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# Consumer's preferences for goat meat in the United States : an application of choice-based conjoint analysis

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CONSUMERS' PREFERENCES FOR GOAT MEAT IN THE UNITED STATES: AN  
APPLICATION OF CHOICE-BASED CONJOINT ANALYSIS

A Dissertation

Submitted to the Graduate Faculty of the  
Louisiana State University and  
Agricultural and Mechanical College  
in partial fulfillment of the  
Requirements for the degree of  
Doctor of Philosophy

in

The Department of Agricultural Economics & Agribusiness

by

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B.S. Auburn University, 2006  
M.S. Auburn University, 2008  
May 2013

## **DEDICATION**

This work is dedicated to my mother, Irene, who passed away in November 2008. The strength and courage she showed even through the most difficult times gave me the motivation to always work hard and never feel that there was anything I could not accomplish.

## **ACKNOWLEDGEMENTS**

This major academic accomplishment in my life could not have been possible without so many people helping me and encouraging me. I would like to thank my major professor, Dr. Wes Harrison, for his guidance throughout my PhD career. I would like to thank my committee, Dr. Roger Hinson, Dr. Jeff Gillespie, Dr. Kenneth McMillin, Dr. Michael Salassi, and Dr. John Caprito, for their invaluable input into the completion of my dissertation. I would also like thank all the Agricultural Economics grad students for all the wonderful memories that we shared during our time at LSU. Thank you to my office mate and good friend, Lily, for the all laughter and advice. Special thanks to David, Tatsuya, Caroline, Maryam, Abhishek, Gnel, Ana, and Michelle. I have formed life-long friendships with you all. And a special thank you to Dr. Krisanna Machtmes and Dr. Pamela Blanchard for your unconditional support and encouragement. Last but not least, thank you to my family, my father, Tommy Jr., who called just to say, 'I love you' not knowing it were those phone calls that kept me going on some of the most difficult days; and my brothers, Thomas, Ulysses, and Alexander, thank you for always looking out for your little sister. And my dear husband, Erastus, thank you for taking this journey with me. Without you my days would've been a little darker.

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## **ABSTRACT**

The meat goat industry is one of the fastest growing agricultural sectors in the United States. However, there has been limited research on consumers' preferences for goat meat; therefore, a choice experiment was used to assess consumer preferences for goat meat and live goats. A national online survey was conducted from April 27, 2012 to May 4, 2012 collecting a representative sample of 2000 goat meat eaters, in addition to 2000 respondents from the general population. Respondents were asked to complete either the goat meat choice experiment, live goat choice experiment or both. In addition to the choice experiment, respondents answered a set of questions about goat meat consumption and purchasing behavior as well as demographics. The attributes that consumers evaluated for the goat meat choice experiment included, cut, color, source and price. The attributes that consumers evaluated for the live goat choice experiment included, age, sex, slaughter method, and price. The results revealed that goat meat consumers preferred chops and cubes over whole and half carcasses. The attribute, color, was not as important to consumers' choice as hypothesized, in the estimated models the attribute was statistically insignificant or had a small effect on preference. Goat meat consumers valued domestic over imported goat meat. The random parameters logit model and latent class logit model revealed heterogeneous preferences. In the latent class model, age, gender, and consumption frequency did fairly well in defining the class; however, overall the demographic variables failed to distinctly characterize the classes. The results from the live goat choice experiment revealed that age and slaughter method were the most important attributes to consumers. These consumers valued younger goats and preferred to have the farmer to perform the slaughter.

## **CHAPTER 1: INTRODUCTION**

### **1.1 History of the Meat Goat Industry in the United States**

Goats are the earliest domesticated animals and very popular throughout the world. However, in the United States, goat meat has yet to become as familiar on dinner plates as beef, pork, chicken or lamb (Gipson, 2000 and Pinkerton et al., 1994). The goat industry in the United States got its start in the 1500s when goats escaped from Spanish explorers. Goats were scattered throughout the southeast of the United States but the majority of the population settled in Texas due to its dry climate and more suitable forage species (Shurley and Craddock). Since then, several associations have been formed to educate producers and promote meat-type goats. In 1992, the American Meat Goat Association was founded to promote meat type goats. In 1993, the South African Boer goat was introduced into the United States, the Boer goat is considered a premier meat-type goat, and in the same year the American Boer Goat Association (ABGA) was formed. In addition to the ABGA, two other Boer goat associations were formed, the International Boer Goat Association and the U.S. Boer Goat Association. Perhaps one of the most significant events for the meat goat industry was the repeal of the Wool Act of 1954 in 1993, which resulted in the loss of the wool and mohair incentive program in 1995. Due to the repeal, Angora goat numbers declined to almost 30,000 head in 2002 while meat goat numbers grew to 1.94 million head (Shurley and Craddock).

The number of meat goats in the United States have been on the rise; however, they numbers continue to trail behind other livestock. According to the USDA National Agricultural Statistics Service (NASS), the United States inventory for all cattle and calves on January 1, 2013, totaled 89.3 million head; hogs and pigs inventory was 65.9 million head on March 1, 2013; and all sheep and lamb inventory totaled 5.34 million head on January 1, 2013. Compared to the livestock numbers of cattle, hogs, and sheep, goat numbers in the United States, including

Angora goats, milk goats, and meat and other goats, totaled 2.81 million head as of January 1, 2013. Despite the small numbers, the meat goat industry is one of the fastest growing. In Figure 1, the inventory for all goats, angora goats, milk goats, and meat goats from 2005 to 2013 are shown. Meat goats made up 2.32 million head of the total inventory for all goats in 2013, a slight decrease in inventory from 2012 with 2.36 million head, but a nearly eight percent increase from 2.15 million head in 2005. As can be seen in the Figure 1, the number of meat goats increased from 2005, with the largest inventory in 2008 with 2.6 million head. Starting in 2009, there has been a yearly decrease in meat goats' inventory possibly due to the recession in 2008. However, compared to Angora and milk goats, meat goats have far outpaced these sectors in numbers of head. The loss of the mohair and wool incentive program in 1995 and an increase in immigration from goat meat-consuming countries has undoubtedly contributed to the industry's growth.

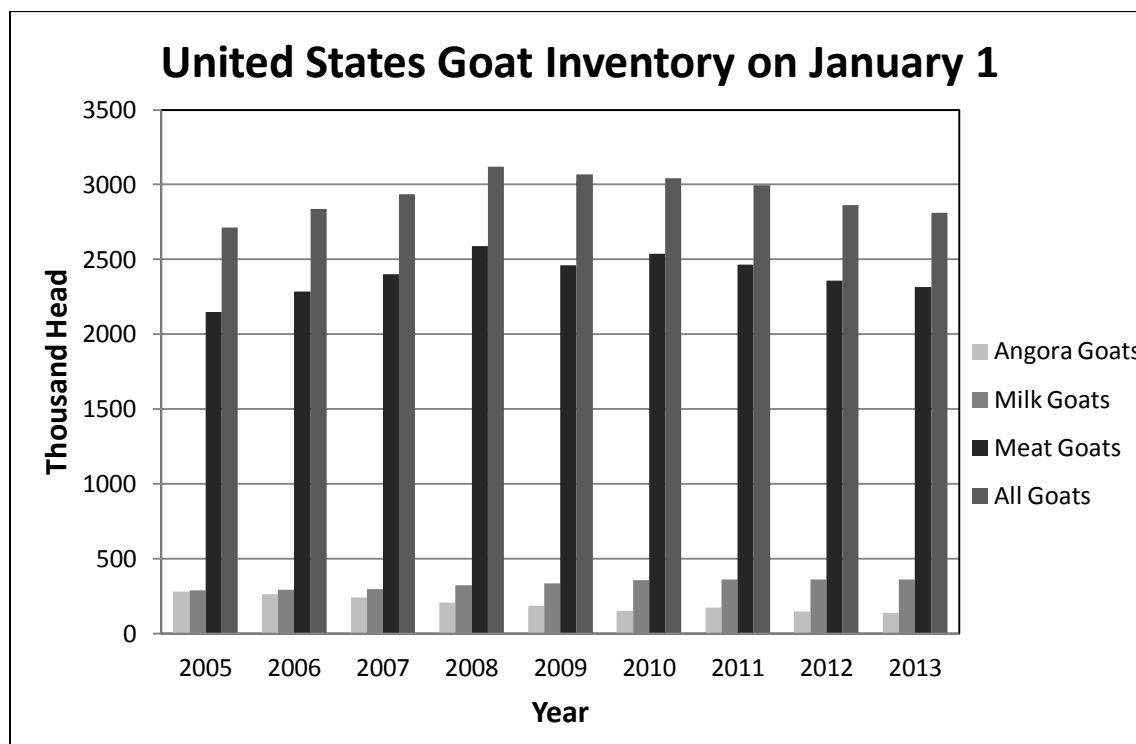


Figure 1 - United States Inventory for Goats  
Source: USDA NASS 2005-2013

The USDA Animal and Plant Health Inspection Service (APHIS) released a report in June, 2011, on small-scale goat farms defined as having fewer than 500 goats. They found that about 4 out of 10 operations focused primarily on meat goat production and many producers were relatively new to the industry, managing goats for ten years or less. Goat production has traditionally been heavily concentrated in Texas, but in the past few years it has increased into the southeastern part of the United States. About a third of all goats remain in Texas. As shown in Figure 2, meat and other goats distribution is heavily concentrated in the southeast, primarily in Texas. Financial settlements resulting from class action lawsuits against the U.S. tobacco industry have also played a role in increased meat goat production in the southeast (Spencer, 2008). As resources were diverted to other forms of agricultural production, many states such as Kentucky, North and South Carolina, Virginia, and Tennessee switched to meat goat production. Goats do not require a lot of acreage and are easier for women and children to handle, making them an optimal agricultural enterprise for small-scale producers.

## **1.2 Indicators of Growth**

There have been several indicators pointing to an increase in meat goat production, including an increase in the number of goats slaughtered, increased goat meat imports, and a rise in immigration. Goats can be slaughtered in federally-inspected and non-federally inspected abattoirs. The federally inspected slaughter statistics from 1978 to 1997 and from 2006 to 2011 are shown in Figure 3 and Figure 4. As shown in Figure 3, as reported by the USDA NASS, in 1980, there were 66,000 goats slaughtered and that number continued to increase up to 394,835 in 1997. The number of goats slaughtered more than quadrupled from 1980 to 1997.

