ARMAX Demo

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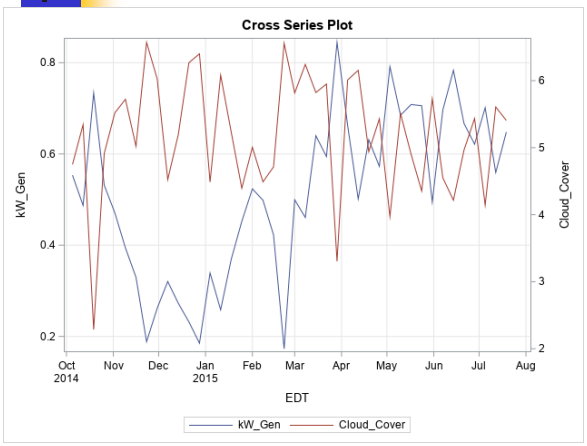
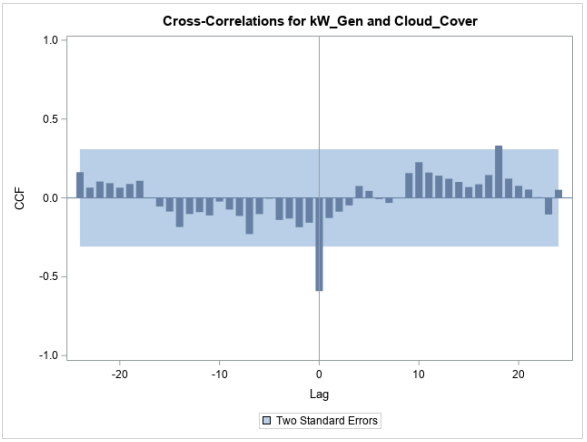
Continue to Use Solar Power Data

- Program2_ARIMA_Models
- SolarPV data that has following variables:
- **kW_Gen**: Average daily solar electricity production in the week in kilowatt hours
- Cloud_Cover: Average daily *estimated* cloud cover in the week, scaled 0-10
- Cosval: A discretized cosine wave starting at the summer solstice, with a cycle of one year

```
LIBNAME COURSE 'H:\DATA\MKTG6413';
/* Program2_ARIMA_Models: ARMAX models Weekly Solar Power Data from SAS */
Ods graphics on/imagemap=on;
Title 'Generating plots on weekly solar power data for relating Y to X variables';
proc timeseries data=COURSE.SOLARPV
                crossplots=(series ccf);
   id EDT interval=week;
   var kW_Gen;
   crossvar Cloud_Cover cosval;
   ods exclude CCFNORMPlot;
run;
ods graphics off;
```

Plots from SAS





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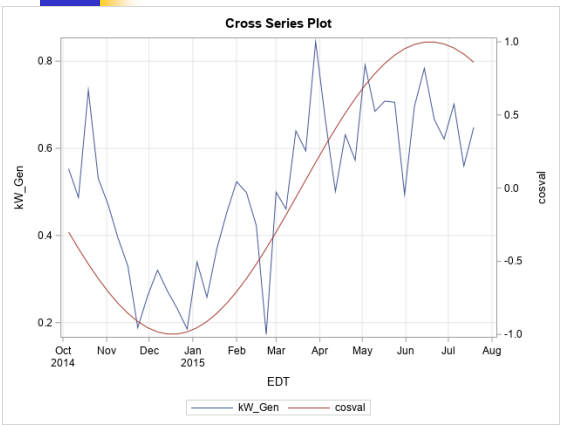
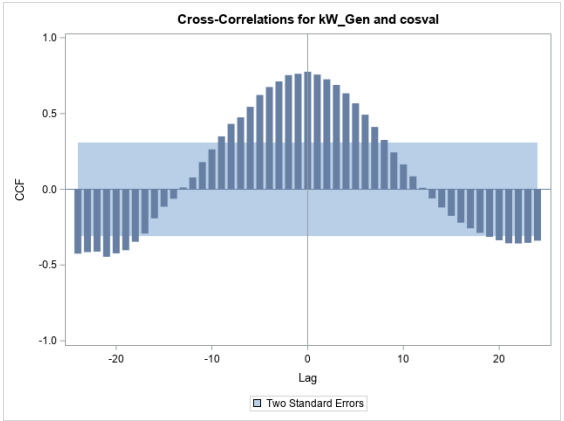
Plots from SAS (Contd.)





