TESTIMONY

OF

EDWARD L. SPITZNAGEL, JR.

1. Q. Please state your name, business address, and employer.

A. My name is Edward L. Spitznagel, Jr., and my business address is Campus Box 1146, One Brookings Drive, St Louis, Missouri 63130. I am employed by Washington University.

2. Q. What is your present position?

A. I am Professor of Mathematics in the College of Arts and Sciences at Washington University. I also hold a joint appointment in the Division of Biostatistics of the Washington University School of Medicine.

3. Q. Please review your educational background and work experience.

A. I hold a Bachelor of Science, summa cum laude, in mathematics, awarded in 1962 by Xavier University, Cincinnati, Ohio. I hold a Master of Science 1963) and Ph.D. (1965) in mathematics awarded by the University of Chicago. I have served on the Faculty of Arts and Sciences of Washington University since 1969. I have held a joint appointment in the Division of Biostatistics since 1978. From 1965 to 1969 I was on the faculty of Northwestern University.

Attached to my testimony is Appendix A, which provides a more detailed listing of my education and qualifications in the area of mathematics and statistics.

4. Q. **What is the purpose of your testimony in this case?**

A. I have been employed by Tennessee American Water Company to make weather-normalized predictions of water utilization for the period January 2011 to December 2011.

5. Q. **What is weather normalization?**

A. From one year to the next, variations in temperature and precipitation lead to changes in water consumption. More water will generally be used during hotter, drier periods. The regulatory question is how to reflect those weather-related differences when setting rates.

For ratemaking purposes, revenues need to be set at as "normal" a level as possible, factoring out the potential or actual results of unusual weather conditions. This can be accomplished by building statistical models that predict water utilization from meteorological data and other possible predictors. An estimate of future utilization can then be made by using a long-term average of meteorological data (since there is no better way to forecast next year's weather than as an average) and known values of the other predictors.

6. Q. What are examples of these other, non-meteorological predictors?

A. One is the year itself. Due to gradual introduction of water-conserving plumbing fixtures and appliances use of water appears to be gradually declining over time.

Another is the month of the year. While water utilization increases during the warmer, drier summer months, analysis of variance shows that month as a categorical variable is a powerful predictor even after temperature and moisture have been included in the model.

7. Q. What model for water utilization did you employ?

A. In a previous case before the Public Service Commission of the Commonwealth of Kentucky (1997), I screened a large number of candidate predictors by examining data from sixteen different operating companies in five states, Kentucky, Missouri, Ohio, Tennessee, and Virginia. Tennessee American Water Company was one of these sixteen companies.

I used as candidate predictors only those variables that correlated consistently with utilization for most or all of these operating companies.

I then fitted the surviving candidates in a multivariate model to predict utilization. I found that calendar month was a strong predictor even in the presence of heat and moisture variables. Therefore I included month as a categorical variable. With month included, I tested drought severity index, temperature, and calendar year as potential numeric predictors. I found that temperature was not a useful predictor in the presence of the other variables, so from that point onward, I did not use it.

For the months of January through April, there was no evidence that moisture predicted utilization. For the months of May through December, there was evidence of moisture predicting utilization, being a weak predictor in the months of May, June, November, and December and a strong predictor for the months of July through October.

I found the Palmer Drought Index (all versions) to be an excellent predictor of utilization.

Month was a very strong predictor, both as a main effect and interacting with the drought severity index. Because of this, I estimated twelve separate predictive models, one for each month of the year.

For the present case I used month, year, and the Palmer Modified Drought Index (PMDI) to model Tennessee American Water Company utilization by fitting them to monthly TAWC consumption data from April 2000 through March 2010. The models were estimated separately for residential and commercial consumption. The coefficient estimates can be found in Appendix B.

8. Q. Not all of the coefficient estimates are statistically significant. Is this a problem?

A. No. The candidate variables were obtained as described above, by examining data from 16 different water companies, selecting those that correlated with utilization over most or all of those companies. Once those variables were selected, the resulting estimates based on them will be unbiased. If they are subject to further selection based on statistical significance, there is a chance that a small amount of bias could result.

9. Q. Once you had estimated the coefficients in these monthly models, how did you project utilization for January 2011 through December 2011?

