COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

IN THE MATTER OF:	)	
	)	
NOTICE OF ADJUSTMENT OF THE RATES OF	)	**CASE NO. 2007-00143**
KENTUCKY-AMERICAN WATER COMPANY	)	
EFFECTIVE ON AND AFTER MAY 30, 2007	)	

DIRECT TESTIMONY OF DR. EDWARD L. SPITZNAGEL, JR.

April 30, 2007

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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 Kentucky American Water Company to make weather-normalized predictions of water utilization by residential and commercial customers for the period December 2007 to November 2008.

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 to 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 for both residential and commercial customer classes.

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 this Commission, 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.

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 for Kentucky American Water Company. 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 added 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.

I updated the model for the present case by fitting the same predictors to utilization data from January 1998 through December 2006.

8. Q. THIS IS A PERIOD OF NINE YEARS. WHY DID YOU NOT EMPLOY THE CUSTOMARY PERIOD OF TEN YEARS?

A. In 1998, a new, more precise reporting method became available, which gives consumption per billed day. To take advantage of the more precise information, I was limited to nine rather than ten years of data. In future cases, it will be possible to base weather-normalized estimates on a full ten years of data.

9. Q. YOUR WEATHER-NORMALIZED ESTIMATES OF CONSUMPTION MADE BACK IN 2004 FOR THE YEAR 2007 WERE 158.56 GAL/CUST DAY RESIDENTIAL AND 1338.17 GAL/CUST DAY COMMERCIAL. YOUR CURRENT WEATHER-NORMALIZED ESTIMATES FOR THE YEAR 2007 ARE 164.76 GAL/CUST DAY RESIDENTIAL AND 1416.96 GAL/CUST DAY. THE CURRENT ESTIMATES ARE RESPECTIVELY 4% AND 6% HIGHER THAN THE ONES FROM 2004. IS THE NEW REPORTING METHOD THE REASON WHY YOUR CURRENT ESTIMATES FOR 2007 ARE DIFFERENT FROM THOSE YOU MADE IN 2004?

A. No. I compared, year by year, the estimates from the new reporting method, which provides consumption per billed day, and the old reporting method, which provides monthly billed consumption per customer, and found only about a 1% difference between the two methods, for each of the residential and commercial customer classes.

10. Q. WHAT IS THE MOST PLAUSIBLE EXPLANATION FOR THE WEATHER-NORMALIZED ESTIMATES FOR 2007 DISAGREEING BETWEEN 2004 AND 2007?

A. There is a well-known phenomenon that extrapolated estimates become less accurate the farther they are from the data used to estimate them. In the case of the estimates made in 2004 for 2007, there is a three-year gap between the final consumption values, in December 2003, and the period January-December 2007. In the case of the current estimates, there is no gap between the final consumption values, in December 2006, and the period January-December 2007. Because of the greater extrapolation involved, the estimates made in 2004 are expected to be less accurate.

11. Q. IF EXTRAPOLATION IS NOT ACCURATE, WHY HAVE YOU PROVIDED ESTIMATES FOR THE YEARS 2007 THROUGH 2010?

A. My primary reason is to illustrate that per-customer water consumption is estimated to decline over time. This decline plays a role in making the weather-normalized estimates for the period December 2007-November 2008.

12. Q. IS THERE ANY WAY TO VISUALIZE THE DECLINE IN CONSUMPTION OVER TIME?

A. The two graphs in Appendix B show the per-customer water consumption averaged over the 12 months of each year, graphed against year from 1998 to 2006, for residential and customer classes. The graphs include the least-squares regression trend lines, with slopes –2.9 and –10.6, respectively for residential and commercial customers. These graphs exhibit up-and-down trends driven by weather conditions, but they do not adjust for those weather conditions. My weather-normalizations include both time and weather simultaneously, in order to estimate consumption under average weather for December 2007 to November 2008.

13. Q. IN YOUR WEATHER NORMALIZATION, WHAT VARIABLES WERE FOUND TO PREDICT UTILIZATION?

A. The calendar year, the month of the year (as a categorical variable), and the Palmer Drought Severity Index, PDSI. The month of the year was found to interact with PDSI, meaning that the effect of PDSI on consumption varies by month. I therefore accounted for this interaction by running separate models for each month, omitting PDSI for the months of January through April due to there being no weather-driven consumption during these months. These separate models are found in Appendix C.

