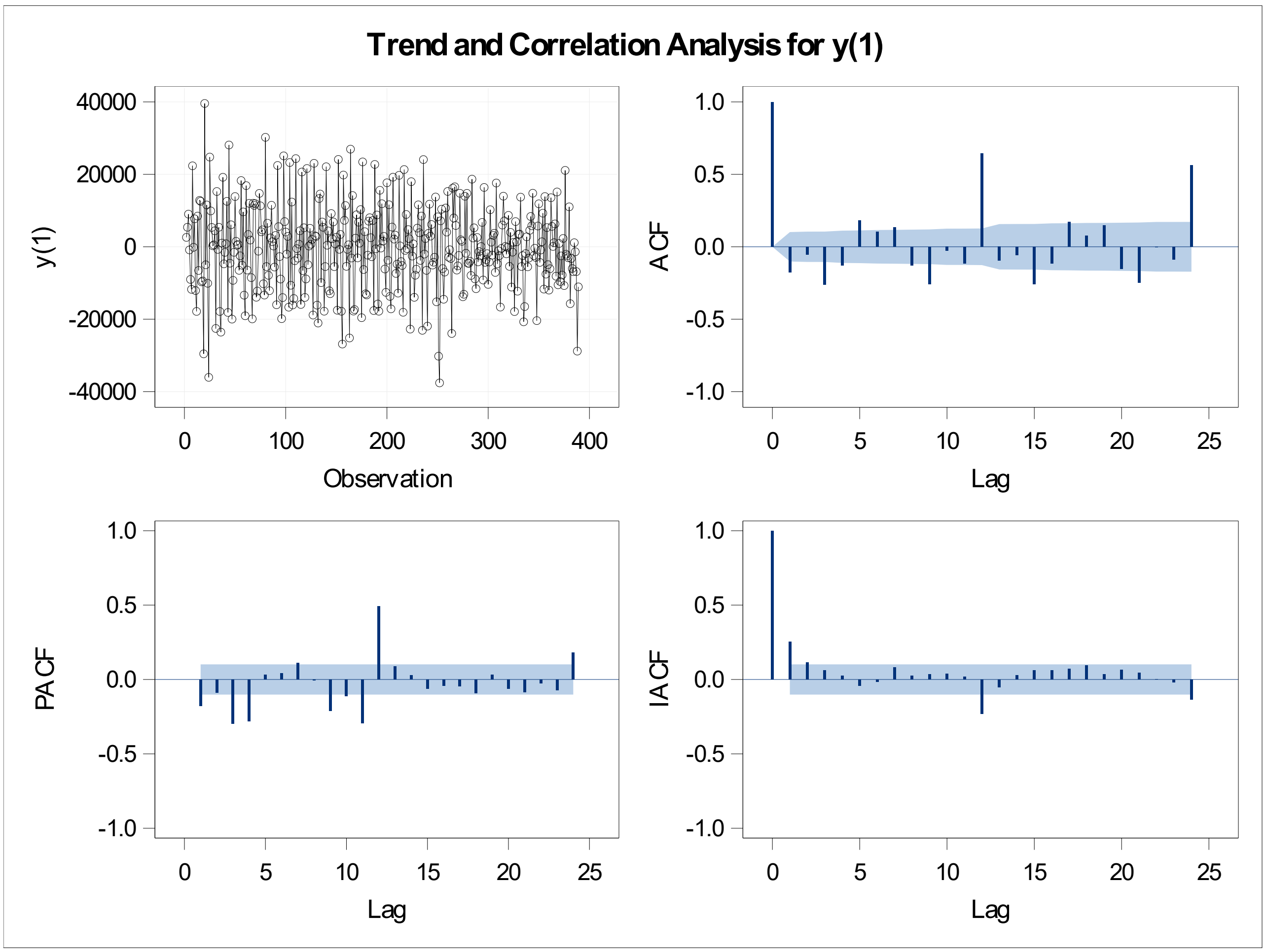
ARMA(p+d,q) Tentative Order Selection Tests	
SCAN	
p+d	**q**
1	5
5	3

(5% Significance Level)



