Price Elasticity for Residential Water Demand in the City of Goodyear

Undergraduate Internship for Science-Practice Integration

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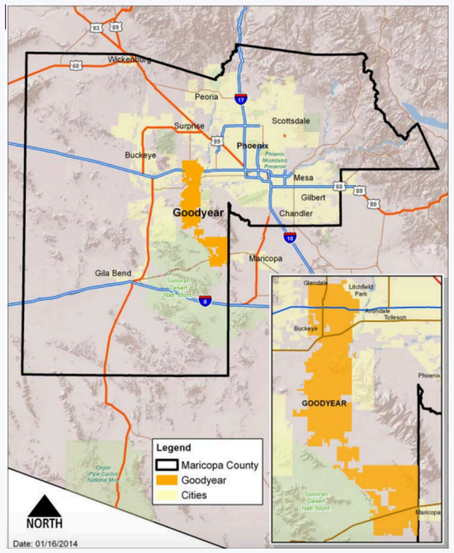
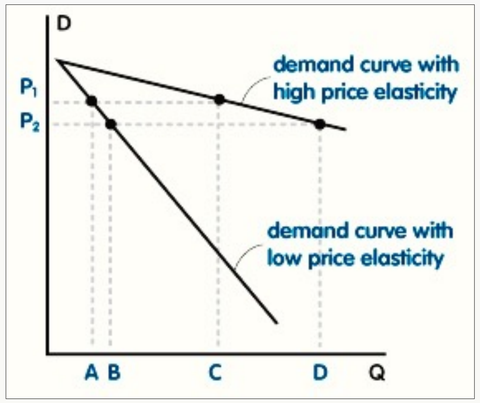
Research Statement

The City of Goodyear is interested in understanding how changes in price and weather patterns will affect revenue from residential water use.



Research Approach

By measuring the elasticity of residential water demand to changes in price and weather through a linear regression model, a reasonable of likely changes in revenue can be provided.



Summary Statistics

The dependent (*criterion*) variable in this equation is residential water consumption

Total Residential Water Consumption Measured in Centum Cubic Feet					
	2010	2011	2012	2013	2014
January	102085	120964	78861	97883	103013
February	74169	78736	99657	76304	83011
March	73292	57099	84887	79141	85269
April	107443	110020	91682	93379	120085
May	101787	133366	134203	132327	109351
June	113668	77089	120647	118195	118730
July	154019	149304	124385	127192	157624
August	147992	155852	148859	160405	120745
September	81661	86156	112928	112766	110054
October	135179	137150	103899	130109	120821
November	123628	120518	126045	100302	97441
December	60065	70173	86142	81681	74878
Total	1274988	1306270	1312195	1309684	1301022

*One Centum Cubic Foot (CCF) Equals 748 Gallons

The independent (*predictor*) variables are price, temperature, and precipitation

City of Goodyear Increasing Block Rate Prices Per 1,000 Gallons					
Rate Blocks	2010	2011	2012	2013	2014
0-6,000 gal	$ 1.27	$ 1.32	$ 1.46	$ 1.18	$ 1.18
6,001-12,000 gal	$ 2.54	$ 2.64	$ 2.92	$ 2.36	$ 2.36
12,001-30,000 gal	$ 3.81	$ 3.96	$ 4.38	$ 3.54	$ 3.54
30,001 plus gal	$ 4.95	$ 5.15	$ 5.69	$ 5.69	$ 5.69

City of Goodyear Base Rate Prices Monthly					
Meter Size (inches)	2010	2011	2012	2013	2014
0.75	$ 9.69	$ 9.94	$ 10.05	$ 10.23	$ 10.23
1	$ 10.95	$ 11.81	$ 12.74	$ 14.14	$ 14.14
1.5	$ 13.56	$ 16.36	$ 19.74	$ 22.86	$ 22.86
2	$ 21.47	$ 26.22	$ 32.02	$ 37.01	$ 37.01
3	$ 38.05	$ 48.43	$ 61.64	$ 70.67	$ 70.67
4	$ 69.78	$ 83.36	$ 99.58	$ 115.24	$ 115.24
6	$ 135.11	$ 158.83	$ 189.08	$ 218.71	$ 218.71

