APPENDIX J. CLOTHES WASHER CONSUMER ANALYSIS

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CLOTHES WASHER CONSUMER ANALYSIS

J.1 EXECUTIVE SUMMARY

The objective of this study is to determine which clothes washer attributes consumers value most and estimate how changes in these attributes resulting from an efficiency standard may affect consumer utility and clothes washer purchases. To this end, several different analysis methods were used. First, focus groups were held to develop a list of clothes washer attributes consumers value. The attributes that were cited most often by the focus groups and were also likely to be affected by an efficiency standard were included in the second analysis method - conjoint analysis. Conjoint analysis is a stated preference technique that requires respondents to trade off different attributes against each other. By examining how respondents make these tradeoffs, the relative values placed on the clothes washer attributes can be determined.

The conjoint analysis results were combined with survey data and used to evaluate the relative importance placed on clothes washer attributes and how demand for washers might change with an efficiency standard. The analysis methods and results are summarized in the remainder of this introduction with more detailed descriptions provided in the following chapters.

J.2 FOCUS GROUPS

Focus groups were used to identify the most important clothes washer attributes among consumers. The primary purpose of the focus groups was to determine which clothes washer attributes should be included in the conjoint analysis. The focus groups were conducted to develop a list of all equipment attributes that influence the decision to purchase a clothes washer. This was accomplished by having the moderator guide the discussion to get an unprompted list of important clothes washer attributes. Once the unaided list of attributes was obtained, the moderator suggested other attributes that were not volunteered initially for the group to discuss. Focus group participants were then asked to list their top ten most important attributes if they were to purchase a new clothes washer today.

Focus groups were conducted in five cities; Washington DC, San Francisco Bay Area CA, Madison WI, Miami FL, and Dallas TX. These cities were selected so that input could be obtained from five different regions of the country. Ten focus groups were conducted, two in each city, with a total of 90 participants. Focus group participants were recruited randomly by phone to ensure a mix of demographic types. The only condition for participation was that the respondent had to be the person that did the laundry for their household.

Based on the focus group results, the following six clothes washer attributes were selected for the conjoint: clothes washer price, energy and water savings, capacity, water temperature, door placement, and load size adjustment. This group of attributes contains five washer attributes that would be potentially affected by an efficiency standard. In addition, these attributes were ranked among the top ten important attributes by consumers.

J.3 CONJOINT ANALYSIS

Conjoint analysis is a stated preference survey technique that involves having respondents sort through and rank sets of cards that reflect different equipment options. In this application, respondents ranked cards that represented clothes washers. Each card contained different values for the six washer attributes selected from the focus groups. The different values on the cards were chosen to represent standard, medium, and high efficiency levels. The advantage of conjoint analysis is that it makes respondents evaluate all six attributes simultaneously and requires them to make tradeoffs, just as they would if they were actually purchasing a new clothes washer.

The ranking information obtained during the conjoint sessions was used to estimate a logit model of clothes washer purchases.[1] By examining how respondents ranked their cards, the importance placed on each attribute was estimated. In addition, changes in clothes washer attributes and the impact on overall utility and the decision to purchase a clothes washer was also determined.

Along with the conjoint analysis, respondents at these sessions were given a short survey that contained a variety of demographic questions as well as questions directed at whether they would repair a broken washer or purchase a new one. These questions provided additional information on consumer preferences and sensitivity to clothes washer price. Survey responses were also used to segment the sample so that model estimation could be conducted for different population subgroups.

J.4 RESULTS

The value placed on different attributes during the conjoint analysis was measured in three different ways. First, the data were used to calculate *importance statistics* for each of the six washer attributes. The importance statistics illustrate the contribution that each attribute makes towards the total utility associated with the clothes washer as defined by the six attributes. The larger the importance statistic, the greater the value placed on that attribute.

Second, the data were used to estimate the *probability of purchase*. From the conjoint results, the probability of purchasing a clothes washer was estimated as a function of the six attributes. Changes in these attributes then change the probability of making a purchase. By changing attributes such as price, savings, and door placement, different efficiency levels can be simulated and the effect on purchases estimated. By examining how much the probability of purchase changes, we can evaluate how sensitive consumers are to changes in price and other washer attributes.

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[1] A logit model differs from a standard regression model in two important aspects. First, the logit model has a dependent variable that is discrete reflecting two or more distinct choices while the dependent variable of a standard regression model is continuous and can take on an infinite number of values. Second, the random component of a logit model follows a logistic distribution instead of a normal distribution that applies for a standard least squares regression model.

The purchase scenarios were run assuming a standard efficiency machine as the base case and comparing that with a medium efficiency machine and a high efficiency machine. The standard efficiency option assumes a price of $400, no energy and water savings, and a top loading machine. The medium efficiency washer has a price of $450 and energy and water savings of $10 annually, and is a top loading machine. This is consistent with an approximately 20 percent improvement in efficiency. The high efficiency equipment options have a price of $650, annual savings of $50, and are either front loading machines with hot water wash capability or top loading machines with no hot water capability. These high efficiency options were designed to coincide with an approximately 40 percent improvement in efficiency.

Thirdly, the data were used to calculate the *price elasticity of demand* based on the conjoint analysis results. Price elasticity is a measure how much demand for a good changes with a change in price while holding everything else constant. In this analysis, price elasticities were calculated starting at the standard efficiency case and calibrating the purchase probability to the market purchase probability based on conjoint analysis survey data. From this starting point reflecting current market conditions, the price elasticity was calculated based on the change in price going from a standard efficiency to a high efficiency machine.

J.5 CONCLUSIONS

The analysis techniques described above resulted in the following key conclusions.

Price is the most important clothes washer attribute. All of the analysis results show price as the most important attribute when consumers are purchasing a new clothes washer. Price was cited most often in the focus groups when the respondents identified their "top ten" lists of important washer attributes. In addition, the conjoint analysis results show price as the primary attribute respondents focused on when ranking their cards. This resulted in the highest importance statistic of all the washer attributes used in the conjoint.

In the purchase scenarios, the purchase probabilities were more sensitive to price than any of the other washer attributes. While the shift from a standard to a high efficiency machine resulted in a significant drop in the estimated purchase probability, this was due to the change in price rather than to changes in the other attributes. When price is held constant at the standard efficiency level while the other attributes are allowed to change to reflect a high efficiency machine, the likelihood of purchase actually increases. This is due to the benefit of additional savings from the high efficiency machine outweighing the disutility associated with a front loading machine.

Door placement is not as important as other attributes. Although the focus groups, included door placement as one of the 10 most important attributes, both the conjoint results and survey results show that door placement is not as important to consumers as a number of other attributes. In the calculation for importance (i.e., *the importance statistic*) door placement was second from last in importance among the six attributes used in the conjoint. In addition, 70 percent of the survey respondents said that they would consider purchasing a front loading machine if they were going to

buy a new clothes washer. For these people, door placement was tied for last in terms of importance, comprising only 8 percent of total utility.

The lower value placed on door placement was also evident in the purchase scenarios where the benefit of the higher savings outweighed the disutility of the door placement. When price is held constant, the higher savings combined with a front loading machine resulted in a higher estimated purchase probability relative to the standard efficiency case with no savings and a top loading machine.

Demand is more inelastic for those that currently own washers. Both the survey and conjoint results indicate that demand is more inelastic for respondents who currently own clothes washers than non-owners, even with large increases in the clothes washer price. According to survey results, those consumers that currently own clothes washers are much more likely to replace their washer if it breaks than to start doing their laundry at a laundromat. Of those surveyed, only 2 percent said that if their machine broke they would start going to the laundromat or do their laundry somewhere else, while the rest opt to get their machine fixed or purchase a new clothes washer. As a result, 0.98 can be considered an upper bound for the likelihood of purchase under current market conditions and is used as the starting point for calculating the price elasticity.

An additional survey result is that the willingness to start doing laundry elsewhere decreases as income increases. For the low income respondents, 5 percent said they would start doing their laundry somewhere else while among high income respondents (those with incomes at $75,000 or above), no respondents were willing to start doing their laundry elsewhere.

When the purchase probabilities are calibrated to mirror this result, changes in price result in little change in the likelihood of making a purchase. If the likelihood of purchase is calibrated up to 98 percent to match the survey results, the price elasticity estimate for current washer owners is –0.16, which reflects demand for clothes washers that is relatively insensitive to price. Stated another way, a 10 percent increase in price would result in only a 1.6 percent decrease in demand for clothes washers.

Elasticities were also calculated for those in the sample that do not currently own a clothes washer or that purchased one for the first time in the last 2 years. This group is likely the most sensitive to price and can be considered discretionary clothes washer purchasers. For this group, the price elasticity is –1.92, which reflects an elastic demand or demand for washers that is sensitive to price. In this case, a 10 percent increase in price results in a 19 percent decrease in demand.

The remainder of this report discusses all of the research methods and analysis results in detail. The *Methodology chapter outlines the research framework and the analysis techniques used for this study. Section J.7, Focus Group Results,* describes the results of the focus groups and how these results were used in the conjoint portion of this study. The Survey Results chapter provides the results from the survey that respondents filled out during the conjoint sessions. The estimation results based on the conjoint data are presented in the *Conjoint Analysis Results.* The final chapter,

Conclusions, presents a summary of the major findings of the study. Complete survey and estimation results are included as appendices at the end of this report.

J.6 METHODOLOGY

J.6.1 Introduction

The objective of this study is to determine which clothes washer attributes consumers value most and estimate how changes in these attributes resulting from an efficiency standard may affect clothes washer purchases and consumer utility. As discussed in this chapter, conjoint analysis data were used to estimate the probability of purchasing standard and high efficiency clothes washers. These purchase probabilities provide an intuitive context to evaluate clothes washer demand, since changes in equipment attributes are expressed as a change in the likelihood of making a clothes washer purchase as well as a change in utility.

Focus groups were used to determine the most important clothes washer attributes. These attributes were presented to respondents during conjoint analysis sessions.[2] Conjoint analysis is advantageous because it allows the respondent to compare washer attributes simultaneously, thereby forcing respondents to make tradeoffs across attributes as they would if they were actually purchasing a washer. The conjoint estimation results were combined with model parameters at different efficiency levels to estimate the probability of purchasing a clothes washer and calculate purchase elasticities.

During the conjoint sessions, respondents were also given a short survey to complete. This survey asked a variety of questions designed to get at sensitivity to clothes washer price as well as additional demographic information. These questions were also used to stratify the conjoint sample so that purchase probabilities and utility could be estimated for different demographic groups. For example, separate estimates were conducted for those that indicated on the survey that they would consider purchasing a horizontal axis machine. This survey is discussed in more detail in both the Conjoint Analysis Results and the Survey Results chapter of this report.

The layout of this chapter is as follows. First, we discuss the focus group method and sample. Next, a detailed description of the sampling scheme for the analysis is presented. This includes a discussion of sample stratification as well as expected completion rates based on past conjoint analysis recruiting efforts. Following this, the conjoint analysis technique is described as

[2] In order to verify the reliability of the six attributes, at the beginning of the conjoint session, respondents were asked to list the five most important attributes on a clothes washer that they would consider when purchasing a new clothes washer. This list was elicited with no group discussion for comparison with the list derived during the focus group discussions where respondents were allowed to express opinions to the group. The results of this survey are discussed in the *Survey Results* chapter of this report.

well as the model specification for estimating the purchase probabilities. Finally, probability calculations are presented and potential market scenarios are discussed.

J.6.2 Focus Groups

The primary purpose of the focus groups was to identify the most important clothes washer attributes. Once identified, these key washer attributes were included in the conjoint analysis. The focus groups allowed the development of a list of all equipment attributes that influence the decision to purchase a clothes washer. This was accomplished by the moderator encouraging an open dialogue among focus group members to obtain an unsolicited list of clothes washer attributes. Once the unaided list of attributes was obtained, the moderator suggested other attributes that were not volunteered initially for the group to discuss.[3] When the clothes washer attributes discussion was completed, the moderator asked the focus group participants to identify which ten attributes would most significantly influence their selection of a new clothes washer, assuming they had made the decision to purchase a new clothes washer. These responses were then totaled across all ten focus groups to arrive at a list of the six most important clothes washer attributes to consumers.

Focus groups were conducted in five cities: Washington DC, San Francisco Bay Area CA, Madison WI, Miami FL, and Dallas TX. These cities were selected so that five different regions of the country were represented in the focus groups. Ten focus groups were conducted, two in each city, with a total of 90 focus group participants divided approximately evenly across the ten sessions. Focus group participants were recruited randomly by phone to ensure a mix of demographic types. Each respondent was paid a $50 incentive for participating in the focus group.

As discussed, the top attributes as decided during the focus groups were used in the conjoint analysis. The remainder of this chapter describes the conjoint analysis method, the sample used for the conjoint analysis, and how the conjoint results were used to estimate the purchase probabilities and utility.

J.6.3 Conjoint Analysis

Conjoint session design. Conjoint analysis is a stated preference survey technique that involves having respondents sort through and rank cards that reflect different clothes washer equipment options. Each card describes a separate clothes washer based on the six most important washer attributes as determined from the focus groups. Respondents rank the cards from most preferred to least preferred. As discussed below, this ranking information was used to estimate the probability of purchasing different clothes washer options based on the equipment attributes.

[3] The moderator relied on a list of attributes provided by the clothes washer working group to the Department of Energy. The working group consisted of manufacturers, advocates, utilities, and other interested parties.

The success of conjoint sessions relied on making sure that respondents were well informed as to what was expected during the sessions as well as with the equipment being evaluated. The conjoint session moderator explained that respondents should rank the set of cards from most preferred to least preferred. Photographs and additional information on high efficiency clothes washers were available at each session. This allowed respondents to become familiar with high efficiency washers so that they could make informed decisions while doing the conjoint analysis.

Full Profile Conjoint Analysis. Conjoint analysis is a method that enables researchers to determine which product attributes are most valued by consumers. Past experience as well as existing literature indicates that the most successful conjoint designs limit each exercise to ranking 16 cards at a time with 4 to 6 attributes on each card. Including more cards or additional attributes tends to overwhelm respondents and results in less reliable data. For these reasons, the clothes washer conjoint was designed with 16 cards that presented 6 different attributes.

The full profile conjoint method utilizes an orthogonal card design, which means that there is zero correlation between each of the attributes on a card. This is critical to the analysis, as correlation across attributes results in a loss of precision and makes it difficult to estimate the importance that respondents place on each attribute. For example, consider the situation where price and rebate are two of the attributes being evaluated and on each card savings is 10 percent of the price. Since price and savings are perfectly correlated, there is no way to determine from the data if a respondent is ranking the cards based on price or savings. For this reason, having an orthogonally designed study was essential.

In addition to empirically determining the value consumers placed on each clothes washer attribute included on the cards, the conjoint method used in the consumer analysis enabled DOE to estimate the likelihood of making a clothes washer purchase. Upon completing the rankings the respondents were asked to determine which clothes washers they would actually purchase given their situation today. This was done by inserting a 'Purchase Card' in the deck after each respondent completed the ranking process. The cards ranked above the Purchase Card were recorded as the clothes washers the respondent would consider purchasing today while those below the Purchase Card were recorded as clothes washers they would not consider purchasing today. As discussed below, Purchase Card placement was used to estimate the Purchase Probability.

Conjoint Sampling Method. Given the scope and budget of the clothes washer study, the conjoint sample size was set at 400 respondents. Individuals were phoned randomly from a database of phone numbers in zip codes located near each conjoint session location. The sample was stratified across several key demographic groups so that purchase probabilities could be estimated with confidence for these groups. Finally, respondents that attended the conjoint sessions were paid a $50 incentive for their time.

One of the goals of the clothes washer study was to utilize a national sample with several different geographic regions represented. As a result, the conjoint sessions were conducted in four different regions: Washington, DC (East), Dallas TX (South), Madison WI (Midwest), and San

Francisco Bay Area CA (West). The sample was divided so a goal was set at 100 respondents to be recruited from each region, for a total targeted sample of 400.

In addition, steps were taken to insure that a large enough subsample of low-income and elderly respondents were included in the sample to allow a statistical analysis of the data collected from these two groups. Approximately a quarter of the sample (90 respondents) were targeted from households with annual incomes of less than $25,000. This allowed for separate estimation of probabilities for the low income group and determined if there were statistically significant differences in purchase behavior between low income households and the rest of the population. While age is related to income, it is useful to separately explore differences between younger users (18 to 24), older users (65 and older), and the rest of the sample. As a result, the targeted sample contained 60 respondents from both the younger and older age groups.

