

The Impact of a Xeriscape Newsletter on Residential Water Demand

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THE IMPACT OF A XERISCAPE NEWSLETTER ON RESIDENTIAL WATER DEMAND

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ABSTRACT

*Interest in xeriscape--landscape practices utilizing low water-demand, drought-resistant plants--has intensified in the U.S, particularly in the West in the past decade. This study provides an empirical analysis of the effect of a water conservation oriented "xeriscape newsletter" on the demand for water using a data set of residential households in Austin, Texas for period from 1985 to 1991. While interest in using xeriscape techniques has grown tremendously in the past decade, there are no studies to date which have econometrically evaluated the effectiveness of xeriscaping or the factors that influence the adoption of xeriscaped landscapes.*

*The estimation procedure used in this analysis corrects for both selectivity bias and choice-based sampling since the data set under investigation may be potentially subjected to these types of biases. Sample selectivity arises because households that are more interested in engaging in conservation practices may be more likely to want to receive the xeriscape newsletter. Choice-based sampling arises because of differences in sampling rates among xeriscape newsletter users and non-xeriscape newsletter users. Without correcting for these biases, the effectiveness of the xeriscape newsletter on water conservation practices for the average household may be overstated. To correct for selectivity bias, an explicit analysis of the factors involved in the selection of the newsletter is performed; to correct for choice-based sampling, a set of weights is calculated to account for differences in sampling rates.*

*The results of our analysis indicate that: (1) the newsletter*

recipients' unadjusted summer monthly water use is 2,441 gallons less than that for the rest of the general population, but (2) the newsletter recipients' water use, adjusted for selectivity bias, is only 255 gallons less, and, (3) newsletter recipients are less sensitive to water prices, lotsize, and climatic conditions.

## I. INTRODUCTION

In the western states, water utilities are increasing efforts to reduce long-run demands as a water supply strategy because water supplies have approached full-appropriation. However, the effectiveness of conservation measures has received empirical study only recently. Substantiating the effectiveness of conservation measures is critical in enabling water planners to confidently pursue and rely upon water conservation strategies in order to insure that adequate water supplies are available at a given time. Xeriscaping is promoted as a means of reducing water demand through a variety of landscape designs which involve variations in turf type, turf size, lot size, plant selection, use of mulches, and soil amendment practices. This use of horticultural principles to reduce the consumptive water demand of landscapes has been one of the most touted conservation principles in recent years, and is often one of the first strategies selected in the development of a water conservation program.

The contributions of this paper are two-fold. First, we examine the effect of xeriscape practices on residential water demand using survey data collected in Austin, Texas for the 1985-1991 time period. Our analysis examines the differences in the water demand equations of households who indicate some interest in xeriscaping practices versus a random selection of households.<sup>1</sup> In so doing, we are able to estimate the effect that xeriscaping

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<sup>1</sup> "Interest in xeriscape practices" is proxied, in this study, by a household's willingness to subscribe to the City's xeriscape newsletter which provides valuable information and guidelines for proper water conservation practices.

practices have on total residential water demand. To date, no studies have evaluated the effectiveness of xeriscape practices for decreasing municipal water demands in the actual urban environment. Previous studies regarding xeriscape have been controlled experiments examining only a limited number of factors which define xeriscape (Nelson, 1987).

Second, in this analysis we are especially interested in the econometric issues which focus on the measurement, sampling and modelling of the receipt of the xeriscape newsletter, which is the key element signalling interest in xeriscaping practices. It is important to note that receipt of this newsletter is not a random event; households *choose* to receive the newsletter and, consequently, it is important to model this decision variable in the appropriate manner. If water planners decide to send the newsletter to every household in the population then the effect of this newsletter in reducing water demand might not be as great as when the newsletter were voluntarily adopted by households. The relevance of this analysis for water planners is obvious: if xeriscape can be shown to be effective in decreasing water use, and, if this practice can be shown to occur as a variety of landscape choices which makes it more likely that consumers would accept xeriscape as a landscape practice, then an effective means of reducing water demand would involve promoting xeriscape practices in residential areas.