14. Q. ONCE YOU HAD ESTIMATED THE COEFFICIENTS IN THESE MONTHLY MODELS, HOW DID YOU PROJECT UTILIZATION FOR DECEMBER 2007 THROUGH NOVEMBER 2008?

A. I put the coefficients from the monthly regressions into Excel spreadsheets, one for each of the two customer classes. I then calculated the monthly mean PDSI over the 30 year period from January 1977 to December 2006. These spreadsheets are given in Appendix D.

15. Q. HAVING INSERTED THE MEAN DROUGHT SEVERITY INDICES IN THE SPREADSHEETS, HOW DID YOU PROCEED?

A. I then projected an average daily utilization for each month under average weather. I then computed a weighted average of these 12 utilizations using as weights the number of days from the preceding month. Using the days from the preceding month allows for the fact that bills in, for example, March include utilization from the latter part of February.

16. Q. DID YOU ACCOUNT FOR 2008 BEING A LEAP YEAR?

A. Yes, I did, by modifying the formulas for the column headed by the year 2008, as well as the formula for the normalized estimates for the period December 2007 through November 2008.

17. Q. WHAT ARE YOUR PROJECTIONS OF DAILY UTILIZATION UNDER AVERAGE WEATHER FOR THE TWO CUSTOMER CLASSES?

A. For residential customers: 162.80 gallons / customer / day
For commercial customers: 1408.90 gallons / customer / day

18. Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes, it does.

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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16. Use of a questionnaire-oriented research project in teaching undergraduate statistics. *Proceedings of the Fourth Annual Conference on Computers in the Undergraduate Curricula*, 352-357 (1973).

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18. Use of SAS in teaching a first course in statistics. *Proceedings of the First Annual Conference of SAS Users Group International*, 85-89 (1976).

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20. K.W.I.C. indexes with SAS. *Proceedings of the Third Annual Conference of SAS Users Group International*, 267-270 (1978).

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23. Interfacing SAS with Mark IV. *Proceedings of the Fourth Annual Conference of SAS Users Group International,* 41-44 (1979).

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43. Breast self examination as a screening procedure. *Third International Conference on System Science in Health Care*, 455-458 (1984). (With Gohagan et al.)

44. ROC analysis of mammography alone and in combination with clinical palpation for breast screening. *Third International Conference on System Science in Health Care,* 463-466 (1984). (With Gohagan et al.)

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46. Graphic representation of logistic regression models. *Proceedings of the Ninth Annual Conference of SAS Users Group International,* 870-873 (1984). (With Gohagan et al.)

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48. ROC analysis of mammography and palpation for breast screening. *Invest Radiol* **19**, 587-592 (1984). (With Gohagan et al.)

49. A proposed solution to the base rate problem in the kappa statistic. *Arch Gen Psychiatry* **42**, 725-728 (1985). (With Helzer)

50. A comparison of clinical and Diagnostic Interview Schedule diagnoses: Physician reexamination of lay-interviewed cases in the general population. *Arch Gen Psychiatry* **42**, 657-666 (1985). (With Helzer et al.)

51. A mouse embryo culture system for quality control testing of human in vitro fertilization and embryo transfer media and fetal cord sera. *Gamete Research* **11**, 411-419 (1985). (With Cheung et al.)

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53. Sampling the household population. in *Epidemiologic Field Methods in Psychiatry: The NIMH Epidemiologic Catchment Area Program,* edited by W. Eaton and L. Kessler. Academic Press. 23-48 (1985). (With Holzer et al.)

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72. The relation of ulcerative colitis to psychiatric factors: a review of findings and methods. *Am J Psychiatry* **147**, 974-981 (1990). (With North et al.)

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74. Time-series analysis of myoelectric cycling of sphincter of Oddi: evidence of cycling during fed state. *Am J Physiology* **259**, 511-517 (1990). (With Zenilman et al.)

75. The effect of prescribed daily dose frequency on patient medication compliance. *Arch Intern Med* **150**, 1881-1884 (1990). (With Eisen et al.)

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82. Agreement between DSM-III and III-R substance use disorders. *Drug and Alcohol Dependence* **29**, 17-25 (1991). (With Cottler et al.)