The sample size and segmentation process is consistent with similar conjoint applications in the literature. For example, Currim (1981)[1] used a sample of 608 for a conjoint study to estimate a model of transportation mode choice. This study segmented the sample into 10 segments, with some segments having as few as 16 and 24 observations and with 8 of the 10 segments having less than 90 observations. Similarly, Green and Krieger (1988)[2] used a conjoint sample of only 170 to test the sensitivity of different model specifications estimated from conjoint data. Green and Helsen (1989) [3]relied on a sample of 99 in their conjoint model to estimate apartment choice. This sample was further reduced by a segmentation scheme that split the group into subsamples of 45 and 54 observations each. In addition, Allison and Christakis(1994)[4] used a sample of 413 doctors to estimate the importance of different medical treatments and Louviere and Hensher (1983)[5] used a sample of 550 to estimate the potential demand for future cultural event using conjoint. Given these sample sizes, the proposed sample of 400 for the clothes washer study as well the segmenting scheme is well within the accepted range of sampling methods found in the conjoint literature.

Response Rates. There is a wide range of response rates for surveys, with no one response level considered acceptable for all situations. Response rates typically vary by length and type of survey and by the sensitivity of the questions asked. In The Practice of Social Research by Babbie, p. 242[6], general rules for expected completion rates are described:

> A quick review of the survey literature will uncover a wide range of response rates. …Even so, it's possible to state some rules of thumb about return rates. I feel that a response rate of at least 50 percent is *adequate* for analysis and reporting. A response of at least 60 percent is *good*. And a response rate of 70 percent is *very good*. You should bear in mind, however, that these are only rough guides; they have no statistical basis, and a demonstrated lack of response bias is far more important than a high response rate.

In addition to differences due to survey content and target samples, there is also a difference in response rates between phone surveys and on-site surveys. On-site surveys include focus groups and conjoint analysis sessions, where respondents have to drive to a location to complete surveys. The differences in recruiting between phone and on-site surveys are discussed below.

For phone surveys, it is possible to repeatedly call respondents to encourage them to complete the survey. This can result in completion rates as high as 80 or 90 percent among qualified respondents, with some respondents having been called ten times or more. While repeated calling can be successful in phone surveys, it is not an effective method for increasing recruitment rates for on-site surveys. On-site sessions require a substantial time investment for respondents, sometimes 3 or 4 hours or more. After an initial refusal, repeatedly calling is very unlikely to encourage attendance.

Because of the difference between phone surveys and on-site surveys, the traditional response rate for phone surveys is not appropriate for evaluating conjoint recruiting. For on-site surveys, the appropriate statistic is attendance rate, or the percentage of those that are recruited that actually show up for the conjoint session.

To maximize attendance for on-site surveys, it is general practice to send out reminder letters to respondents that agree to participate. The letters remind the respondent of the date and time of the session as well as give directions to the session site. In addition to the letters, each recruit is called the night before the session and reminded again. Based on our experience, this method maximizes the completion rate for on-site surveys. Efforts beyond this, such as additional reminder phone calls, tend to result in an even lower completion rate as respondents become irritated and are discouraged from participating.

The remainder of this chapter describes how the conjoint analysis results were used to estimate purchase probabilities and purchase scenarios.

Purchase Probability. The decision to make a clothes washer purchase is the referred to as *Purchase Probability* throughout this report. This probability is estimated from the conjoint analysis data based on the placement of the Purchase Card. Since the purchase choice variable is discrete, the model is estimated using a standard logit model specification. In this application, the dependent variable has a value of one for those cards placed above the Purchase Card and a value of zero for those below. The independent variables are the values for the attributes on each card. In equation form, this is given by:

$$\text{Purchase } (0,1) = \alpha + \Sigma_J \beta_j' X_{ij} + \varepsilon_{ij}$$

Where Purchase = 1 if card is ranked above the Purchase Card, 0 if ranked below

X_{ij} = Value of attribute j on card i

β_j = Coefficients to be estimated

α = Constant to be estimated

ε_{ij} = random error term assumed to be logistically distributed

A hypothetical example of one individual's conjoint data used to estimate the purchase probability is shown in Table J.1. The shaded region highlights those choices that are above the Purchase Card, indicating that these are options the respondent would purchase.

Using the estimation results from this purchase logit, the probability of making any equipment purchases Prob(Purchase) is given by:

$$\text{Prob(Purchase)} = \exp(b'X) / (1 + \exp(\beta'X))$$

Table J.1 Hypothetical Example – Conjoint Data Using the Purchase Card For Purchase Probability Estimation

	Dependent Variable	Independent Variables					
Rank	Purchase	Price	Savings	Door Placement	Capacity	Water Temperature	Load Size Adjustment
1	1	400	50	Front	Standard	Warm, Cold	Non-Adjustable
2	1	400	50	Top	Standard	Hot, Warm, Cold	Adjustable
3	1	400	10	Front	Standard	Hot, Warm, Cold	Non-Adjustable
4	1	400	10	Top	Standard	Warm, Cold	Adjustable
5	0	400	0	Front	Extra Large	Hot, Warm, Cold	Non-Adjustable
6	0	400	0	Top	Extra Large	Warm, Cold	Adjustable
7	0	400	0	Front	Extra Large	Warm, Cold	Adjustable
8	0	400	0	Top	Extra Large	Hot, Warm, Cold	Adjustable
9	0	450	50	Top	Extra Large	Warm, Cold	Non-Adjustable
10	0	450	10	Top	Extra Large	Hot, Warm, Cold	Non-Adjustable
11	0	450	0	Front	Standard	Warm, Cold	Adjustable

Table J.1a

Rank	Dependent Variable: Purchase	Independent Variables: Price	Savings	Door Placement	Capacity	Water Temperature	Load size Adjustment
1	1	400	50	Front	Standard	Warm, Cold	Non-Adjustable
2	1	400	50	Top	Standard	Hot, Warm, Cold	Adjustable
3	1	400	10	Front	Standard	Hot, Warm, Cold	Non-Adjustable
4	1	400	10	Top	Standard	Warm, Cold	Adjustable
5	0	400	0	Front	Extra Large	Hot, Warm, Cold	Non-Adjustable
6	0	400	0	Top	Extra Large	Warm, Cold	Adjustable
7	0	400	0	Front	Extra Large	Warm, Cold	Non-Adjustable
8	0	400	0	Top	Extra Large	Hot, Warm, Cold	Adjustable
9	0	450	50	Top	Extra Large	Warm, Cold	Non-Adjustable
10	0	450	10	Top	Extra Large	Hot, Warm, Cold	Non-Adjustable
11	0	450	0	Front	Standard	Warm, Cold	Adjustable
12	0	450	0	Front	Standard	Hot, Warm, Cold	Adjustable
13	0	650	50	Front	Extra Large	Hot, Warm, Cold	Adjustable
14	0	650	10	Front	Extra Large	Warm, Cold	Adjustable
15	0	650	0	Top	Standard	Warm, Cold	Non-Adjustable

In this hypothetical example, a 1 for the dependent variable (i.e., Purchase) indicates that the respondent would consider purchasing this clothes washer, and a 0 indicates the respondent is not inclined to purchase this clothes washer. Price reflects the retail price of the washer while Savings is the annual dollar amount that the washer will save off the combined energy and water bill. Door Placement can take on two values, either "Top" indicating a top loading machine, or "Front" indicating a front loading machine. Capacity also has two values, either "Extra Large" or "Standard." Similarly, there are two alternatives for Water Temperature, either "Hot, Warm, Cold," where all temperatures are available for wash cycles, or "Warm, Cold" where only warm and cold water are available for wash cycles. Finally, Load Size Adjustment is either "Adjustable" indicating that the machine allows the user to adjust water levels to match the wash load size, or "Non-Adjustable," indicating that the water level cannot be adjusted.

Equipment Choice Model. A separate estimation is done based on the card rankings and the values of attributes on the cards. This provides an estimate of how attribute levels affect card rankings and is used to estimate total utility for each equipment option. Using a slightly different version of the logit model, the rankings of the cards are regressed against the attribute levels on the cards. This has a different appearance than the standard conditional logit since the dependent

variable is the actual ranking rather than a zero or one value.[4] However, estimation of this model is conducted the same as with the more familiar logit specification. The equation to be estimated in this stage is given by:

$Rank_i = \Sigma_J \beta_j' X_{ij} + \varepsilon_{ij}$

Where $Rank_i$ = The ranking of card i

X_{ij} = Value for attribute j from card i

β_j = Coefficients to be estimated

ε_{ij} = Random error term assumed to be logistically distributed

Table G.-2.2 shows a hypothetical example of the individual level data that would be used to estimate the equipment choice model.

Using these estimated results, a clothes washer choice set is constructed that reflects both standard and high efficiency equipment options. Using the logit density function, the probability of choosing any option n among M different equipment options given that a purchase is made is:

$$Prob(Equip_n \mid Purchase) = \exp(\beta' X_n) / \Sigma_M (\exp(\beta' X_m))$$

[4] A more complete description of how ranked conjoint data can be analyzed using this logit specification is contained in "Logit Models for Sets of Ranked Items", Nicholos Christakis and Paul Allison, *Sociological Methodology*, Volume 24, 1994, pp. 199-228.

Table J.2 Hypothetical Example - Individual Ranked Conjoint Data For Equipment Choice Estimation

Dependent Variable	Independent Variables					
Rank	Price	Savings	Door Placement	Capacity	Water Temperature	Load size Adjustment
1	400	50	Front	Standard	Warm, Cold	Non-Adjustable
2	400	50	Top	Standard	Hot, Warm, Cold	Adjustable
3	400	10	Front	Standard	Hot, Warm, Cold	Non-Adjustable
4	400	10	Top	Standard	Warm, Cold	Adjustable
5	400	0	Front	Extra Large	Hot, Warm, Cold	Non-Adjustable
6	400	0	Top	Extra Large	Warm, Cold	Adjustable
7	400	0	Front	Extra Large	Warm, Cold	Non-Adjustable
8	400	0	Top	Extra Large	Hot, Warm, Cold	Adjustable
9	450	50	Top	Extra Large	Warm, Cold	Non-Adjustable
10	450	10	Top	Extra Large	Hot, Warm, Cold	Non-Adjustable
11	450	0	Front	Standard	Warm, Cold	Adjustable
12	450	0	Front	Standard	Hot, Warm, Cold	Adjustable
13	650	50	Front	Extra Large	Hot, Warm, Cold	Adjustable
14	650	10	Front	Extra Large	Warm, Cold	Adjustable
15	650	0	Top	Standard	Warm, Cold	Non-Adjustable
16	650	0	Top	Standard	Hot, Warm, Cold	Non-Adjustable

Purchase Scenarios. The estimation results provide an intuitive means for evaluating the importance of washer attributes. This is done by estimating the effect an efficiency standard has on utility by looking at how the likelihood of purchasing a washer increases or decreases with changes in washer attributes. The analysis of purchase scenarios using the purchase probability estimates is discussed below.

Probability Scenarios. The probability estimates are used to estimate the change in purchases due to changes in clothes washer design resulting from an efficiency standard. To evaluate the effect these changes will have on purchases, the purchase probabilities were calculated using the values for attributes of the original equipment before the standard. For example, the pre-standard purchase probability is given by:

$$Prob_1 = \exp(\beta'X) / (1 + \exp(\beta'X))$$

Where β = Estimated coefficients from the purchase logit
X = Attribute values such as price, savings, axis orientation for the pre-standard equipment design.

This pre-standard purchase probability is compared with the post-standard purchase probability. The post-standard probability is calculated using the same formula with post-standard values for price, savings, and other equipment attributes:

$$Prob_2 = \exp(\beta'X) / (1 + \exp(\beta'X))$$

Where β = Estimated coefficients from the purchase logit

X = Attribute values such as price, savings, axis orientation for the post-standard equipment design.

The effect of the standard can be shown by comparing the difference in purchase probabilities before and after the standard:

$$\text{Effect of Standard} = (Prob_1 - Prob_2)/ Prob_1.$$

For example, if the pre-standard purchase probability is 0.15 and the post-standard purchase probability is 0.10 then the effect of the standard is (0.15 - 0.10)/0.15 or 0.33, which indicates a 33 percent reduction in the likelihood of purchasing a clothes washer. This result reflects the effect of the standard through those equipment attributes used in the analysis. Additional effects may also occur through demographic or other market factors not explicitly addressed in the conjoint analysis.

In order to determine the value placed on attributes independently of price and operating costs, it is useful to look at changes in attributes while holding price and operating costs constant. Holding these attributes constant allows the evaluation of different equipment configurations that will comply with the standard independent of price considerations. As a hypothetical example, suppose that there are two different equipment designs that comply with the new standard. The first option meets the standard utilizing a horizontal axis. The second option meets the standard using a vertical axis and no hot water option for the rinse and wash cycles. The same probability calculations can be used to determine which equipment configuration is more popular holding price constant:

$$Prob_{A1} = \exp(\beta'X) / (1 + \exp(\beta'X))$$

Where β = Estimated coefficients from the logit purchase model

X = Pre-Standard equipment attributes (vertical axis) for choice A with the post-standard equipment price.

The post-standard purchase probability for Option A is given by:

$$Prob_{A2} = \exp(\beta'X) / (1 + \exp(\beta'X))$$

Where β = Estimated coefficients from the logit purchase model

X = Post-Standard equipment options (horizontal axis) with the post-standard equipment price.

The same method is used to calculate pre-standard and post-standard purchase probabilities for Option B with and without the hot water attribute:

$Prob_{B1}$ = Purchase probability with pre-standard options (hot water) and post standard price.

$Prob_{B2}$ = Purchase probability with post-standard options (no hot water) and post-standard price.

In this hypothetical example, the effect of the standard on these two different equipment options can be evaluated the same as before. Suppose that the options have the following probabilities:

$Prob_{A1} = 0.20$ $Prob_{B1} = 0.15$

$Prob_{A2} = 0.10$ $Prob_{B2} = 0.10$

The effect of the efficiency standard on Option A is (0.20 – 0.10) / 0.20 = 0.50 or a 50 percent reduction in the likelihood of making a purchase. In the case of Option B the change is a 33 percent reduction in the purchase probability. In this example, meeting the standard using the Option B equipment design utilizes more popular equipment attributes and will have less of a detrimental effect on purchases.

Elasticity Scenarios. The sensitivity of purchases to changes in equipment attributes can also be evaluated by calculating the elasticity associated with each equipment attribute. The purchase elasticities are calculated using the price and equipment options as well as the estimated purchase probabilities. For the elasticity with respect to price, the elasticity is calculated by:

$$\text{Price Elasticity} = (\Delta \text{Prob} / \Delta \text{Price}) * (\text{Price}_{mid} / \text{Prob}_{mid})$$

Where Δ Prob = Change in purchase probability due to the change in price

Δ Price = Change in price resulting from the efficiency standard

$Prob_{mid}$ = Midpoint between pre-standard and post-standard purchase probability

$Price_{mid}$ = Midpoint between pre-standard and post-standard price.

This number reflects how sensitive the purchase probability is to changes in price. In general, an elasticity with an absolute value of less than one is considered inelastic or insensitive to changes in price while an elasticity greater than one is elastic or sensitive to changes in price.

By calculating the elasticities, the sensitivity of washer purchases to changes in each of the equipment attributes used in the purchase decision can be evaluated. However, each elasticity provides information on only one individual attribute while holding all other attributes constant. To evaluate the effect of changing several equipment attributes simultaneously, examining the change in overall purchase probabilities as described above is appropriate.

J.6.4 Summary

In the clothes washer consumer analysis a combination of focus groups and conjoint analysis were used to determine which washer attributes consumers value most, and to estimate the effect that changes in these attributes due to an efficiency standard will have on clothes washer purchases. The attributes that are used in conjoint sessions were determined from focus groups to ensure input from as broad a range of customers as possible. As described above, the conjoint analysis results were used to estimate clothes washer purchase probabilities according to the stated preference of consumers.

In this analysis the sample was designed to obtain a large enough sample for key demographic groups so that differences across groups could be empirically explored. In addition, the sample allocated for demographic groups are consistent with similar conjoint studies found in the literature. Finally, experience with recruiting for on-site surveys shows that a 65 to 70 percent completion rate is a reasonable expectation given that repeated call backs are not an option.

The results of the focus groups sessions as well as the conjoint sessions are presented in the remaining chapters of this report.

J.7 FOCUS GROUP RESULTS

J.7.1 Introduction

The primary purpose of the focus groups is to identify the most important clothes washer attributes among consumers for use in the conjoint analysis. The focus groups were conducted to develop a list of all equipment attributes that influence the decision to purchase a clothes washer. This was accomplished by having the moderator guide the discussion to get an unsolicited list of important clothes washer attributes. Once the unaided list of attributes was obtained, the moderator suggested other attributes that were not volunteered initially for the group to discuss. Once the complete attribute list was determined, questions were asked to determine which attributes are considered the most important in selecting a specific clothes washer.