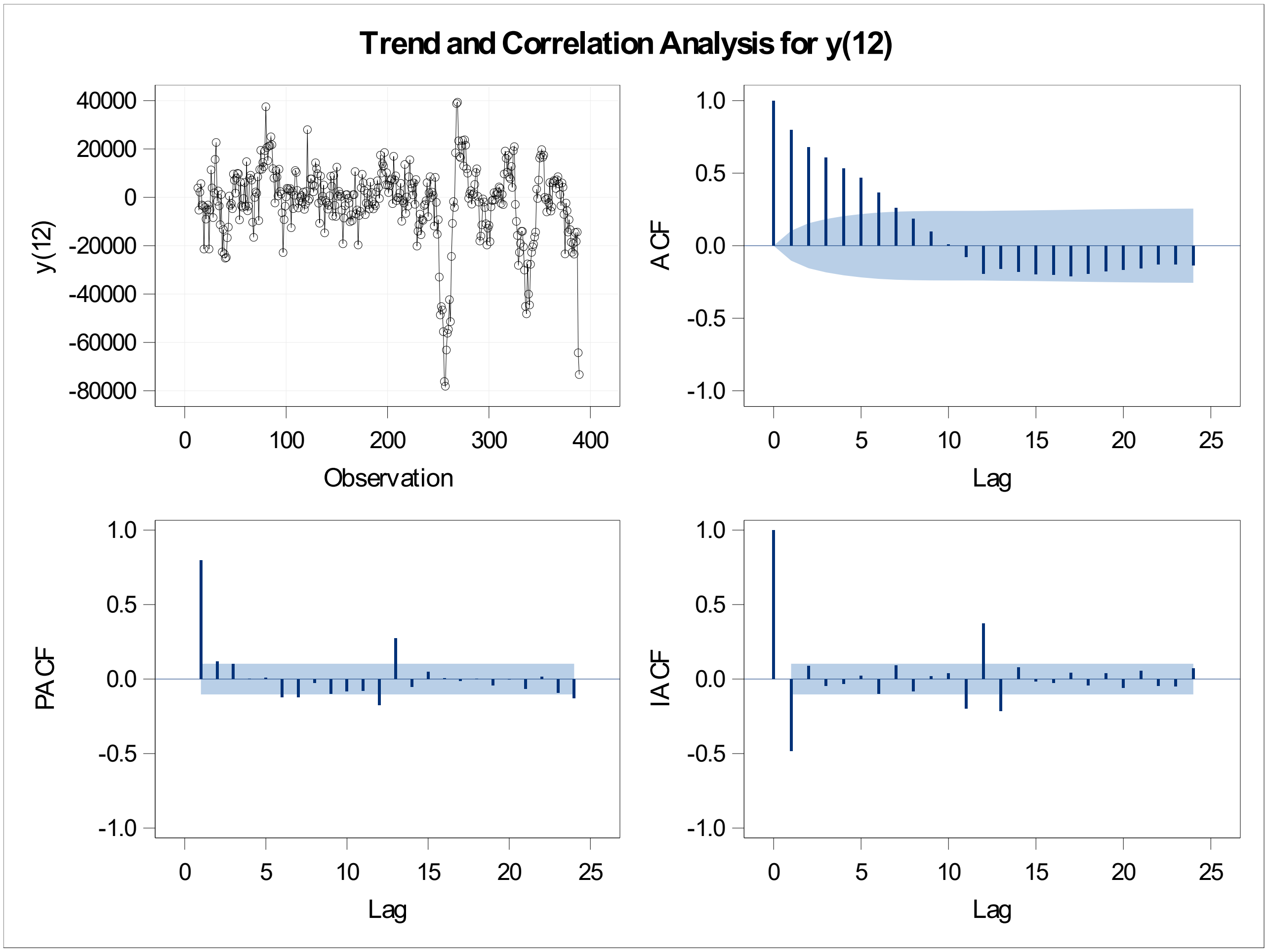
Name of Variable = y	
Period(s) of Differencing	1
Mean of Working Series	-285.731
Standard Deviation	11842.14
Number of Observations	388
Observation(s) eliminated by differencing	1

Autocorrelation Check for White Noise									
To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	63.41	6	<.0001	-0.176	-0.054	-0.260	-0.128	0.181	0.103
12	275.94	12	<.0001	0.133	-0.127	-0.257	-0.028	-0.116	0.644
18	327.60	18	<.0001	-0.096	-0.056	-0.257	-0.116	0.172	0.075
24	505.88	24	<.0001	0.148	-0.152	-0.247	-0.001	-0.087	0.562