An analysis of the factors which determine the desirability or adoption of xeriscape practices on the part of water-consuming households is, in and of itself, worthy of study in order to provide water planners with valuable information about consumer behavior. If, for example, households choose xeriscape for reasons other than as a response to increasing water

prices, then water demands may not be expected to decrease in response to price-oriented policies. In particular, there is some evidence to support the notion that one reason consumers may choose to xeriscape is due to concern for environmental problems (e.g., xeriscape is also promoted as a strategy for reducing urban non-point source pollution). Additionally, if water planners are considering implementing mandatory xeriscape programs, then an understanding of the factors which may affect the success of these xeriscape programs is crucial.

The plan of the rest of the paper is as follows. The next section discusses the background of the xeriscape survey which provided the data set for this analysis. Section III discusses the existence of sample selectivity and choice-based sampling in the data. The model is described in section IV, and the empirical results are given in section V. A brief concluding section follows.

## II. Background of the 1991 Xeriscape Survey

The City of Austin provides water to over 500,000 people and has had active water conservation programs in place since 1983. In 1984 the City of Austin initiated a xeriscape program with an emphasis on educating the public on the use of xeriscape principles. Since then the City of Austin has developed a xeriscape newsletter and has tracked homeowners who expressed an interest in xeriscape through the xeriscape newsletter database.

In 1991 the City's Environmental Services and Conservation Department decided to investigate whether homeowners who implemented xeriscape principles

used less water than homeowners with more traditional landscapes. In order to investigate the efficacy of xeriscape in reducing outdoor water use, a survey was conducted by the City of Austin, the Lower Colorado River Authority and the Texas Water Commission (now part of the Texas Natural Resources Conservation Commission). One goal of the investigation was to create an index measuring the intensity of xeriscape practices. The measurement of the xeriscape index variable and its relation to water demand is the subject of future study. The current paper focuses on the xeriscape newsletter itself, which espouses the importance of the xeriscape principles.

Xeriscape principles emphasize the conservation of water (as well as protection of water quality through the decrease of non-point source pollution associated with urban irrigation). The utilization of the following seven basic principles should result in lower water use: good design, practical lawn areas, appropriate plant selection, use of mulches, appropriate maintenance, soil analysis, and improvements in and efficient use of irrigation.

In order to be included in the survey, each home had to meet the following characteristics: (1) owner-occupied, (2) no swimming pools, (3) no duplexes, and (4) landscape installed prior to March 1991. The necessary water utility data (e.g. water rates, water consumption, and property values) were obtained from the City of Austin's records. Additionally, this data set was augmented by gathering monthly rainfall and temperature data for Austin from the U.S. National Oceanic and Atmospheric Administration. For this study, the months of April through October were used as the normal irrigation season in Austin. A description of the variables in the data set is given in Table 1. Table 2 provides the mean statistics for households that subscribed

to the city's xeriscape newsletter, the "xeriscape newsletter group", and those who did not, the "non-xeriscape newsletter group." Table 3 describes the uniform block pricing schedule.

### III. SELECTIVITY BIAS AND CHOICE BASED SAMPLING

The data set used in this analysis is subject to two statistical anomalies that arise from sampling procedures: self-selectivity bias and choice-based sampling, each of which is discussed below. A reasonable test of xeriscape effectiveness could be conducted by randomly choosing households, applying different treatments (i.e., some households receive the newsletter, some do not), and observing the effects. This, however, is not practical in the setting used in this analysis. The source of the self selectivity bias in the sample should be obvious: the receipt of the xeriscape newsletter is not a random event but, rather, is *chosen* by the household. Consequently, it may be the case that households which are more likely to receive the newsletter may be systematically more likely to engage in water-conserving behavior. Thus the estimated effectiveness (on water conservation) of receipt of the xeriscape newsletter may be exaggerated due to biasedness of the estimated coefficients of the model. Cameron and Wright (1990), for example, investigated the potential selectivity bias for the effectiveness of water conservation retrofit activity in Los Angeles where participants voluntarily chose to participate in conservation programs. Correction for this selectivity bias requires that the household's process of selecting the newsletter be modelled.