Focus groups were conducted in five cities; Washington DC, San Francisco Bay Area CA, Madison WI, Miami FL, and Dallas TX. These cities were selected so that five different regions were represented in the focus groups. Ten focus groups were conducted, two in each

city, with a total of 100 focus group participants divided evenly across the ten sessions. Focus group participants were recruited randomly by phone to ensure a mix of demographic types. Each respondent was paid a $50 incentive for participating in the focus group.

Focus Group Sample. The criterion for recruiting for focus group participants was that the respondent had to be the person that did the laundry for the household. While attention was paid to ensuring that a mix of different income and ethnic backgrounds were represented in the focus groups, there was no sampling quota set for these groups.

Table J.3 DOE Clothes Washer Focus Group Response Rates

City	Calls	Recruited	% Recruited	Attendees	Completion Rate	% of Calls
Washington, DC	793	27	3.4%	16	59.3%	2.0
San Francisco Bay Area, CA	880	23	2.6%	18	78.3%	2.0
Madison, WI	795	24	3.0%	19	79.2%	2.4%
Dallas, TX	903	26	2.9%	17	65.4%	1.9%
Miami, FL	3922	29	0.7%	20	69.0%	0.5%
Total	**7,293**	**129**	**1.8%**	**90**	**69.8%**	**1.2%**

Table J.3 shows the completion rate for the focus groups conducted for the first portion of the clothes washer study. The recruitment rate reflects the number of people called to the number that are recruited to participate in the focus group. The completion rate is the number that actually attend the focus group relative to the number recruited. As evidenced by Miami, regional differences, in this case severe language barriers, can result in dramatically different recruitment rates. However, completion rates tend to be more consistent across regions, ranging from approximately 60 to 80 percent.[5]

Overall, focus group participants came from a broad range of demographic groups. Across the entire sample, 19 percent came from household with annual incomes of less than $25,000 while 20 percent came from high income homes making more than $75,000 a year. Different age and race groups were also well represented in the focus groups. Of the 90 attendees, 12 percent were 65 years old or older while 36 percent were in the 18 to 34 years old range. Non-white attendees comprised 26 percent of the focus group sample, with African Americans comprising 15 percent.

[5] The attendance rate for the Washington DC focus groups is skewed downward due to bad weather for the second of the two sessions. The first group had 11 of 14 recruits show up for a completion rate of 79 percent. With the bad weather, only 5 of 13 showed up for the second group for a completion rate of 39 percent, which lowers the overall completion rate down to 59 percent for the Washington DC groups.

Almost 80 percent of the respondents had completed at least some college, and 56 percent had completed college. About 13 percent had high school degrees, and the remaining 7 percent completed trade or vocational school. The majority of participants, 87 percent, lived in households of three or fewer members, with 38 percent living in households of two. About half of the participants owned their homes, and half rented.

Finally, although the majority of participants did their laundry at home, a fair number used a laundromat or apartment laundry room. Specifically, 88 percent of the focus group sample did their laundry at home, 12 percent used a laundromat or apartment laundry room. The latter group ensures that those that might be in the market in the future for a clothes washer were able to provide their input to the analysis.

Focus Group Responses. As discussed previously, each focus group was conducted so that the first part of the session was spent eliciting from the group those attributes that they felt were most important in clothes washers. The moderator would then suggest other attributes to get comments from the group. Once the complete attribute list was derived, respondents were asked to rank the top ten attributes that they would look for when purchasing a new clothes washer.

Table J.4 shows the top 12 attributes mentioned from all of the focus groups as well as the percentage of respondents who listed that attribute. A complete list of all attributes as well as the attributes broken out by location is given in Section J.10.

Table J.4 Focus Group Results Most Important Clothes Washer Attributes

Feature	Frequency in Top 10	Percent of Respondent (n=90)
Price	75	83
Capacity	73	81
Energy & Water Costs	65	72
Load Size Options	61	68
Durability	54	60
Water Temperature Options	54	60
Door Placement	38	42
Quiet Operation	36	40
Wash Time	34	38
Warranty	33	37
Multiple Wash Cycle Options	30	33
Horizontal/Vertical Axis	25	28

Price was mentioned most often as an important attribute for selecting a clothes washer, with 75 of 90 respondents mentioning price. This was followed by capacity, mentioned by 73 of 90

respondents, and by energy and water costs, which was listed by 65 of the respondents. The ability to adjust the water to fit different wash load sizes was mentioned by 61 respondents, and durability and water temperature options were mentioned by 54 of the respondents.

One important item to note is that door placement and axis orientation were kept as two distinct washer attributes. The focus group moderators spent time explaining to each group the difference between vertical and horizontal axis machines and emphasized that horizontal axis machines can be either front or top loading. The focus group discussions tended to center on door placement rather than axis orientation, with respondents citing issues such as bending over and the ability to add clothes in mid-cycle as being important. The fact that door placement is cited more often than axis orientation in the final attribute list is consistent with these discussions.

As discussed in the *Methodology*, the conjoint analysis is limited to a maximum of six attributes. This has been shown to be about the upper limit of attributes that respondents can reasonably expected to consider when ranking the cards. In addition, more than six attributes will result in a conjoint design that utilizes 25 cards rather than the desired 16, which would also tend to overwhelm respondents.

Ideally, the top six attributes from the focus groups would be used for the conjoint analysis so that the conjoint utilizes those attributes that make up the largest share of overall utility. However, it is also important to include those attributes that are likely to be affected by an efficiency rule. If these attributes are omitted, then the conjoint analysis results will not be able to estimate changes in utility resulting from the standard, which is the primary purpose of this analysis.

Of the most important attributes from the focus groups, the ones that are most likely to be affected by an efficiency standard are price, energy and water costs, door placement, capacity, and water temperatures. As shown in Table J.4, these five attributes placed in the top seven attributes in terms of importance in the focus groups. To include these attributes, the decision was made to drop durability as an attribute in the conjoint analysis. Although important, durability is difficult to quantify because it is a performance characteristic that means different things to different people, not a tangible clothes washer attribute like top or front door placement. In addition, durability is unlikely to change as the result of an efficiency rule.

Based on the focus group results, clothes washer price, energy and water savings, capacity, water temperature, door placement, and load size adjustment were selected as attributes to use in the conjoint analysis. This group of attributes contains the five attributes that will be potentially affected by an efficiency standard. In addition, these attributes were ranked among the very most important attributes among consumers.

As stated previously, during the conjoint sessions, respondents were first asked to list the five most important attributes on a clothes washer that they would consider when purchasing a new clothes washer. This list was elicited with no group discussion, for comparison with the list derived during the focus group discussions where respondents were allowed to express opinions to the group.

Table J.5 Top Twelve Clothes Washer Attributes Listed by Conjoint Respondents

Attribute	Percent of Respondents that Listed Attribute Among the Five Most Important
Price	56.2
Energy and Water Costs/Energy Efficiency	47.8
Capacity	43.6
Multiple Wash Cycle Options	35.4
WaterTemperature Options	27.0
Machine Size	26.3
Brand	20.7
Load Size Options	19.1
Reliability	17.0
Quiet Operation	15.2
Warranty	15.2
Door Placement	13.5

The results of this survey are shown in Table J.5, above. The complete list can be found in Section J.11. All six of the attributes shown on the clothes washer cards are among the twelve most frequently cited by the respondents. This list is fairly similar to the list derived during the focus group discussions. Price, capacity, energy and water savings, were the top three on both lists. Nine of the twelve attributes are among the top 12 attributes in both lists. The conjoint session participants' 'top twelve' list includes machine size, brand, and reliability, while the focus group list did not. These attributes ranked 22nd , 16th , and 17th on the focus group list, respectively. The focus groups had durability, wash time, and horizontal/vertical axis on the top twelve list, while these attributes ranked 14th , 19th and 49th on the conjoint session respondent list.

The results of the conjoint analysis using the attributes and the relative importance placed on these attributes is discussed in the *Conjoint Analysis Results* chapter of this report.

J.8 CONJOINT SESSION SURVEY RESULTS

J.8.1 Introduction

In addition to ranking the clothes washer attributes by sorting the 16 cards, respondents were given a short survey to complete after they finished ranking the conjoint cards. This survey asked a variety of questions designed to get at sensitivity to clothes washer price as well as collect additional demographic information. These questions were used to stratify the conjoint sample so

that purchase probabilities and utility could be estimated for different demographic groups. For example, separate estimates were conducted for those that indicated on the survey that they would consider purchasing a horizontal axis machine. A complete copy of the survey and a summary of the participant responses can be found in Appendix C.

This section presents a summary of the major findings of these surveys. Findings are presented by demographic group and by clothes washer demand attributes. These discussions also incorporate some exploration of relationships between question responses. Finally, the list of important attributes elicited during the conjoint sessions is compared with that derived during the focus group discussions. These surveys were conducted independently from the conjoint analysis.

J.8.2 Conjoint session Survey Results

J.8.2.3 Demographics

Table J.6 Sampling Results

Group	Definition	Target Sample	Percent of Target Sample	Actual Sample	Percent of Actual Sample
East Region	Washington, DC	100	22.2%	95	21.8%
South Region	Dallas, TX	100	26.2	111	25.5
Mid-West Region	Madison, WI	100	26.2	111	25.5
West Region	San Francisco Bay Area, CA	100	25.3	118	27.1
Young	18 - 24 Years	60	12.8	53	12.2
Elderly	65 And Older	60	15.8	67	15.4
Low Income	Annual Income <$25,000	90	24.4	107	24.6

The respondents were recruited to represent diverse segments of the consumer market for clothes washers. Particular attention was paid to age, income level, and region of the country. The target and actual sample composition in these key age, income and regional categories are shown in Table J.6 above. The actual sample population was a little more than 15 percent elderly people, coming within one-half of one percent of the target percent. The actual sample was about 12 percent young people, which fell 3 percent short of the target. Nearly one-quarter of the sample population had incomes below $25,000 per year, well above the target of 23 percent. The actual sample was also fairly evenly distributed across the four regional categories: east, south, mid-west, and west, as was the target sample. The south and mid-west regions composed just over 25 percent of the total sample each. The east region was a little smaller, at 22 percent, and the west region was the largest, at 27 percent.

Table J.7 Income Distribution

Income Range	Percent of Total Sample	Percent of those 65 and Older
Less than $10,000	6.2	3.0
$10,000 - $25,000	18.3	23.9
$25,000 - $50,000	31.9	44.8
$50,000 - $75,000	24.5	10.4
$75,000 - $100,000	9.6	11.9
$100,000 and over	8.7	6.0
Refused	0.4	0.0

A more detailed examination of the income distribution of respondents is shown in Table J.7. There was a significant diversity of income levels among the participants. Table J.7 shows the distribution of income levels among all respondents, and those 65 and older. Fewer than 25 percent of the sample had incomes of less than $25,000 per year, with 6 percent of the sample earning less than $10,000 per year. A little more than 18 percent of the sample earned $75,000 per year or more, with about 9 percent earning more than $100,000 per year. Well over half of those surveyed (56 percent) had incomes between $25,000 and $75,000 per year. The median income range was $25,000 to $50,000. Among those over 65 years old, 27 percent had incomes below $25,000 per year, and 18 percent had incomes over $75,000.

Table J.8 Ethnic Background of Respondents

Group	Percent of Sample
Caucasian/White	75.2
African-American/Black	14.9
Latino/Hispanic	5.3
Asian	3.0
Other	1.6

As shown in Table J.8 above, the sample had a fair representation of different ethnic backgrounds. Twenty five percent of those surveyed were of non-Caucasian ethnicity. A little less than 15 percent were black, 5 percent were Hispanic, and 3 percent Asian. About 60 percent of non-Caucasian respondents had incomes over $25,000, with the majority (37 percent) between $25,000 and $50,000. Among those over 65 in age, 21 percent were of non-Caucasian ethnicity.

Table J.9 Distribution of Educational Achievement

Education	Percent of All Respondents	
Some High School	1.2	
High School Graduate	8.5	
Some College	23.9	
College Graduate	63.8	
Trade Vocational School	2.6	

Table J.9 shows the distribution of the respondents' educational achievement. Most respondents were college graduates (64 percent), with most of the remaining 36 percent having some college or finishing high school. Among those with income less than $25,000 per year, 79 percent had at least some college. The percentage among all three groups that had completed trade or vocational schooling was quite small, between 2 percent and 3 percent.

About 63 percent of respondents live by themselves or with one other person, while 22.1 percent lived in households of four or more people. About 75 percent of respondents had no children between 6 and 18 year old living in their household, with the remaining 25 percent having at least one such child in their household. Of those who did have children, about half had just one child, and 82 percent had two or fewer. Seventy-one percent sent their children to public school.

A large portion of the sample, 60 percent, owned their homes, while the other 40 percent rents. The typical respondent did their laundry at home. Over 72 percent of those surveyed did laundry at home. The second most common place was an apartment laundry room, at 19 percent. A little more than 7 percent did laundry at a laundromat. Among respondents with incomes under $25,000, 13 percent used a laundromat, 45 percent did their laundry at home, and 35 percent in an apartment laundry room. Among respondent over 65 years of age, only 3 percent did their laundry at a laundromat, 18 percent in an apartment laundry room, and 76 percent at home.

More than 17 percent of respondents had purchased a new clothes washer within the past two years. With regard to horizontal axis clothes washers, 57 percent of those surveyed had used them in the past, and 70 percent stated that they would consider purchasing such a machine. Among those over 65 in age, 40 percent had used horizontal machines in the past, and 60 percent would consider purchasing such a machine.

Clothes Washer Demand Characteristics.

Table J.10 Distribution of Expected Price for a New Clothes Washer

	All Respondents	Over 65 Years Old	Income Under $25,000
Less than $350	0.7%	0.0%	1.0%
$350 to $449	29.8%	28.4%	26.2%
$450 to $549	48.9%	55.2%	52.4%
$550 to $649	14.9%	10.4%	12.6%
$650 to $750	4.0%	3.0%	4.9%
Greater than $750	0.5%	1.5%	1.0%
Refused/Don't Know	0.9%	1.5%	1.9%

In order to assess peoples' expectations of the price of a new clothes washer, we asked them how much they think a new clothes washer would cost. Table J-10 shows the distribution of all responses, as well as those for the elderly and lower income segments. Among those who had not recently purchased a new clothes washer, 47 percent thought the price would be between $450 and $549. The second most popular response was $350 to $449, at 29 percent. Overall, among those who had not recently purchased a washer, 90 percent thought the price would be between $350 and $649. Among those who had recently purchased a machine, the results were quite similar. About 52 percent thought the price would be between $450 and $549, and 30 percent thought it between $350 and $449. Overall, among those who had recently purchased a machine, 98 percent thought the price would be between $350 and $649.

Table J.11Distribution of Desired Price Range for a New Washer

Price Range	All Respondents	Over 65 Years Old	Income Under $25,000
$200-349	6.9%	4.5%	16.5%
$350 to $499	51.3%	46.3%	56.3%
$500 to $649	34.0%	35.8%	22.3%
$650 to $849	5.9%	10.4%	3.9%
$850 to $999	1.4%	3.0%	0.0%
$1,000 to $1,200	0.0%	0.0%	0.0%
Refused	0.5%	0.0%	1.0%

As a final approach to identifying consumers' willingness to pay for clothes washers, we asked in what price range would they like to stay within if they were to purchase a new washer. Specifically, the question stated "The price of a new clothes washer ranges from a low of $200 to a high of $1,200. If you were to purchase a new clothes washer today, what price range would you hope to stay within." Table J.11 shows the distribution of responses to this question. The exhibit shows that over half (51 percent) hope to pay between $350 and $499. The second most popular category was $500 to $649, with 34 percent of respondents.

Those over 65 years old expressed similar opinions regarding what they hoped to pay for a new clothes washer. Over 46 percent of elderly respondents hoped to stay between $350 and $499, while nearly 36 percent hoped to stay between $500 and $649. Among those with incomes below $25,000, a greater portion of respondents wanted to stay in the $200 to $349 range and the $350 to $499 range.

Table J.12 Choice Sensitivity to Price Change; All Respondents

Option	New Washer Cost $400	New Washer Cost $450	New Washer Cost $650
Purchase the new machine	63.6%	53.9%	16.3%
Fix old machine for $150	32.9%	41.8%	74.7%
Do laundry somewhere else	1.7%	0.9%	2.6%
Shop for a used machine	0.9%	1.1%	1.1%
Refused/Don't Know	0.9%	1.1%	1.1%

Posed with the problem of a hypothetical broken washer, Table J.12 shows how the respondents' solution choices changed with the price of a new washer. More specifically, respondents were asked to imagine that their clothes washer had broken. This washer was imagined to be 10 years old and had an expected life of 15 years. They were offered various optional approaches to this problem; they could:

- fix the washer,
- buy a new washer;
- do laundry somewhere else (not replace of fix),
- or shp for a used machine.