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Estimating Parameters in ARMAX

```
Ods graphics on/imagemap=on;
Title 'Estimating ARMAX Parameters - One X Variable';
proc arima data=COURSE.SOLARPV
           plots(only)=(series(corr crosscorr)
                        residual(corr normal));
   identify var=kW_Gen crosscorr=(Cloud_Cover);
   estimate p=(1) input=(Cloud_Cover) method=ML;
   run;
ods graphics off;
```

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ARMAX Output from SAS

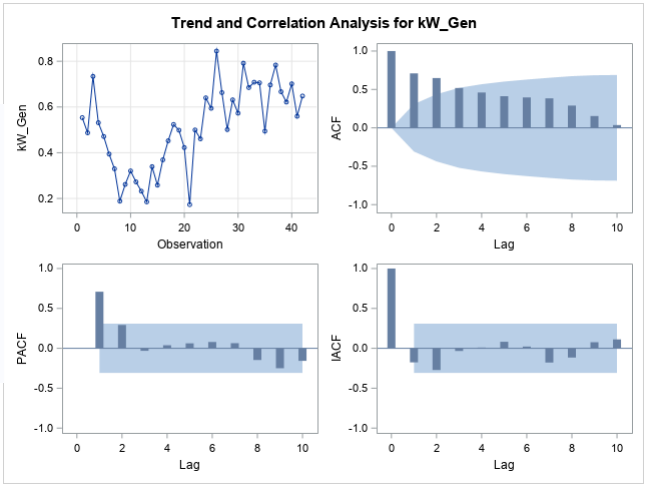
Estimating ARMAX Parameters

The ARIMA Procedure

Name of Variable = kW_Gen	
Mean of Working Series	0.511078
Standard Deviation	0.179364
Number of Observations	42

Autocorrelation Check for White Noise								
To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations				
6	81.65	6	<.0001	0.709	0.648	0.519	0.460	0.412	0.396

Correlation of kW_Gen and Cloud_Cover	
Variance of input =	0.775925
Number of Observations	42



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ARMAX Output from SAS (contd.)

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag	Variable	Shift
MU	1.00001	0.08901	11.23	<.0001	0	kW_Gen	0
AR1,1	0.86587	0.07766	11.15	<.0001	1	kW_Gen	0
NUM1	-0.09061	0.0096050	-9.43	<.0001	0	Cloud_Cover	0

Constant Estimate	0.134134
Variance Estimate	0.005503
Std Error Estimate	0.074179
AIC	-95.0433
SBC	-89.8303
Number of Residuals	42

Correlations of Parameter Estimates

Variable	Parameter	kW_Gen MU	kW_Gen AR1,1	Cloud_Cover NUM1
kW_Gen	MU	1.000	0.103	-0.553
kW_Gen	AR1,1	0.103	1.000	0.033
Cloud_Cover	NUM1	-0.553	0.033	1.000

Autocorrelation Check of Residuals

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	2.08	5	0.8379	-0.058	0.056	-0.109	0.057	0.139	0.043
12	7.16	11	0.7860	0.225	-0.101	0.112	0.024	-0.116	-0.071
18	14.98	17	0.5970	0.029	0.121	-0.006	-0.202	-0.212	0.086
24	16.33	23	0.8406	-0.033	0.030	-0.016	-0.051	-0.088	-0.040

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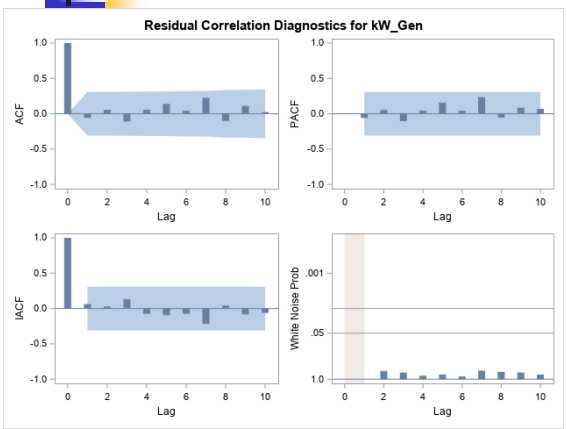
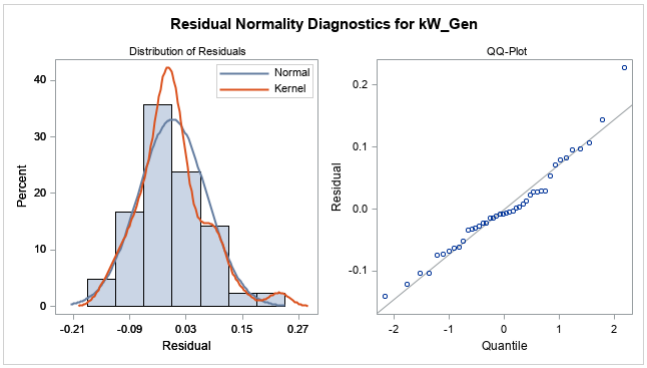
ARMAX Output from SAS (contd.)