The reason for the existence of choice-based sampling in the data set

should also be obvious. Households in our sample are classified according to whether or not they receive the xeriscape newsletter, and the choice to receive this newsletter is, itself, an endogenous one. Two difficulties arise from applying standard estimation techniques without correcting for the presence of choice-based sampling. First, application of the traditional Probit or Logit estimation techniques to a model with choice-based sampling will not provide an unbiased estimate of the conditional probability of choosing to receive the xeriscape newsletter for a household chosen at random.

This is due to the fact that the proportion of newsletter recipients in the sample differs significantly from the true proportion in the population. In our analysis, the number of newsletter recipients in the population of City of Austin water customers is relatively small; only about two percent of the population received this newsletter. Consequently, if one were to employ strictly random sampling procedures in selecting households into the sample, it is likely that the newsletter recipient group would be too small to provide reliable estimates. In order to ensure that a large enough number of newsletter recipients are included, our sample was designed so that approximately sixty-five percent of the households in the sample were newsletter recipients.

The second problem that arises from the presence of choice-based sampling is that the error term of the model will not satisfy the assumption of a zero-mean. The standard result of this violation is to introduce bias into the model's estimates. To correct for this bias, it is necessary to transform the model so that the transformed error term exhibits a zero mean.

To correct for the biases introduced by both of the problems associated

with choice-based sampling, it is necessary to calculate a set of weights which are based on the true population proportions and the sample proportions of newsletter recipients and non-newsletter recipients (see for example, Hall and Duncan, 1984). In our analysis, the actual proportion of households who receive the xeriscape newsletter in the population is, as discussed above, approximately two percent while the proportion in our sample is approximately sixty-five percent. Furthermore, the actual proportion of households who do not receive the xeriscape newsletter in the population is approximately ninety-eight percent while the proportion in our sample is approximately thirty-five percent. The weights with which to transform the model incorporate these sample and population proportions for the newsletter recipient as well as non-newsletter recipient households. The sample contained 100 households, 65 which received the newsletter and 35 which did not. If a household made significant changes to their landscape, only the months after the change were included. This implies that most of the observations were in the 1989-91 period.

#### IV. THE MODEL

An extensive review of the primary issues associated with the estimation of water demand is provided by Nieswiadomy (1992) and will not be repeated here. The models for this study are variations of the demand function used by Nieswiadomy (1992) and Nieswiadomy and Cobb (1993). The first model estimates a probit equation to determine the factors influencing the decision to receive the newsletter and to calculate the inverse Mills ratio. Next the water demand models for recipients and nonrecipients of the Austin xeriscape

newsletter are estimated using the selectivity correction factor. Following standard demand theory, functional forms of log-log water demand models are used. Specifically, the structure of the problem is as follows.

$$(1) \quad Y_{1i} = X_i \hat{\alpha}_1 + u_{1i} \quad (\text{for participants, i.e. chooses to receive xeriscape newsletter})$$

$$(2) \quad Y_{2i} = X_i \hat{\alpha}_2 + u_{2i} \quad (\text{for nonparticipants, i.e. chooses not to receive xeriscape newsletter})$$

$$(3) \quad I_i^* = Z_i \tilde{\alpha} + \hat{\alpha}_i \quad (\text{participation decision function})$$

$$I_i = 1 \text{ iff } I_i^* > 0;$$

$$I_i = 0 \text{ iff } I_i^* \leq 0$$

The observed  $y$  is defined as

$$y_i = y_{1i} \text{ iff } I_i = 1$$

$$y_i = y_{2i} \text{ iff } I_i = 0$$

$$\text{Cov}(u_{1i}, u_{2i}, \hat{\alpha}_i) =$$

$$\begin{matrix} \sigma_{11} & \sigma_{12} & \sigma_{1\hat{\alpha}} \\ \sigma_{21} & \sigma_{22} & \sigma_{2\hat{\alpha}} \\ \sigma_{1\hat{\alpha}} & \sigma_{2\hat{\alpha}} & 1 \end{matrix}$$