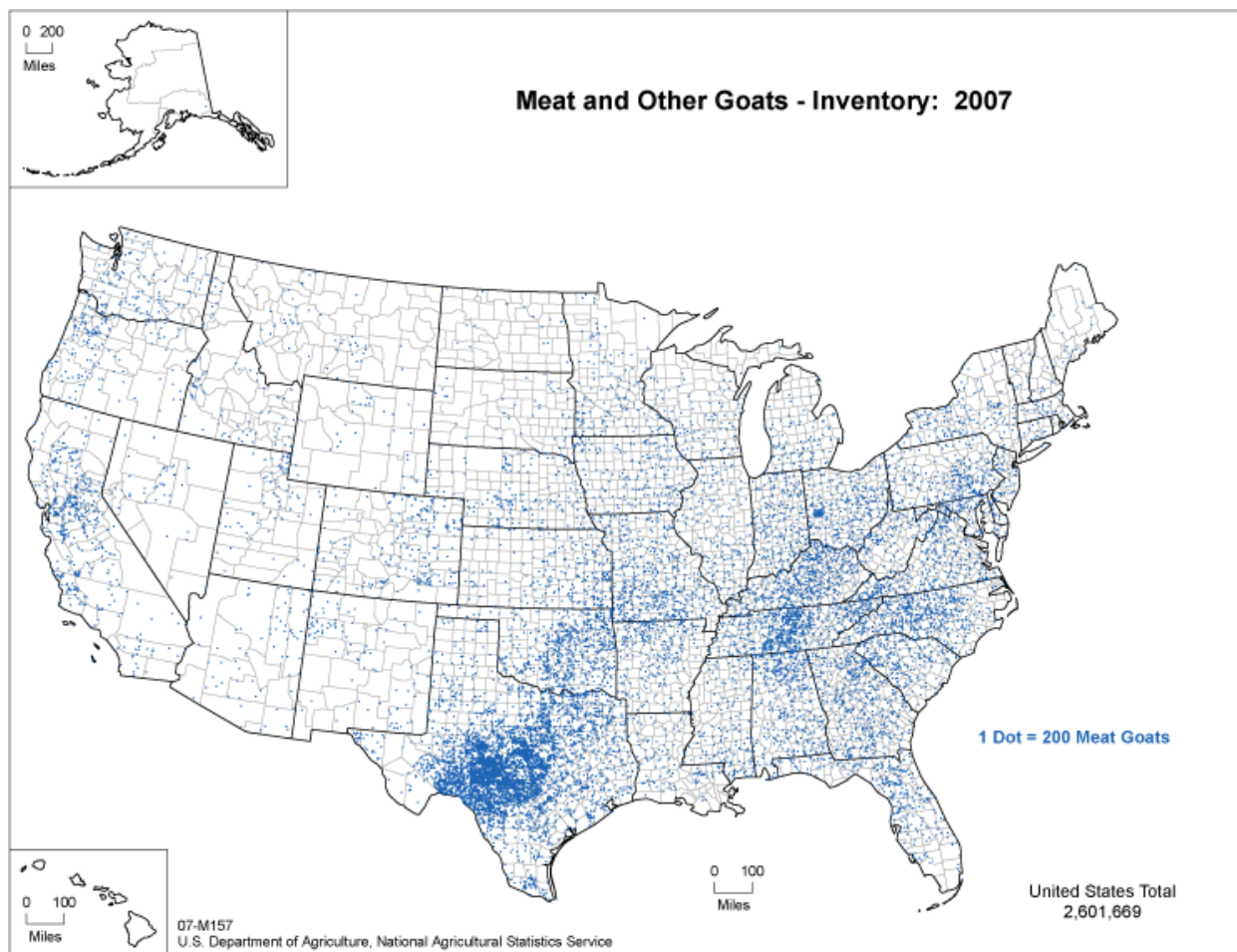


Figure 2 – Distribution of Meat and Other Goats in the United States  
Source: USDA APHIS 2011

In Figure 4, the numbers of goats slaughtered peaked in 2008 and then started to decline from 2009 to 2011. The number of goats slaughtered increased nearly 13 percent from 2006 to 2007. Over the past five years, there was an almost eight percent increase, with 607,890 goats slaughtered in 2011 compared to the 564,884 goats slaughtered in 2006. Federally-inspected slaughters started to decline in 2009, possibly due to the recession starting in 2008, but slaughter numbers held steady in 2010 and 2011. Another possible reason for the slowdown in federally-inspected slaughter numbers could be due to the increase in imports of goat meat during this time, as shown in Figure 5. In addition to the recession and increased imports, if there were increased on-farm slaughters and slaughters at commercial plants, this could lead to the reduction

in federally-inspected slaughters, because on-farm and commercial plant's slaughters are not included in federally-inspected slaughter statistics.



Figure 3 - Actual Number of Goats Slaughtered under Federal Inspection from 1978-1997  
Source: USDA NASS 1998

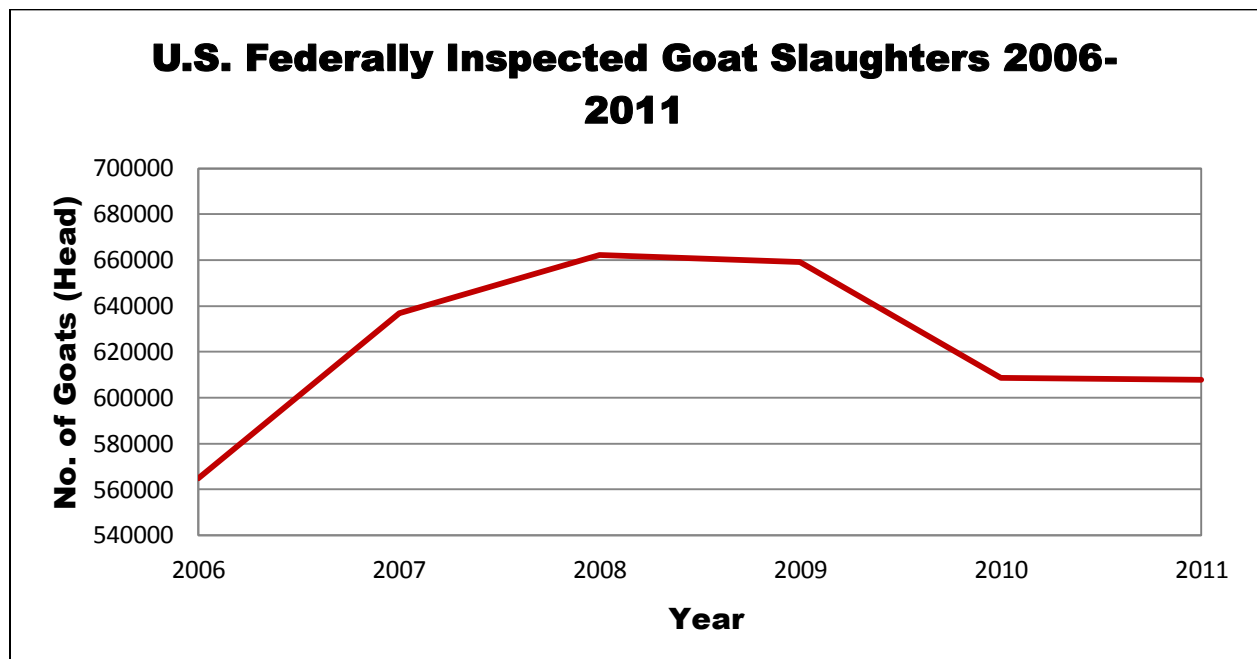


Figure 4 - Actual Number of Goats Slaughtered under Federal Inspection from 2006-2011  
Source: USDA AMS 2012

According to Gipson (2000) and a recent article on eXtension.org (2012), the United States was a net exporter of goat meat until the 1990s, when exports decreased due to increased domestic demand after 1994. Australia and New Zealand are the top exporters of goat meat to the United States, with Australia holding over 90 percent share of the imports (FAOSTAT, 1961-2010). Mexico holds less than one percent of the share of goat meat imports into the United States (FAOSTAT, 1961-2010). Shown in Figure 5, U.S. goat meat imports started to increase in the early 1990s. In 2006 and 2007, the U.S. was the top importer of goat meat with 11,070 metric tons and 10,166 metric tons valued at \$40.8 million and \$37 million, respectively (FAOSTAT, 1961-2010). In 2008, the U.S. imported 10,764 metric tons of goat meat valued at \$38.1 million, with the United Arab Emirates ahead with 12,039 metric tons valued at \$36 million (FAOSTAT, 1961-2010). The U.S. imported 11,707 metric tons of goat meat in 2009, valued at \$37.7 million and 13,405 metric tons of goat meat in 2010, valued at \$61 million (FAOSTAT, 1961-2010). That is an almost 15 percent increase in the amount of goat meat imported and a 62 percent increase in the value of goat meat imported into the United States from 2009 to 2010. Over 29 million pounds of goat meat was imported in 2010, valued at \$2.07 per pound (FAOSTAT, 1961-2010).