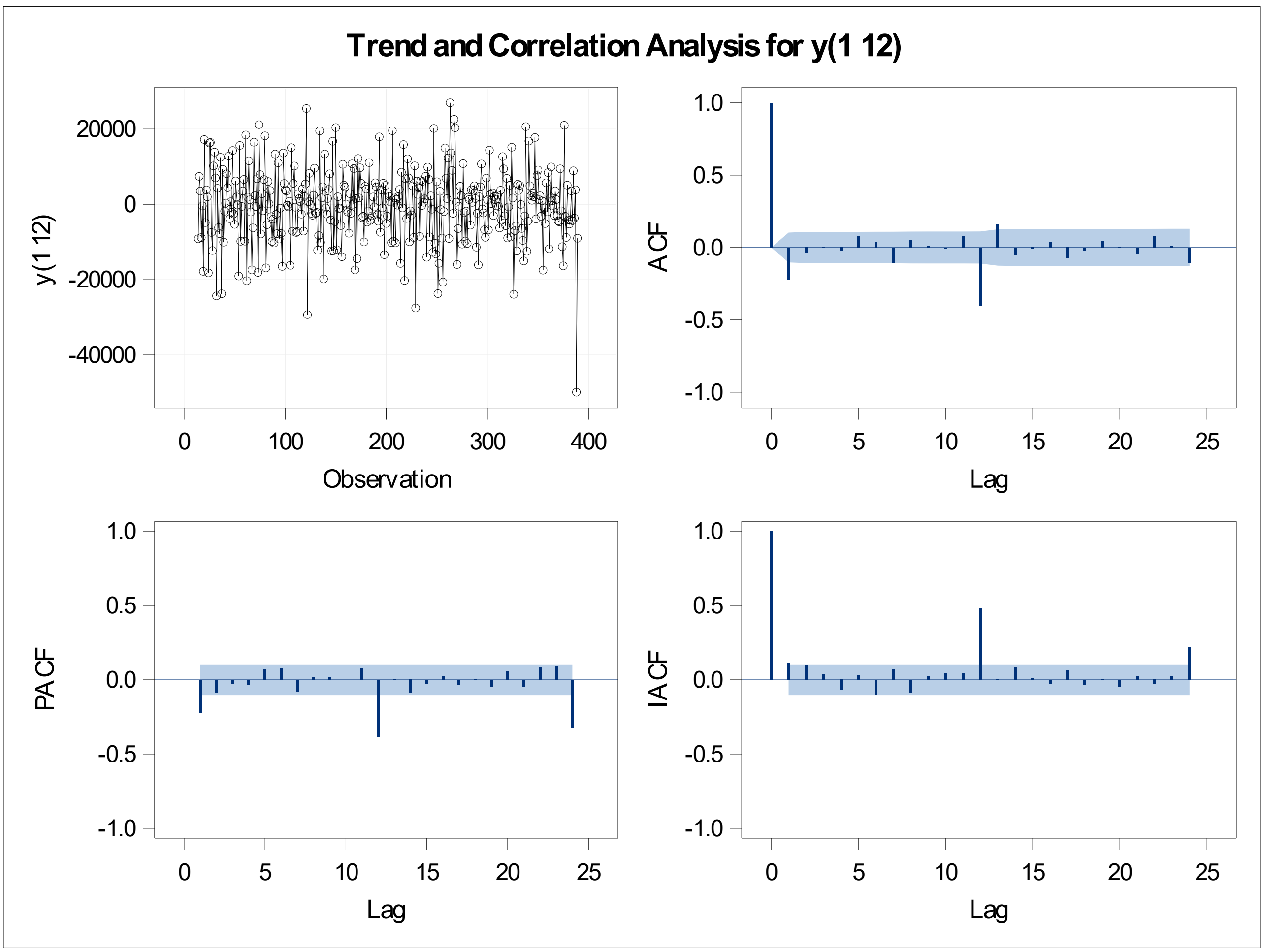
Name of Variable = y	
Period(s) of Differencing	12
Mean of Working Series	-2278.11
Standard Deviation	16326.48
Number of Observations	377
Observation(s) eliminated by differencing	12

Autocorrelation Check for White Noise									
To Lag	**Chi-Square**	**DF**	**Pr > ChiSq**	**Autocorrelations**					
6	799.95	6	<.0001	0.796	0.678	0.606	0.531	0.467	0.367
12	859.34	12	<.0001	0.259	0.185	0.096	0.007	-0.077	-0.192
18	945.36	18	<.0001	-0.158	-0.179	-0.198	-0.201	-0.210	-0.192
24	999.25	24	<.0001	-0.175	-0.167	-0.156	-0.128	-0.129	-0.136



Name of Variable = y	
Period(s) of Differencing	1,12
Mean of Working Series	-205.169
Standard Deviation	9761.007
Number of Observations	376
Observation(s) eliminated by differencing	13

Autocorrelation Check for White Noise									
To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	21.79	6	0.0013	-0.219	-0.035	0.002	-0.021	0.080	0.038
12	93.39	12	<.0001	-0.108	0.052	0.008	-0.005	0.080	-0.403
18	107.18	18	<.0001	0.159	-0.049	-0.008	0.037	-0.076	-0.019
24	115.82	24	<.0001	0.041	0.000	-0.042	0.080	0.008	-0.108



Name of Variable = y	
Period(s) of Differencing	1,12
Mean of Working Series	-205.169
Standard Deviation	9761.007
Number of Observations	376
Observation(s) eliminated by differencing	13