Thus the model is estimated as

$$(4) \quad Y_{1i} | I_i^* > 0 = X_i \hat{\alpha}_1 + \sigma_{1\hat{\alpha}} [\phi(Z_i \tilde{\alpha}) / \Phi(Z_i \tilde{\alpha})] \quad \text{if } I_i = 1$$

$$(5) \quad Y_{2i} | I_i^* \leq 0 = X_i \hat{\alpha}_2 + \sigma_{2\hat{\alpha}} [-\phi(Z_i \tilde{\alpha}) / (1 - \Phi(Z_i \tilde{\alpha}))] \quad \text{if } I_i = 0$$

Specifically, equations (4) and (5) are estimated in log-log form as:

$$(4') \quad \ln Q_1 = \hat{\alpha}_{01} + \hat{\alpha}_{11} \ln P_{\text{water}} + \hat{\alpha}_{21} \ln \text{Income} + \hat{\alpha}_{31} \ln \text{Rain} + \hat{\alpha}_{41} \ln \text{Temp} \\ + \hat{\alpha}_{51} \ln \text{Lotsize} + \sigma_{1\hat{\alpha}} \epsilon_1$$

$$(5') \quad \ln Q_2 = \hat{\alpha}_{02} + \hat{\alpha}_{12} \ln P_{\text{water}} + \hat{\alpha}_{22} \ln \text{Income} + \hat{\alpha}_{32} \ln \text{Rain} + \hat{\alpha}_{42} \ln \text{Temp} \\ + \hat{\alpha}_{52} \ln \text{Lotsize} + \sigma_{2\hat{\alpha}} \epsilon_2$$

where  $\epsilon_1 = [\partial(Z_i\alpha)/\partial(Z_i\alpha)]$  and  $\epsilon_2 = [-\partial(Z_i\alpha)/(1-\partial(Z_i\alpha))]$ . Note that  $\epsilon_1 > 0$  and  $\epsilon_2 < 0$ .

The estimation of the probit model requires the use of some factors that can explain the choice to receive the newsletter. Several factors potentially could influence a household's decision to receive the newsletter. Household income (proxied by assessed home value) and lotsize are obvious candidates. The survey also provided some additional data that may be related to the decision to receive the newsletter. One survey question asked the households what was "the most important consideration when choosing a landscape." A dummy variable (Instcost) was created that was equal to one if installation cost was the most important variable and zero otherwise. The rationale behind this variable is that it may be a proxy for the cost of changing the landscape from "traditional" to xeriscape. Some landscapes may be more difficult to change than others. We hypothesize therefore that the sign of this variable's coefficient is negative, i.e., if a person perceives that the cost of changing their landscape is high, then this person is less likely to receive the newsletter. Another dummy variable (Vegetabl) was created which is equal to one if the household had a vegetable garden and zero otherwise. Since, this variable may indicate that the household has a comparative advantage in landscaping, we hypothesize that this household will be more likely to receive the newsletter. The third dummy variable is the "bagit" variable which takes on a value of one if the household bags grass clippings, and zero otherwise. We hypothesize that a person who bags grass clippings is less environmentally sensitive and thus would be less likely to receive the newsletter. The probit

model is estimated in LIMDEP, using its choice based weighting option. The correct asymptotic covariance matrix is also calculated in LIMDEP.

#### V. EMPIRICAL RESULTS

Table 4 presents the probit regression of receipt of the newsletter against the vegetable garden dummy, the installation cost dummy, the bagit dummy and lnIncome and lnLotsize. The lnIncome, lnLotsize, bagit and vegetable variables' coefficients all have the expected signs but are not statistically significant in the probit model. However, they were somewhat significant in the first stage linear probability model. The installation cost dummy variable is highly significant in the probit model. This result implies that households are less likely to receive the xeriscape newsletter the higher the perceived cost of changing their landscape is. In fact, none of the newsletter group stated that installation costs was their number one concern in choosing a landscape.