This question was posed with three different prices for a new machine, $400, $450, and $650. The cost to fix the machine stayed constant, at $150. At a price of $400 for a new machine, nearly 64 percent stated they would purchase a new machine , while less than 2 percent said they would do laundry somewhere else, and 33 percent said they would fix the broken machine. When the price rose to $450, the number willing to purchase a new machine fell to 54 percent, most deciding to repair instead, which rose to 41 percent. At a price of $650, only 16 percent opted to purchase the new machine. Nearly 75 percent chose to repair their machine, and 3 percent would do their laundry someplace else.

Table J.13 Option Choice Sensitivity to Price Change; Respondents with Income Less than $25,000 Per Year

Option	New Washer Cost $400	New Washer Cost $450	New Washer Cost $650
Purchase the new machine	54.5%	42.7%	11.7%
Fix old machine for $150	37.9%	47.6%	69.9%
Do laundry somewhere else	4.9%	3.9%	8.7%
Shop for a used machine	1.9%	4.9%	8.7%
Refused/Don't Know	1.0%	2.0%	1.0%

Table J.13 shows the same results for the low income portion of the sample. Among respondents with yearly incomes of $25,000 or less, the results show a much greater tendency to choose to go someplace else to do laundry or repair the old machine. At a price of $400 for a new machine nearly 5 percent stated they would do laundry someplace else, and 38 percent stated they would fix the old machine. The number choosing to purchase the new machine for $400 is 54 percent. At a price of $450 for a new machine, 48 percent stated they would repair the old machine, and only 43 percent would purchase the new machine. The number choosing to do laundry someplace else actually falls slightly, to 4 percent. At a price of $650, most (70 percent) of lower income respondents choose to fix the old machine, 12 percent would purchase the new machine. At this price, 9 percent state they would choose to do laundry someplace else.

Table J.14 Option Choice Sensitivity to Price Change; Respondents Over 65 Years of Age

Option	New Washer Cost $400	New Washer Cost $450	New Washer Cost $650
Purchase the new machine	76.1%	67.2%	31.3%
Fix old machine for $150	20.9	31.3	65.7
Do laundry somewhere else	0.0	0.0	1.5
Shop for a used machine	1.5	0.0	0.0
Refused/Don't Know	1.5	1.5	1.5

Table J.14 is similar to Table J.12 and J.13, except it displays the results for the elderly portion of the sample. Among respondents over 65, the exhibit shows a greater reluctance to do laundry someplace else, or repair the old machine. At a price of $400 and $450 for a new machine, no elderly respondents stated they would do laundry someplace else. At the $400 price, only 21 percent of elderly stated they would fix the old machine versus 33 percent for the entire sample. The

number of elderly respondents choosing to purchase the new machine for $400 comprise 76 percent, significantly higher than the 64 percent result in the entire sample. At a price of $450 for a new machine, the results are similar. At a price of $650, the number choosing to purchase a new machine drops to 31 percent, which is almost double the percent of the whole sample who indicated they would purchase a new washer at this price. At $650, a very small percentage would do laundry somewhere else, while most (66 percent) would choose to fix the old machine.

J.9 CONJOINT ANALYSIS RESULTS

J.9.1 Introduction

This section presents the results of the conjoint data analysis. Results are presented for the full sample, as well as various sample subgroups. Survey questions were used to stratify the conjoint sample so that purchase probabilities and utility could be estimated for different demographic groups. The results were also used to evaluate the relative importance of each of the clothes washer attributes for the various groups. In addition, the potential impact of efficiency standards on the likelihood of purchasing a new clothes washer is analyzed and presented for a number of subgroups, as well as the full sample.

The section begins with a review of the equipment choice model approach, and then presents the results for the full sample. There is also an explanation of the relative importance statistic, which is used to identify which attributes were most important in determining consumer utility. This is followed by an examination of the coefficients and the implied relative importance of each attribute to respondents.

A detailed review of the equipment choice model coefficient estimation results is presented next, concentrating on the differences in results among various sample subgroups. The relative importance of attributes is then compared and contrasted by sample subgroup.

Finally, the purchase model estimation results are presented. In addition, analysis was conducted on the sensitivity of the likelihood of purchasing a washer to various equipment options reflecting different efficiency levels. This analysis was conducted over the entire sample as well as for different subgroups within the sample.

Equipment Choice Model Results. This section presents the results of the equipment choice modeling and begins with review of the clothes washer card attributes, and definitions of specific attributes used in the analysis. (A copy of the cards can be found in Section J.14.) This is followed by an explanation of the relative importance statistic, including the method used to derive the statistic and an explanation of its meaning. Overall estimation results are presented, which includes the coefficient estimates and relative importance statistics for the full sample. This is followed by sections that compare coefficient and importance statistics across various sample subgroups.

Table J.15 Attribute Definitions

Variable	Description
Price	Dollar value of retail price of machine
Savings	Dollar value of annual water and energy bill savings
Capacity	Binary variable: zero for standard capacity machine, one for extra large capacity.
Door Placement	Binary variable zero for front loader, one for top loader.
Water Temp.	Binary variable: zero for 'cold/warm', one for 'cold/warm/hot' washing temperature options
Load Size	Binary variable: zero if there is no load sizie adjustment option, one if there is

Table J.15 describes the attributes used in the equipment choice model. As stated previously, participants were asked to rank a series of cards, each with six attributes. The order in which the attributes were presented on each card was varied across the groups. This was done to avoid any potential bias due to the card presentation. The six attributes presented on each card were as follows:

- Price – retail cost of clothes washer ($400, $450 or $600),
- Savings - annual energy and water bill savings ($0, $10, or $50),
- Capacity - standard or extra large capacity,
- Door placement - Indicates either top or front door placement,
- Water Temperature – Indicates whether hot water is available, either hot, warm and cold wash cycle options, or warm and cold options only,
- Load size - adjustable water level (to match load size) or non-adjustable (one water level.)

Equipment Choice Model Approach. The equipment choice model analyzes the choice of a specific equipment option, given that the decision to purchase a washer has already been made. In the conjoint analysis session the respondents ranked 16 clothes washer cards, from the most preferred to the least preferred. When all the conjoint data were collected, the attribute levels on the cards were regressed against the rankings of the cards:

Rank =

$$\beta'\text{Price}_i + \beta'\text{Savings}_i + \beta'\text{DoorPlacement}_i + \beta'\text{Capacity}_i + \beta'\text{WaterTemp}_i + \beta'\text{LoadSize}_i + \varepsilon_i$$

Where Rank = Rank value from 1 to 16, based upon the respondents' relative assessment of each card.

Price_i = Value for price on card i
Savings_i = Value for energy and water savings on card i
DoorPlacement_i = 1 for top loading, 0 for front loading on card i

$Capacity_i$ = 0 for standard capacity, 1 for large capacity on card i
$WaterTemp_i$ = 1 for hot water available, 0 if no hot water on card i
$LoadSize_i$ = 1 if Adjustable, 0 if nonadjustable on card i
β_j = Coefficients to be estimated
ε_i = random error term assumed to be logistically distributed

Importance Statistics. The results of the equipment choice model can be used to infer the relative importance of each attribute to the consumer's total utility. Specifically, the coefficient estimates from the equipment choice model can be used to calculate an "importance statistic." This statistic measures the importance of one design attribute, relative to that of all other design attributes in determining a card's total utility.

The total utility of each card can be calculated by inserting attribute values into the estimated regression equation:

Total $Utility_i$ =

β'$Price_i$ + β'$Savings_i$ + β'$DoorPlacement_i$ + β'$Capacity_i$ + β'$WaterTemp_i$ + β'$LoadSize_i$

Using the coefficient estimates and the values for the attributes used in the conjoint analysis, the importance statistic is defined as:

$$IMP_I = \frac{\Delta Yi = \text{The\_maximum\_utility\_change\_due\_to\_attribute\_i}}{\Delta y \quad \text{The\_maximum\_utility\_change\_due\_to\_all\_attributes}}$$

The importance statistic measures the percentage of the total maximum change in utility across all card choices that is attributable to a single attribute. Stated another way, the importance statistic measures each attribute's contribution to the total utility based on the six attributes included in the conjoint analysis.

Overall Estimation Results. This section describes the results of the equipment choice model estimation for the full sample. The estimated coefficients for each clothes washer attribute, as well as each relative importance statistic are reviewed.

Table J.16 Regression Coefficients and Relative Importance; All Respondents

	Coefficient	Standard Error	Significance Level	Relative Importance
Price	-0.33359	0.000	1%	26%
Savings	0.010	0.001	1%	14%
Capacity	0.248	0.024	1%	7%
Door Placement	0.383	0.024	1%	11%
Water Temperature	0.614	0.024	1%	18%
Load Size	0.852	0.024	1%	25%
				100%

The results of this estimation are shown in Table J.16. (See Section J.14 for additional subgroup statistics.) The coefficient estimate for price is negative and significant and the estimate for savings is positive and significant. All of the remaining attributes are statistically significant, with positive coefficient estimates. A positive coefficient for "Capacity" indicates people prefer extra-capacity machines to standard capacity. Regarding door placement, respondents indicated a preference for top-loaders over front-loaders. Having a hot water wash option was attractive, as was the ability to adjust the water level to match the size of the load. All of these coefficients are significant at the 1 percent level of significance, which means that the estimates are significantly different from zero with a 99 percent degree of confidence.

While coefficients estimates do provide some information on the influence of the variable on total utility, it is misleading to look only at the coefficient to gauge the influence of that variable. For example, the savings coefficient is ten times the magnitude of the price coefficient since savings is measured in tens of dollars and price in hundreds of dollars. Only looking at the magnitude of the coefficients would give the misleading impression that savings is considered much more important than price. To address this issue, relative importance statistics are calculated that combine both the coefficient and attribute value to get an overall measure of the influence on total utility. The relative importance statistic can be interpreted as each attribute's contribution to total utility.

The relative importance statistics show that while price is the most important attribute to consumers, it just barely surpasses adjustable load size in terms of importance in total utility based on the six washer attributes. Together, these two attributes contribute about half of the total utility. Having a hot water wash option was the third most important attribute, contributing about 18 percent of total utility. Door placement finished second-to-last in importance, with 11 percent of total utility, and capacity ranked last in terms of impact on total consumer utility, at 7 percent.

Sample Subgroup Comparison of Coefficient Estimates. This section provides a more detailed review of the coefficient estimation results, including an examination of the differences in results between various sample subgroups.

Table J.17 Regression Coefficient Estimates for Regional Subgroups

Coefficient Estimates								
	Full Sample	Low Income	65 & Older	18-24 Yrs. Old	Recent Purchasers	Have Tried Horizontal Axis	Would Consider Purchasing H-Axis Machine	Would Not Consider Purchasing H-Axis Machine
Price	-0.00359	-0.00397	-0.00246	-0.00519	-0.00239	-0.00346	-0.00367	-0.00351
Savings	0.010	0.010	0.0067	0.016	0.005	0.009	0.011	0.006
Capacity	0.248	0.255	0.124	0.375	0.173	0.260	0.266	0.194
Door Placement	0.383	0.330	0.352	0.460	0.300	0.303	0.264	0.709
Water Temperature	0.614	0.518	0.524	0.547	0.520	0.624	0.653	0.533
Load Size	0.852	0.648	0.817	0.657	0.861	0.867	0.834	0.927

Table J.17 presents coefficient estimates for various demographic subgroups of the sample. The same statistical regression analysis performed on the whole sample, discussed above, was performed on various subgroups of the sample to assess any prominent differences among segments. The subgroups shown above include:

- lower income ($25,000 per year or less),
- elderly (65 and older),
- young (18 to 24),
- those who recently purchased a clothes washer (within the past two years) ,
- those who have tried a horizontal axis machine,
- those that would consider purchasing a horizontal axis machine, and
- those that would not consider purchasing a horizontal axis machine.

Table J.18 Regression Coefficient Estimates for Regional Subgroups

Coefficients Estimates					
	Full Sample	**Madison**	**Washington DC**	**Dallas**	**San Francisco Bay Area**
Price	-0.00359	-0.00477	-0.00319	-0.00336	-0.00357
Savings	0.010	0.016	0.010	0.005	0.011
Capacity	0.248	0.483	0.191	0.156	0.235
Door Placement	0.383	0.558	0.178	0.523	0.339
Water Temperature	0.614	0.768	0.616	0.523	0.638
Load Size	0.852	1.008	0.756	0.836	0.916

Conjoint sessions were held in four cities: Madison (Wisconsin), Washington DC, Dallas (Texas) and the San Francisco Bay Area (California). Roughly one hundred participants completed the ranking exercise in each city. Coefficient estimation results for the regional subgroups, as well as the full sample, are shown in Table J.18.

The signs of the estimated coefficients for each regional subgroup are consistent with those for the overall sample, indicating a directional consensus on the desirability of attributes. Moreover, the magnitudes of the coefficients for each subgroup are generally similar to those of the overall sample.

As stated earlier, the coefficient estimates provide information regarding the sensitivity to different attributes, but do not provide information regarding the attributes relative importance to any one group. Thus, the simple fact that the coefficient for savings is largest for young people across the subgroups does not necessarily imply young people place the highest relative value on savings.

The coefficient for price is fairly consistent. The range of estimated coefficients varies between –0.002 to –0.005, with an overall coefficient estimate of -0.004. Young people and people in Madison are most sensitive to changes in price. Those who have recently purchased a new washer and those over 65 years old are least sensitive to price.

Young people and people from Madison are the most sensitive to savings, while those who have recently purchased a machine and people from Dallas are the least sensitive. The difference between the highest and the lowest coefficient estimates is a factor of more than three, 0.005 versus 0.016. Older people and those who would not consider purchasing a horizontal axis machine are also relatively insensitive to savings.

While most of the subgroups examined have a coefficient estimate for capacity of about 0.2, there are some notable exceptions. Again, the Madison group stands out from the rest, with the

highest coefficient for capacity at 0.48. Also, age seems to be relevant to the sensitivity to clothes washer capacity. The second largest estimated coefficient for capacity was for young people, 0.38. Conversely, the group with the smallest coefficient for capacity was those over 65, at 0.12.

The respondents who indicated that they would not consider purchasing a horizontal axis machine were quite sensitive to door placement, and had the highest estimated coefficient, 0.71. Conversely, restricting the sample to those who would consider purchasing a horizontal axis machine resulted in a lower than average coefficient for door placement, 0.26. The group least sensitive to door placement were those in Washington DC, with a coefficient of 0.19.

Having a hot water wash temperature option was important for all of the subgroups, and the coefficients are fairly consistent, varying from a low of 0.51 for the low income group to a high of 0.77 for the Madison group.

An adjustable load size option had high coefficient estimates across all of the subgroups, but the Madison group stands out again with the highest estimate, 1.0. The lowest estimated coefficient was 0.65, for the low income group.

Review of Relative Importance Results

Table J.19 Relative Importance Statistics for Demographic Subgroups

	Coefficient Estimates							
	Full Sample	Low Income	65 & Older	18-24 Yrs. Old	Recent Purchasers	Have Tried Horizontal Axis	Would Consider Purchasing H-Axis Machine	Would Not Consider Purchasing H-Axis Machine
Price	26%	30%	22%	31%	22%	26%	26%	25%
Savings	14%	16%	11%	19%	9%	13%	15%	9%
Capacity	7%	8%	5%	9%	6%	8%	8%	5%
Door Placement	11%	10%	13%	11%	11%	9%	8%	20%
Water Temperature	18%	16%	19%	13%	19%	19%	19%	15%
Load Size	25%	20%	30%	16%	32%	26%	24%	26%

Table J.19 compares the relative importance statistics of each attribute across the demographic and regional subgroups. Again, the relative importance statistic identifies the contribution of each attribute to respondents' perception of total utility. It can be compared across the subgroups to determine which subgroup places the most emphasis on an attribute.

Table J.20 Relative Importance Statistics for Regional Subgroups

Coefficients Estimates					
	Full Sample	**Madison**	**Washington DC**	**Dallas**	**San Francisco Bay Area**
Price	26%	25%	26%	27%	25%
Savings	14%	16%	16%	8%	15%
Capacity	7%	10%	6%	5%	7%
Door Placement	11%	12%	6%	17%	10%
Water Temperature	18%	16%	20%	17%	18%
Load Size	25%	21%	25%	27%	26%

Table J.20 presents relative importance statistics for regional subgroups. For most of the subgroups, price contributed a little over 25 percent to total utility, and was the most important single attribute, albeit by a slim margin. Low income people and young people (who are likely also to have lower incomes) placed the highest relative value on price, 30 percent and 31 percent, respectively. On the other side, recent purchasers and people over 65 responded more strongly to adjustable load size than to price. For both groups, price comprised 22 percent of total utility.