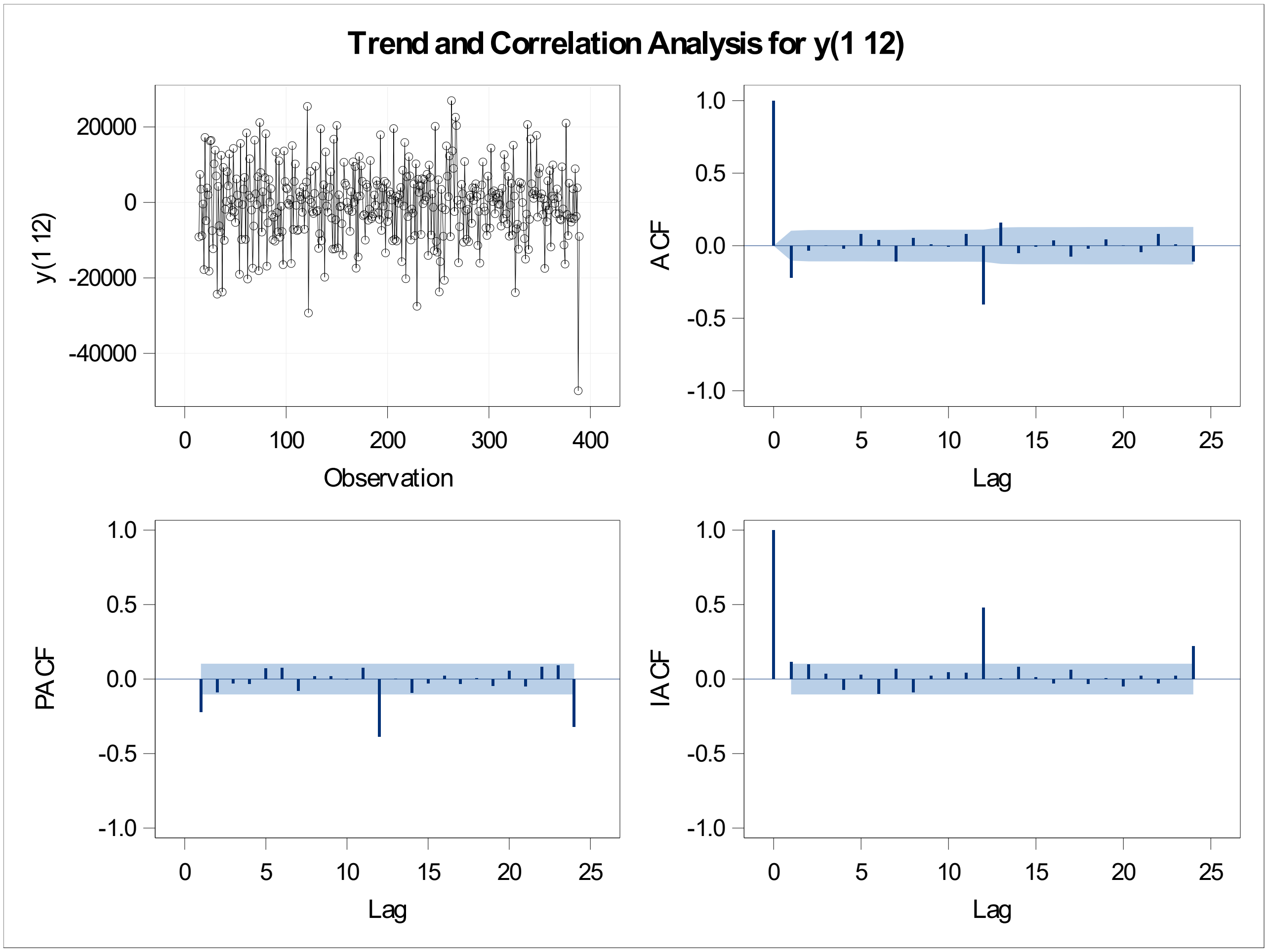
Autocorrelation Check for White Noise									
To Lag	**Chi-Square**	**DF**	**Pr > ChiSq**	**Autocorrelations**					
6	21.79	6	0.0013	-0.219	-0.035	0.002	-0.021	0.080	0.038
12	93.39	12	<.0001	-0.108	0.052	0.008	-0.005	0.080	-0.403
18	107.18	18	<.0001	0.159	-0.049	-0.008	0.037	-0.076	-0.019
24	115.82	24	<.0001	0.041	0.000	-0.042	0.080	0.008	-0.108

Squared Canonical Correlation Estimates						
Lags	**MA 0**	**MA 1**	**MA 2**	**MA 3**	**MA 4**	**MA 5**
AR 0	0.0482	0.0013	<.0001	0.0005	0.0069	0.0016
AR 1	0.0082	<.0001	0.0004	<.0001	0.0039	0.0095
AR 2	0.0010	0.0004	<.0001	0.0015	0.0023	0.0030
AR 3	0.0013	0.0024	0.0042	0.0026	0.0035	0.0055
AR 4	0.0055	0.0047	0.0005	0.0062	0.0015	0.0023
AR 5	0.0063	0.0124	0.0057	0.0055	0.0015	0.0018

SCAN Chi-Square[1] Probability Values						
Lags	**MA 0**	**MA 1**	**MA 2**	**MA 3**	**MA 4**	**MA 5**
AR 0	<.0001	0.5026	0.9746	0.6899	0.1259	0.4702
AR 1	0.0795	0.9113	0.7415	0.8967	0.3413	0.0794
AR 2	0.5424	0.7202	0.9783	0.4707	0.4852	0.3590
AR 3	0.4856	0.3897	0.3435	0.4840	0.4119	0.2134
AR 4	0.1508	0.2456	0.7184	0.3219	0.5796	0.5417
AR 5	0.1249	0.0539	0.2599	0.3967	0.6627	0.6655

ARMA(p+d,q) Tentative Order Selection Tests	
SCAN	
p+d	**q**
1	0
0	1

(5% Significance Level)



Preliminary Estimation

Initial Moving Average Estimates	
	Estimate
1	0.21904

Initial Moving Average Estimates	
	Estimate
12	0.40337

Constant Term Estimate	-205.169
White Noise Variance Est	81944235

Conditional Least Squares Estimation							
Iteration	SSE	MU	MA1,1	MA2,1	Constant	Lambda	R Crit
0	2.567E10	-205.169	0.21904	0.40337	-205.169	0.00001	1
1	2.075E10	10.07798	0.24766	0.79572	10.07798	1E-6	0.353204
2	2.059E10	-71.9106	0.24982	0.87944	-71.9106	1E-7	0.122687
3	2.05E10	-60.4005	0.24735	0.84516	-60.4005	1E-8	0.071756
4	2.05E10	-52.8934	0.24821	0.85341	-52.8934	1E-9	0.014631
5	2.05E10	-53.9974	0.24806	0.85011	-53.9974	1E-10	0.005584
6	2.05E10	-53.6818	0.24816	0.85132	-53.6818	1E-11	0.002009
7	2.05E10	-53.7271	0.24815	0.85110	-53.7271	0.1	0.00076