Monthly Average of Average Daily Temperatures (Degrees Fahrenheit)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	55.06	57.7	61.48	68.8	76.03	88.07	94.63	91.81	87.79	74.55	59.53	56.39
2011	52.92	53.79	65.32	72.27	76.79	87.65	93.65	95.82	87.92	75.15	60.5	51.05
2012	56.21	57.71	63.31	72.98	81.65	90.97	92.13	93.68	86.32	75.37	64.82	53.56
2013	51.47	55.09	66.92	72.45	81.11	92.02	94.74	91.81	85.47	70.74	63.27	53.03
2014	56.6	61.62	66.61	72.4	81.08	90.42	94.08	89.45	86.1	76.27	62.27	55.18

Monthly Sum of Precipitation (Inches)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	3.28	1.6	1.07	0	0	0	0.91	1.21	0	0.45	0.11	1.83
2011	0	0.8	0.23	0.39	0	0	0.4	0	0.11	0.34	0.61	1.06
2012	0.03	0.02	0.67	0.03	0	0	1.18	1.59	0.14	0	0.02	1.06
2013	1.14	0.15	0.26	0.03	0	0	0.26	1.74	1.05	0.05	2.26	0.61
2014	0	0	1.23	0	0	0	0.53	2.38	5.4	0.21	0	0.74

*Continuity of Operations (COOP) Site at Litchfield Park, AZ Selected

- The control variable for this model was population, data was found using the 2010 U.S. Census Report and the 2012 U.S. Census Bureau, American Community Survey report

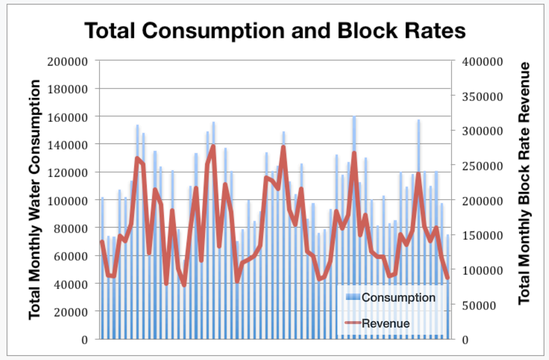
Research Methods

- Consumption data cleaned to reflect proper demographics
- Increasing block prices identified as function of consumption
- Averaged price method used in block rate pricing calculations
- Ordinary Least Squares method used for estimation of elasticities

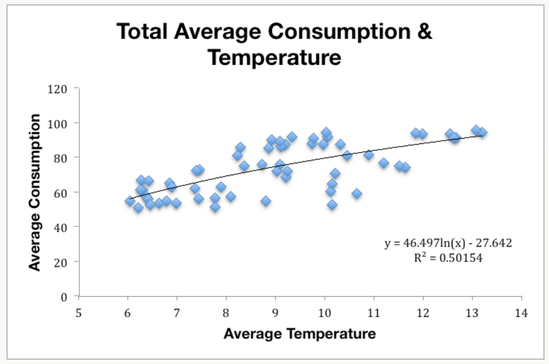
Limitations

- Water conservation data unavailable: unaccounted effect
- Household data integration unachievable due to time constraint

Analysis



- The statistical software, SPSS, was used to perform an Ordinary Least Squares (OLS) regression analysis



Results

Model Summary and Coefficients						
	Zero order r	B	SE B	b	t	p
Population	-.039	-.161	1.072	-0.20	-.150	.881
Price	.175	23387.85	18059.16	.178	1.295	.201
Precipitation	.044	1734.19	3866.65	.060	.449	.656
Temperature	.035	-1.694	245.27	-.001	-.007	.995

*Overall Model. R^2 = .035, adjusted R^2 = -.036; F (1, 59) = .492 p = .742
**Tolerance: Population .985, Price .925, Precipitation .984, Temperature .933

Conclusions

A reliable estimate of the elasticity proved difficult due to endogeneity in the error term possibly from the omitted conservation variable.

Strongly correlated predictors have made regression coefficients unstable, also negatively impacting the ability to interpret the impact of price and weather patterns on water consumption.

Future Research

Further understanding of more sophisticated methods for modeling increasing block rate structure using marginal price and alternative specifications for the demand equation must be understood to complete this research project.

Acknowledgment

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