The estimates for the water demand equation for the newsletter group are shown in Table 5. It should be noted that two yearly dummies were created for 1990 and 1991, with 1989 being the base year. Since the city was heavily emphasizing water conservation during this time, these dummies allow each year to have its own level of autonomous demand. Interestingly, these dummies' coefficients indicate that water demand did not significantly change in 1990 or 1991, compared to 1989. Much of their reduction in water demand may have already occurred with the change in landscape. The income elasticity of demand is significant, but the price elasticity is not significantly different from zero. Evidently, the xeriscape newsletter recipients did not respond to

changes in real water prices during this period. Whether or not this holds for other newsletter recipients in other times and places is subject to further study. The lotsize variable's coefficient is positive but not significant, which is an interesting finding. Evidently, differences in lotsize do not cause water use to vary greatly, perhaps because xeriscape practices can vary widely. For example, one lot may be larger than another but have less irrigated area. Also the rainfall coefficient has the expected sign but is not significant. Xeriscape practices evidently reduce the sensitivity to rainfall. However, the temperature coefficient is statistically significant. Lambda's coefficient is not statistically significant, but the positive sign is somewhat puzzling.

The estimates for the water demand equation for the non newsletter group are shown in Table 6. The coefficients on the yearly dummies are interesting.

The non newsletter group's demand curve shifted down in 1990 and in 1991, whereas the xeriscape newsletter's demand did not change significantly. The 1991 dummy's coefficient is larger (in absolute value) than the 1990 dummy's coefficient. Recall that the sample only uses those monthly observations after a household has made significant landscape changes. Since the newsletter group is more likely to have already made changes, there is less room for reduction in water demand than for the non newsletter group. The coefficients of rain, temperature and lotsize have the expected signs and are all statistically significant. Evidently this group is more sensitive to climatic changes because they are more likely to have a traditional landscape.

The large price elasticity of -4 is somewhat puzzling. Lambda's coefficient is negative and statistically significant, indicating selectivity bias does

exist. Since  $\lambda$  is negative for the non newsletter group,  $\hat{\beta}^2 = [-\phi(Z_i\hat{\alpha})/(1-\phi(Z_i\hat{\alpha}))]$ , the non newsletter group uses more water than a household selected randomly from the population.

Because water managers are interested in the effectiveness of the xeriscape program, the difference in total water demand for the two groups needs to be calculated. The net difference in monthly water use of a randomly drawn household can be calculated as:

$$E(y^{1i}) - E(y^{2i}) = x^i(\hat{\alpha}^1 - \hat{\alpha}^2),$$

where the average characteristics of the overall group are used in  $x^i$ , and the subscripts refer to the xeriscape newsletter and non newsletter groups. This calculation reveals that the saving in water usage is approximately 255 gallons per month, which is considerably less than the uncorrected difference of 2,441 gallons, as shown in Table 2. (Notice that since this involves a random selection, there is no need to use the selection correction factors.)

This result indicates that effectiveness of the newsletter is highly dependent upon the voluntary selection of the newsletter. A household chosen at random to receive the newsletter would not be as likely to save as much water as a household that voluntarily chose to receive the newsletter.

## VI. CONCLUSION

This paper has examined the factors that influence the adoption of xeriscape measures and the effect of a xeriscape newsletter on water demand. The study used a data set collected in the city of Austin, Texas for the time period 1985-91. Several interesting conclusions can be made. First, with regard to water demand, our findings indicate that households that receive the

xeriscape newsletter did have lower water demand, *ceteris paribus*, and after correcting for selectivity bias. However, this reduction was quite small (approximately 255 gallons per month) especially in comparison to the uncorrected difference of 2,441 gallons shown in Table 2. Thus almost all of the difference in water demand for the newsletter and non newsletter groups is due to self selection. Very little effect can be attributed to the newsletter. This does not imply that the newsletter has no value, because it may take time for other households to "catch on." Second, newsletter recipients are found to be less sensitive to real water prices, rainfall, temperature, and lotsize than non recipients. Inclusion of yearly dummies in the water demand equation indicates a decrease in overall demand from 1989 to 1991, which we believe reflects the success of water conservation programs promoted by the local government during this period. Third, the cost of installing a xeriscape landscape was found to be a highly significant factor in influencing a household's decision to adopt such a landscape. Finally, evidence of self selectivity was found in the water demand equation for the non newsletter group, as indicated by the statistically significant coefficient for  $\lambda$ . We also can conclude that the non newsletter household uses more water than a randomly selected household.