ARIMA Estimation Optimization Summary	
Estimation Method	Conditional Least Squares
Parameters Estimated	3
Termination Criteria	Maximum Relative Change in Estimates
Iteration Stopping Value	0.001
Criteria Value	0.000843
Alternate Criteria	Relative Change in Objective Function
Alternate Criteria Value	1.497E-7
Maximum Absolute Value of Gradient	25638035
R-Square Change from Last Iteration	0.00076
Objective Function	Sum of Squared Residuals
Objective Function Value	2.05E10
Marquardt's Lambda Coefficient	0.1
Numerical Derivative Perturbation Delta	0.001
Iterations	7

Conditional Least Squares Estimation					
Parameter	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**	**Lag**
MU	-53.72706	50.55020	-1.06	0.2885	0
MA1,1	0.24815	0.05108	4.86	<.0001	1
MA2,1	0.85110	0.03114	27.33	<.0001	12

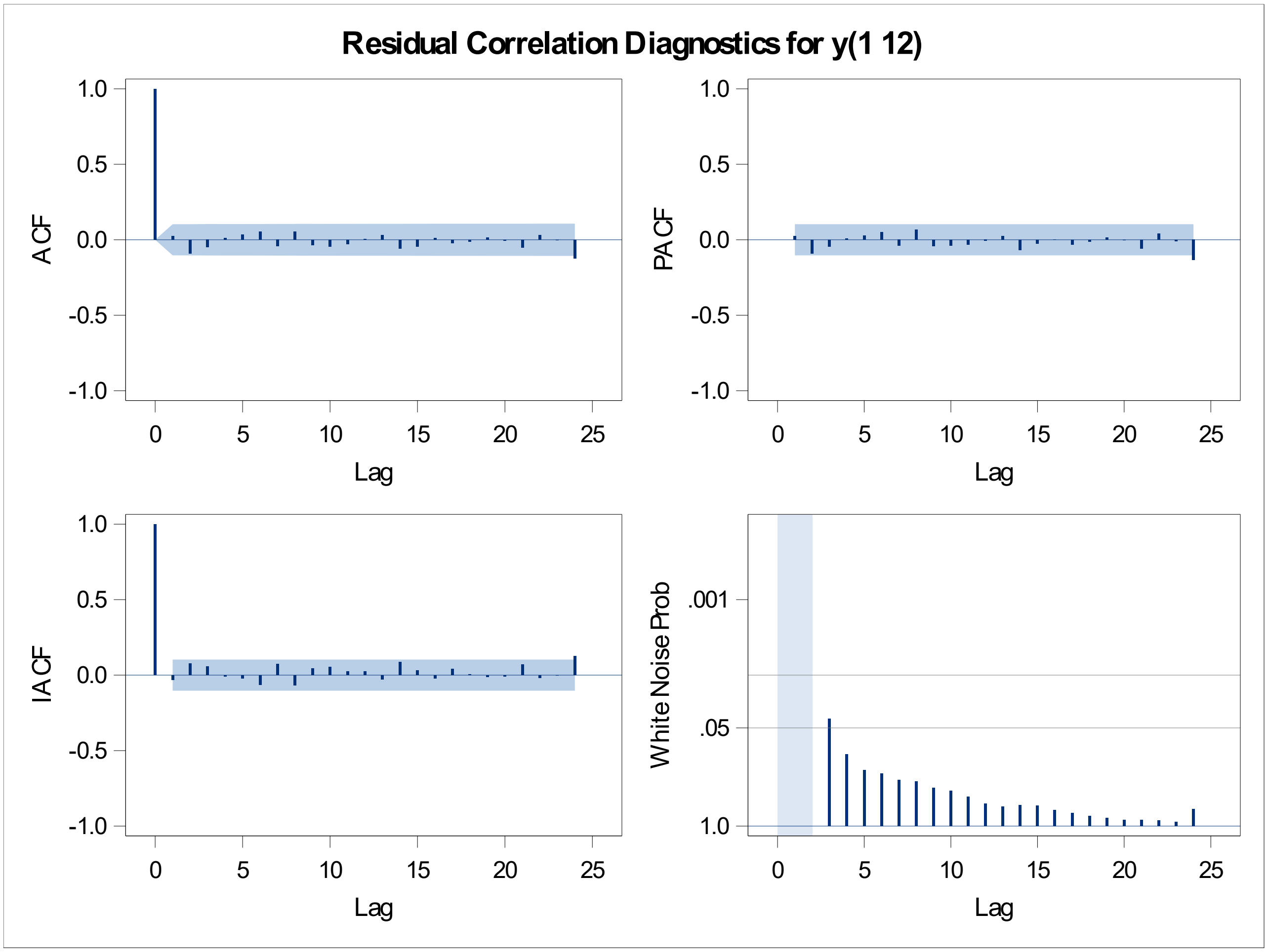
Constant Estimate	-53.7271
Variance Estimate	54961974
Std Error Estimate	7413.634