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106. Prediction of occult neck disease in laryngeal cancer by means of a logistic regression statistical model. *Laryngoscope* **104**, 1280-1284 (1994). (With Ghouri et al.)

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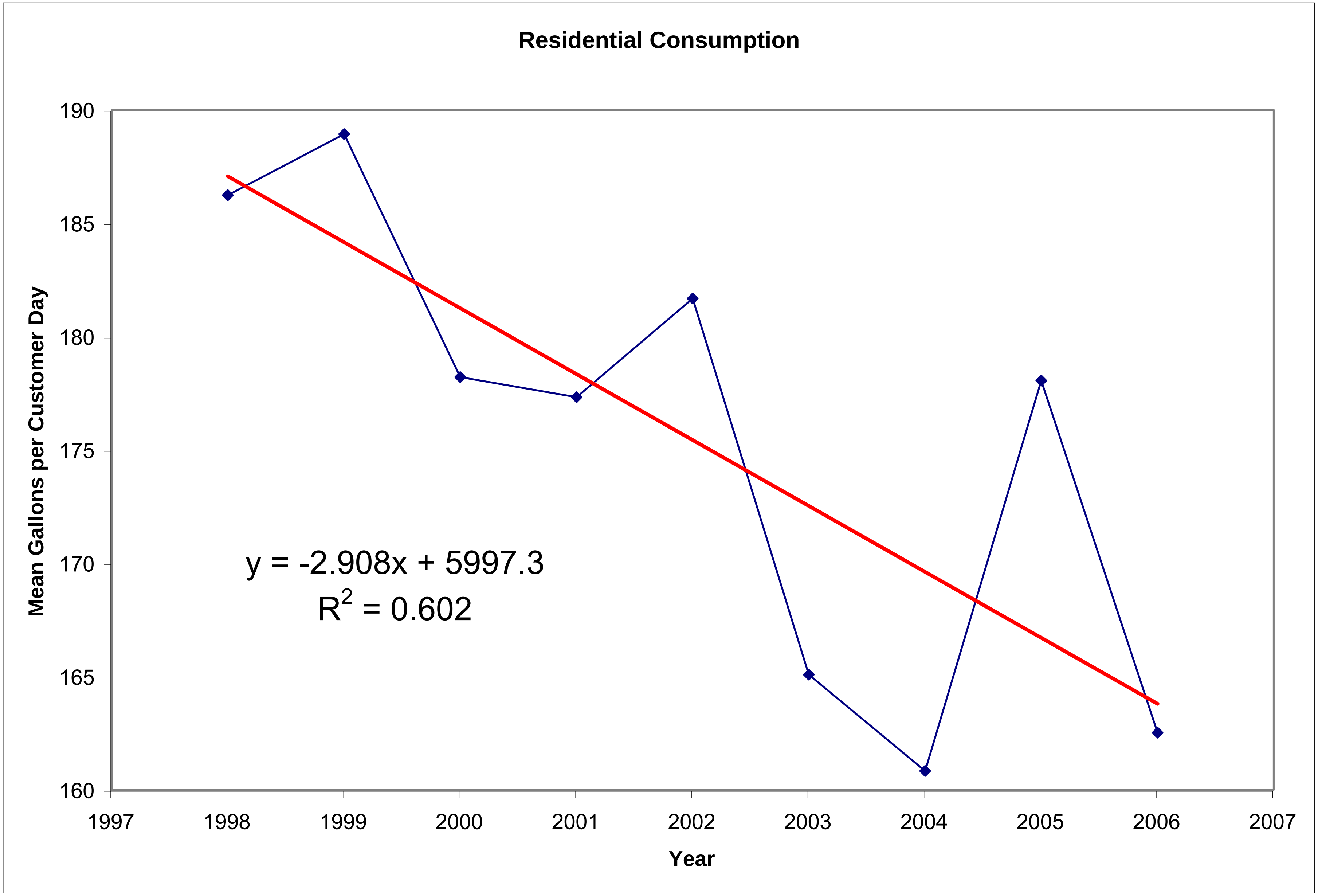
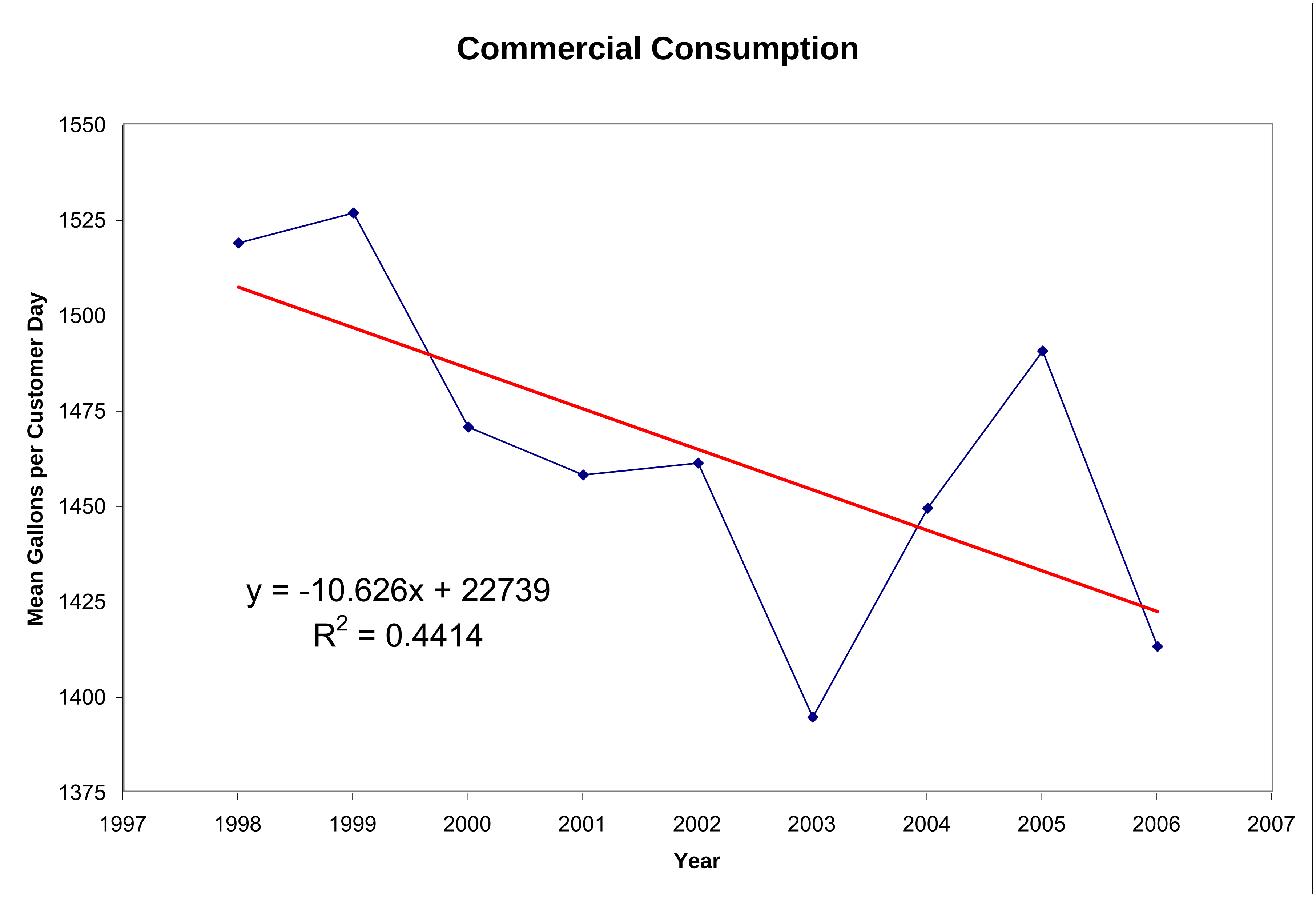
APPENDIX B