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Table 1

## Definitions of Variables

Water	Monthly household water use (100 gallons) for April through October months (1985-1991)
Pwater	Marginal Price of water per 1,000 gallons
Mincharg	Minimum charge for first 2,000 gallons/month
Rain	Monthly rainfall in inches
Temp	Monthly temperature (degrees Fahrenheit)
Income	Assessed property value in 1991\$
Lotsize	Lot size minus footprint of house (in square feet)
Instcost	dummy variable = 1 if installation cost is the most important factor in landscape choice; 0 otherwise
Vegetabl	dummy variable = 1 if owner has a vegetable garden; 0 otherwise
Bagit	dummy variable = 1 if owner bags grass clippings; 0 otherwise
Yr90dum	dummy variable = 1 if year is 1990, 0 otherwise
Yr91dum	dummy variable = 1 if year is 1991, 0 otherwise

Table 2

## MEAN STATISTICS

	Xeriscape Newsletter Group	Non Xeriscape Newsletter Group
Water	132.97	157.38
Pwater	\$2.19	\$2.21
Mincharg	\$6.01	\$6.02
Rain	2.67	2.60
Temp	78.77	79.27
Income	\$96,546.00	\$89,856.00
Lotsize	8,947.40	9,514.40
Number of observations	1,092.00	684.00

Table 3

## Water Rate Schedule

Summer of Year:	Minimum Charge (for 2,000 gallons)	Marginal Price (only one block exists)
1985	\$4.68	\$1.41
1986	\$5.26	\$1.58
1987	\$6.02	\$1.81
1988	\$6.02	\$2.14
1989	\$6.02	\$2.14
1990	\$6.02	\$2.26

1991	\$6.02	\$2.26
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Table 4

Binomial Probit Model

MODEL COMMAND:

PROBIT;LHS=VOLUNDUM;RHS=0;WTS=WT;CHOICEBASED;HOLD\$

Dependent variable is binary, y=0 or y not equal 0

Ordinary least squares regression. Dep. Variable = VOLUNDUM  
 Observations = 1776 Weights = WT  
 Mean of LHS = 0.9925484E+00 Std.Dev of LHS = 0.8602472E-01  
 StdDev of residuals= 0.7860755E-01 Sum of squares = 0.1093709E+02  
 R-squared = 0.1673607E+00 Adjusted R-squared= 0.1650086E+00  
 F[ 5, 1770] = 0.7115408E+02  
 Log-likelihood = 0.1999849E+04 Restr.(β=0) Log-l = 0.1837207E+04  
 Amemiya Pr. Criter.= -0.2245325E+01 Akaike Info.Crit. = 0.6200023E-02

ANOVA Source	Variation	Degrees of Freedom	Mean Square
Regression	0.2198358E+01	5.	0.4396715E+00
Residual	0.1093709E+02	1770.	0.6179147E-02
Total	0.1313545E+02	1775.	0.7400252E-02

Variable	Coefficient	Std. Error	t-ratio	Prob t >α	Mean of X	Std.Dev.of X
Constant	1.0003	0.4799E-01	20.844	0.00000		
LINCOME	0.36801E-02	0.4294E-02	0.857	0.39147	11.369	0.48057
LLOTSIZE	-0.54836E-02	0.4362E-02	-1.257	0.20873	8.9988	0.47829
INSTCOST	-0.98907	0.5323E-01	-18.581	0.00000	0.12310E-02	0.35074E-01
VEGETABL	0.51197E-02	0.4014E-02	1.276	0.20209	0.36906	0.48269
BAGIT	-0.12781E-01	0.7420E-02	-1.722	0.08499	0.71654E-01	0.25799