AIC	7771.159
SBC	7782.948
Number of Residuals	376

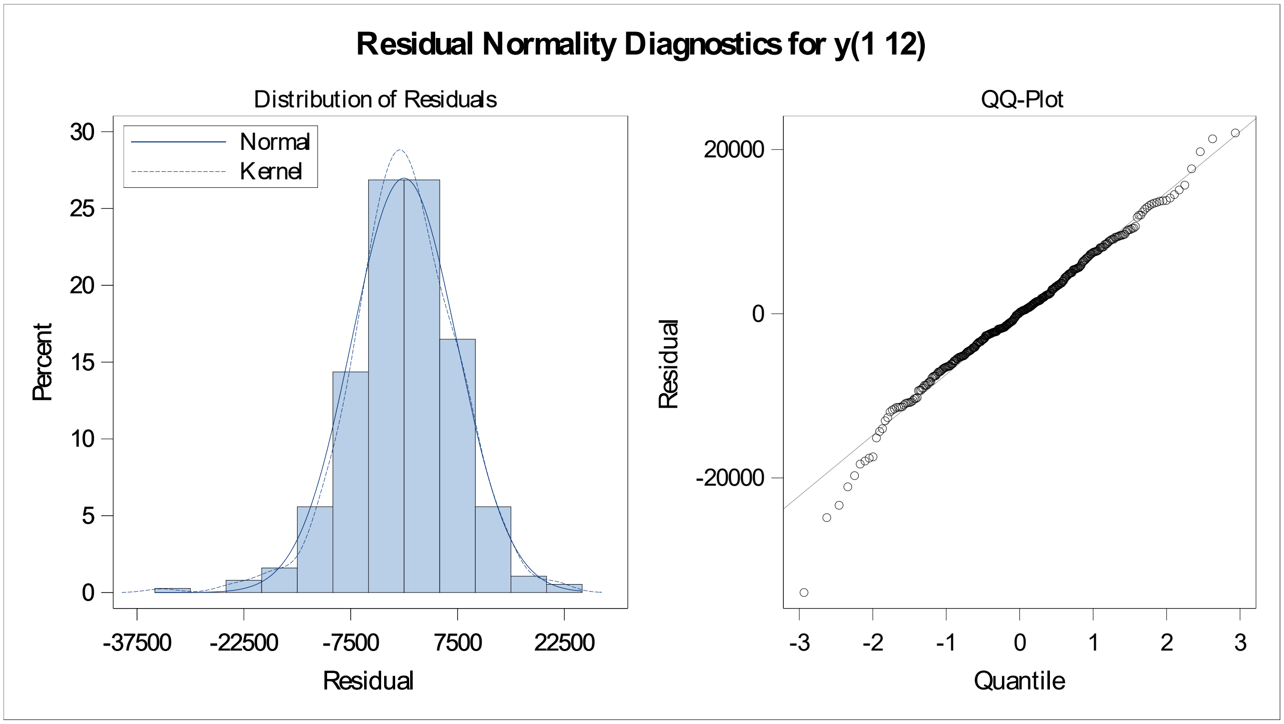
**** AIC and SBC do not include log determinant.***

Correlations of Parameter Estimates			
Parameter	**MU**	**MA1,1**	**MA2,1**
MU	1.000	0.016	0.084
MA1,1	0.016	1.000	0.014
MA2,1	0.084	0.014	1.000

Autocorrelation Check of Residuals									
To Lag	**Chi-Square**	**DF**	**Pr > ChiSq**	**Autocorrelations**					
6	5.96	4	0.2023	0.025	-0.091	-0.050	0.012	0.036	0.053
12	9.33	10	0.5011	-0.043	0.053	-0.035	-0.044	-0.029	0.004
18	12.16	16	0.7331	0.032	-0.057	-0.046	0.010	-0.022	-0.013
24	19.75	22	0.5985	0.016	-0.005	-0.050	0.032	-0.002	-0.123
30	23.10	28	0.7278	-0.034	0.036	-0.018	-0.019	0.070	-0.012
36	26.78	34	0.8061	0.042	-0.048	-0.025	-0.033	0.036	-0.042
42	29.68	40	0.8839	-0.034	0.024	-0.017	-0.028	0.053	-0.035
48	31.64	46	0.9472	0.032	0.002	-0.004	-0.025	-0.017	0.051