Residential Consumption
190
185
180
175
170
165
160
Mean Gallons per Customer Day
y = -2.908x + 5997.3
R2 = 0.602
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Year



Commercial Consumption
Mean Gallons per Customer Day
1550
1525
1500
1475
1450
1425
1400
1375
y = -10.626x + 22739
R2 = 0.4414
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Year

Run regressions by month: Lexington, JAN1998-DEC2006
Residential Model, JANUARY

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	143.62348	143.62348	2.01	0.1995
Error	7	500.94567	71.56367		
Corrected Total	8	644.56916			

Root MSE	8.45953	R-Square	0.2228
Dependent Mean	154.73778	Adj R-Sq	0.1118
Coeff Var	5.46701		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	173.30378	13.40538	12.93	<.0001
since_90	1	-1.54717	1.09212	-1.42	0.1995

Run regressions by month: Lexington, JAN1998-DEC2006
Residential Model, FEBRUARY

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	461.42720	461.42720	10.97	0.0129
Error	7	294.43469	42.06210		
Corrected Total	8	755.86189			

Root MSE	6.48553	R-Square	0.6105
Dependent Mean	155.81889	Adj R-Sq	0.5548
Coeff Var	4.16222		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	189.09689	10.27729	18.40	<.0001
since_90	1	-2.77317	0.83728	-3.31	0.0129

Run regressions by month: Lexington, JAN1998-DEC2006
Residential Model, MARCH

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	165.03734	165.03734	13.06	0.0086
Error	7	88.48826	12.64118		
Corrected Total	8	253.52560			

Root MSE	3.55544	R-Square	0.6510
Dependent Mean	151.25000	Adj R-Sq	0.6011
Coeff Var	2.35071		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	171.15200	5.63413	30.38	<.0001
since_90	1	-1.65850	0.45901	-3.61	0.0086

Run regressions by month: Lexington, JAN1998-DEC2006
Residential Model, APRIL

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	168.40451	168.40451	30.33	0.0009
Error	7	38.86629	5.55233		
Corrected Total	8	207.27080			

Root MSE	2.35634	R-Square	0.8125
Dependent Mean	152.31333	Adj R-Sq	0.7857
Coeff Var	1.54703		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	172.41733	3.73397	46.18	<.0001
since_90	1	-1.67533	0.30420	-5.51	0.0009

Run regressions by month: Lexington, JAN1998-DEC2006
Residential Model, MAY

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	496.87873	248.43937	1.60	0.2777
Error	6	932.80467	155.46744		
Corrected Total	8	1429.68340			

Root MSE	12.46866	R-Square	0.3475
Dependent Mean	168.64000	Adj R-Sq	0.1301
Coeff Var	7.39365		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	197.23268	20.75819	9.50	<.0001
pdsi	1	-1.36851	2.24752	-0.61	0.5649
since_90	1	-2.39045	1.69089	-1.41	0.2072

Run regressions by month: Lexington, JAN1998-DEC2006
Residential Model, JUNE

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	2698.62205	1349.31103	9.48	0.0139
Error	6	854.41010	142.40168		
Corrected Total	8	3553.03216			

Root MSE	11.93322	R-Square	0.7595
Dependent Mean	187.43778	Adj R-Sq	0.6794
Coeff Var	6.36650		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	235.15337	18.93887	12.42	<.0001
pdsi	1	-6.70023	1.99567	-3.36	0.0153
since_90	1	-3.88820	1.54474	-2.52	0.0455

Run regressions by month: Lexington, JAN1998-DEC2006
Residential Model, JULY

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	2811.59626	1405.79813	9.07	0.0154
Error	6	930.27076	155.04513		
Corrected Total	8	3741.86702			

Root MSE	12.45171	R-Square	0.7514
Dependent Mean	210.73444	Adj R-Sq	0.6685
Coeff Var	5.90872		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	227.67383	19.75963	11.52	<.0001
pdsi	1	-7.26819	1.76704	-4.11	0.0063
since_90	1	-1.42709	1.60970	-0.89	0.4094

Run regressions by month: Lexington, JAN1998-DEC2006
Residential Model, AUGUST

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	3818.70583	1909.35292	21.42	0.0019
Error	6	534.94297	89.15716		
Corrected Total	8	4353.64880			

Root MSE	9.44231	R-Square	0.8771
Dependent Mean	212.45000	Adj R-Sq	0.8362
Coeff Var	4.44448		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	182.87586	17.09380	10.70	<.0001
pdsi	1	-10.37049	1.63216	-6.35	0.0007
since_90	1	2.04969	1.36919	1.50	0.1850

Run regressions by month: Lexington, JAN1998-DEC2006
Residential Model, SEPTEMBER