A. I put the coefficients from the monthly regressions into Excel spreadsheets, one for residential customers, and the other for commercial customers. I calculated the mean Palmer Modified Drought Index for each of the twelve calendar months over the 30 year period from April 1980 to March 2010 and inserted those values into the spreadsheets.

I then projected an average daily utilization for each month. Once these twelve monthly projections were computed, I calculated average daily utilization for the year by taking an average weighted by the number of days in each calendar month.

These spreadsheets are given in Appendix C.

10. Q. What are your projections of daily utilization in 2011 under average weather for the two customer classes?

A. For residential customers: 135.93 gallons/customer/day
For commercial customers: 989.64 gallons/customer/day

11. Q. Customers are billed at various days during a given month for approximately thirty days of usage, while PMDI is reported for the entire month. Is any inaccuracy introduced by the PMDI not coinciding exactly with the usage period?

A. In my study for Kentucky American Water Company referred to on Pages 3-4 above, I examined this extensively and found the effect of non-coincidence to be very small. The average difference in time interval is approximately two weeks. This can be compensated by using the average of each PMDI value with that of the preceding month. I have done this in the present case and found the estimates to change by a very small amount. Using two-month averaged PMDI, the estimates become:

For residential customers: 135.82 gallons / customer / day
For commercial customers: 988.51 gallons / customer / day

The differences, as shown on Appendix D, are extremely small, and in both cases are negative. For simplicity, I recommend using the estimates based on the single-month PMDI.

12. Q. Does this conclude your testimony?

A. Yes, it does.

TENNESSEE REGULATORY AUTHORITY

STATE OF MISSOURI

COUNTY OF SAINT LOUIS

BEFORE ME, the undersigned authority, duly commissioned and qualified in and for the State and County aforesaid, personally came and appeared Dr. Edward L. Spitznagel, Jr., being by me first duly sworn deposed and said that:

He is appearing as a witness on behalf of Tennessee-American Water Company before the Tennessee Regulatory Authority, and if present before the Authority and duly sworn, his testimony would set forth in the annexed transcript consisting of 7 pages.

Dr Edward L. Spitznagel, Jr
Dr. Edward L. Spitznagel, Jr.

Sworn to and subscribed before me
this 10 day of September 2010.

Jacquelin C Metcalfe
Notary Public

My commission expires _______________.

JACQUELIN C. METCALFE
Notary Public - Notary Seal
State of Missouri
Commissioned for St. Louis County
My Commission Expires: August 23, 2014
Commission Number: 10916396

Edward L. Spitznagel, Jr.

Born: Cincinnati, Ohio, September 4, 1941.

Education:

Xavier University, 1959-1962
Awarded Bachelor of Science Degree (Summa cum Laude), 1962
University of Chicago, 1962-1965
Awarded Master of Science Degree, 1963
Awarded Ph.D. in Mathematics, 1965

Scholarships and Fellowships:

Xavier University, 1959-1962
Honorary Woodrow Wilson Fellow, 1962-1963
National Science Foundation Fellow, 1962-1965

Positions:

Assistant Professor of Mathematics
Northwestern University, 1965-1969
Associate Professor of Mathematics
Washington University, 1969-1980
Professor of Mathematics
Washington University, 1980-present
Joint appointment, Division of Biostatistics,
Washington University School of Medicine, 1978-present

Consulting Experience:

Litton Industries (USACDCEC, Fort Ord, CA)
Price Waterhouse (Advanced Auditing Methods, NY)
Mallinckrodt, Inc.
St. Louis County Juvenile Court
Monsanto Company
American Red Cross
Carboline Corporation
Regional Justice Information Service
Harris-Stowe State College
Equal Employment Opportunity Commission
American Optometric Association
Petrolite Corporation
U.S. Army Atmospheric Sciences Laboratory (White Sands, NM)
St. Louis County Water Company
Gateway Medical Research, Inc.
MasterCard
Simmons Market Research Bureau
Transactional Data Solutions
Missouri-American Water Company
Capital City Water Company
Kentucky-American Water Company
Tennessee-American Water Company
Iowa-American Water Company
New Jersey-American Water Company
Anheuser-Busch, Inc.
Partek, Inc.
Santa Clara County Mental Health Administration (San Jose, CA)
and many law firms