For most groups, savings contributed between 9 percent and 16 percent to total utility, and was not in the top three important attributes. Those from Dallas placed an unusually low value on savings, at 8 percent of total utility, and young people placed a very high value on savings, 19 percent.

A large capacity clothes washer was not very important to most subgroups, with relative importance ratings varying from a low of 5 percent for elderly people and people from Dallas, to a high of 10 percent for people from Madison. Young people also placed a higher than average value on capacity, 9 percent. There appears to be some correlation between age and the relative importance of clothes washer capacity.

Door placement ranked fifth out of six attributes for the full sample. For most of the subgroups the relative importance was similar. Not surprisingly, those who would not consider purchasing a horizontal axis machine placed the highest relative importance on door placement. Door placement was the third most important attribute for this subgroup. People from Dallas also placed a relatively high importance on door placement, at 17 percent of total utility. Older people placed a somewhat higher than average importance on door placement, 13 percent.

For most subgroups, as well as the full sample, a hot water wash option was the third most important attribute. Relative importance statistics vary from a low of 13 percent for young people to a high of 20 percent for the Washington DC group. Most subgroups found hot water to contribute between 16 percent and 19 percent to total utility.

Adjustable load size was almost invariably either the first or second most important attribute to each subgroup. Most subgroups found this attribute contributed 20 percent to 30 percent of to total utility. Adjustable load size was the single most important attribute to the elderly, recent purchasers, those who would not consider purchasing horizontal axis machines, and those from the San Francisco Bay Area. Adjustable load size tied price as the most important attribute for the Dallas subgroup, and those who have tried horizontal axis machines. With the exception of young people, the remaining subgroups found adjustable load the second most important attribute. Age seems to be correlated to the relative importance of adjustable load size. The elderly subgroup placed the highest relative importance on this attribute, 30 percent, while young people placed the lowest, 16 percent. It should be noted that among low income people, adjustable load size ran a distant second to price: 30 percent for price, and 20 percent for adjustable load size.

Purchase Scenarios. As discussed in the *Methodology*, the conjoint results can be used to estimate the likelihood of purchasing a clothes washer based on the placement of the purchase card. This section discusses these estimation results as well as some scenarios for different equipment options reflecting different efficiency levels. These probabilities are estimated for the entire group as well as different subgroups within the sample.

Purchase Model Estimation Results. During the conjoint analysis, once respondents completed ranking their cards, they were asked to place the Purchase Card in the card set to indicate which of the 16 clothes washers indicated on the cards they would actually considering purchasing. Based on this information, the probability of making a purchase can be estimated based on the attributes on the cards above and below the Purchase Card. In equation form:

Purchase (0,1) =

$$\alpha + \beta'\text{Price}_i + \beta'\text{Savings}_i + \beta'\text{DoorPlacement}_i + \beta'\text{Capacity}_i + \beta'\text{WaterTemp}_i + \beta'\text{LoadSize}_i + \varepsilon_i$$

Where Purchase = 1 if card is ranked above the Purchase Card, 0 if ranked below

Price_i	=	Value for price on card i
Savings_i	=	Value for energy and water savings on card i
DoorPlacement_i	=	1 for top loading, 0 for front loading on card i
Capacity_i	=	0 for standard capacity, 1 for large capacity on card i
WaterTemp_i	=	1 for hot water available, 0 if no hot water on card i
Load Size_i	=	1 if Adjustable, 0 if nonadjustable on card i
B_j	=	Coefficients to be estimated
α	=	Constant to be estimated
ε_i	=	random error term assumed to be logistically distributed

Table J.21 Purchase Model Coefficient Estimates; Full Sample

	Coefficient	Standard Error	Significance Level
Intercept	-0.949	0.224	1%
Price	-0.0066	0.000	1%
Savings	0.029	0.002	1%
Capacity	0.452	0.072	1%
Door Placement	0.698	0.075	1%
Water Temp.	1.438	0.071	1%
Load Size	1.809	0.071	1%

Table J.21 shows the coefficient estimates for the purchase model using the entire sample. The coefficient estimates for the sample subgroups are given in Appendix E of this report. As these results show, the coefficient estimates are very similar to those found in the equipment choice model used to estimate relative importance of attributes. All of the coefficient estimates are statistically significant at the 1 percent level. The intercept term reflects the average effect of all the factors that influence the decision to purchase a clothes washer that are not captured in the six attributes included in the conjoint. Price is negative and is large in magnitude, which indicates that washer price was an important determinant in the decision to make a clothes washer purchase. Similarly, hot water and the ability to adjust the amount of water to fit the size of the wash load were also very important factors in determining the likelihood of purchase. Door placement was also influential, but not considered as important as hot water or adjustable load size. However, the importance of door placement did tend to vary across different demographic segments, as shown in the purchase scenarios discussed below.

Purchase Probability Scenarios. Once this model was estimated, the probability of making a purchase was calculated by combining the coefficient estimates with the six washer attributes and plugging in the logit probability function:

$$\text{Prob(Purchase)} = \exp(\beta'X) / (1 + \beta'X)$$

Where $\beta'X$ reflects the sum of the coefficient estimates used in the conjoint analysis as shown in Exhibit 5-7. By using different values for price, savings, and the equipment attributes to simulate different efficiency levels, this equation can be used to determine the overall effect on utility of an efficiency standard.

Table J.22 Purchase Scenario for Demographic Subgroups

Sample Group	Standard Efficiency	Medium Efficiency	High Efficiency Front Load	High Efficiency No Hot Water	High Efficiency, Front Load, Constant Price	High Efficiency, Front Load, Constant Price and No Savings
Full Sample	0.59	0.58	0.36	0.21	0.75	0.42
Low Income	0.65	0.63	0.41	0.26	0.78	0.50
Elderly	0.59	0.59	0.39	0.26	0.66	0.39
Young	0.64	0.61	0.29	0.28	0.76	0.44
Recent Purchasers	0.55	0l.54	0.33	0.17	0.67	0.40
Have Tried H-Axis	0.57	0.56	0.39	0.19	0.78	0.45
Would Consider H-Axis	0.56	0.55	0.42	0.21	0.78	0.43
Would Not Consider Axis	0.67	0.64	0.21	0.23	0.62	0.35

Table J.22 shows purchase scenarios probability estimates for different sample subgroups. These probabilities are calculated for standard efficiency, medium efficiency, and several high efficiency equipment options. The standard efficiency option assumes a price of $400, no energy and water savings, and a top loading machine. The medium efficiency washer has a price of $450 and energy and water savings of $10 annually, and is a top loading machine. This is consistent with an approximately 20 percent improvement in efficiency. The high efficiency equipment options have a price of $650, annual savings of $50, and are either front loading machines with hot water wash capability or top loading machines with no hot water capability. To judge the effect of price in these scenarios, the high efficiency option is also calculated holding price constant at $400, while having a front loading machine with $50 annual savings.

The first row of Table J.22 shows the purchase probability estimates for the full sample for a variety of washer efficiency levels. For the full sample, the initial likelihood of purchase estimate is 59 percent, meaning that 59 percent of those surveyed would be willing to purchase the standard efficiency clothes washer. This provides a starting point from which to compare changes in attributes and the effect these will have on the likelihood of purchase. In this sense, examining the changes in purchase probability reflects the change in utility, since lower utility washer configurations will have a lower likelihood of being purchased.

Full Sample Probability Estimates. When the probability is calculated using numbers for the medium efficiency washer, there is virtually no change in the estimated likelihood of purchase. This indicates that the increase in savings to $10 is enough to offset the increase in price from $400 to $450. This suggests that a washer design that increases efficiency with a modest increase in price and savings that has a top loading design will have a minimal effect on overall purchases.

The high efficiency equipment options tend to have much greater effect on the likelihood of purchase. This results from the greater change in price as well as changing the design of the machine to be either a front loader or to have the machine clean without using hot water. As shown in Table J.22, a high efficiency front loading washer at a price of $650 and annual savings of $50 will decrease the likelihood of purchase from 0.59 to 0.36, a decrease of 39 percent. If the machine is designed to run without hot water instead of being a front loader, the decrease is even greater. In this case, the likelihood of purchase probability goes from 0.59 to 0.21, a decrease of 64 percent.

For these high efficiency options, the changing likelihood of purchase is the combined result of changes in price, savings, and either door placement or water temperature options. As discussed in the analysis of the importance statistics, for the overall sample, price plays the greatest role in influencing utility, followed by water temperature and door placement. This also can be seen when equipment options are changed but price is held constant. When price is held constant and compared with the other estimated probabilities, the importance of price is apparent.

Table J.22 also shows the likelihood of purchase for high efficiency machines that have the standard efficiency ($400) price. In the case where savings is $50 annually and the machine is a front loader, then the purchase probability is estimated to increase from 0.59 to 0.75. This shows that the increase in savings more than offsets the decrease in utility due to switching from a top loader to a front loader. When price and savings are held constant and the washer is changed from a top loader to a front loader, the estimated purchase probability falls almost 30 percent from 0.59 to 0.42.

Regional Probability Estimates

Table J.23 Purchase Scenarios for Regional Subgroups

Sample Group	Standard Efficiency	Medium Efficiency	High Efficiency Front Load	High Efficiency No Hot Water	High Efficiency, Front Load, Constant Price	High Efficiency, Front Load, Constant Price and No Savings
Washington, DC	0.57	0.58	0.50	0.29	0.75	0.48
San Francisco Bay Area, CA	0.60	0.59	0.41	0.19	0.80	0.43
Madison, WI	0.63	0.60	0.30	0.18	0.83	0.45
Dallas, TX	0.58	0.57	0.26	0.20	0.58	0.32

The same purchase probability analysis was done by breaking the sample out by region. These results are shown in Table J.23. Given the overall sample probability estimate of 0.59 for a standard efficiency machine, both the Washington DC and Dallas estimates are below the sample average while Madison and the San Francisco Bay Area are above the sample average.

The biggest differences for all of the sample subgroups come from the regional estimates for standard and high efficiency machines in Madison and Dallas. For the Madison group, moving from standard efficiency to front load high efficiency machines decreases the purchase probability by 52 percent, compared with only a 39 percent decrease for the entire sample. Similarly, the same move from standard to high efficiency decreases the purchase probability by 55 percent for the Dallas group.

While both groups are sensitive to the move from standard to high efficiency, they are reacting to different attributes. This is shown when price is held constant and savings and door placement are allowed to vary. When price is held constant, Madison has a 32 percent increase in purchase probability. This indicates that the decrease in probability going to high efficiency is due primarily to the price increase.

For Dallas, holding price constant results in no increase in the purchase probability from the standard efficiency case. Dallas is the only subgroup for which this is true. For the Dallas group, door placement is relatively more important. Thus, the relatively large increase in savings just offsets the disutility of a front loading machine. For all other demographic groups the increase in savings more than makes up for the front loading design. This latter result is also reflected in the importance statistics, where door placement had the highest importance rating in Dallas relative to the other cities, as well as different sample subgroups.

Elasticity Estimates. In addition to calculating the importance statistics and purchase probabilities, price elasticities were also calculated to provide a different measure of the importance of price. These results are discussed below.

Price elasticity provides a measure of how sensitive consumer demand is to changes in price. Unlike the purchase scenarios, where price was varied along with other washer attributes, elasticity calculations examine the effect of changes in price while all other attributes remain constant. As a result, price elasticity addresses the question of what will happen when price changes but everything else remains the same.

In this analysis, the current market conditions are assumed to be those of the standard efficiency washer. Under these conditions, machines are top loaders with normal capacity, adjustable load sizing, and hot water. In addition price is set at $400 and energy and water savings are assumed to be zero. From this starting point, price elasticity is calculated by:

$$\text{Price Elasticity} = (\Delta \text{ Prob} / \Delta \text{ Price}) * (\text{Price}_{mid} / \text{ Prob}_{mid})$$

Where Δ Prob = Change in purchase probability due to the change in price

Δ Price = Change in price resulting from the efficiency standard

$Prob_{mid}$ = Midpoint between pre-standard and post-standard purchase probability

$Price_{mid}$ = Midpoint between pre-standard and post-standard price.

This measures how much demand changes with a change in price. Using this equation, an elasticity result greater than one in absolute magnitude means that demand is price *elastic*, or relatively sensitive to changes in prices. Stated another way, when demand is elastic, an increase in price of 10 percent will cause demand to decrease by *more than* 10 percent. Similarly, when elasticity is less than one demand is considered *inelastic*. In the inelastic case, a 10 percent increase in price will cause demand to decrease by *less than* 10 percent. The specific calculations for the elasticity estimates are included in Section J.15.

Full Sample Results. For the entire sample result, the initial price elasticity going from a price of $400 to the high efficiency price of $650 results in an price elasticity estimate of –2.0, meaning that in general clothes washer purchases are sensitive to changes in price. However, this calculation is based on stated preference data and is not calibrated to actual purchase behavior. As a result, other factors such as the convenience of owning a clothes washer at all or the unwillingness of current owners to give up their clothes washer are not taken into account in the elasticity estimate.

To address this issue, the estimated purchase probabilities can be calibrated to other measures of the likelihood of purchase to give a more realistic starting point for the elasticity calculations. For example, the uncalibrated likelihood of purchase estimate for the entire sample is 0.59. For some market segments, this estimate is likely to be quite low. For example, consider those who are current washer owners and are used to doing their laundry at home. For this group, if a machine breaks, and they are faced with purchasing a new machine or going to the laundromat, the likelihood of purchase is estimated at 90 percent or greater.

To provide additional information on this issue, survey questions were asked to determine how likely consumers would be to replace a broken clothes washer. Respondents were asked if they would repair a broken machine for $150, purchase a new one for $400, or do clothes elsewhere. Only 2 percent of respondents said that they would start doing laundry somewhere else, and the remainder opted to purchase a new or used machine or get the old machine fixed.

The survey questions provide a starting point for calibrating the purchase probability and to calculate price elasticities. The calibration is done by adjusting the constant term in the purchase probability equation so that the resulting purchase probability for the standard efficiency machine equals 0.98. This is done for that segment of the sample that are homeowners that do laundry at home. For this demographic group, the price is changed from $400 to $650, which results in the purchase probability falling from 0.98 to 0.91. Using these numbers to calculate the price elasticity yields an estimate of -0.16, which indicates that washer demand is relatively insensitive to price

changes. Again, this applies to those customers that currently own a clothes washer that has broken and are looking to replace it rather than start doing their laundry outside the home.

The preceding case assumes that everyone who stated they would repair or purchase a used machine would purchase a new machine at $400 if repairing is not an option. As a result, this should be considered an upper bound. A lower bound estimate can be derived from the survey questions as well. The lower bound assumes that all those that said that they would repair their machine or purchase a used machine would start going to the laundromat if repairing were not an option. This lower bound case produces a likelihood of purchase of 0.64.

Using the 0.64 as a starting point for the lower bound likelihood of purchase, a price change from $400 to $650 results in a price elasticity estimate of –1.64. This reflects a more elastic demand for clothes washer, where changes in price will have a greater impact on purchases than in the upper bound scenario. In this lower bound case, a 10 percent increase in price results in a 16 percent decrease in clothes washer demand.

Low Income Households. The same elasticity calculation was estimated for low income households. Using those respondents with annual household incomes of $25,000 or less, the purchase probability was estimated. Similar to the previous example, survey questions were used to estimate an upper bound for the purchase probability of the low income group. When faced with the choice of purchasing a new washer for $400 or repairing the old one for $150, 7 percent of low income respondents said that they would start doing their laundry elsewhere or shop for a used machine. Using this result, 0.93 was used as an upper bound for the purchase probability for use in the price elasticity estimate. From this starting point, increasing the price from $400 to $650 gives a price elasticity of -0.53 for low income households. While still considered inelastic, this estimate is greater in magnitude than for home owners in general and indicates low income households are more concerned with price than households on average that currently have clothes washers.

The same survey questions were used to determine the lower bound by assuming all those that would repair at $150 would start going to the laundromat if repairing was not an option. In this case, the purchase probability for low income households is 0.54. This results in a price elasticity estimate of –2.10, which is elastic and greater than the estimate for households in general.

Discretionary Clothes Washer Purchasers. The preceding estimates calculated using those respondents that currently own clothes washers. A separate segment of the population are those that do not currently own clothes washers or who have only recently purchased a clothes washer for the first time. Since these people are currently doing without a clothes washer, they can be considered discretionary purchasers since they may or not be in the market for a new clothes washer.