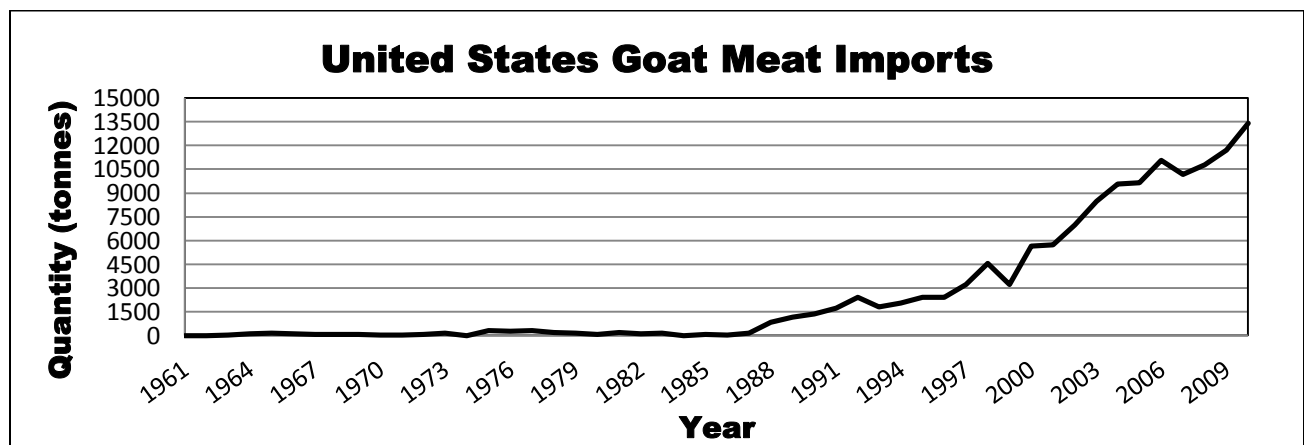


Figure 5 - U.S. Goat Meat Import Quantity in Tonnes  
Source: FAOSTAT 1961-2010

Increased immigration from heavy goat consuming countries has contributed to the U.S. meat goat industry, specifically in the Southeast (Pinkerton et al., 1994; Gipson, 2000; Sande et al., 2005; Shiflett, 2007). According to a 2010 American Community Survey (ACS), the newly arrived foreign-born population, defined as those that entered the United States in 2005 or later, were more likely to settle outside the traditional “gateway” states of California, New York, Illinois, New Jersey, and Florida (Walters and Trevelyan, 2011). And states with a history of lighter immigration saw some of the highest numbers of newly arrived immigrants in 2005 or later, including: Alabama, Kentucky, Louisiana, Mississippi, North and South Dakota, West Virginia, and Wyoming (Walters and Trevelyan, 2011).

Eighty percent of the newly arrived immigrants are from Latin America, the Caribbean, and Asia; and two country-of-birth groups from Asia, China and India, represent an increasing percentage of the newly arrived (Walters and Trevelyan, 2011). These immigrants including those from Africa and the Middle East consume goat meat regularly in their native countries. An increase in access and mobility in international foods has allowed immigrants to continue the consumption of their traditional foods. Goat is the most consumed meat in the world and many immigrants continue to have a preference for goat meat once in the United States, particularly during family gatherings, holidays and religious events (Spencer, 2008).

These groups exhibit diverse preferences for goats including: age, sex, weight, and slaughter method. Goat preferences differ depending on the holiday or religious event. A calendar on ethnic demand for goats can be found at [sheepgoatmarketing.info](http://sheepgoatmarketing.info) (Coffey, 2006). According to the calendar, during Easter, a fleshy, milk fed kid with relatively light colored meat, around three months old or younger weighing between 20 and 50 pounds is preferred. According to the calendar, during the Hindu holiday, Navaduragara or Navrato Dashara or



Dassai, only male goats are used for slaughter. Carcass size depends on number of people being fed during the holiday; weaned market kids or yearlings are preferred.

Muslims have specific preferences depending on the occasion. During the beginning of Ramadan and Id a Fitr, male and female kids less than 12 months of age and 60 pounds live weight are preferred; overly fat kids are not desired. During Id al Adha, the festival of Sacrifice, yearlings that are blemish-free and kids 60 to 100 pounds are most preferred (Geisler, 2009). Goats for Muslim consumption must be killed according to Halal law. This presents a problem for both goat producers and Muslim consumers, which must locate slaughter facilities that adhere to Halal practices, which are often far from point of production. During Caribbean holidays, young, smelly bucks, 60 to 80 pounds, are in demand (Geisler, 2009). However, older animals of all sexes are used due to the fact that customers may prefer them rather to paying the higher price for prime young bucks. The Chinese market prefers goats that are 60 to 80 pounds live weight and their demand peaks during the cooler months (Sande et al., 2005). Hispanics, the fastest growing group of immigrants, prefer Cabrito (young kids) ranging from 15 to 30 pounds live weight and young goats about 50 pounds live weight (Gipson, 2000 and Sande et al., 2005).

### **1.3 Need for the Study**

With a growing ethnic population and increased meat goat production, an in-depth study of the United States meat goat industry and consumers' preferences is needed. The meat goat industry is growing. However, several issues need to be addressed if it is to have continued long-term growth: 1) goat production is seasonal and domestic supply is not enough to meet peak demand usually around holidays and religious events, which is supplemented through imports; 2) there is no formal grading system such as the USDA grading system for beef, thus carcass characteristics and quality are inconsistent across producers; 3) the long distance between the meat goat production, primarily located in the Southeast, and consumption, primarily located in

the East and West metropolitans areas, leads to higher production costs and subsequently higher retail prices (Pinkerton et al., 1991). However; there has been an increase in goat meat consumers in the Southeast; 4) there are limited slaughter facilities and they are often located far from point of production, leading to high transportation costs; and 5) there has been limited empirical research on consumers in regard to demographics and goat meat preferences.

This study will focus on the latter issue concerning consumers' preferences for goat meat and live goats. Through observance of the meat goat market, information about consumption behavior and consumer preferences for goat meat has been reported (Geiser, 2009; Sande et al., 2005). Data on per capita consumption and prices is available for beef, pork, and chicken. However, this type of data is not readily available data for goat meat. Due to the lack of information on prices and consumption, the choice-based conjoint analysis is a preferred method to measure preferences for goat meat and estimate consumers' willingness to pay.

#### **1.4 Purpose and Objectives**

The overall purpose of this study was to measure consumer preferences for goat meat and live goats in the United States through a national online survey utilizing choice-based conjoint analysis. Specifically, the objectives were to:

1. Describe goat meat consumers in the United States based on socio-demographic, and consumption and purchasing data.
2. Measure consumer preferences for goat meat and live goat attributes through a choice-based conjoint analysis.
3. Determine the relative importance placed by consumers on specific attributes associated with cuts of goat meat and live goats.
4. Estimate consumers' willingness-to-pay for goat meat and live goat attributes.

### **1.5 Significance of the Study**

This study will contribute to the current body of literature on goat meat preferences. First, this study will use a representative sample of goat meat consumers from throughout the United States. To our knowledge, this is the first study to use choice-based conjoint analysis to assess consumer preferences for goat meat and live goats. The analysis from this research will provide meat goat producers with valuable information on goat meat consumers. This will allow producers to plan more effective marketing campaigns and reach target consumers thereby increasing consumption among goat meat consumers. The rest of the paper is as organized as follows, first there is a literature review on previous research on goat meat, followed by the methodology and data, then results and finally conclusions.

## **CHAPTER 2: REVIEW OF LITERATURE**

Fisher et al. (2009), Ibrahim et al. (2008), and Worley et al. (2004), conducted qualitative studies on Muslims, considered to be one of the largest groups of goat meat consumers. Both Fisher et al. (2009) and Worley et al. (2004) conducted focus groups to understand Muslims' purchase and consumption behavior regarding Halal meat, specifically goat. Fisher et al. (2009) recruited participants from several different Islamic centers located in Ohio. The participants included those of Arab origin primarily from the Middle East; some were from Lebanon, Palestine, and Iran as well as from Pakistan and India. Worley et al. (2004) looked at the Muslim population from Somalia located in Columbus, Ohio, the second largest population of Somalis. Ibrahim, et al. (2008) used surveys that were collected on-site and on-line with participants from different Mosques located in metro Atlanta, Georgia. Over half of the respondents were from the sub-Saharan African Region and almost 24 percent were from Asia, with more than half residing in the United States for ten years or less.

Muslims prefer Halal meat and are often concerned with "unclean" meat. The participants in the Fisher et al. (2009) study indicated that they primarily shopped at Halal markets/ groceries, a few purchased direct from farmers, but many indicated a preference for regular grocery stores due to convenience. Both Fisher et al. (2009) and Ibrahim et al. (2008) found that consumption of goat or lamb rose significantly during Ramadan, Eid al-Aadha and Eid al-Fitr. The Worley et al. (2004) study found that Somalis ate goat 1-2 times per day and often slaughtered goats to celebrate the birth (baptism) of a baby. Participants in all of the studies preferred fresh over frozen goat meat in order to gauge quality and were willing to pay a premium for fresh. The participants in the Fisher et al. (2009) study seemed more price conscious. They noted that some specialty stores attempted to carry Halal meat, but were charging a premium of \$3.50 per pound when the average was \$1.99 per pound for frozen goat

meat and \$2.99 per pound for fresh goat meat. Ibrahim et al. (2008) found that 60 percent of their respondents were willing to pay a premium for Halal meat, and over a quarter of them spent between \$50 and \$99 per month on goat meat. Worley et al., found that whole and half frozen carcasses sold at \$1.99/lb; and fresh goat meat could sell around \$2.99/lb. at grocery stores that sold Halal meat. Somalis indicated that they paid \$0.80-\$0.85 per pound live weight or \$60 per head. The average price they would be willing to pay was \$1.99 per pound for frozen and \$2.99 per pound for fresh goat meat. Fisher et al. (2009) found that most participants purchased whole carcasses of goat meat due to limited availability but indicated that respondents would like retail cuts: leg (71%), chops (42%), shoulder (24%), and breast (4%). Forty-two percent of the respondents preferred intact males. Both Ibrahim et al. (2008) and Worley et al. (2004) found that Muslims preferred smaller goats weighing 50 pounds or less; Somalis indicated that 35 -40 pounds was a good range because heavier goats were often older and lacked the quality they preferred.