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	1834.81434	917.40717	1.72	0.2569
Error	6	3201.87628	533.64605		
Corrected Total	8	5036.69062			

Root MSE	23.10078	R-Square	0.3643
Dependent Mean	204.08556	Adj R-Sq	0.1524
Coeff Var	11.31916		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	230.52715	45.81873	5.03	0.0024
pdsi	1	-4.10746	3.96129	-1.04	0.3398
since_90	1	-2.22819	3.74942	-0.59	0.5740

Run regressions by month: Lexington, JAN1998-DEC2006
Residential Model, OCTOBER

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	9
Number of Observations Used	8
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	2022.69552	1011.34776	2.63	0.1662
Error	5	1926.31837	385.26367		
Corrected Total	7	3949.01389			

Root MSE	19.62813	R-Square	0.5122
Dependent Mean	192.15125	Adj R-Sq	0.3171
Coeff Var	10.21494		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	249.89731	37.86708	6.60	0.0012
pdsi	1	-1.37656	2.87100	-0.48	0.6518
since_90	1	-4.85544	3.14374	-1.54	0.1831

Run regressions by month: Lexington, JAN1998-DEC2006
Residential Model, NOVEMBER

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	990.78530	495.39265	13.64	0.0059
Error	6	217.95545	36.32591		
Corrected Total	8	1208.74076			

Root MSE	6.02710	R-Square	0.8197
Dependent Mean	163.48778	Adj R-Sq	0.7596
Coeff Var	3.68657		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	194.39926	11.54170	16.84	<.0001
pdsi	1	-1.59607	0.75569	-2.11	0.0791
since_90	1	-2.53354	0.95872	-2.64	0.0384

Run regressions by month: Lexington, JAN1998-DEC2006
Residential Model, DECEMBER

The REG Procedure
Model: MODEL1
Dependent Variable: residential

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	301.58043	150.79021	11.71	0.0085
Error	6	77.27326	12.87888		
Corrected Total	8	378.85369			

Root MSE	3.58872	R-Square	0.7960
Dependent Mean	155.07889	Adj R-Sq	0.7280
Coeff Var	2.31412		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	178.26895	6.89188	25.87	<.0001
pdsi	1	-0.38854	0.45868	-0.85	0.4294
since_90	1	-1.93348	0.56495	-3.42	0.0141

Run regressions by month: Lexington, JAN1998-DEC2006
Commercial Model, JANUARY

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	9
Number of Observations Used	8
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	69.58172	69.58172	0.02	0.9060
Error	6	27526	4587.62881		
Corrected Total	7	27595			

Root MSE	67.73204	R-Square	0.0025
Dependent Mean	1241.17000	Adj R-Sq	-0.1637
Coeff Var	5.45711		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1254.90090	114.03522	11.00	<.0001
since_90	1	-1.18115	9.59075	-0.12	0.9060

Run regressions by month: Lexington, JAN1998-DEC2006
Commercial Model, FEBRUARY

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	39.93504	39.93504	0.01	0.9264
Error	7	30494	4356.32881		
Corrected Total	8	30534			

Root MSE	66.00249	R-Square	0.0013
Dependent Mean	1298.05111	Adj R-Sq	-0.1414
Coeff Var	5.08474		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1307.84111	104.59075	12.50	<.0001
since_90	1	-0.81583	8.52088	-0.10	0.9264

Run regressions by month: Lexington, JAN1998-DEC2006
Commercial Model, MARCH

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	760.06004	760.06004	0.22	0.6522
Error	7	24021	3431.50469		
Corrected Total	8	24781			

Root MSE	58.57905	R-Square	0.0307
Dependent Mean	1288.80111	Adj R-Sq	-0.1078
Coeff Var	4.54524		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1331.51111	92.82720	14.34	<.0001
since_90	1	-3.55917	7.56252	-0.47	0.6522

Run regressions by month: Lexington, JAN1998-DEC2006
Commercial Model, APRIL

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	210.78753	210.78753	0.09	0.7727
Error	7	16365	2337.81835		
Corrected Total	8	16576			

Root MSE	48.35099	R-Square	0.0127
Dependent Mean	1307.19222	Adj R-Sq	-0.1283
Coeff Var	3.69884		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1329.68422	76.61933	17.35	<.0001
since_90	1	-1.87433	6.24209	-0.30	0.7727