A separate likelihood of purchase model was estimated for these people based on those respondents that do not currently own clothes washers or that recently purchased a washer for the first time. For this group, the upper bound likelihood of purchase is set at 0.59. This is the uncalibrated purchase probability estimate for the entire sample. This was chosen as the upper bound because the entire conjoint analysis exercise was presented in a manner that made the

purchase decision a discretionary purchase. That is, respondents were asked to go through the thought process as if they were currently making the decision to purchase a clothes washer, which is similar to this group of customers in the population.

Given the upper bound purchase probability of 0.59, the price elasticity estimate for discretionary purchasers is –1.92. This reflects a greater sensitivity to price and is more elastic than the estimate for current washer owners.

The price elasticity for discretionary purchasers was also estimated using a lower bound purchase probability of 0.10. This lower bound reflects the sample proportion of those previously did own a clothes washer that purchased one within the last two years. Using this lower bound, the estimated price elasticity of –2.80, showing an even greater sensitivity to price.

These results show that sensitivity to price depends largely on which market segment the consumer falls under. Those that currently own clothes washer or that otherwise might have a high initial likelihood of purchase (such as the new construction market) are less sensitive to changes in price. As prices increase, demand for clothes washers will fall only slightly for these segments of the market if all other washer attributes are held constant. Other segments such as low income segments or that portion of the population that has for whatever reason does not currently own a clothes washer are more sensitive to price. As price increases for these segments, demand for clothes washers will fall at an even greater rate than the price increase for low income and discretionary purchasers.

Conclusions. The objective of this study was to determine which clothes washer attributes consumers value most and estimate how changes in these attributes resulting from an efficiency standard may affect consumer utility and clothes washer purchases. The analysis methods described in this report use several techniques to address these issues. Information obtained in both focus groups and conjoint analysis allowed respondents to state which clothes washer attributes were most important. Surveys were used to determine how respondents would react to different price levels and repair/purchase scenarios. The conjoint analysis allowed purchase probabilities to be estimated, which in turn were used to estimate price elasticities and calculate importance statistics for each of the washer attributes. These different analysis techniques resulted in several key conclusions that are discussed below.

Price is the most important clothes washer attribute. All of the analysis results show price as the most important attribute when consumers are purchasing a new clothes washer. Price was cited most often in the focus groups when the respondents identified their top ten lists of important washer attributes. In addition, the conjoint analysis results show price as the primary attribute respondents focused on when ranking their cards. This resulted in the highest importance statistic of all the washer attributes used in the conjoint.

In the purchase scenarios, the purchase probabilities were more sensitive to price than any of the other washer attributes. While the shift from a standard to a high efficiency machine resulted in a significant drop in the estimated purchase probability, this was due primarily to the change in

price rather than to changes in the other attributes. When price is held constant at the standard efficiency level while the other attributes are allowed to change to reflect a high efficiency machine, the likelihood of purchase actually increases. This is due to the benefit of additional savings from the high efficiency machine outweighing the disutility associated with a front loading machine.

Door placement is not as important as other attributes. Although the focus groups included door placement as one of the 10 most important attributes, both the conjoint results and survey results show that door placement is not as important to consumers as a number of other attributes. During the conjoint analysis, 65 percent of the respondents indicated with their placement of the purchase card that they would be willing to purchase a front loading clothes washer. In the calculation of importance statistics, door placement was second from last in importance among the six attributes used in the conjoint. In addition, 70 percent of the survey respondents said that they would consider purchasing a front loading machine if they were going to buy a new clothes washer. For these people, door placement was tied for last in terms of importance, comprising only 8 percent of total utility.

The lower value placed on door placement was also evident in the purchase scenarios where the benefit of the higher savings outweighed the disutility of the door placement. When price is held constant, the higher savings combined with a front loading machine resulted in a higher estimated purchase probability relative to the standard efficiency case with no savings and a top loading machine.

Demand is more inelastic for those that currently own washers. Both the survey and conjoint results indicate that demand is more inelastic for respondents who currently own clothes washers than non-owners, even with large increases in the clothes washer price. According to survey results, those consumers that currently own clothes washers are much more likely to replace their washer if it breaks than to start doing their laundry at a laundromat. Of those surveyed, only 2 percent said that if their machine broke they would start going to the laundromat or do their laundry somewhere else, while the rest opt to get their machine fixed or purchase a new clothes washer. As a result, 0.98 can be considered an upper bound for the likelihood of purchase under current market conditions and is used as the starting point for calculating the price elasticity.

An additional survey result is that the willingness to start doing laundry elsewhere decreases as income increases. For the low income respondents, 5 percent said they would start doing their laundry somewhere else while among high income respondents (those with incomes at $75,000 or above), no respondents were willing to start doing their laundry elsewhere.

When the purchase probabilities are calibrated to mirror this result, changes in price result in only a very small change in the likelihood of making a purchase. If the likelihood of purchase is calibrated up to 98 percent to match the survey results, the price elasticity estimate is –0.16, which reflects demand for clothes washers that is relatively insensitive to price. A lower bound estimate using a likelihood of purchase probability of 0.64 results in a more elastic estimate of –1.64.

A similar result holds for low income households, which includes those with annual incomes of $25,000 or less. For low income households, consumers are slightly more sensitive to price, but demand is still considered inelastic with an upper bound estimate of –0.53. For the lower bound, price elasticity is estimated to be –2.1.

These results suggest that households that currently own clothes washers will likely continue to purchase new ones when needed, even with large price increases. For example, using the upper bound elasticity estimate for all current clothes washer owners, a 63 percent price increase from $400 to $650 results in only a 10 percent decrease in purchases for this sector of the market. For low income segments, the same 63 percent price increase results in a 33 percent decrease in purchases.

Discretionary purchasers, which include those consumers that do not currently own clothes washers, are more sensitive to price. This is due in part to discretionary purchasers also being low income households. Of the discretionary purchasers, 47 percent had annual incomes of $25,000 or less. For this group the price elasticity is –1.92, which reflects a demand for washers that is more sensitive to price than current washer owners. In this case, a 10 percent change increase in price results in a 19 percent decrease in demand. This reflects an upper bound purchase probability estimate for this group; the lower bound purchase probability estimate results in even a greater sensitivity to price, with an elasticity of –2.80.

J.10 FOCUS GROUP ATTRIBUTE RESULTS

Table J.24 All Focus Groups - 10 Groups - 90 Participants

Feature	Freq. in Top 10	% out of 90	Feature	Freq. in Top 10	% out of 90
Price	75	83%	On Wheels	4	4%
Capacity	73	81%	Rust Proof	4	45
Energy & Water Costs	65	72%	Agitation (side to side/up down)	3	3%
Load Size Options	61	68%	Pre-Wash	3	3%
Durability	54	60%	Self Cleaning Filter	3	3%
Water Temperature Options	54	60%	Soap Dispenser	3	3%
Door Placement	38	42%	Tub Material (Plastic/Metal	3	3%
Quiet Operation	36	40%	Heavy Duty cycle	2	2%
Wash Time	34	38%	Hot Water Pressure	2	2%
Warranty	33	37%	Machine Design	2	2%
Multiple Wash Cycle Options	30	33%	Motor Quality/Size	2	2%
Horizontal/Vertical Axis	25	28%	Removable Tub	2	2%
Agitation Speed	22	24%	Simple Settings	2	2%
Extra Rinse Cycle	22	24%	Spin Length	2	2%
Availability of Service	17	19%	Washer/Dryer Combo	2	2%
Brand	17	19%	Ability to Re-Use Rinse Water	1	1%
Reliability	17	19%	Basket for Odd Shaped Items	1	1%
Bleach/Softener Dispenser	15	17%	Control Labels	1	1%
Lint Removal	15	17%	Connected to Water Softener	1	1%
Buttons/Dials	14	16%	Cycle Stops when Lid Open	1	1%
Corrects Out-of-Balance	14	16%	Electrical Compatibility	1	1%
Machine Size	14	16%	Gas/Electric	1	1%
Hand Washables	13	14%	Heat Own Water	1	1%
Soak Option	12	13%	Lid Lock	1	1%
Door Size	12	13%	Motor Optimizer	1	1%
Spin Speed	11	12%	Safety	1	1%
End-of-Cycle Signal	8	9%	Spin Only Option	1	1%
Add Clothes in Mid Cycle	7	8%	Time Remaining Indicator	1	1%
Color	7	8%	User Friendly Controls	1	1%
Delicate Cycle	6	7%	Two Speed Motor	1	1%
Gentle Cycle	6	7%	Viewing Window	1	1%
Detergent Cost Savings	5	6%	Warning Lights	1	1%
Clear Instructions	4	4%			

Table J-25 Washington DC Focus Group, Combined Group, 16 Participants

Feature	Frequency in Top 10		Feature	Frequency in Top 10
Price	16		Add Clothes Mid-Cycle	3
Capacity	15		Durability	3
Water Temperature Options	13		Horizontal/Vertical Axis	3
Energy and Water Costs	12		Spin Speed	3
Load Size Options	10		End-of-Cycle Signal	2
Door Placement	9		Machine Size	2
Wash Time	9		Warranty	2
Quiet Operation	8		Agitation (side-to-side/up-down)	1
Reliability	8		Corrects Out-of-Balance	1
Availability of Service	7		Detergent Cost Savings	1
Hand Washables	7		Heat Own Water	1
Brand	6		Lint Removal	1
Buttons/Dials	6		Multiple Wash Cycle Options	1
Agitation Speed	5		On Wheels	1
Delicate Cycle	4		Time Remaining Indicator	1
Extra Rinse Cycle	4		Viewing Window	1

Table J.26 San Francisco Bay Area Focus Group, Combined Group, 18 Participants

Feature	Frequency in Top 10		Feature	Frequency in Top 10
Durability	16		Color	3
Price	16		Gentle Cycle	3
Capacity	12		Soak Option	3
Warranty	11		Soap Dispenser	3
Load Size Option	10		Add Clothes in Mid Cycle	2
Water Temperature Options	10		Agitation (side-to-side/up-down)	2
Door Placement	9		Bleach/Softner Dispenser	2
Quiet Operation	9		Hand Washable Cycle	2
Energy and Water Costs	8		Horizontal/Vertical Axis	2
Brand	7		Hot Water Pressure	2
Extra Rinse	7		Removable Tub	2
Wash Time	7		Washer/Dryer Combo	2
Corrects Out-of-Balance	6		Buttons/Dials	1
Lint Removal	4		On Wheels	1
Machine Size	4		Spin Length	1
Spin Speed	4		Spin Only Option	1
Availability of Service	3		User Friendly Controls	1

Table J.27 Madison Focus Group, Combined Group, 19 Participants

Feature	Frequency in Top 10	Feature	Frequency in Top 10
Capacity	18	End-of-Cycle Signal	3
Durability/Reliability Brand	18	Extra Rinse Cycle	3
Price	17	Add Clothes Mid-Cycle	2
Energy and Water Costs	16	Agitation Speed	2
Load Size Options	14	Bleach/Softener Dispenser	2
Water Temperature Options	13	Delicate Cycle	2
Quiet Operation	10	Door Placement	2
Horizontal/Vertical Axis	9	Hand Washable Cycle	2
Multiple Wash Cycle Options	9	Heavy Duty Cycle	2
Door Size	8	Spin Speed	2
Wash Time	8	Ability to Re-Use Rinse Water	1
Soak Option	7	Basket for Odd Shaped Items	1
Lint Removal	6	Control Labels	1
Corrects Out-of-Balance	4	Electrical Compatibility	1
Detergent Cost Savings	4	Motor Optimizer	1

Table J.28 Dallas Focus Group, Combined Group, 17 Participants

Feature	Frequency in Top 10	Feature	Frequency in Top 10
Capacity	13	Quiet Operation	3
Energy and Water Costs	13	Self Cleaning Filter	3
Multiple Wash Cycle Options	13	Tub Material (Plastic/Metal)	3
Load Size Option	10	Warranty	3
Reliability	9	Wash Time	3
Bleach/Softener Dispenser	8	Availability of Services	2
Door Placement	8	Buttons/Dials	2
Price	8	Machine Size	2
Agitation Speed	7	Motor Quality/Size	2
Horizontal/Vertical Axis	7	Pre-Wash	2
Water Temperature Options	7	Simple Settings	2
Clear Instructions	4	Soak Option	2
Extra Rinse Cycle	4	Spin Speed	2
Lint Removal	4	Hand Washables	1
Brand	3	Lid Lock	1
Color	3	Safety	1
End-of-Cycle Signal	3	Spin Length	1
Gentle Cycle	3	Two-Speed Motor	1

Table J.29 Miami Focus Group, Combined Group, 20 Participants

Feature	Frequency in Top 10	Feature	Frequency in Top 10
Price	18	Horizontal/Vertical Axis	4
Durability	17	Rust Proof	4
Load Size Options	17	Bleach/Softener Dispenser	3
Warranty	17	Corrects Out-of-Balance	3
Energy & Water Costs	16	Door Size	3
Capacity	15	Machine Design	2
Water Temperature Options	11	On Wheels	2
Door Placement	10	Brand	1
Agitation Speed	8	Color	1
Multiple Wash Cycle Options	7	Connected to Water Softener	1
Wash Time	7	Cycle Stops When Lid Open	1
Machine Size	6	Gas/Electric	1
Quiet Operation	6	Hand Washables	1
Availability of Service	5	Pre-Wash	1
Buttons/Dials	5	Warning Lights	1
Extra Rinse Cycle	4		

J.11 TOP 5 ATTRIBUTES FROM CONJOINT ANALYSIS SESSIONS

If you were to purchase a new clothes washer today, what are the five most important washer features that would influence your selection?

Table J.30 Top Five Attributes from Conjoint Analysis Session, 429 Respondents

Attribute	Frequency in Top 5	Percentage Out of 429
Price	241	56.2%
Energy and Water Costs/Energy Efficiency	205	47.8
Capacity	187	43.6
Multiple Wash Cycle Options	152	35.4
Water Temperature Options	116	27.0
Machine Size	113	26.3
Brand	89	20.7
Load Size Options	82	19.1
Reliability	73	17.0
Quiet Operation	65	15.2
Warranty	65	15.2
Door Placement	58	13.5
Color	56	13.1
Durability	52	12.1
Simple Settings	43	10.0
Bleach/Softener Dsipenser	33	7.7
Machine Design	28	6.5
User Friendly Controls	27	6.3
Wash Time	26	6.1
Delicate Cycle	26	6.1
Agitation Speed	22	5.1
Availability of Service	21	4.9
Buttons/Dials	21	4.9
Gentle Cycle	19	4.4
Extra Rinse Cycle	18	4.2
Spin Speed	18	4.2
Heavy Duty Cycle	18	4.2
Rated Highly by Consumer Reports	17	4.0
Agitation (side-to-side or up-down)	13	3.0
Self-Cleaning Filter	13	3.0
Corrects Out-of-Balance	8	1.9
Tub Material (Plastic/Metal)	8	1.9
Washer/Dryer Combo	7	1.6
Control Labels	7	1.6
End of Cycle Signal	6	1.4
Soak Option	5	1.2
Detergent Cost Savings	5	1.2
Pre-Wash	5	1.2
Soap Dispenser	5	1.2
Ability to Re-Use Rinse Water	5	1.2
Safety	5	1.2
Time Remaining Indicator	5	1.2
Clear Instructions	4	0.9
Motor Quality/Size	4	0.9
Warning Lights	4	0.9
Add Clothes in Mid Cycle	3	0.7
Removable Tub	3	0.7
Gas/Electric	3	0.7
Horizontal/Vertical Axis	2	0.5
Lint Removal	2	0.5
Hot Water Pressure	2	0.5
Spin Length	2	0.5
Connected to Water Softener	2	0.5
Heat Own Water	2	0.5
Lid Lock	2	0.5
Hand Washables	1	0.2
Door Size	1	0.2
On Wheels	1	0.2
Electrical Compatibility	1	0.2

J.12 CONJOINT SESSIONS SURVEY WITH RESPONSE FREQUENCIES

Clothes Washer Analysis Follow-up Questionnaire

1. How many people currently live in your household? _____

Response	All Respondents	Low-Income (less then $25k/yr)	65 and Older
1	27.2%	35.0%	43.3%
2	35.5	33.0	38.8
3	14.7	10.7	7.5
4	13.9	9.7	7.5
5	4.7	6.8	1.5
6	2.8	2.9	0.0
7	0.5	0.0	0.0
8	0.0	0.0	0.0
9	0.2	1.0	0.0
10	0.2	0.0	0.0
Refused	0.2	1.0	1.5

2. How many children ages 6 to 18 live in your household? ___

Number	All Respondents	Low Income (less than $25k/yr)	65 and Older
0	74.5%	75.7%	91.0%
1	12.3	9.7	3.0
2	8.7	9.7	4.5
3	2.6	2.9	0.0
4	0.9	1.9	0.0
5	0.2	0.0	0.0
Refused	0.7	0.0	1.5