Knight et al. (2006) conducted a telephone survey targeting southern U.S. residents which elicited information on consumers shopping preferences for goat meat. They found that blacks, Hispanics, and other non-Caucasian races were more likely to have previously consumed goat meat than Caucasians. Males were more likely than females to have previously consumed goat meat or indicate a willingness to try goat meat. Older respondents, age 45 to 64, were most likely to have previously consumed goat meat, while younger respondents indicated a willingness to try. The sample was divided into three categories: non-consumers, potential consumers, and current consumers. In all three categories, Hispanics were more likely than Blacks to eat goat meat and older individuals were more likely to eat goat meat than the younger respondents. In all three categories, having a graduate or professional degree increased the

probability of goat meat consumption and those living in the South Atlantic and East South Central were the least likely to eat goat meat. It was also revealed that lamb consumers were more likely to eat goat meat. Other studies (Fisher et al. 2009; Ibrahim et al. 2008; and Worley et al. 2004) have found that consumers were willing to substitute goat for lamb. All three categories indicated that those who placed a high importance on convenience were less likely to eat goat meat. This is probably due to the lack of availability in traditional shopping venues such as grocery stores and supermarkets. Also a lack of knowledge on preparing goat meat might be a hindrance.

Nelson et al. (2004) conducted a study on the flavor profile of barbequed and chipped goat meat compared to beef and pork at the Sunbelt Agricultural Exposition held in Moultrie, Georgia. Samples were offered to visitors and they were later asked to complete a questionnaire. They found that the majority of respondents indicated that the flavor of goat meat was “better than” or “about the same” as that of beef and pork. The sample was composed of about 79 percent whites, 15 percent blacks, 4 percent Hispanics and about 2 percent other respondents (Nelson et al. 2004). One-third of the respondents were female and 59.4 percent of the respondents were 41 years and older. The study revealed that about 55 percent of the respondents had previously consumed goat meat. More Hispanics and blacks had previously consumed goat meat, and whites were the least likely to have eaten goat meat but over half had previously tried it.

To understand within racial groups’ demographics for segmentation, Nelson et al. (2004) created six new variables by combining race and gender and twelve by combining race and age. The reported ANOVA revealed that Hispanic males, and black males and females, rated the flavor of goat meat higher than any other race/gender combinations. Regarding the race/age

variables, it was revealed that blacks younger than 41 years old, and Hispanics 41 years and older rated the flavor of goat meat better than either pork or beef.

McLean-Meynsse (2003) used binomial logit and ordered probit models to estimate the relationship between demographic, socioeconomic, and geographic factors and the willingness to try goat meat and purchase processed goat products such as nuggets, patties, and roasts, respectively. The data were collected from a stratified random sample from 1,421 telephone interviews with residents located in Alabama, Arkansas, Florida, North Carolina, South Carolina, Tennessee, Texas, and Virginia. She found that goat consumption was the highest among men, African Americans, Texas residents, older respondents, and households of more than three persons. Younger consumers and those from households with fewer than three persons were the least likely to try goat meat. The results from the binomial logit model revealed that females were less likely to have eaten goat meat compared to the base group, white males from Texas. Older respondents, blacks and other races, and households of three or more persons were more likely to have previously consumed goat meat compared to the base group. The results from the ordered probit model for willingness to try goat meat revealed that females and whites were more likely to try goat meat; younger respondents with households of less than three were less likely to try goat meat. The results from the ordered probit model for interest in buying goat meat revealed that blacks and other races and Catholics were more likely to buy goat meat products as well as packaged goat meat with recipes, and marinated goat meat. Females were the least likely to purchase goat meat products.

McLean-Meynsse (1999) and Hui and McLean-Meynsse (1996) both conducted studies that assessed the demand for specialty meat, including goat meat. However, these studies did not specifically assess demand for goat meat as an individual product. The McLean-Meynsse (1999)

study determined how demographic, geographic, and socioeconomic factors affected consumer decisions to shop at stores offering specialty meat which included alligator, goat, and/or rabbit; and the characteristics of these shoppers. A telephone interview to assess consumer demand for specialty meat was administered to 1,002 randomly selected households located in Louisiana and Southeast Texas. The primary grocery shopper in each household was asked to rate their preference using the following statement, “I like to shop at stores that offer specialty meat (alligator, goat, and/or rabbit),” on a five-point likert scale ranging from strongly disagree to strongly agree. From these responses, shoppers who strongly agreed with the statement were described as early triers; those who somewhat agreed or were neutral were described as late triers; and those who strongly agreed or somewhat disagreed were described as non-triers (McLean-Meynise, 1999). The dependent variable, LIKESHOP, was created from these classifications and an ordered probit model was estimated. About 80 percent of the respondents were from Louisiana, over 70 percent were women and Caucasian from households of three and the average age was 42 years. Over one-third of the respondents indicated that they strongly agree with the statement that they like to shop at stores for specialty meat; fifteen percent strongly disagreed. Mclean-Meynise found that the likelihood of shopping at these stores offering specialty meat was influenced by age, household size, education, ethnicity, and prices. Individuals who were 42 years old, from a three-person household, and had less than a high school education were the most likely to shop at stores for specialty meat. Caucasians were found to be less likely than non-Caucasians to shop for specialty meat at these stores.

Hui and McLean-Meyinsse (1996) conducted a study to assess the market potential for rabbit, goat, and quail; and the influence of geographic, demographic, and socioeconomic factors on consumption behavior and attitudes. A telephone interview to assess consumer demand for



specialty meat was administered during February, 1993, to 1,002 randomly selected households located in Louisiana and Southeast Texas. A binomial-logit model was estimated where the dependent variable was a dummy created variable with 1 representing that they had eaten rabbit, goat, or quail meat and 0, otherwise. An ordered-logit model was used to estimate how geographic, demographic, and socioeconomic factors affected their attitudes towards these specialty meats. Of the sample population, 31 percent had eaten goat meat. On a scale of 1 (very negative) to 5 (very positive) measuring attitudes towards rabbit, goat, and quail, overall, goat meat received the lowest scores. Consumers responded more negatively towards goat meat (1.92) versus rabbit meat (2.68) or quail (3.07). They found that males, non-whites, younger than 18-39 years of age, and older than 60 years of age with more than a high school education were positive about goat meat. Females and whites had a negative attitude towards goat meat. Catholics, Baptists, and other Protestants all held a negative attitude towards goat meat, but other Protestants were less negative.

There appears to be a significant lack of empirical analysis in the scholarly articles published on the subject of goat meat preferences. This study will differ in several ways from previous studies. One, this study uses a national survey that will provide a national representative sample of goat meat consumers in the United States. Previous studies such as Fisher et al. (2009) and Worley et al. (2008) focused on small concentrated populations such as Muslims in Ohio or the Knight et al. (2006), McLean-Meynissee (1999 and 2003), and Hui and McLean-Meynissee (1996) studies which focused on the Southern U.S. region. The Nelson et al. (2004) available sample population was attendees at an Ag Expo. The results from these studies would be very difficult to apply to larger, more representative samples. In addition to providing a national representative sample, this study will assess consumer preferences for goat meat attributes using

choice-based conjoint analysis. In addition to the standard conditional logit model used to estimate discrete choice data, the random parameters logit and latent class logit models will be employed to assess heterogeneous preferences and the source of heterogeneity among the sample population. Previous studies assessed consumer willingness to buy or try goat meat, but none have estimated willingness to pay. This study will estimate consumer's willingness to pay for goat meat attributes that will provide producers and processors with marketing information.

## **CHAPTER 3: DATA AND METHODS**

### **3.1 Conjoint Analysis**

The main objective of this research is to determine consumer preferences for goat meat and live goat attributes. Conjoint analysis is a multivariate technique that has been used extensively in the marketing, transportation, health, and environmental literature to measure the tradeoffs consumers make when choosing a product or service. Conjoint analysis draws upon Lancaster's (1966) consumer theory that the attributes of a product rather than the product itself offers utility. Utility is the sum of the part-worths for each attribute's levels. For example, a car is a single good; however, a consumer's utility from the car is determined by the characteristics (attributes) such as miles per gallon (mpg), color, and brand, and the levels which describe the attributes. The first step in a conjoint analysis is to determine the attributes and levels that are most important considering the research objectives (Hair et al. 2006). With the car example, the levels associated with mpg could be 40 mpg, 30 mpg, and 20 mpg; color would be black, red, or silver; and brand could be Toyota, Honda, or Ford. For these levels, which may include two or more, all possible product profiles are created.

In the car example, there are three attributes with three levels each, which would create 27 ( $3 \times 3 \times 3$ ) stimuli. This is the full factorial design. A stimulus is a specific set of levels for each attribute evaluated by the respondent (Hair et al. 2006). Stimuli of 27 would be a difficult task for many respondents to complete due to fatigue; therefore, to reduce the number of profiles, a fractional factorial design, which uses only a subset of the possible profiles needed to estimate the results, is typically used (Hair et al. 2006). Hair et al. (2006) stated that the main objective of a fractional factorial design is to reduce the number of evaluations collected while still maintaining orthogonality. Orthogonality is the ability to change one level associated with an attribute without it affecting another level; i.e. independence is maintained among the levels.

Once the desired number of profiles has been selected, there are several methods available to collect data. Traditional conjoint analysis involves the ranking or rating of product profiles. The respondents will rank each product from 1 to 9 in the order of their most preferred to least preferred or they will rate each product on a Likert scale such as from 1 to 7, 1 indicating “I would definitely not buy this product” to 7 indicating “I would definitely buy this product.” During the early years of conjoint analysis, the product profiles were presented to the respondents as cards that had written descriptions of the product. But now, the stimuli presented to respondents often include color pictures or actual experimentally designed prototypes, which are considered more engaging and convey more information with little ambiguity (Green et al. 2001). Also, the use of computers and the internet to present the conjoint task has made the task easier and faster, and has enhanced the ability to collect a larger number of respondents.

Once the data have been collected, the part-worths are estimated for each level and the utility is the sum of each of these part-worths, which gives the consumer preference for the product (Hair et al. 2006). Part-worths are the separate utility values for each of the levels associated with the attributes. Ordinary least squares regression is commonly employed with the ratings or rankings as the dependent variable regressed on the independent variables. The discrete variables are created from the levels of each attribute. Once the part-worths have been estimated, consumer preferences for any combination of levels can be assessed for a respondent, as well as determination of the relative importance of each attribute when determining overall utility and product choice (Hair et al. 2006). Relative importance is the weight that is placed on each attribute in the buying process when a consumer considers the product. The relative importance of a factor is represented by the range of its levels (i.e., the difference between the highest and lowest values) divided by the sum of the ranges across all factors (Hair et al. 2006).