Run regressions by month: Lexington, JAN1998-DEC2006
Commercial Model, MAY

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	14897	7448.71392	2.01	0.2148
Error	6	22246	3707.60784		
Corrected Total	8	37143			

Root MSE	60.89013	R-Square	0.4011
Dependent Mean	1415.22111	Adj R-Sq	0.2014
Coeff Var	4.30252		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1593.06759	101.37168	15.72	<.0001
pdsi	1	-3.24091	10.97564	-0.30	0.7777
since_90	1	-14.83884	8.25739	-1.80	0.1225

Run regressions by month: Lexington, JAN1998-DEC2006
Commercial Model, JUNE

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	64396	32198	14.71	0.0049
Error	6	13130	2188.34868		
Corrected Total	8	77526			

Root MSE	46.77979	R-Square	0.8306
Dependent Mean	1517.74000	Adj R-Sq	0.7742
Coeff Var	3.08220		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1759.85643	74.24289	23.70	<.0001
pdsi	1	-31.93983	7.82328	-4.08	0.0065
since_90	1	-19.75642	6.05559	-3.26	0.0172

Run regressions by month: Lexington, JAN1998-DEC2006
Commercial Model, JULY

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	76970	38485	17.94	0.0029
Error	6	12872	2145.28890		
Corrected Total	8	89842			

Root MSE	46.31726	R-Square	0.8567
Dependent Mean	1667.50000	Adj R-Sq	0.8090
Coeff Var	2.77765		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1869.48845	73.50090	25.43	<.0001
pdsi	1	-33.70895	6.57294	-5.13	0.0022
since_90	1	-16.90416	5.98768	-2.82	0.0302

Run regressions by month: Lexington, JAN1998-DEC2006
Commercial Model, AUGUST

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	147373	73687	14.31	0.0052
Error	6	30886	5147.73939		
Corrected Total	8	178260			

Root MSE	71.74775	R-Square	0.8267
Dependent Mean	1749.03667	Adj R-Sq	0.7690
Coeff Var	4.10213		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1715.67315	129.88790	13.21	<.0001
pdsi	1	-59.29888	12.40202	-4.78	0.0031
since_90	1	0.40834	10.40386	0.04	0.9700

Run regressions by month: Lexington, JAN1998-DEC2006
Commercial Model, SEPTEMBER

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	10224	5111.87167	0.19	0.8348
Error	6	164771	27462		
Corrected Total	8	174995			

Root MSE	165.71625	R-Square	0.0584
Dependent Mean	1697.21000	Adj R-Sq	-0.2554
Coeff Var	9.76404		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1591.52650	328.68618	4.84	0.0029
pdsi	1	-17.26505	28.41678	-0.61	0.5657
since_90	1	8.70305	26.89694	0.32	0.7572

Run regressions by month: Lexington, JAN1998-DEC2006
Commercial Model, OCTOBER

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	9
Number of Observations Used	8
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	36389	18194	1.44	0.3201
Error	5	63039	12608		
Corrected Total	7	99428			

Root MSE	112.28490	R-Square	0.3660
Dependent Mean	1657.43625	Adj R-Sq	0.1124
Coeff Var	6.77461		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1946.20650	216.62278	8.98	0.0003
pdsi	1	-0.84320	16.42384	-0.05	0.9610
since_90	1	-24.31297	17.98408	-1.35	0.2343

Run regressions by month: Lexington, JAN1998-DEC2006
Commercial Model, NOVEMBER

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	26348	13174	3.14	0.1168
Error	6	25192	4198.61283		
Corrected Total	8	51540			

Root MSE	64.79670	R-Square	0.5112
Dependent Mean	1424.73333	Adj R-Sq	0.3483
Coeff Var	4.54799		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1646.16351	124.08365	13.27	<.0001
pdsi	1	-3.14956	8.12439	-0.39	0.7116
since_90	1	-18.36882	10.30707	-1.78	0.1250

Run regressions by month: Lexington, JAN1998-DEC2006
Commercial Model, DECEMBER

The REG Procedure
Model: MODEL1
Dependent Variable: commercial

Number of Observations Read	9
Number of Observations Used	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	32418	16209	1.85	0.2360
Error	6	52432	8738.69224		
Corrected Total	8	84850			