(If greater than 0)

→ Do these children attend public or private schools?
___Public
___Private
___Both (e.g., one attends a public school and one attends a private school)

Response	All Respondents	Low Income (less than $25k/yr)	65 and Older
Public	71.4%	72.0%	80.0%
Private	22.9	28.0	20.0
Both	4.8	0.0	0.0
Refused	1.0	0.0	0.0

3. Which category best describes your age?

Age Category	All Respondents	Low Income (less than $25k/yr)
18 to 24	12.8%	30.1%
25 to 34	18.7	19.4
35 to 44	19.9	15.5
45 to 54	18.7	6.8
55 to 64	14.2	10.7
65 or older	15.8	17.5

4. Which category best describes your education?

Education Category	All Respondents	Low Income (less than $25k/yr)	65 and Older
Some High School	1.2%	2.9%	0.0%
High School Graduate	8.5	16.5	10.4
Some College	23.9	33.0	37.3
College Graduate	63.8	45.6	50.7
Trade/Vocational School	2.6	1.9	1.5

5. Do you own or rent your home?

Response	All Respondents	Low Income (less than $25k/yr)	65 and Older
Own	60.0%	30.1%	89.6%
Rent	39.5	68.9	10.4
Refused	0.5	1.0	0.0

6. Which range coincides with the monthly rent or mortgage payment for your primary residence?

Monthly Rent	All Respondents	Low Income (less than $25k/yr)	65 and Older
Less than $200	11.6%	14.6%	34.3%
$200 to $499	18.7	38.8	25.4
$500 to $999	35.9	34.0	9.0
$1,000 to $1,499	17.5	3.9	7.5
$1,500 to $2,000	6.4	1.9	1.5
Greater than $2,000	4.3	1.9	3.0
Refused	5.7	4.9	19.4

7. Do you have a satellite dish for your TV reception?

Response	All Respondents	Low Income (less than $25k/yr)	65 and Older
Yes	4.5%	4.9%	3.0%
No	95.5	95.1	97.0

8. How many automobiles does your household own or lease?

Number of Autos	All Respondents	Low Income (less than $25k/yr)	65 and Older
0	6.9%	14.6%	6.0%
1	40.4	51.5	47.8
2	36.4	22.3	40.3
3	9.5	2.9	3.0
4	5.4	8.7	3.0
5 or More	1.1	0.0	0.0
Refused	0.2	0.0	0.0

9. What is the year, make, and model of each automobile? (open ended responses)

10. Where do you do your laundry?

Location	All Respondents	Low Income (less than $25k/yr)	65 and Older
Home	72.1%	46.6%	77.6%
Laundromat	7.3	13.6	3.0
Apartment Laundry Room	18.7	35.9	16.4
Other	1.4	3.9	1.5
Refused	0.5	0.0	1.5

11. Have you purchased a new clothes washer within the last 2 years?

Response	All Respondents	Low Income (less than $25k/yr)	65 and Older
Yes	17.3%	9.7%	26.9%
No	82.3	89.3	70.1
Refused	0.5	1.0	3.0

(If yes)

→How much did you pay for your new clothes washer?_____

Price Range	All Respondents	Low Income (less than $25k/yr)	65 and Older
$200-$299	4.1%	20.0%	0.0%
$300-$399	11.0	0.0	11.1
$400-$499	37.0	30.0	33.3
$500-$599	16.4	20.0	16.7
$600-$699	8.2	0.0	16.7
$700-$799	1.4	0.0	0.0
$800-$899	0.0	0.0	0.0
$900-$999	2.7	0.0	0.0
$1000-$1100	5.5	0.0	5.6
Refused	13.7	30.0	16.7

→Why did you purchase the clothes washer?

Response	All Respondents	Low Income (less than $25k/yr)	65 and Older
Replaced your old clothes washer because it was not working properly	56.0%	40.0%	50.0%
Replaced your old clothes washer because you wanted a newer model	13.3	0.0	27.8
Been washing clothes outside home and decided to purchase a clothes washer for your home	6.7	0.0	5.6
Moved to a new residence and needed a clothes washer	16.0	30.0	0.0
Bought a new clothes dryer and wanted a matching clothes washer	1.3	0.0	0.0
Other (please specify)	6.7	10.0	11.1

12. The majority of residential clothes washers sold in the U.S. are vertical axis machines (see Figure 1), with horizontal axis machines comprising the remaining portion (see Figure 2). Before today, did you know that you could buy a horizontal axis machines for residential use?

Response	All Respondents	Low Income (less than $25k/yr)	65 and Older
Yes	43.0%	32.0%	40.3%
No	56.3	66.0	56.7
Refused	0.7	1.9	3.0

(If yes)

→Where did you learn this? _____

13. Have you ever washed clothes in a horizontal axis machine?

Response	All Respondents	Low Income (less than $25k/yr)	65 and Older
Yes	57.0%	58.3%	41.8%
No	42.3	40.8	55.2
Refused	0.7	1.0	1.5

(If yes)

→Where did you wash them? _____

14. If you had to purchase a clothes washer today, would you **consider** purchasing a horizontal axis machine?

Response	All Respondents	Low Income (less than $25k/yr)	65 and Older
Yes	70.0%	72.8%	56.7%
No	28.4	25.2	40.3
Refused	1.7	1.9	3.0

(If no)

→Why would you NOT consider purchasing a horizontal axis clothes washer?

_____

15. Suppose you went home today and learned that your clothes washer does not work. You decide to purchase a new clothes washer. Please indicate the **highest price** you could **afford** to pay for a new clothes washer.

Highest Price	All Respondents	Low Income (less than $25k/yr)	65 and Older
$300	3.1%	6.8%	1.5%
$400	18.7	34.0	19.4
$500	35.5	37.9	31.3
$600	19.4	10.7	17.9
$700	7.3	1.0	7.5
$800	5.0	1.0	6.0
$900	0.5	0.0	0.0
$1000	9.0	4.9	11.9
Refused	1.6	3.9	4.5

16. What do you think the **average** price for a new clothes washer is today?

Price	All Respondents	Low Income (less than $25k/yr)	65 and Older
Less than $350	0.7%	1.0%	0.0%
$350-$449	29.8	26.2	28.4
$450-$549	48.9	52.4	52.2
$550-$649	14.9	12.6	11.9
$650-$750	4.0	4.9	3.0
Greater than $750	0.5	1.0	1.5
Refused	0.9	1.9	3.0

17. The price of a new clothes washer ranges from a low of $200 to a high of $1,200. If you were to purchase a new clothes washer today, what price range would you hope to stay within?

Price Range	All Respondents	Low Income (less than $25k/yr)	65 and Older
$200-$349	6.9%	16.5%	4.5%
$350-$499	51.3	56.3	44.8
$500-$649	34.0	22.3	38.8
$650-$849	5.9	3.9	10.4
$850 - $999	1.4	0.0	1.5
$1,000-$1,200	0.0	0.0	0.0
Refused	0.5	1.0	0.0

18. If you were to purchase a new clothes washer today, what means would you use to pay for it?

Payment Method	All Respondents	Low Income (less than $25k/yr)	65 and Older
Cash	10.2%	14.6%	7.5%
Check	24.3	21.4	16.4
Credit Card	41.6	30.1	62.7
Store Financing	10.2	14.6	6.0
Credit Card Financing	9.0	7.8	3.0
Bank Loan	1.4	3.9	1.5
Home Equity Loan	0.7	1.0	1.5
Other	2.1	5.8	1.5
Refused	0.5	1.0	0.0

19. Imagine you have a clothes washer that is 10 years old, which the manufacturer claims should last for 15 years, on average. This machine is not working properly and you call a service technician to look into the problem. The technician gives you the option of fixing your 10 years old clothes washer for **$150** or purchasing a new one with the same features for **$400**. What would you do?

Response	All Respondents	Low Income (less than $25k/yr)	65 and Older
Purchase the new machine at $400	63.6%	54.4	76.1
Fix your old machine at $150	32.9	37.9	20.9
Do laundry somewhere else	1.7	4.9	0.0
Shop for a used machine	0.9	1.9	1.5
Refused	0.9	1.0	1.5

20. Imagine you have a clothes washer that is 10 years old, which the manufacturer claims should last of 15 years, on average. This machine is not working properly and you call a service technician to look into the problem. The technician gives you the option of fixing your 10 years old clothes washer for **$150** or purchasing a new one with the same features for **$450**. What would you do?

Response	All Respondents	Low Income (less than $25k/yr)	65 and Older
Purchase the new machine at $450	53.9%	42.7	67.2
Fix your old machine at $150	41.8	47.6	31.3
Do laundry somewhere else	0.9	3.9	0.0
Shop for a used machine	2.1	3.9	0.0
Refused	1.1	2.0	1.5

21. Imagine you have a clothes washer that is 10 years old, which the manufacturer claims should last for 15 years, on average. This machine is not working properly and you call a service technician to look into the problem. The technician gives you the option of fixing your 10 years old clothes washer for **$150** or purchasing a new one with the same features for $650. What would you do?

Response	All Respondents	Low Income (less than $25k/yr)	65 and Older
Purchase the new machine at $650	16.3%	11.7	31.3
Fix your old machine at $150	74.7	69.9	65.7
Do laundry somewhere else	2.6	8.7	1.5
Shop for a used machine	5.2	8.7	0.0
Refused	1.1	1.0	1.5

Selected Cross Tabular Results

Relationship Between Experience With Horizontal Axis Machines and Willingness to Consider Purchase:

People Who Have Experience with Horizontal Axis Clothes Washing Machines	**Percent** (Total=238)
Would Consider Purchasing a H-Axis Machine	69.3%
Would Not Consider Purchasing a H-Axis Machine	30.7

People Who Have NO Experience with Horizontal Axis Clothes Washing Machines	**Percent** (Total=176)
Would Consider Purchasing a H-Axis Machine	73.3%
Would Not Consider Purchasing a H-Axis Machine	26.7

J.13 CONJOINT ANALYSIS CARDS AND INSTRUCTIONS

CLOTHES WASHER.....CARD - 1

Price of Clothes Washer $450
Energy and Water Savings $50
Wash Capacity . . . . . Standard
Top or Front Load . . . . . Top
Wash/Rinse Temperature . . . . . Cold, Warm
Load Size . . . . . Non-Adjustable

CLOTHES WASHER.....CARD - 2

Price of Clothes Washer $400
Energy and Water Savings $50
Wash Capacity . . . . . Extra
Top or Front Load . . . . . Front
Wash/Rinse Temperature . . . . . Cold, Warm
Load size . . . . . Non-Adjustable

CLOTHES WASHER.....CARD - 3

Price of Clothes Washer $400
Energy and Water Savings $10
Wash Capacity . . . . . Extra
Top or Front Load . . . . . Front
Wash/Rinse Temperature . . . . . Cold, Warm, Hot
Load Size . . . . . Non-Adjustable

CLOTHES WASHER.....CARD - 4

Price of Clothes Washer $400
Energy and Water Savings $0
Wash Capacity . . . . . Standard
Top or Front Load . . . . . Front
Wash/Rinse Temperature . . . . . Cold, Warm, Hot
Load Size . . . . . Non-Adjustable

CLOTHES WASHER.....CARD - 5

Price of Clothes Washer $450
Energy and Water Savings $0
Wash Capacity . . . . . Extra
Top or Front Load . . . . . Front
Wash/Rinse Temperature . . . . . Cold, Warm
Load Size . . . . . Adjustable

CLOTHES WASHER.....CARD - 6

Price of Clothes Washer $450
Energy and Water Savings $0
Wash Capacity . . . . . Extra
Top or Front Load . . . . . Front
Wash/Rinse Temperature . . . . . Cold, Warm, Hot
Load Size . . . . . Adjustable

CLOTHES WASHER.....CARD - 7

Price of Clothes Washer $400
Energy and Water Savings $0
Wash Capacity . . . . . Standard
Top or Front Load . . . . . Top
Wash/Rinse Temperature . . . . . Cold, Warm
Load Size . . . . . Adjustable

CLOTHES WASHER.....CARD - 8

Price of Clothes Washer $650
Energy and Water Savings $0
Wash Capacity . . . . . Extra
Top or Front Load . . . . . Top
Wash/Rinse Temperature . . . . . Cold, Warm
Load Size . . . . . Non-Adjustable

CLOTHES WASHER.....CARD - 9

Price of Clothes Washer $650
Energy and Water Savings $50
Wash Capacity . . . . . Standard
Top or Front Load . . . . . Front
Wash/Rinse Temperature . . . . . Cold, Warm, Hot
Load Size . . . . . Adjustable

CLOTHES WASHER.....CARD - 10

Price of Clothes Washer $400
Energy and Water Savings $50
Wash Capacity . . . . . Extra
Top or Front Load . . . . . Top
Wash/Rinse Temperature . . . . . Cold, Warm, Hot
Load Size . . . . . Adjustable

CLOTHES WASHER.....CARD - 11

Price of Clothes Washer $400
Energy and Water Savings $0
Wash Capacity . . . . . Standard
Top or Front Load . . . . . Front
Wash/Rinse Temperature . . . . . Cold, Warm
Load Size . . . . . Adjustable

CLOTHES WASHER.....CARD - 12

Price of Clothes Washer $400
Energy and Water Savings $10
Wash Capacity . . . . . Extra
Top or Front Load . . . . . Top
Wash/Rinse Temperature . . . . . Cold, Warm
Load Size . . . . . Adjustable

CLOTHES WASHER.....CARD - 13

Price of Clothes Washer $650
Energy and Water Savings $10
Wash Capacity . . . . . Standard
Top or Front Load . . . . . Front
Wash/Rinse Temperature . . . . . Cold, Warm
Load Size . . . . . Adjustable

CLOTHES WASHER.....CARD - 14

Price of Clothes Washer $400
Energy and Water Savings $0
Wash Capacity . . . . . Standard
Top or Front Load . . . . . Top
Wash/Rinse Temperature . . . . . Cold, Warm, Hot
Load Size . . . . . Adjustable

CLOTHES WASHER.....CARD - 15

Price of Clothes Washer $650
Energy and Water Savings $0
Wash Capacity . . . . . Extra
Top or Front Load . . . . . Top
Wash/Rinse Temperature . . . . . Cold, Warm, Hot
Load Size . . . . . Adjustable

CLOTHES WASHER.....CARD - 16

Price of Clothes Washer $450

Energy and Water Savings $10

Wash Capacity . . . . . Standard

Top or Front Load . . . . . Top

Wash/Rinse Temperature . . . . . Cold, Warm

Load Size . . . . . Non-Adjustable

J.14 INSTRUCTIONS

J.14.1 Clothes Washers

Assume that you are purchasing a new clothes washer. You have in front of you a series of cards that contain different combinations of clothes washer prices, expected annual energy and water savings, and different washer features such as capacity, wash and rinse water temperatures, and load size adjustments. We're going to ask you to sort these cards according to your preference for the features described on each. These features are defined below and are also shown in the laminated exhibits you have in front of you. Please read these instructions and look at the exhibits carefully to make sure you understand the definitions before you begin sorting through the cards.

Price. The price refers to the cost of a new clothes washer.

Top or Front Load. Top or front load refers to the placement of the door on the machine. "Top" means the door is on the top of the machine and "Front" means the door is on the front side. Please refer to Figure 1 to see different examples of top loading and front loading clothes washers.

Energy and Water Savings. The savings shown on the card reflects an average expected bill savings (both water and energy) for an entire year using the clothes washer.

Wash/Rinse Temperature. This feature refers to the water temperature options available on the machine for the wash and rinse cycles. The two categories are "Cold, Warm, Hot" and "Cold, Warm".

Wash Capacity. Wash capacity refers to the amount of clothes that can be washed in one wash load. The categories are "Standard" and "Extra Large". The "Extra Large" capacity is 20 percent larger than the standard tub.

Load Size. Load size refers to a feature that allows you to adjust the amount water during the wash cycle to match a small, medium, or large wash load. "Adjustable" means that the water level can be adjusted to match the load size, while "Non-adjustable" indicates a washer that uses the same amount of water regardless of the size of the load.