These are represented in percentage values, and the higher the percentage, the greater importance placed on that attribute.

Adaptive conjoint analysis differs from traditional conjoint analysis in that it combines self-explicated and part-worth conjoint models. In a self-explicated model, respondents are asked to rate the desirability of each level of an attribute and then rate the relative importance of the attribute overall (Hair et al. 2006). The part-worths are calculated by combining the respondents' ratings from both the level and the relative importance. Adaptive conjoint analysis uses the self-explicated approach to produce a subset of profiles from the fractional factorial design. Essentially, adaptive conjoint uses the information from the respondent to build the desired profiles based on their ratings and then have them evaluate the profiles created. This method is useful due to the realization that some products can have more than twenty attributes that need to be evaluated, which is restricted in traditional conjoint to ten attributes or less. By obtaining the respondent's rating on attributes, the number of attributes can be reduced significantly to include only those that are most important, taking in consideration the information from the respondent.

Choice-based conjoint analysis has become a popular conjoint method because it provides respondents with a more realistic decision making process; it has been used extensively in marketing, transportation, health, and environmental studies. Choice-based conjoint analysis has increasingly been used in discrete choice studies and to estimate willingness to pay. Lusk and Parker (2009) conducted a choice-based analysis to determine consumers' preferences and their willingness-to-pay for improved fat content in beef. Steiner et al. (2009) looked at consumers in Alberta, Canada and their willingness to pay a premium for farm origin traceability and non-GMO production labeling for bison and beef. Liljenstolpe (2008) looked at consumer willingness

to pay for animal welfare attributes applied to Swedish pig production. Carlsson et al. (2007) looked at consumer preferences for GMO-free meat products for either labeling GMO products or an outright ban of these products and the willingness to pay for either. Loureiro and Umberger (2007) looked at consumer preferences for food safety, country-of -origin labeling, and traceability for ribeye steaks and their willingness to pay for such attributes. Nalley et al. (2004) estimated willingness-to-pay for attributes associated with “farm-raised” pre-cooked roast beef. Other choice-based conjoint studies include the Darby et al. (2008) study which used stated-preference data from a choice experiment to estimate willingness to pay for strawberries that are differentiated only by location of production and guaranteed freshness; and Mayen et al. (2007), used choice-based conjoint to estimate consumers’ willingness to pay a premium for reduced juices in containers for fresh cut melon.

A choice-based conjoint task consists of a set of hypothetical products made up of attributes and their corresponding levels. These products are typically presented as two or more to be evaluated by the respondent, who chooses which of the products, would be purchased. In addition to the hypothetical products, an opt-out or will-not-purchase option included to add to the realism of an actual shopping experience. This is one of the main differences between traditional conjoint and choice-based conjoint. In traditional conjoint analysis, a fractional factorial design contains the profiles displaying the attributes and levels and the respondent rates or ranks each profile. In choice-based conjoint, the profiles are created; then those profiles are paired into choice tasks where the respondent will make a choice for each task. The situation is similar to what would be encountered in a real-world market setting (i.e. grocery store) when faced with a purchase decision among competing products. Both the traditional conjoint method and the choice-based conjoint method use full-profile stimuli, however, the choice task differs.

In the traditional conjoint method, respondents are presented with full-profile stimuli representing the different combinations of the levels for each attribute. Respondents rate or rank each full-profile. Choice-based conjoint analysis requires that the respondent choose among a choice set which has several full-profile stimuli and the number of profiles may or may not vary across choice sets (Hair et al. 2006).

In traditional conjoint analysis, respondents evaluate each full-profile stimuli separately that has a level for each attribute. Therefore the respondent has to include each level for every attribute in their decision-making process, which is considered an information-intensive approach. In choice-based conjoint analysis, the respondent is presented with a set of full-profile stimuli; therefore they consider only a subset of those attributes during the decision-making process. However, as Hair et al. (2006) indicate each choice set contains several stimuli and each stimulus contains several attributes and the corresponding levels, which presents a larger amount of information that the respondent must process in the decision-making process.

### **3.2 Design of the Goat Meat Choice Experiment**

After a review of the literature and conversations with industry experts, four attributes were selected for the goat meat choice experiment. The attributes for goat meat including cut, color, source, and price, as well as their respective levels are presented in table 2.

A 2004 report from the USDA Animal and Plant Inspection Services (APHIS) reported that demand for retail cuts had not yet arisen, and consumers preferred whole carcasses, quarters or sixths of the carcass. However, Fisher et al. (2009) found that consumers preferred retail cuts, such as legs, chops, shoulders and breast. Several different cuts including steaks, ribs, chops, cubes, carcasses, etc., were identified. However a review of the literature and conversations with industry experts suggested that only whole carcass (not pre-cut), half carcass (not pre-cut), chops, and cubes should be included in the choice experiment.

The color of the meat was included after research on goat meat and conversations with industry experts. The color of meat can be an indication of the goat's age; older goats tend to have darker colored meat and are less tender, but are more juicy and flavorful compared to kids. It is hypothesized that younger goats are preferred among specific ethnicities. Light pink, medium red, and dark red were the representative colors chosen to be included in the choice experiment. To identify the colors, pictures of actual goat carcasses were taken that were considered representative of the shades chosen according to industry experts. To insure consistency across the cuts so that only color was varied, one representative photo of the medium red color was taken for each type of cut. That picture was then imported into Adobe Photoshop CS5.1 where the levels for fuzziness, hue, saturation, and lightness were adjusted from their original values to be representative of light pink and dark red. These pictures were used in the choice experiment to represent the light pink, medium red, and dark red.

There has been an increase in goat meat imports, with the majority of imports from Australia and New Zealand. In addition, it has been stated in the literature that fresh is preferred over frozen. To test this hypothesis, a composite attribute, source, representing the country of origin and whether the meat was fresh or frozen, was created. There were three levels included, fresh never frozen domestic goat meat, frozen domestic goat meat, and imported goat meat.

There were three levels included for price. The levels for price were determined after contacting meat markets about their prices for goat meat and discussions with industry experts. Several meat markets were contacted and many stated that did not sell goat meat or only provided it when there was a demand. However, two were found that sold goat meat. One of the markets contacted indicated that they sold whole carcasses for \$4.25/lb. and the other market sold pre-cut carcasses for \$4.89/lb. Three price levels were used in the survey: \$3.89/lb.,



\$5.39/lb., and \$6.89/lb. After several conversations with goat experts, it was determined that these prices were comparable to the market prices for the four types of cuts included in this study.

Table 1. Goat Meat Attributes and Levels

Attributes	Levels
Price	\$3.89/lb. \$5.39/lb. \$6.89/lb.
Cut	Whole carcass Half carcass Chops Cubes
Color	Light pink Medium red Dark red
Source	Fresh domestic Frozen domestic Frozen import

There are four attributes, three with three levels and one with four levels. Therefore up to 108 ( $3^3 \times 4^1$ ) different profile combinations could be evaluated. It would be burdensome for a respondent to evaluate all 108 profiles; therefore, to reduce respondent fatigue, a subset of the full factorial design was used to create the choice sets. SAS macros created by Kuhfeld (2010) were used to design the choice experiment based on the D-efficiency. The program finds the choice design which maximizes the D-efficiency, in which the determinant of the inverse of the variance-covariance matrix, the D-error is minimized (Hensher et al. 2005). Therefore, we are minimizing the variance and maximizing the Fisher information matrix which is the determinant of the variance-covariance matrix. This design is known as the D-optimal design because it is the most statistically efficient design. However, it should be noted that this design may not be

orthogonal but the parameters are estimated with statistical efficiency. To find the D-optimal design, the modified Federov algorithm is used. First, a candidate set is built, which is a list of potential alternatives (Zwerina et al., 1996). A random selection from this list of potential alternatives is used for the starting choice design (Zwerina et al., 1996). The modified Federov algorithm exchanges the alternatives in the starting design with the candidate alternatives and once all sequential exchanges have been made, the first iteration is complete (Zwerina et al., 1996). The algorithm will go through this process of iterations until the most efficient design is found based on the D-efficiency. The final choice design consisted of 18 choice sets with two alternatives each and a no-purchase option was included. To further reduce the number of choice sets a respondent would have to evaluate, the eighteen choice sets were equally divided into three blocks, each consisting of nine choice sets.

Each respondent was randomly assigned to one of the three blocks and evaluated six choice sets where they were asked to choose between two hypothetical goat products that varied according to the type of cut, the color, the source, and price. A no purchase option was included. Respondents were reminded of their budget constraints to reduce hypothetical bias, as suggested in Darby et al. 2008 and Loomis (1997) by including in the conjoint description, *“Remember that any purchase will reduce your income available to buy other products for you and your family.”*

### **3.3 Design of the Meat Goat Choice Experiment**

It has been stated in the literature that some goat consumers prefer to purchase live goats to slaughter, specifically for family gatherings and religious events. There is little to no information on consumers' preferences regarding goats. And the information available has been gathered through observing the market and speaking with producers. There are no empirical studies that measure consumer preferences for attributes associated with goats. Therefore, to assess consumer preferences for live goats, a choice experiment was designed. After a review of

the literature and conversations with industry experts, there were four attributes for goats including, price, age, sex, and slaughter method. In Table 2, goat attributes and their respective levels are presented.

Table 2. Live Goat Attributes and Levels

Attributes	Levels
Price	\$75/head \$130/head \$195/head
Sex	Female Castrated male Intact male
Age	Less than one year One year Two year
Slaughter Method	Buyer Farmer Commercial Plant

Age and sex have been referenced as important attributes consumers consider when purchasing goats. As previously mentioned, it has been noted that different ethnic groups have specific preferences regarding goats' age and sex. However, there has been no published literature that specifically assesses consumer preferences for these attributes. There were three levels included for the attribute age: less than one year old, one year old, and two years old. There were three levels included for sex: intact male (buck), castrated male (wether), and female (doe).