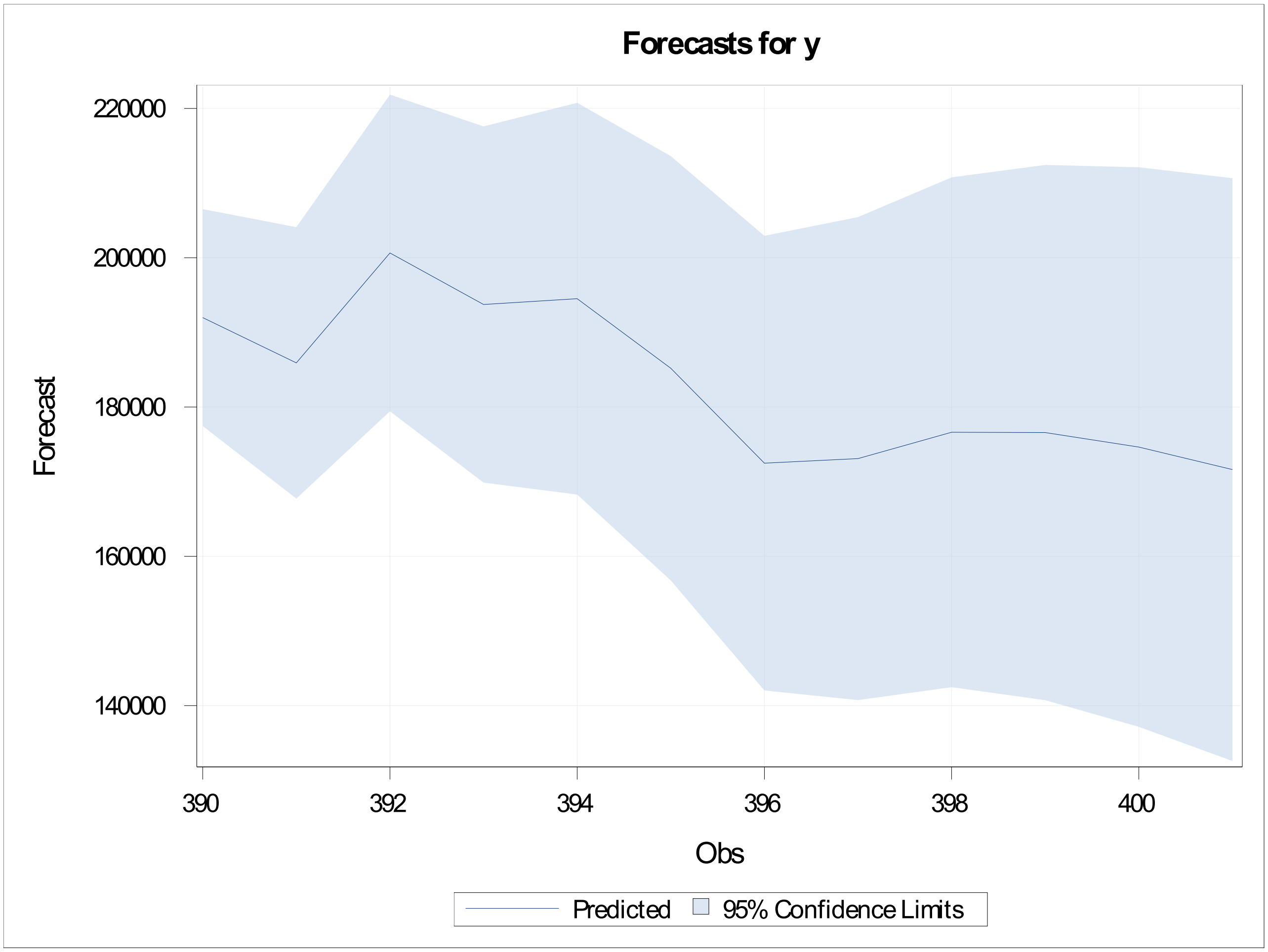
Residual Correlation Diagnostics for y(1 12)
ACF
PACF
IACF
White Noise Prob
1.0
0.5
0.0
-0.5
-1.0
.001
.05
0
5
10
15
20
25
Lag



Model for variable y	
Estimated Mean	-53.7271
Period(s) of Differencing	1,12

Moving Average Factors	
Factor 1:	1 - 0.24815 B**(1)
Factor 2:	1 - 0.8511 B**(12)

Forecasts for variable y				
Obs	Forecast	Std Error	95% Confidence Limits	
390	191980.5	7413.63	177450.0	206510.9
391	185914.2	9275.30	167735.0	204093.5
392	200639.9	10821.29	179430.5	221849.2
393	193734.8	12172.49	169877.1	217592.4
394	194513.9	13388.00	168273.9	220753.9
395	185191.2	14501.99	156767.8	213614.6
396	172480.7	15536.31	142030.1	202931.3
397	173091.6	16505.94	140740.6	205442.7
398	176619.5	17421.69	142473.7	210765.4
399	176579.0	18291.65	140728.0	212430.0
400	174638.0	19122.07	137159.4	212116.5
401	171620.2	19917.90	132581.8	210658.6


Forecasts for y
220000
200000
180000
160000
140000
Forecast
390
392
394
396
398
400
Obs
Predicted
95% Confidence Limits

APPENDIX AND REFERENCES

APPENDIX A

DATA EXPLORATION FOR FREIGHT SUMMARY

For Weekly Avg. Class I Rail Volumes (Carloads + Intermodal), Cass Shipment (Index), ATA Truck (Tonnage), and West Coast Ports (TEU's) data is available from Jan 2000 to April 2020.

For VA Export Coal Loadings (Tons, 000s) data is available from Jan 2003 to Feb 2020.

For Spot Dry Van TL Pricing (includes fuel), and Spot Flatbed TL Pricing (includes fuel) data is available from Jan 2008 to April 2020.

For Trucking Market Demand Index data is available from Feb 2008 to April 2020.