Publications:

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Chattanooga -- Fit Separate Monthly Regressions
Residential Model, JANUARY

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	613.33640	613.33640	13.91	0.0058
Error	8	352.78205	44.09776		
Corrected Total	9	966.11845			

Root MSE	6.64061	R-Square	0.6348
Dependent Mean	133.37500	Adj R-Sq	0.5892
Coeff Var	4.97890		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	148.37133	4.53640	32.71	<.0001
since_2000	1	-2.72661	0.73111	-3.73	0.0058

Chattanooga -- Fit Separate Monthly Regressions
Residential Model, FEBRUARY

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	508.52461	508.52461	4.15	0.0760
Error	8	980.09360	122.51170		
Corrected Total	9	1488.61821			

Root MSE	11.06850	R-Square	0.3416
Dependent Mean	135.47700	Adj R-Sq	0.2593
Coeff Var	8.17002		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	149.13200	7.56123	19.72	<.0001
since_2000	1	-2.48273	1.21860	-2.04	0.0760

Chattanooga -- Fit Separate Monthly Regressions
Residential Model, MARCH

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	636.39816	636.39816	6.82	0.0311
Error	8	746.94225	93.36778		
Corrected Total	9	1383.34041			

Root MSE	9.66270	R-Square	0.4600
Dependent Mean	132.99700	Adj R-Sq	0.3926
Coeff Var	7.26535		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	148.27267	6.60088	22.46	<.0001
since_2000	1	-2.77739	1.06383	-2.61	0.0311

Chattanooga -- Fit Separate Monthly Regressions
Residential Model, APRIL

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	360.07571	360.07571	13.02	0.0069
Error	8	221.18838	27.64855		
Corrected Total	9	581.26409			

Root MSE	5.25819	R-Square	0.6195
Dependent Mean	135.98900	Adj R-Sq	0.5719
Coeff Var	3.86663		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	145.39018	3.09052	47.04	<.0001
since_2000	1	-2.08915	0.57891	-3.61	0.0069

Chattanooga -- Fit Separate Monthly Regressions
Residential Model, MAY

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read 10
Number of Observations Used 10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	347.51113	173.75556	4.80	0.0486
Error	7	253.20428	36.17204		
Corrected Total	9	600.71541			

Root MSE	6.01432	R-Square	0.5785
Dependent Mean	146.42300	Adj R-Sq	0.4581
Coeff Var	4.10750		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	155.74997	3.55983	43.75	<.0001
pmdi	1	-0.37378	0.89727	-0.42	0.6895
since_2000	1	-2.07299	0.66882	-3.10	0.0173

Chattanooga -- Fit Separate Monthly Regressions
Residential Model, JUNE

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	331.62843	165.81422	1.51	0.2840
Error	7	766.26266	109.46609		
Corrected Total	9	1097.89109			

Root MSE	10.46260	R-Square	0.3021
Dependent Mean	161.64100	Adj R-Sq	0.1026
Coeff Var	6.47274		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	168.08065	6.34330	26.50	<.0001
pmdi	1	-2.24094	1.43759	-1.56	0.1630
since_2000	1	-1.28662	1.17939	-1.09	0.3114

Chattanooga -- Fit Separate Monthly Regressions
Residential Model, JULY

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	181.21286	90.60643	0.80	0.4860
Error	7	791.58715	113.08388		
Corrected Total	9	972.80001			

Root MSE	10.63409	R-Square	0.1863
Dependent Mean	171.07700	Adj R-Sq	-0.0462
Coeff Var	6.21597		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	175.41371	6.62408	26.48	<.0001
pmdi	1	-1.75384	1.42966	-1.23	0.2596
since_2000	1	-0.68972	1.20021	-0.57	0.5835

Chattanooga -- Fit Separate Monthly Regressions
Residential Model, AUGUST

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	524.56386	262.28193	5.57	0.0356
Error	7	329.38823	47.05546		
Corrected Total	9	853.95209			