Root MSE	93.48097	R-Square	0.3821
Dependent Mean	1313.16667	Adj R-Sq	0.1761
Coeff Var	7.11874		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1555.37275	179.52375	8.66	0.0001
pdsi	1	22.63926	11.94801	1.89	0.1069
since_90	1	-20.12724	14.71612	-1.37	0.2204

	Projections of Residential Water Utilization, Gallons per Day, Kentucky-American								
	Slope of	Slope of		30-yr Avg	Days	2007	2008	2009	2010
Month	PDSI	SINCE_90	Intercept	PDSI		Gal/Day	Gal/Day	Gal/Day	Gal/Day
Jan	0	-1.54717	173.3038	0.03400	31	147.00	145.45	143.91	142.36
Feb	0	-2.77317	189.0969	-0.20967	31	141.95	139.18	136.41	133.63
Mar	0	-1.65850	171.1520	-0.33733	28	142.96	141.30	139.64	137.98
Apr	0	-1.67533	172.4173	-0.15167	31	143.94	142.26	140.59	138.91
May	-1.36851	-2.39045	197.2327	0.22600	30	156.29	153.90	151.50	149.11
Jun	-6.70023	-3.88820	235.1534	0.30033	31	167.04	163.15	159.27	155.38
Jul	-7.26819	-1.42709	227.6738	-0.02067	30	203.56	202.14	200.71	199.28
Aug	-10.37049	2.04969	182.8759	-0.08400	31	218.59	220.64	222.69	224.74
Sep	-4.10746	-2.22819	230.5272	0.11933	31	192.16	189.93	187.70	185.47
Oct	-1.37656	-4.85544	249.8973	0.60467	30	166.52	161.67	156.81	151.96
Nov	-1.59607	-2.53354	194.3993	0.66233	31	150.27	147.74	145.20	142.67
Dec	-0.38854	-1.93348	178.2690	0.55067	30	145.19	143.25	141.32	139.39
			Annual projections:			164.76	162.64	160.63	158.56
KYAM2007.XLS	**Projection: Dec 2007 to Nov 2008**						162.80		

	Projections of Commercial Water Utilization, Gallons per Day, Kentucky-American								
	Slope of	Slope of		30-yr Avg	Days	2007	2008	2009	2010
Month	PDSI	SINCE_90	Intercept	PDSI		Gal/Day	Gal/Day	Gal/Day	Gal/Day
Jan	0	-1.18115	1254.901	0.03400	31	1,234.82	1,233.64	1,232.46	1,231.28
Feb	0	-0.81583	1307.841	-0.20967	31	1,293.97	1,293.16	1,292.34	1,291.52
Mar	0	-3.55917	1331.511	-0.33733	28	1,271.01	1,267.45	1,263.89	1,260.33
Apr	0	-1.87433	1329.684	-0.15167	31	1,297.82	1,295.95	1,294.07	1,292.20
May	-3.24091	-14.83884	1593.068	0.22600	30	1,340.07	1,325.24	1,310.40	1,295.56
Jun	-31.93983	-19.75642	1759.856	0.30033	31	1,414.40	1,394.65	1,374.89	1,355.14
Jul	-33.70895	-16.90416	1869.488	-0.02067	30	1,582.81	1,565.91	1,549.01	1,532.10
Aug	-59.29888	0.40834	1715.673	-0.08400	31	1,727.60	1,728.00	1,728.41	1,728.82
Sep	-17.26505	8.70305	1591.527	0.11933	31	1,737.42	1,746.12	1,754.82	1,763.53
Oct	-0.84320	-24.31297	1946.207	0.60467	30	1,532.38	1,508.06	1,483.75	1,459.44
Nov	-3.14956	-18.36882	1646.164	0.66233	31	1,331.81	1,313.44	1,295.07	1,276.70
Dec	22.63926	-20.12724	1555.373	0.55067	30	1,225.68	1,205.55	1,185.42	1,165.29
			Annual projections:			1,416.96	1,407.25	1,398.30	1,388.97
KYAM2007.XLS			**Projection: Dec 2007 to Nov 2008**				1,408.90		