For IANA Domestic Containers, Class 8 Truck Orders, Trailing 3-Month SAAR, and Backlog/Build data is available from Jan 2000 to March 2020.

For Trucking Market Demand Index data is available from Feb 2008 to April 2020.

For East Coast Ports (TEU's) (Imports, Exports, and Total) and IATA Int'l Air Cargo(Volumes (FTK's), Capacity (AFTK's)) data is available from Jan 2003 to March 2020.

For Canadian Ports (TEU's) (Imports, Exports, and Total) data is available from July 2009 to March 2020.

For Spot Container Rates (HK-LA) data is available from Jan 2006 to April 2020.

For Domestic Integrator Volumes(UPS Louisville) data is available from Jan 2016 to March 2020.

For Domestic Integrator Volumes(FDX Memphis) data is available from Jan 2015 to March 2020.

For Shanghai Pudong Air Cargo (PACTL) (Tonnage) data is available from Jan 2010 to March 2020.

For Air Freight Price (Index) data is available from Nov 2008 to March 2020.

APPENDIX B

NA Class I Rail Volumes (Carloads + Intermodal), Cass Shipment (Index), ATA Truck (Tonnage), West Coast Ports (TEU's) (Imports, Exports, and Total), and Freight Average data is available from Jan 2001 to April 2020.

VA Export Coal Loadings (Tons, 000s) data is available from Jan 2001 to Feb 2020.

Spot Dry Van TL Pricing (includes fuel), Spot Flatbed TL Pricing (includes fuel), and TL Market Demand Index data is available from Feb 2009 to April 2020.

LTL Monthly Tonnage / Day Simple Avg. data is available from Jan 2008 to March 2020.

IANA Domestic Containers, Class 8 Truck Orders, and Trailing 3-Month SAAR data is available from Jan 2001 to March 2020.

East Coast Ports (TEU's) and IATA Int'l Air Cargo data is available from Jan 2004 to March 2020.

Canadian Ports (TEUs) data is available from July 2010 to March 2020.

Spot Container Rates (HK-LA) data is available from Jan 2007 to April 2020.

Domestic Integrator Volumes(UPS Louisville, simple average) data is available from Jan 2017 to March 2020.

Domestic Integrator Volumes(FDX Memphis) data is available from Jan 2016 to March 2020.

Shanghai Pudong Air Cargo (PACTL) (Tonnage) data is available from Jan 2011 to March 2020.

Air Freight Price (Index) data is available from Nov 2009 to March 2020.

APPENDIX C

NA Class 1 Rail Volumes (Carloads + Intermodal), Cass Shipment (Index), ATA Truck (Tonnage), and West Coast Ports (TEU's) quarterly data is available from the year 2000 to 2020.

For VA Export Coal Loadings (Tons, 000s) quarterly data is available from 1st quarter of the year 200o to 2020.

Case Shipment (index) and ATA Truck (Tonnage) data is available from 1st quarter of year 2000 to 1st quarter of year 2020.

For Dry Van TL Pricing (includes fuel) and Flatbed TL Pricing (includes fuel) data is available from 4th quarter 2008 to 1st quarter 2020.

In TL Market Demand Index quarterly data is available from 2nd quarter of the year 2008 to 1sr quarter of the year 2020.

Quarterly data for IANA Domestic Containers, Class 8 Truck Orders is available from 1st quarter of the year 2000 to 1st quarter of the year 2020.

For West Coast ports (TEU's) (Imports, Exports, and Total quarterly data is available from the year 2000 to 2020

For East Coast Ports (TEU's) (Imports, Exports, and Total) quarterly data is available form1st quarter of 2000 to 4th quarter of 2019.

For Canadian Ports (TEU's) (Imports, Exports, and Total) quarterly data is available from 3rd quarter of the year 2009 to 4th quarter of the year 2019.

For Spot Container Rates (HK-LA) quarterly data is available from 1st quarter of the year 2006 to 1st quarter of 2020.

In Domestic Integrator Volumes (UPS Louisville) quarterly data is available from 1st quarter of the year 2016 to 1st quarter of the year 2020.

In Domestic Integrator Volumes (UPS Louisville) quarterly data is available from 1st quarter of the year 2015 to 4th quarter of the year 2019.

For IATA Int'l Air Cargo (Volumes (FTK's), Capacity (AFTK's)) quarterly data is available from 1st quarter of 2003 to 1st quarter of the year 2020.

In Shanghai Pudong Air Cargo (PACTL) (Tonnage) quarterly data is available from 1st quarter of the year 2010 to 4th quarter of the year 2019.

For Air Freight Price (Index) quarterly data is available from 4th quarter of 2008 to 1st quarter of the year 2020.

REFERENCES

- *Forecasting, Time Series, and Regression*, 4th edition, 2005, Bowerman, O'Connell, and Koehler, Thomson Learning ISBN 0-534-40977-6 (REQUIRED)
- Brocklebank & Dickey, SAS for Forecasting Time Series, 2nd Ed., Wiley 2009, ISBN 978-1-59047-182-1 (OPTIONAL text)
- SAS Institute (2017) - THE ARIMA PROCEDURE Available from: https://documentation.sas.com/?docsetId=etsug&docsetTarget=etsug_arima_overview.htm&docsetVersion=14.3&locale=en