Root MSE	6.85970	R-Square	0.6143
Dependent Mean	166.46900	Adj R-Sq	0.5041
Coeff Var	4.12071		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	177.74659	4.16542	42.67	<.0001
pmdi	1	-1.57529	0.81575	-1.93	0.0948
since_2000	1	-2.28454	0.76436	-2.99	0.0203

Chattanooga -- Fit Separate Monthly Regressions
Residential Model, SEPTEMBER

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	797.60706	398.80353	5.66	0.0345
Error	7	493.38719	70.48388		
Corrected Total	9	1290.99425			

Root MSE	8.39547	R-Square	0.6178
Dependent Mean	165.51500	Adj R-Sq	0.5086
Coeff Var	5.07233		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	176.19794	5.23768	33.64	<.0001
pmdi	1	-2.79927	0.89628	-3.12	0.0168
since_2000	1	-1.68101	0.93952	-1.79	0.1167

Chattanooga -- Fit Separate Monthly Regressions
Residential Model, OCTOBER

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	561.97261	280.98631	9.85	0.0092
Error	7	199.63143	28.51878		
Corrected Total	9	761.60404			

Root MSE	5.34030	R-Square	0.7379
Dependent Mean	154.26600	Adj R-Sq	0.6630
Coeff Var	3.46175		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	164.14126	3.17154	51.75	<.0001
pmdi	1	-1.67471	0.54519	-3.07	0.0180
since_2000	1	-1.92096	0.58807	-3.27	0.0137

Chattanooga -- Fit Separate Monthly Regressions
Residential Model, NOVEMBER

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	858.61412	429.30706	24.90	0.0007
Error	7	120.69613	17.24230		
Corrected Total	9	979.31025			

Root MSE	4.15239	R-Square	0.8768
Dependent Mean	145.01500	Adj R-Sq	0.8415
Coeff Var	2.86342		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	159.82140	2.47655	64.53	<.0001
pmdi	1	-0.67926	0.40426	-1.68	0.1368
since_2000	1	-3.16835	0.45764	-6.92	0.0002

Chattanooga -- Fit Separate Monthly Regressions
Residential Model, DECEMBER

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	734.45383	367.22691	8.77	0.0124
Error	7	293.06838	41.86691		
Corrected Total	9	1027.52221			

Root MSE	6.47046	R-Square	0.7148
Dependent Mean	140.28300	Adj R-Sq	0.6333
Coeff Var	4.61244		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	153.08620	3.81482	40.13	<.0001
pmdi	1	0.62668	0.66715	0.94	0.3788
since_2000	1	-2.95350	0.71404	-4.14	0.0044

Chattanooga -- Fit Separate Monthly Regressions
Commercial Model, JANUARY

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	12172	12172	2.52	0.1509
Error	8	38609	4826.11322		
Corrected Total	9	50781			

Root MSE	69.47023	R-Square	0.2397
Dependent Mean	926.58600	Adj R-Sq	0.1447
Coeff Var	7.49744		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	993.39267	47.45720	20.93	<.0001
since_2000	1	-12.14667	7.64842	-1.59	0.1509

Chattanooga -- Fit Separate Monthly Regressions
Commercial Model1, FEBRUARY

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	2564.79273	2564.79273	0.22	0.6529
Error	8	94027	11753		
Corrected Total	9	96591			

Root MSE	108.41274	R-Square	0.0266
Dependent Mean	942.19100	Adj R-Sq	-0.0951
Coeff Var	11.50645		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	972.85733	74.06000	13.14	<.0001
since_2000	1	-5.57570	11.93585	-0.47	0.6529

Chattanooga -- Fit Separate Monthly Regressions
Commercial Model, MARCH

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	7788.83142	7788.83142	0.86	0.3808
Error	8	72431	9053.88094		
Corrected Total	9	80220			

Root MSE	95.15188	R-Square	0.0971
Dependent Mean	973.24200	Adj R-Sq	-0.0158
Coeff Var	9.77680		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1026.68267	65.00111	15.79	<.0001
since_2000	1	-9.71648	10.47588	-0.93	0.3808

Chattanooga -- Fit Separate Monthly Regressions
Commercial Model, APRIL

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	14608	14608	2.94	0.1246
Error	8	39719	4964.85468		
Corrected Total	9	54327			