Goats are sold through auctions and on-farm. In the conjoint survey, consumers are given a scenario where they visit a farm to purchase goats. It has been stated that some goat consumers prefer to slaughter the goats they purchase. Some ethnic populations serve goat during

celebrations such as the birth of a baby, weddings, and other family gatherings. Some goat producers have noted that buyers will bring their family to the farm to choose a goat for purchase. Therefore, who performs the slaughter was included as an attribute in the choice experiment. There were three levels, including slaughtered by you (the buyer), slaughtered by the farmer, and slaughtered in a commercial plant. After conversations with industry experts, it was concluded that slaughter method should be included because consumers having specific slaughter requirements due to religious beliefs. The attribute price had three levels: \$75 per head, \$130 per head, and \$195 per head. These prices were chosen after reviewing goat auctions prices and conversations with industry experts.

There were four attributes with three levels each; therefore, up to 81 ( $3^4$ ) different profile combinations could be evaluated. It would be burdensome for a respondent to evaluate all 81 profiles; therefore, to reduce respondent fatigue, a subset of the full factorial was used to create the choice sets. Once again, following Kuhfeld's SAS programming explained previously for developing efficient choice designs, a design for live goats was constructed that included nine choice sets with two alternatives each and a no purchase option. To further reduce cognitive burden on the respondent's part, three blocks with nine choice sets each were created. Respondents were randomly assigned to one the three blocks. Respondents were reminded of their budget constraint to reduce hypothetical bias, as suggested in Darby et al. (2008) and Loomis (1997), by including in the conjoint description, *"Remember that any purchase will reduce your income available to buy other products for you and your family."*

### **3.4 Conditional Logit Model**

Choice theory can be seen as a marriage between Lancaster (1966) consumer theory and McFadden (1986) random utility theory. Choice theory follows the assumption that consumers make choices among products which maximize their utility (McFadden 1986). Lancaster (1966)

stated that utility is obtained from the attributes that make up the product in which the separate utilities (part-worths) for each attribute can be estimated. McFadden's random utility theory states that we cannot observe all the factors which influence an individual's behavior, which is captured in the stochastic portion of the utility. Thus, utility can be decomposed into two components,

$$U_{ij} = V(s, x) + \varepsilon(s, x) \quad (1)$$

where  $V$  is the nonstochastic portion representing the preferences of the population, and  $\varepsilon$  is the stochastic portion representing the  $i$ th individual's preferences influencing choice for the alternative  $x$  given attributes  $s$ . Assuming that  $v$  is linear in unknown parameters, the function  $v(s, x)$  takes the linear form

$$v(s, x) = \beta_1 v^1(s, x) + \dots + \beta_k v^k(s, x) \quad (2)$$

Assuming that the  $i$ th ( $i = 1 \dots I$ ) individual in a population has a vector of measured attributes, and faces  $J$  alternatives ( $j = 1, \dots, J$ ) described by a vector of attributes  $x_j$ . The resulting random utility model for the  $i$ th individual choosing alternative  $j$  is represented by

$$U_{ij} = \beta x_{ij} + \varepsilon_{ij}, \quad (3)$$

where  $\beta$  is a vector of parameters to be estimated,  $x$  is the vector of attributes represented by alternative  $j$  and individual  $i$ , and  $\varepsilon$  is the random error term. We cannot observe an individual's utility but we can observe an individual's choice. Therefore, the probability that the  $i$ th individual will choose the  $j$ th alternative from the choice  $B$  is that the utility from the  $j$ th choice is greater than the utility for all other  $k$  choices in that choice set, mathematically represented as

$$P_i = P(\varepsilon_{ik} - \varepsilon_{ij} < \beta x_{ik} - \beta x_{ij}) \text{ for all } i \neq j \quad (4)$$

If the random error terms are independently identically distributed with the Weibull distribution and the scale parameter is one, the probability that individual  $i$  will choose alternative  $j$  is represented by

$$P_{ij} = P(x_{ij} | s_i, B_i) = \frac{\exp(\beta x_{ij})}{\sum_{k=1}^J \exp(\beta x_{ik})} \quad (5)$$

This is McFadden's conditional logit model, which has been a popular model to fit to discrete choice data and is estimated using maximum likelihood. Luce (1959) introduced an axiom which states that the relative odds of one alternative being chosen over another alternative should be independent of the presence or absence of a third alternative (McFadden, 1973); i.e. the introduction of the third alternative should not affect the probability of choosing the first or second alternative. This is called the Independence of Irrelevant Alternatives (IIA) and the conditional logit model is based on this property. The IIA property does not always hold and can lead to biased estimates if violated. There are several other models that have been introduced that relax the IIA assumption; examples include the heteroscedastic extreme value model, the latent class heteroscedastic MNL model, the multinomial probit, and the random parameters logit model.

### **3.5 Random Parameters Logit Model**

The conditional logit model should always be estimated as the base model for choice experiments to check the data and make sure it is clean; and that the results (e.g. parameter signs and significance) make sense (Hensher et al, 2005). However, the restrictive IIA property and assumption of homogenous preferences across the population have led to the use of less restrictive models. The random parameters logit model relaxes the IIA property and allows for preference heterogeneity across the population, i.e. the parameters vary across individuals. As

stated by Revelt and Train (1998) and Hole (2007), the utility that an individual  $n$  obtains from alternative  $j$  in choice situation  $t$  is given by

$$U_{njt} = \beta'_n x_{njt} + \varepsilon_{njt} \quad (6)$$

where  $\beta_n$  is the parameter vector that varies across individual  $n$  and is unobserved,  $x_{njt}$  is a vector of individual- and alternative-specific attributes, and  $\varepsilon_{njt}$  is the individual-specific random term of unobserved heterogeneity that is distributed independently and identically extreme value type 1 across individuals, alternatives, and choice situations. The IID property does not allow for the error components of different alternatives to be correlated (Hensher et al., 2005). To take this into account, we can partition the random term  $\varepsilon_{njt}$  into two uncorrelated parts given by (Hensher et al., 2005 and Hensher and Greene, 2003)

$$U_{njt} = \beta'_n x_{njt} + [\eta_{nj} + \varepsilon_{njt}] \quad (7)$$

where  $\eta_n$  is a random term whose distribution over individuals depends on the underlying parameters and observed data;  $\beta_n$  may contain individual-specific constants, thus  $\eta_n$  may vary across choices, and possibly induce correlation across choices; and  $\varepsilon_n$  is a random term independently and identically distributed with zero mean and does not depend on the parameters or data.

A general distribution for  $\eta_n$  is assumed in the random parameters logit model. Therefore, the parameters can take on different distributional forms: normal, lognormal, uniform, or triangular. The density of  $\eta_n$  is denoted by the function  $f(\eta | \Omega)$  where  $\Omega$  is the fixed parameters of the distribution. Conditional on knowing  $\beta_n$  and a given value of  $\eta$ , the probability that individual  $n$  chooses alternative  $i$  in period  $t$  is the conditional logit given by

$$L_{nit}(\beta_n | \eta) = \frac{e^{\beta'_n x_{nit}}}{\sum_j e^{\beta'_n x_{njt}}} \quad (8)$$

Conditional on knowing  $\beta_n$ , the probability of individual  $n$  is observed sequence of choices is the product of the conditional logit given by

$$S_n(\beta_n) = \prod_t L_{ni(n,t)t}(\beta_n) \quad (9)$$

Since  $\eta$  is unknown, the unconditional probability for the sequence of choices is

$$P_n = \int S_n(\eta) f(\eta_n|\Omega) d\eta \quad (10)$$

The variation in  $\beta_n$  is induced by the random vector,  $\eta_n$ , thus accounting for the variation in the integral. This denotes the random parameters logit model because the choice probability  $P_n$  is a mixture of logits with  $f$  as the mixing distribution. Therefore, the model does not hold the IIA property, and different substitution patterns can be obtained through specifications of  $f$ .

Therefore, by allowing the parameters of  $\beta_n$  to vary across individuals, each estimated  $\beta_n$  associated with an attribute will have both a mean coefficient and a standard deviation. A statistically significant standard deviation indicates preference heterogeneity in the sampled population.

There is little guidance in way of determining the mixing distribution. The distribution of the parameters can be normal, lognormal, triangular, or uniform; all have their advantages and disadvantages. The normal distribution is the most widely used. The normal distribution is symmetric around the mean, with support on both sides of zero. This presents a problem when parameters are necessarily signed such as price coefficients. A lognormal distribution avoids wrong signs and is of particular interest due to the central limit theorem. The central limit theorem explains the normal random variable; the mean of a sufficiently large number of independent random variable, each with finite mean and variance, will be approximately normally distributed. Hensher et al. (2005) explained that if a large number of positive or negative random shocks change the size of a particular attribute,  $x$ , in an additive fashion, the



distribution of that attribute will tend to become normal as the shocks increase. However, if these shocks act multiplicatively, changing the value of  $x$  by randomly distributed proportions instead of absolute amounts, the central limit theorem applied to a lognormal distributed  $x$  tend to produce a normal distribution (Hensher et al. 2005). Lognormal distributions are useful if a parameter is to be restricted to non-negative however, Hensher et al. (2005) explained that lognormal distributions typically have a very long right tail, which may lead to implausibly large willingness to pay values. The triangular distribution is constrained to equal the mean; it avoids wrong signs and the implausibly large values that come with using a lognormal distribution. The uniform distribution with a (0, 1) bound should be used when there are dummy variables.

The density of this distribution has parameters, which describe the distribution of individual parameters; these needs to be estimated. The choice probability in Equation (10) cannot be calculated because the integral lacks a closed-form solution. Therefore, the model's coefficients are estimated through simulation. To do this, for any given value of the parameters, a value for  $\eta$  is drawn from the distribution. Using this draw, the logit formula for  $L_n(\eta)$  is calculated (Hensher and Greene, 2003). There are repeated draws for  $\eta$ , and the mean of the resulting  $L_n(\eta)$  is taken as an approximate choice probability given by

$$SP_i = (1/R) \sum_{r=1}^R L_i(\eta_{ir}), \quad (11)$$

where  $R$  is the number of draws of  $\eta$ ,  $\eta_{ir}$  is the  $r^{\text{th}}$  draw, and  $SP_i$  is the simulated probability that an individual chooses alternative  $i$ .