Once you've looked through the cards, sort them into three piles in the rough order of your preference for them. To help you, we have provided marker cards labeled:

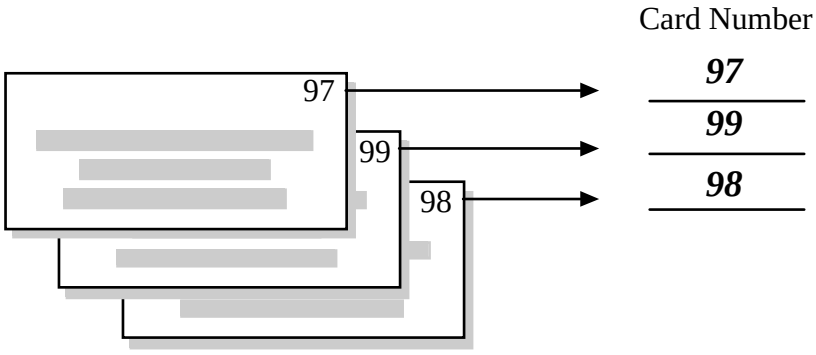
Product/Service I would be MORE LIKELY to choose	Product/Service I would be NEITHER MORE nor LESS LIKELY to choose	Product/Service I would be LESS LIKELY to choose

After you have sorted the cards into three piles, pick up the cards in your "More Likely" pile. Sort them according to your preference for them so that the one you most prefer is on the top and the one you least prefer is on the bottom.

Repeat this sorting procedure for the cards in your "Neither More Nor Less Likely" pile. Then, sort the cards in your "Less Likely" pile. If you feel inclined to move a card to a different stack during the sorting procedure, please feel free to do so.

Please review your three piles to ensure that the cards are sorted from most preferred to least preferred. We would now like you to record the clothes washer you prefer most, second most, and so on down to the clothes washer you prefer least.

Note that there is a number located on the upper right hand corner of each card. On your response sheet, write down the number of the cards under the column labeled "Card Number" beginning with the top card on your "More Likely" pile. When you reach the bottom of the first pile, proceed to the "Neither More Nor Less Likely" pile and then to the "Less Likely" pile. When you are done, the number of your least preferred card should be written on the last line of the "Card Number" column and every line should have only one card number entered.



J.15 CONJOINT ANALYSIS COEFFICIENT ESTIMATES

Coefficient Estimates

All Respondents

Equipment Choice Model

	Coefficient	Standard Error	Significance Level	Relative Importance
Price	-0.0036	0.000	1%	26%
Savings	0.010	0.001	1%	14%
Capacity	0.248	0.024	1%	7%
Door Placement	0.383	0.024	1%	11%
Water Temp.	0.614	0.024	1%	18%
Load Size	0.852	0.024	1%	25%
				100%

Likelihood of Purchase

	Coefficient	Standard Error	Significance Level	Relative Importance
Intercept	-0.949	0.224	1%	0%
Price	-0.0066	0.000	1%	22%
Savings	0.029	0.002	1%	19%
Capacity	0.452	0.072	1%	6%
Door Placement	0.698	0.075	1%	9%
Water Temp.	1.438	0.071	1%	19%
Load Size	1.809	0.071	1%	24%
				100%

Low Income, Less than $25k

Equipment Choice Model

	Coefficient	Standard Error	Significance Level	Relative Importance
Price	-0.0040	0.000	1%	30%
Savings	0.010	0.001	1%	16%
Capacity	0.255	0.049	1%	8%
Door Placement	0.330	0.049	1%	10%
Water Temp.	0.518	0.049	1%	16%
Load Size	0.648	0.049	1%	20%
				100%

Likelihood of Purchase

	Coefficient	Standard Error	Significance Level	Relative Importance
Intercept	-0.230	0.387	55%	0%
Price	-0.0066	0.001	1%	24%
Savings	0.025	0.003	1%	19%
Capacity	0.369	0.132	1%	5%
Door Placement	0.624	0.134	1%	9%
Water Temp.	1.262	0.130	1%	19%
Load Size	1.600	0.129	1%	24%
				100%

Elderly, 65 and older

Equipment Choice Model

	Coefficient	Standard Error	Significance Level	Relative Importance
Price	-0.0025	0.000	1%	22%
Savings	0.006	0.001	1%	11%
Capacity	0.124	0.061	4%	5%
Door Placement	0.352	0.061	1%	13%
Water Temp.	0.524	0.062	1%	19%
Load Size	0.817	0.063	1%	30%
				100%

Likelihood of Purchase

	Coefficient	Standard Error	Significance Level	Relative Importance
Intercept	-1.963	0.542	1%	0%
Price	-0.0044	0.001	1%	16%
Savings	0.022	0.004	1%	17%
Capacity	0.447	0.177	1%	7%
Door Placement	0.794	0.183	1%	12%
Water Temp.	1.392	0.176	1%	21%
Load Size	1.873	0.179	1%	28%
				100%

Young, 18-24

Equipment Choice Model

	Coefficient	Standard Error	Significance Level	Relative Importance
Price	-0.0052	0.000	1%	31%
Savings	0.016	0.002	1%	19%
Capacity	0.375	0.069	1%	9%
Door Placement	0.460	0.070	1%	11%
Water Temp.	0.547	0.071	1%	13%
Load Size	0.657	0.069	1%	16%
				100%

Likelihood of Purchase

	Coefficient	Standard Error	Significance Level	Relative Importance
Intercept	0.628	0.537	24%	0%
Price	-0.0081	0.001	1%	28%
Savings	0.027	0.004	1%	19%
Capacity	0.634	0.186	1%	9%
Door Placement	0.818	0.188	1%	11%
Water Temp.	0.867	0.181	1%	12%
Load Size	1.508	0.180	1%	21%
				100%

Recent Purchasers

Equipment Choice Model

	Coefficient	Standard Error	Significance Level	Relative Importance
Price	-0.0024	0.000	1%	22%
Savings	0.005	0.001	1%	9%
Capacity	0.173	0.059	1%	6%
Door Placement	0.300	0.059	1%	11%
Water Temp.	0.520	0.059	1%	19%
Load Size	0.861	0.060	1%	32%
				100%

Likelihood of Purchase

	Coefficient	Standard Error	Significance Level	Relative Importance
Intercept	-1.596	0.573	1%	0%
Price	-0.0056	0.001	1%	20%
Savings	0.022	0.004	1%	16%
Capacity	0.562	0.180	1%	8%
Door Placement	0.605	0.187	1%	8%
Water Temp.	1.468	0.176	1%	21%
Load Size	1.976	0.183	1%	28%
				100%

Have Tried Horizontal Axis

Equipment Choice Model

	Coefficient	Standard Error	Significance Level	Relative Importance
Price	-0.0035	0.000	1%	26%
Savings	0.009	0.001	1%	13%
Capacity	0.260	0.032	1%	8%
Door Placement	0.303	0.033	1%	9%
Water Temp.	0.624	0.033	1%	19%
Load Size	0.867	0.033	1%	26%
				100%

Likelihood of Purchase

	Coefficient	Standard Error	Significance Level	Relative Importance
Intercept	-0.766	0.309	1%	0%
Price	-0.0069	0.001	1%	23%
Savings	0.030	0.002	1%	20%
Capacity	0.455	0.099	1%	6%
Door Placement	0.484	0.102	1%	6%
Water Temp.	1.483	0.095	1%	20%
Load Size	1.841	0.097	1%	25%
				100%

Would Consider Purchasing H-Axis Machine

Equipment Choice Model

	Coefficient	Standard Error	Significance Level	Relative Importance
Price	-0.0037	0.000	1%	26%
Savings	0.011	0.001	1%	15%
Capacity	0.266	0.028	1%	8%
Door Placement	0.264	0.028	1%	8%
Water Temp.	0.653	0.029	1%	19%
Load Size	0.834	0.029	1%	24%
				100%

Likelihood of Purchase

	Coefficient	Standard Error	Significance Level	Relative Importance
Intercept	-0.953	0.252	1%	0%
Price	-0.0063	0.001	1%	22%
Savings	0.031	0.002	1%	21%
Capacity	0.482	0.083	1%	7%
Door Placement	0.499	0.085	1%	7%
Water Temp.	1.520	0.082	1%	21%
Load Size	1.671	0.081	1%	23%
				100%

Would Not Consider Purchasing H-Axis Machine

Equipment Choice Model

	Coefficient	Standard Error	Significance Level	Relative Importance
Price	-0.0035	0.000	1%	25%
Savings	0.006	0.001	1%	9%
Capacity	0.194	0.046	1%	5%
Door Placement	0.709	0.047	1%	20%
Water Temp.	0.533	0.046	1%	15%
Load Size	0.927	0.047	1%	26%
				100%

Likelihood of Purchase

	Coefficient	Standard Error	Significance Level	Relative Importance
Intercept	-1.296	0.513	1%	0%
Price	-0.0072	0.001	1%	22%
Savings	0.022	0.004	1%	14%
Capacity	0.392	0.149	1%	5%
Door Placement	1.347	0.163	1%	16%
Water Temp.	1.245	0.144	1%	15%
Load Size	2.273	0.156	1%	28%
				100%

Madison, WI

Equipment Choice Model

	Coefficient	Standard Error	Significance Level	Relative Importance
Price	-0.0048	0.000	1%	25%
Savings	0.0157	0.001	1%	16%
Capacity	0.4834	0.052	1%	10%
Door Placement	0.5579	0.052	1%	12%
Water Temp.	0.7683	0.052	1%	16%
Load Size	1.0077	0.052	1%	21%
				100%

Likelihood of Purchase

	Coefficient	Standard Error	Significance Level	Relative Importance
Intercept	0.358	0.49	46%	0%
Price	-0.0098	0.00	1%	27%
Savings	0.036	0.00	1%	20%
Capacity	0.662	0.15	1%	7%
Door Placement	0.747	0.16	1%	8%
Water Temp.	1.427	0.15	1%	16%
Load Size	1.934	0.15	1%	21%
				100%

Washington DC

Equipment Choice Model

	Coefficient	Standard Error	Significance Level	Relative Importance
Price	-0.0032	0.000	1%	26%
Savings	0.0099	0.001	1%	16%
Capacity	0.1912	0.052	1%	6%
Door Placement	0.1779	0.052	1%	6%
Water Temp.	0.6164	0.052	1%	20%
Load Size	0.7559	0.052	1%	25%
				100%

Likelihood of Purchase

	Coefficient	Standard Error	Significance Level	Relative Importance
Intercept	-1.359	0.408	1%	0%
Price	-0.0045	0.001	1%	18%
Savings	0.024	0.003	1%	19%
Capacity	0.521	0.140	1%	8%
Door Placement	0.394	0.141	1%	6%
Water Temp.	1.284	0.137	1%	20%
Load Size	1.767	0.138	1%	28%
				100%

Dallas, TX

Equipment Choice Model

	Coefficient	Standard Error	Significance Level	Relative Importance
Price	-0.0034	0.000	1%	27%
Savings	0.005	0.001	1%	8%
Capacity	0.156	0.048	1%	5%
Door Placement	0.523	0.048	1%	17%
Water Temp.	0.523	0.048	1%	17%
Load Size	0.836	0.049	1%	27%
				100%

Likelihood of Purchase

	Coefficient	Standard Error	Significance Level	Relative Importance
Intercept	-2.039	0.510	1%	0%
Price	-0.0054	0.001	1%	19%
Savings	0.022	0.004	1%	15%
Capacity	0.325	0.151	3%	4%
Door Placement	1.105	0.164	1%	15%
Water Temp.	1.472	0.152	1%	20%
Load Size	1.977	0.158	1%	27%
				100%

San Francisco Bay Area

Equipment Choice Model

	Coefficient	Standard Error	Significance Level	Relative Importance
Price	-0.0036	0.000	1%	25%
Savings	0.011	0.001	1%	15%
Capacity	0.235	0.046	1%	7%
Door Placement	0.339	0.047	1%	10%
Water Temp.	0.638	0.047	1%	18%
Load Size	0.916	0.048	1%	26%
				100%

Likelihood of Purchase

	Coefficient	Standard Error	Significance Level	Relative Importance
Intercept	-0.985	0.45	3%	0%
Price	-0.0070	0.00	1%	22%
Savings	0.034	0.00	1%	21%
Capacity	0.312	0.15	3%	4%
Door Placement	0.684	0.15	1%	9%
Water Temp.	1.747	0.15	1%	22%
Load Size	1.749	0.14	1%	22%
				100%

J.16 ELASTICITY CALCULATIONS

Low Income Households

Variable	Description
Price	Dollar value of retail price of machine
Savings	Dollar value of annual water and energy bill savings
Capacity	Binary variable: zero for standard capacity machine, one for extra large capacity.
Door Placement	Binary variable: zero for front loader, one for top loader.
Water Temp	Binary variable: zero for 'cold/warm', one for 'cold/warm/hot' washing temperature options
Load Size	Binary variable: zero if there is no load size adjustment option, one if there is

Directions

To calculate a **price elasticity** use the "Likelihood of Purchase Model" to the left. Fill in the Initial Price and probability, and new price and probability cells in the "Price Elasticity of Demand" table to generate results for the specific price change

Similarly, when calculating Savings elasticity, be sure the initial and new market conditions differ only in their savings estimates.

Low Income Households

Note: Includes those in sample with household annual incomes of $25,000 or less.

Likelihood of Purchase Model

Variable	Coefficient	Current Market Conditions	Product of Coefficient and Current Market Value
Intercept	-0.230267252	3	-0.690801756
Price	-0.006588926	400	-2.6355704
Savings	0.025374155	50	1.268707725
Capacity	0.368678255	0	0
Door Placement	0.623771343	1	0.623771343
Water Temp	1.262196472	1	1.262196472
Load Size	1.599534028	1	1.599534028
Sum			1.427837412
Likelihood of Purchase			81%

Upper Bound = 0.93

Source: Survey Q19, 7 percent of low incomes respondents claim that would go to laundromat rather than repair or purchase new machine at $400. This assumes that respondents that chose to repair at $150 would choose to purchase a new machine if repairing were not an option

Price Elasticity of Demand	
Initial Price	400
Initial Probability	0.93
New Price	650
New Probability	0.72
Price Elasticity	-0.53

Savings Elasticity of Demand	
Initial Savings	0
Initial Probability	0.93
New Savings	50
New Probability	0.98
Savings Elasticity	0.03

Lower Bound = 0.54

Source: Survey Q19, proportion of people low income respondents that would do laundry elsewhere or shop for a used machine rather than repair at $150 or purchase a new machine at $650. This assumes that all those that choose to repair would start going to the laundromat if repairing were not an option.

Price Elasticity of Demand	
Initial Price	400
Initial Probability	0.54
New Price	650
New Probability	0.18
Price Elasticity	-2.10

Savings Elasticity of Demand	
Initial Savings	0
Initial Probability	0.54
New Savings	50
New Probability	0.81
Savings Elasticity	0.20

Low Income Households

Variable	Description
Price	Dollar value of retail price of machine
Savings	Dollar value of annual water and energy bill savings
Capacity	Binary variable: zero for standard capacity machine, one for extra large capacity.
Door Placement	Binary variable: zero for front loader, one for top loader.
Water Temp	Binary variable: zero for 'cold/warm', one for 'cold/warm/hot' washing temperature options
Load Size	Binary variable: zero if there is no load size adjustment option, one if there is

Directions.

To calculate a **price elasticity** use the "Likelihood of Purchase Model" to the left. Fill in the Initial Price and probability, and new price and probability cells in the "Price Elasticity of Demand" table to generate results for the specific price change

Similarly, when calculating Savings elasticity, be sure the initial and new market conditions differ only in their savings estimates.

Low Income Households

Note: Includes those in sample with household annual incomes of $25,000 or less.

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Variable	Coefficient	Current Market Conditions	Product of Coefficient and Current Market Value
Intercept	-0.230267252	3	-0.690801756
Price	-0.006588926	400	-2.6355704
Savings	0.025374155	50	1.268707725
Capacity	0.368678255	0	0
Door Placement	0.623771343	1	0.623771343
Water Temp	1.262196472	1	1.262196472
Load Size	1.599534028	1	1.599534028
Sum			1.427837412
Likelihood of Purchase			81%

Upper Bound = 0.93

Source: Survey Q19, 7 percent of low incomes respondents claim that would go to laundromat rather than repair or purchase new machine at $400. This assumes that respondents that chose to repair at $150 would choose to purchase a new machine if repairing were not an option

Price Elasticity of Demand	
Initial Price	400
Initial Probability	0.93
New Price	650
New Probability	0.72
Price Elasticity	-0.53

Savings Elasticity of Demand	
Initial Savings	0
Initial Probability	0.93
New Savings	50
New Probability	0.98
Savings Elasticity	0.03

Lower Bound = 0.54

Source: Survey Q19, proportion of people low income respondents that would do laundry elsewhere or shop for a used machine rather than repair at $150 or purchase a new machine at $650. This assumes that all those that choose to repair would start going to the laundromat if repairing were not an option.

Price Elasticity of Demand	
Initial Price	400
Initial Probability	0.54
New Price	650
New Probability	0.18
Price Elasticity	-2.10

Savings Elasticity of Demand	
Initial Savings	0
Initial Probability	0.54
New Savings	50
New Probability	0.81
Savings Elasticity	0.20

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