Root MSE	70.46172	R-Square	0.2689
Dependent Mean	962.58000	Adj R-Sq	0.1775
Coeff Var	7.32009		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1022.45945	41.41415	24.69	<.0001
since_2000	1	-13.30655	7.75758	-1.72	0.1246

Chattanooga -- Fit Separate Monthly Regressions
Commercial Model, MAY

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	5478.73256	2739.36628	0.28	0.7608
Error	7	67440	9634.33586		
Corrected Total	9	72919			

Root MSE	98.15465	R-Square	0.0751
Dependent Mean	1024.68200	Adj R-Sq	-0.1891
Coeff Var	9.57904		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1041.65536	58.09702	17.93	<.0001
pmdi	1	-10.42526	14.64356	-0.71	0.4995
since_2000	1	-3.78112	10.91525	-0.35	0.7392

Chattanooga -- Fit Separate Monthly Regressions
Commercial Model, JUNE

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	6755.18373	3377.59187	0.51	0.6201
Error	7	46167	6595.27984		
Corrected Total	9	52922			

Root MSE	81.21133	R-Square	0.1276
Dependent Mean	1106.15700	Adj R-Sq	-0.1216
Coeff Var	7.34175		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1144.63414	49.23707	23.25	<.0001
pmdi	1	-7.53976	11.15863	-0.68	0.5209
since_2000	1	-8.06458	9.15451	-0.88	0.4076

Chattanooga -- Fit Separate Monthly Regressions
Commercial Model, JULY

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	47254	23627	3.68	0.0810
Error	7	44985	6426.47083		
Corrected Total	9	92239			

Root MSE	80.16527	R-Square	0.5123
Dependent Mean	1155.54400	Adj R-Sq	0.3730
Coeff Var	6.93745		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1234.80811	49.93573	24.73	<.0001
pmdi	1	-27.42851	10.77748	-2.54	0.0384
since_2000	1	-13.32930	9.04781	-1.47	0.1842

Chattanooga -- Fit Separate Monthly Regressions
Commercial Model, AUGUST

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	9630.33471	4815.16735	1.61	0.2654
Error	7	20897	2985.28350		
Corrected Total	9	30527			

Root MSE	54.63775	R-Square	0.3155
Dependent Mean	1151.09700	Adj R-Sq	0.1199
Coeff Var	4.74658		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1193.64683	33.17775	35.98	<.0001
pmdi	1	-8.98576	6.49747	-1.38	0.2092
since_2000	1	-8.19152	6.08817	-1.35	0.2204

Chattanooga -- Fit Separate Monthly Regressions
Commercial Model, SEPTEMBER

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	50824	25412	10.39	0.0080
Error	7	17118	2445.43733		
Corrected Total	9	67942			

Root MSE	49.45136	R-Square	0.7480
Dependent Mean	1184.20900	Adj R-Sq	0.6761
Coeff Var	4.17590		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1242.11860	30.85120	40.26	<.0001
pmdi	1	-23.95103	5.27929	-4.54	0.0027
since_2000	1	-6.93959	5.53403	-1.25	0.2501

Chattanooga -- Fit Separate Monthly Regressions
Commercial Model, OCTOBER

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	20585	10293	2.61	0.1423
Error	7	27614	3944.90805		
Corrected Total	9	48200			

Root MSE	62.80850	R-Square	0.4271
Dependent Mean	1117.83400	Adj R-Sq	0.2634
Coeff Var	5.61877		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1189.93590	37.30126	31.90	<.0001
pmdi	1	-2.84553	6.41207	-0.44	0.6706
since_2000	1	-15.55787	6.91643	-2.25	0.0592

Chattanooga -- Fit Separate Monthly Regressions
Commercial Model, NOVEMBER

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	32237	16119	6.34	0.0268
Error	7	17789	2541.22436		
Corrected Total	9	50026			

Root MSE	50.41056	R-Square	0.6444
Dependent Mean	1055.02500	Adj R-Sq	0.5428
Coeff Var	4.77814		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1129.76833	30.06572	37.58	<.0001
pmdi	1	-12.60500	4.90780	-2.57	0.0371
since_2000	1	-14.34633	5.55580	-2.58	0.0364