Simulations using random draws or Halton draws have been used to approximate the integral. Bhat (2000) and Train (2000) found that using Halton draws over random draws was a vast improvement in random parameters logit estimation. Train (2000) noted two reasons for choosing Halton draws: 1) They give a more evenly distributed mixing distribution for each

observation leading the simulated probabilities to vary less over all observations; and 2) Negatively correlated simulated probabilities over all observations reduce the variance in the log-likelihood function.

### 3.6 Latent Class Logit Model

The latent class logit model has been used to reveal the source of heterogeneity and identify latent classes that share similar taste preferences within classes, but may differ across classes. As Louviere et al. (2000) explained the random parameters logit model has been used to allow for different taste preferences by assuming that the  $\beta_n$  is drawn from some joint density function, and estimation recovers the parameters of the distribution. Often it is left to the researcher to determine the distribution of the parameters, which is a challenge considering there are no set guidelines for choosing the appropriate distribution. The latent class logit model assumes that there are a finite number of  $J$  classes into which individuals are sorted into based on their taste preferences; however, which particular individual is in which class is unknown to the researcher. Therefore, the mixing distribution  $f(\beta_n | \theta)$  is discrete, with  $\beta_n$  taking a finite set of distinct classes (Train, 2000). In the latent class model, class membership is fixed and the individual's choice is assumed to be independent from one choice situation to the next (Greene, 2008). Assume that  $\beta_j$  is generated from a discrete distribution with  $J$  classes so that the distribution of  $\beta_j$  is over these classes, but which individual belongs to which  $J$  latent class is unknown (Greene, 2008). Supposed that the probability of an individual  $n$  choosing alternative  $i$  in choice situation  $t$ , given that they belong to latent class  $j$ , is

$$P(nit/j) = \prod_{t=1}^T \frac{\exp(\beta_j x_{nit})}{\sum_{j=1}^J \exp(\beta_j x_{njt})} \quad (12)$$

where  $x_{nit}$  is a vector of alternative-specific traits associated with alternative  $i$ , and  $\beta_j$  is a class-specific parameter vector;  $t$  represents the number of choice situations for individual  $n$ , and  $\beta_j$  is used to capture heterogeneity in preferences across classes (Ouma et al., 2007).

The class probabilities are constrained to sum to one and the approach that is usually used is to reparameterize them as a set of logit probabilities (Green, 2008).

$$p_{ij}(z_i, \Delta) = \frac{\exp(\theta_{ij})}{\sum_{j=1}^J \exp(\theta_{ij})}, J = 1, \dots, J, \theta_{ij} = z_i' \delta_j, \theta_{ij} = 0 (\delta_J = 0) \quad (13)$$

The class probabilities are unobservable; therefore, class probabilities are specified by the multinomial logit

$$P(j) = \frac{\exp(\theta_j' z_t)}{\sum_{j=1}^J \exp(\theta_j' z_t)} \quad (14)$$

where  $z_t$  is a set of observable characteristics, i.e. demographic, socioeconomic, and geographic characteristics, which enter the model for class membership. The  $j$ th parameter vector is normalized to zero for model identification. Greene (2008) suggested that the expectation-maximization algorithm is particularly well-suited for estimating the parameters of latent class models. With the EM algorithm, the parameters  $\beta$  and  $\theta$  can be easily estimated, treating each individual's class membership as missing information (Pacifico and il Yoo, 2012).

### 3.7 Data

A national online survey was conducted on goat meat consumers in the United States. The criteria for choosing goat meat consumers were at least 18 years of age and had eaten goat meat in the past year. The main purpose of the survey was to assess consumer preferences for goat meat attributes and live goat attributes using a choice experiment. Respondents were asked if they primarily purchased cuts of goat meat and/or live goats for consumption; based on their response, they completed the choice experiment for cuts of goat meat, live goats, or both. At most, respondents could complete up to nine choice tasks, six questions for cuts of goat meat and

three questions for live goats. The choice experiment required respondents to evaluate two hypothetical goat products described by the attributes and their respective levels for either goat meat or live goats. In addition to the choice experiment, socioeconomic, demographic, and geographic data for each respondent were collected. Respondents were also asked about frequency of goat consumption; purchasing behavior; and several attitudinal and lifestyle questions regarding goats, health, shopping and eating habits. The survey was conducted from April 27, 2012 to May 4, 2012 through MRops, a global market research company, which recruited participants throughout the United States to participate in the online questionnaire. There were 2000 surveys collected from goat meat consumers and additional 2000 surveys were collected from the general population, which may included some goat meat consumers. The criteria for the general population were that the respondent was at least 18 years of age.

There were three main sections of the survey: consumption and purchasing behavior, choice experiment, and demographics. To develop the questionnaire, there were several conversations with industry experts in animal science and agricultural economics and, goat producers, to determine the appropriate set of attributes for the choice experiments and questions. The focus of the questionnaire was to gather information about goat meat consumers' consumption and purchasing behavior. The questionnaire addressed several questions about goat meat and live goats. Respondents were required to answer specific questions dependent upon whether they purchased goat meat or live goat. If respondents indicated that they purchased both, goat meat and live goats, they completed all the questions associated with goat meat and live goats. Once respondents had completed all the questions about goat meat consumption and purchasing, they were asked to complete the choice experiment for either goat meat or live goats. Again, goat meat consumers completed both choice experiments for goat meat and live goats if

they indicated they purchased both. For the goat meat choice experiment, pictorial representations for the type of cut and color was used for each hypothetical product. The use of photographs in choice experiments holds respondents interest and convey information with little ambiguity (Green et al., 2001). However, a pictorial representation was not use for the live goat choice experiment. After conversations with the research team, it was decided that including photographs in the live goat choice experiment would offer more confusion than clarity due to the differing weights and sizes associated with intact male versus castrated male versus female goats, as well as the difficulty of finding goats all of the same breed and color. In choice experiments, only the attributes of interest should vary, all other factors should remain constant to reduce biasness.

There were a total of 18 choice sets for the goat meat choice experiment and a total of nine choice sets for the live goat choice experiment. To reduce the cognitive burden on respondents having to evaluate all 18 choice sets, the goat meat choice experiment was divided into three blocks, each with six choice sets, and each choice set contained two choices and a no purchase option. The live goat choice experiment was also divided into three blocks, each with three choice sets, and each choice set contained two choices and a no purchase option. Respondents were randomly assigned to evaluate one of the three blocks, and the choice sets were randomized within each block. Therefore, all respondents did not receive the exact same order of choice sets. This was done to reduce biasness. There were an equal number of respondents assigned to each block until the 2000 responses were collected. At most, a respondent could evaluate nine choice sets, six for goat meat and three for live goats. Once respondents completed the questions related to goat meat consumption and purchasing and either the goat meat or live goat choice experiment, respondents answered several demographic

questions. In addition to collecting data on goat meat consumers, a sample of 2000 was taken of the general population. Within the general population, there could be goat meat consumers. Information about demographics and reasons for not ever consuming goat meat or not consuming goat meat regularly was collected on the general population.

The questionnaire and choice experiments were both internet-based and completed by respondents recruited by MRops. MRops is a market research company that assists in administering online and telephone surveys, as well as a myriad of other data collection methodologies. The questionnaire and choice experiment was completely designed by the researchers. Once the questionnaire was completed, MRops handled the technical issues of administering the online questionnaire, as well as offering suggestions on how to properly phrase questions, placement of questions, etc. After several conversations with the MRops contact, a test run of the questionnaire was completed by members of the research team to insure that there was no confusing wording and that the survey worked as it should. MRops provided a representative sample of goat meat consumers. MRops recruited respondents through national databases they have access to. Respondents were asked several ‘screening’ questions including: gender, age, education, and whether or not they had eaten goat meat in the past year. Respondents were asked these questions to insure that they were at least 18 years of age and had eaten goat meat in the past year. Respondents who indicated that they were at least 18 years of age and had eaten goat meat in the past year were allowed to complete the questionnaire and choice experiments. Once data collection was complete, MRops emailed a comma delimited file containing the data collected on all respondents.

## **CHAPTER 4: RESULTS**

### **4.1 Profile of Goat Meat Consumers**

The first objective of this study was to describe goat meat consumers in the United States using socioeconomic, demographic, and geographic data. Gender, age, children in the home, education, income, number of times beef, pork, chicken, seafood, lamb, and goat were eaten, and how often goat meat was eaten were described using means and standard deviations. Race, ethnicity and the region in which respondents reside was described using frequencies. The demographics of the goat meat consumers are shown in Table 3. The average respondent was male and 41.5 years old. This supports previous studies (Nelson et al., 2004; McLean-Meynis, 2003; and Hui et al., 1996) that found older males were more likely to eat goat meat than females. On average, respondents had at least an Associate's degree. The average annual income was between \$50,000 and \$74,999, which might be considered high, but mostly males responded to survey and they typically have higher incomes than females. Also, the majority of the respondents did not have children in the home, allowing more hours to work. About 34 percent of the respondents indicated that they had at least one child under the age of 18 years in the household. Of the 2000 goat meat consumers, the majority of the respondents (85.75%) purchased cuts of goat meat. Five percent indicated that they purchased only live goats to be slaughtered for consumption; and almost 10 percent indicated that they purchased both cuts and live goats. On average, respondents ate goat meat 1-2 times per year.

The racial makeup of the respondents was 65.4 percent white, nearly 13 percent black, 12 percent Asian, almost two percent Native American, almost one percent Native Hawaiian, and nearly 10 percent other. Previous literature on goat meat demand has stated that goat meat consumption is highest among ethnic groups (Sande et al., 2005; Gipson, 2000; Pinkerton et al. 1994). Respondents were asked to identify their ethnic background to capture any heterogeneity

among ethnic groups. About 16 percent specified their ethnicity as Hispanic/ Latino, 12 percent specified Asian descent, eight percent specified African descent, four percent were Caribbean-born, one percent specified Arabic descent, and nearly 14 percent specified an ethnicity other than the ones listed. Nearly 47 percent chose not to specify their ethnicity.