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Adding Both X Variables in ARMAX

```
Ods graphics on/imagemap=on;
Title 'Estimating ARMAX Parameters - Two X variables';
proc arima data=COURSE.SOLARPV
           plots(only)=(series(corr crosscorr)
                        residual(corr normal));
   identify var=kW_Gen crosscorr=(Cloud_Cover cosval);
   estimate p=(1) input=(Cloud_Cover cosval) method=ML;
   run;
ods graphics off;
```

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ARMAX Output from SAS

Maximum Likelihood Estimation

Parameter	Estimate	Standard Error	t Value	Approx Pr > |t|	Lag	Variable	Shift
MU	0.99744	0.05736	17.39	<.0001	0	kW_Gen	0
AR1,1	0.55574	0.13307	4.18	<.0001	1	kW_Gen	0
NUM1	-0.09091	0.01019	-8.92	<.0001	0	Cloud_Cover	0
NUM2	0.16664	0.02985	5.58	<.0001	0	cosval	0

Constant Estimate	0.443121
Variance Estimate	0.0045
Std Error Estimate	0.067082
AIC	-103.598
SBC	-96.6469
Number of Residuals	42

Correlations of Parameter Estimates

Variable	Parameter	kW_Gen MU	kW_Gen AR1,1	Cloud_Cover NUM1	cosval NUM2
kW_Gen	MU	1.000	-0.036	-0.919	-0.028
kW_Gen	AR1,1	-0.036	1.000	0.037	-0.034
Cloud_Cover	NUM1	-0.919	0.037	1.000	0.065
cosval	NUM2	-0.028	-0.034	0.065	1.000

Autocorrelation Check of Residuals

To Lag	Chi-Square	DF	Pr > ChiSq	Autocorrelations					
6	1.24	5	0.9407	0.029	0.046	-0.139	-0.017	0.052	-0.028
12	7.87	11	0.7245	0.145	-0.160	0.006	-0.071	-0.199	-0.155
18	16.61	17	0.4814	-0.039	0.067	-0.064	-0.242	-0.219	0.069
24	19.11	23	0.6950	0.022	0.111	0.118	0.040	0.007	0.023

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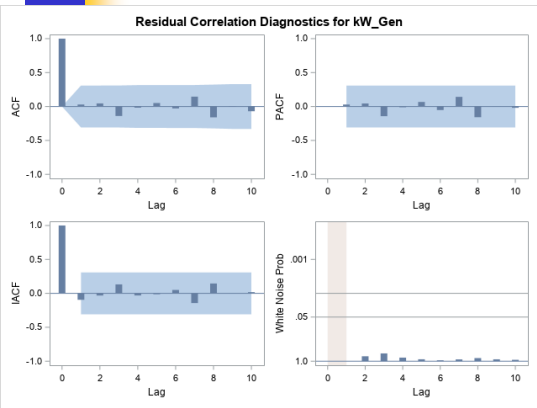
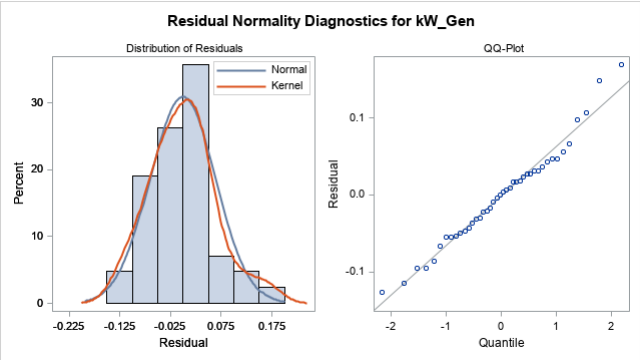
ARMAX Output from SAS (contd.)





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