Chattanooga -- Fit Separate Monthly Regressions
Commercial Model, DECEMBER

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	10
Number of Observations Used	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	11427	5713.60906	0.62	0.5638
Error	7	64239	9176.99801		
Corrected Total	9	75666			

Root MSE	95.79665	R-Square	0.1510
Dependent Mean	995.12000	Adj R-Sq	-0.0915
Coeff Var	9.62664		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1044.10616	56.47931	18.49	<.0001
pmdi	1	-5.22141	9.87737	-0.53	0.6134
since_2000	1	-9.98309	10.57154	-0.94	0.3764

		Projections of Residential Water Utilization, Gallons per Day, Tennessee-American								
	Slope of	Slope of		30-yr Avg	Days	2010	2011	2012	2013	2014
Month	PMDI	SINCE_2000	Intercept	PMDI		Gal/Day	Gal/Day	Gal/Day	Gal/Day	Gal/Day
Jan	0	-2.72661	148.3713	0.24167	31	121.11	118.38	115.65	112.93	110.20
Feb	0	-2.48273	149.1320	0.10000	28	124.30	121.82	119.34	116.86	114.37
Mar	0	-2.77739	148.2727	-0.31733	31	120.50	117.72	114.94	112.17	109.39
Apr	0	-2.08915	145.3902	0.01067	30	124.50	122.41	120.32	118.23	116.14
May	-0.37378	-2.07299	155.7500	0.27133	31	134.92	132.85	130.77	128.70	126.63
Jun	-2.24094	-1.28662	168.0807	0.49800	30	154.10	152.81	151.53	150.24	148.95
Jul	-1.75384	-0.68972	175.4137	0.35033	31	167.90	167.21	166.52	165.83	165.14
Aug	-1.57529	-2.28454	177.7466	0.23600	31	154.53	152.24	149.96	147.68	145.39
Sep	-2.79927	-1.68101	176.1979	0.38000	30	158.32	156.64	154.96	153.28	151.60
Oct	-1.67471	-1.92096	164.1413	0.23667	31	144.54	142.61	140.69	138.77	136.85
Nov	-0.67926	-3.16835	159.8214	0.36300	30	127.89	124.72	121.55	118.39	115.22
Dec	0.62668	-2.95350	153.0862	0.36400	31	123.78	120.83	117.87	114.92	111.97
			Annual projections:			138.11	135.93	133.72	131.58	129.40
TAWC2010.XLS										

		Projections of Commercial Water Utilization, Gallons per Day, Tennessee-American								
	Slope of	Slope of		30-yr Avg	Days	2010	2011	2012	2013	2014
Month	PMDI	SINCE_2000	Intercept	PMDI		Gal/Day	Gal/Day	Gal/Day	Gal/Day	Gal/Day
Jan	0	-12.1467	993.393	0.24167	31	871.93	859.78	847.63	835.49	823.34
Feb	0	-5.5757	972.857	0.10000	28	917.10	911.52	905.95	900.37	894.80
Mar	0	-9.7165	1026.683	-0.31733	31	929.52	919.80	910.08	900.37	890.65
Apr	0	-13.3066	1022.459	0.01067	30	889.39	876.09	862.78	849.47	836.17
May	-10.42526	-3.7811	1041.655	0.27133	31	1,001.02	997.23	993.45	989.67	985.89
Jun	-7.53976	-8.0646	1144.634	0.49800	30	1,060.23	1,052.17	1,044.10	1,036.04	1,027.98
Jul	-27.42851	-13.3293	1234.808	0.35033	31	1,091.91	1,078.58	1,065.25	1,051.92	1,038.59
Aug	-8.98576	-8.1915	1193.647	0.23600	31	1,109.61	1,101.42	1,093.23	1,085.04	1,076.84
Sep	-23.95103	-6.9396	1242.119	0.38000	30	1,163.62	1,156.68	1,149.74	1,142.80	1,135.86
Oct	-2.84553	-15.5579	1189.936	0.23667	31	1,033.68	1,018.13	1,002.57	987.01	971.45
Nov	-12.60500	-14.3463	1129.768	0.36300	30	981.73	967.38	953.04	938.69	924.34
Dec	-5.22141	-9.9831	1044.106	0.36400	31	942.37	932.39	922.41	912.43	902.44
			Annual projections:			999.75	989.64	979.33	969.42	959.32
TAWC2010.XLS										