Table 5

Estimated Water Demand for Xeriscape Newsletter Recipients

Sample Selection Model

Two stage least squares regression.	Dep. Variable	=	LWATER			
Observations = 1092	Weights	=	ONE			
Mean of LHS = 0.4740192E+01	Std.Dev of LHS	=	0.5422774E+00			
StdDev of residuals= 0.4719336E+00	Sum of squares	=	0.2412072E+03			
R-squared = 0.2419171E+00	Adjusted R-squared=		0.2363172E+00			
F[ 8, 1083] = 0.4320045E+02						
Log-likelihood = -0.7249609E+03	Restr.( $\beta=0$ ) Log-l	=	-0.8807011E+03			
Amemiya Pr. Criter.= 0.1344251E+01	Akaike Info.Crit.	=	0.2245570E+00			
Standard error corrected for selection.....			0.91384			
Correlation of disturbance in regression and Selection Criterion (Rho).....			1.0000			
Variable	Coefficient	Std. Error	t-ratio	Prob t  $\geq$ x	Mean of X	Std.Dev.of X
-----						
Constant	-7.9722	5.050	-1.579	0.11441		
LINCOME	0.42369	0.7909E-01	5.357	0.00000	11.370	0.48100
LREALP	0.95825E-01	0.8807	0.109	0.91336	-5.1673	0.38121E-01
LLOTSIZE	0.24803E-01	0.7850E-01	0.316	0.75202	8.9981	0.47906
LRAIN	-0.47761E-01	0.3210E-01	-1.488	0.13678	0.68807	0.95599
LTEMP	1.8737	0.3842	4.877	0.00000	4.3639	0.74388E-01
YR90DUM	-0.20752E-01	0.6965E-01	-0.298	0.76576	0.25549	0.43634
YR91DUM	-0.11257	0.8245E-01	-1.365	0.17216	0.32875	0.46998
LAMBDA	3.8402	2.931	1.310	0.19017	0.17056E-01	0.12307E-01

Table 6

Estimated Water Demand for Non Xeriscape Newsletter Recipients

Sample Selection Model

Two stage least squares regression.	Dep. Variable	=	LWATER			
Observations = 684	Weights	=	ONE			
Mean of LHS = 0.4854585E+01	Std.Dev of LHS	=	0.6288706E+00			
StdDev of residuals= 0.5412526E+00	Sum of squares	=	0.1977442E+03			
R-squared = 0.2581556E+00	Adjusted R-squared=		0.2493634E+00			
F[ 8, 675] = 0.2936179E+02						
Log-likelihood = -0.5461376E+03	Restr.( $\beta=0$ ) Log-l	=	-0.6527940E+03			
Amemiya Pr. Criter.= 0.1623209E+01	Akaike Info.Crit.	=	0.2968090E+00			
Standard error corrected for selection.....			0.54470			
Correlation of disturbance in regression and Selection Criterion (Rho).....			-0.12920			
Variable	Coefficient	Std. Error	t-ratio	Prob t  $\geq$ x	Mean of X	Std.Dev.of X
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Constant	-30.370	7.160	-4.241	0.00002		
LINCOME	0.41665	0.5379E-01	7.745	0.00000	11.304	0.42687
LREALP	-4.0284	1.304	-3.090	0.00200	-5.1604	0.28281E-01
LLOTSIZE	0.13845	0.6232E-01	2.222	0.02630	9.0923	0.36411
LRAIN	-0.52033E-01	0.2476E-01	-2.102	0.03557	0.66069	0.96309
LTEMP	1.9529	0.3058	6.386	0.00000	4.3703	0.72889E-01
YR90DUM	-0.20247	0.5437E-01	-3.724	0.00020	0.27924	0.44895
YR91DUM	-0.50792	0.9304E-01	-5.459	0.00000	0.26901	0.44377
LAMBDA	-0.70375E-01	0.2047E-01	-3.438	0.00059	-2.2719	1.0335