		Projections of Residential Water Utilization, Gallons per Day, Tennessee-American								
				Using Two-Month Average of PMDI						
	Slope of	Slope of		30-yr Avg	Days	2010	2011	2012	2013	2014
Month	PMDI_AVG	SINCE_2000	Intercept	PMDI_AVG		Gal/Day	Gal/Day	Gal/Day	Gal/Day	Gal/Day
Jan	0	-2.72661	148.3713	0.30283	31	121.11	118.38	115.65	112.93	110.20
Feb	0	-2.48273	149.1320	0.17083	28	124.30	121.82	119.34	116.86	114.37
Mar	0	-2.77739	148.2727	-0.10867	31	120.50	117.72	114.94	112.17	109.39
Apr	0	-2.08915	145.3902	-0.12483	30	124.50	122.41	120.32	118.23	116.14
May	-0.51448	-2.10649	155.8402	0.14100	31	134.70	132.60	130.49	128.38	126.28
Jun	-2.49156	-1.24212	167.5868	0.38467	30	154.21	152.97	151.72	150.48	149.24
Jul	-1.47209	-0.63128	174.6487	0.42417	31	167.71	167.08	166.45	165.82	165.19
Aug	-1.73946	-2.34336	178.1761	0.29317	31	154.23	151.89	149.55	147.20	144.86
Sep	-3.24953	-1.69500	175.9810	0.30800	30	158.03	156.34	154.64	152.95	151.25
Oct	-1.71672	-2.06427	165.1423	0.30833	31	143.97	141.91	139.84	137.78	135.71
Nov	-0.71435	-3.15957	159.7842	0.29983	30	127.97	124.81	121.66	118.50	115.34
Dec	0.68004	-2.91499	152.8612	0.36350	31	123.96	121.04	118.13	115.21	112.30
			Annual projections:			138.01	135.82	133.60	131.45	129.27
TAWC2010TEST2MOAVG.XLS										

		Projections of Commercial Water Utilization, Gallons per Day, Tennessee-American								
				Using Two-Month Average of PMDI						
	Slope of	Slope of		30-yr Avg	Days	2010	2011	2012	2013	2014
Month	PMDI_AVG	SINCE_2000	Intercept	PMDI_AVG		Gal/Day	Gal/Day	Gal/Day	Gal/Day	Gal/Day
Jan	0	-12.1467	993.393	0.30283	31	871.93	859.78	847.63	835.49	823.34
Feb	0	-5.5757	972.857	0.17083	28	917.10	911.52	905.95	900.37	894.80
Mar	0	-9.7165	1026.683	-0.10867	31	929.52	919.80	910.08	900.37	890.65
Apr	0	-13.3066	1022.460	-0.12483	30	889.39	876.09	862.78	849.47	836.17
May	-8.06066	-3.8263	1040.929	0.14100	31	1,001.53	997.70	993.88	990.05	986.22
Jun	-10.36564	-8.1935	1144.510	0.38467	30	1,058.59	1,050.39	1,042.20	1,034.01	1,025.81
Jul	-26.92554	-13.1197	1227.951	0.42417	31	1,085.33	1,072.21	1,059.09	1,045.97	1,032.85
Aug	-10.27801	-8.5856	1196.598	0.29317	31	1,107.73	1,099.14	1,090.56	1,081.97	1,073.39
Sep	-25.91745	-6.7459	1237.205	0.30800	30	1,161.76	1,155.02	1,148.27	1,141.52	1,134.78
Oct	-2.66150	-15.7746	1191.280	0.30833	31	1,032.71	1,016.94	1,001.16	985.39	969.62
Nov	-13.12306	-14.1786	1128.953	0.29983	30	983.23	969.05	954.88	940.70	926.52
Dec	-4.66067	-10.3147	1045.232	0.36350	31	940.39	930.08	919.76	909.45	899.13
			Annual projections:			998.66	988.51	978.15	968.19	958.04
TAWC2010TEST2MOAVG.XLS										