The regional background of goat consumers revealed that the highest number of respondents resided in the South, with almost 34 percent. The large number of goat meat eaters in the South could be due to increased goat production in southeast United States and an increase in immigrants, from goat-consuming countries, settling in southeast United States. A little over 26 percent of the respondents resided in the West. The West has a high percentage of Hispanics, who are heavy goat meat consumers. A little over 20 percent of the respondents resided in the Northeast and almost 20 percent resided in the Midwest.

For the general population, the demographics are shown in Table 4. In the general population the average respondent was female and 48.4 years old. A little over 41 percent were male and almost 60 percent were female, compared to the goat meat consumers which had more males (59%) and lesser females (40%). Respondents in the general population were also older compared to goat meat consumers. On average, respondents in the general population had at least an Associate's degree. The average annual income was between \$50,000 and \$74,999, the same as goat meat consumers. The high income range could be due to the fact that the respondents are older and the majority indicated having no children in the home, possibly allowing more hours to work. A little over 41 percent of the respondents indicated that they had at least one child under the age of 18 years in the household. The racial makeup of the respondents was 84.6 percent white, seven percent black, four percent Asian, almost one percent Native American, almost one percent Native Hawaiian, and nearly four percent specified an ethnicity other than the ones



listed. Respondents in the general population were also asked to indicate their ethnic background. Seven percent specified their ethnicity as Hispanic/ Latino, four percent specified Asian descent, five percent specified African descent, about one percent were Caribbean-born, about one percent were of Arabic descent, and almost 16 percent specified other. Almost 67 percent chose not to specify their ethnicity. The regional background of the general population revealed that the highest number of respondents resided in the South, with 31 percent. Almost 25 percent resided in the Midwest and 24 percent resided in the West. Almost 20 percent of the respondents resided in the Northeast.

Out of the 2000 respondents in the general population, almost 13 percent indicated that they had eaten goat meat in the past year. The goat meat consumers included in the general population were not included in the population of goat meat consumers because the quota of 2000 respondents for the goat meat consumers had been met; therefore, these respondents were included in the general population. Of those goat meat consumers, about 87 percent purchased goat meat cuts, about four percent purchased live goats and a little over nine percent purchased both goat meat cuts and live goats. For those in the general population who indicated that they had eaten goat meat, on average they ate goat meat one to two times per year. The type of goat products and number of times goat meat was eaten in a year was similar for the both the general population and the goat meat consumers. The remaining 87 percent had not eaten goat meat in the past year. These respondents were asked if they had ever eaten goat meat in their lifetime, 24 percent indicated that they had eaten goat meat in their lifetime and 76 percent had never eaten goat meat in their lifetime.

Table 3. Summary Statistics and Variable Definitions for Goat Meat Consumers

Variable	Definition	Mean	Frequency
Gender	1 = male; 0 = female	0.599 (0.490) <sup>a</sup>	
Age	Age in years	41.5 (16.078)	
Child	1 = children in household; 0 otherwise	0.337 (0.473)	
Education	1 = grade school; 2 = some high school; 3 = High School diploma; 4 = some college 5 = Associate's; 6 = Bachelor's; 7 = Post Graduate	5.252 (1.427)	
Income	Annual Household Income 1 = less than \$10,000; 2 = \$10,000 to \$14,999... 9 = \$150,000 to \$199,999; 10 = \$200,000 or more; 11 = Prefer not to answer	5.996 (2.443)	
Beef	The last 10 times you ate meat, how many times did you eat beef?	2.731 (1.684)	
Pork	The last 10 times you ate meat, how many times did you eat pork?	1.476 (1.087)	
Chicken	The last 10 times you ate meat, how many times did you eat chicken?	3.014 (1.669)	
Seafood	The last 10 times you ate meat, how many times did you eat seafood?	1.521 (1.245)	
Lamb	The last 10 times you ate meat, how many times did you eat lamb?	0.515 (0.703)	
Goat	The last 10 times you ate meat, how many times did you eat goat?	0.745 (1.092)	
Goat Meat	How often do you eat goat meat? 1 = less than once a year; 2 = 1 to 2 times per year; 3 = 3 to 6 times per year; 4 = 7 to 11 times per year; 5 = once a month; 6 = more than once a month	2.394 (1.395)	
Race	White Black Asian Native American Native Hawaiian Other		65.35% 12.85% 12.00% 1.60% 0.70% 9.65%
Ethnicity	Hispanic/ Latino Asian descent African descent Caribbean-born Arabic descent Other		15.55% 12.10% 8.00% 4.35% 1.10% 13.95%

<sup>a</sup>Numbers in parentheses are standard deviations.

Table 4. Summary Statistics and Variable Definitions for General Population

Variable	Definition	Mean	Frequency
Gender	1 = male; 0 = female	0.4120 (0.492) <sup>a</sup>	
Age	Age in years	48.4 (15.71)	
Child	1 = children in household; 0 otherwise	0.2950 (0.456)	
Education	1 = grade school; 2 = some high school; 3 = High School diploma; 4 = some college 5 = Associate's; 6 = Bachelor's; 7 = Post Graduate	4.944 (1.434)	
Income	Annual Household Income 1 = less than \$10,000; 2 = \$10,000 to \$14,999... 9 = \$150,000 to \$199,999; 10 = \$200,000 or more; 11 = Prefer not to answer	5.653 (2.441)	
Beef	The last 10 times you ate meat, how many times did you eat beef?	2.820 (1.735)	
Pork	The last 10 times you ate meat, how many times did you eat pork?	1.555 (1.094)	
Chicken	The last 10 times you ate meat, how many times did you eat chicken?	2.895 (1.557)	
Seafood	The last 10 times you ate meat, how many times did you eat seafood?	1.523 (1.106)	
Lamb	The last 10 times you ate meat, how many times did you eat lamb?	0.500 (0.663)	
Goat	The last 10 times you ate meat, how many times did you eat goat?	0.707 (0.905)	
Goat Meat	How often do you eat goat meat? 1 = less than once a year; 2 = 1 to 2 times per year; 3 = 3 to 6 times per year; 4 = 7 to 11 times per year; 5 = once a month; 6 = more than once a month	2.398 (1.411)	
Race	White Black Asian Native American Native Hawaiian Other		84.55% 7.05% 4.05% 0.85% 0.50% 4.05%
Ethnicity	Hispanic/ Latino Asian descent African descent Caribbean-born Arabic descent Other		7.10% 4.40% 5.20% 0.90% 0.60% 15.95%

<sup>a</sup>Numbers in parentheses are standard deviations.

## 4.2 Results from Conditional Logit Model for Goat Meat Consumers

The following conditional logit model was estimated for goat meat buyers

$$U_{ij} = \beta_0 + \beta_1 + \beta_2 X_1 + \beta_3 X_2 + \beta_4 X_3 + \beta_5 X_4 + \beta_6 X_5 + \beta_7 X_6 + \beta_8 X_7 + \beta_9 X_8 + \varepsilon_{ij},$$

where  $i = 1, \dots, N$  is the number of respondents, and  $j$  is the number of alternatives in choice set  $J$ .

The dependent variable is the actual choice that respondents made for each choice set evaluated.

The alternative-specific constants,  $\beta_0$  and  $\beta_1$ , are dummy variables indicating either Choice A or Choice B with respect to the no purchase option. Price was \$3.89/lb., \$5.39/lb., or \$6.89/lb. The levels for the attributes, cut, color, and source are effects coded. In comparison to dummy coding which uses 1 to represent the level appearance and 0, otherwise; effects coding uses -1, 0, and 1.

The reference level is coded -1, 1 represents the level appearance, and 0, otherwise. In effects coding, the effects are uncorrelated with the intercept (Bech and Gyrd-Hansen, 2005); therefore, the reference level can be calculated by taking the negative sum of the estimated coefficients.

The variables  $X_2$ ,  $X_3$ , and  $X_4$  define the levels for the attribute, cut; where  $X_2 = 1$ ,  $X_3 = 0$ , and  $X_4 = 0$  represents whole carcass;  $X_2 = 0$ ,  $X_3 = 1$ , and  $X_4 = 0$  represents half carcass;  $X_2 = 0$ ,  $X_3 = 0$ , and  $X_4 = 1$  represents chops; and  $X_2 = -1$ ,  $X_3 = -1$ , and  $X_4 = -1$  represents cubes. The variables  $X_5$  and  $X_6$  define the levels for the attribute, color; where  $X_5 = 1$  and  $X_6 = 0$  represents light pink,  $X_5 = 0$  and  $X_6 = 1$  represents dark red, and  $X_5 = -1$  and  $X_6 = -1$  represents medium red. The variables  $X_7$  and  $X_8$  define the levels for the attribute, source; where  $X_7 = 1$  and  $X_8 = 0$  represents frozen domestic,  $X_7 = 0$  and  $X_8 = 1$  represents imports, and  $X_7 = -1$  and  $X_8 = -1$  represents fresh domestic. The conditional logit model was estimated for the goat meat choice experiment and live goat choice experiment.

In Table 5 are the estimated coefficients and standard errors from the conditional logit model for respondents who purchase cuts of goat meat. The model is statistically significant at the 0.01 critical level as indicated by the likelihood ratio test; the chi-squared statistic of 6995 is

greater than the critical value of  $\chi^2$  with 10 degrees of freedom, rejecting the null hypothesis that all the coefficients are equal to zero. The pseudo  $R^2$  is a measure of model fit for discrete choice models. The pseudo  $R^2$  is calculated by taking the ratio of the log likelihood of the estimated model with all the parameters and the log likelihood of the base model assuming equal choice shares, and this value is subtracted from 1. Therefore, the pseudo  $R^2$  represents how much variation in choice is explained by the model compared to a model assuming equal choice shares (Hensher et al., 2005). Hensher et al. (2005) stated that a pseudo  $R^2$  of 0.3 represents a decent model fit. Pseudo  $R^2$  values between 0.3 and 0.4 can be translated as an  $R^2$  between 0.6 and 0.8 for the linear model equivalent (Hensher et al., 2005). An  $R^2$  of this range indicates that the model does a good job of predicting the outcome. The pseudo  $R^2$  for this model is 0.279, which according to Hensher et al. (2005) would approximately translate into a  $R^2$  value of about 0.6.

The alternative specific constants are positive and statistically significant as expected, indicating that respondents received greater utility from Choice A or Choice B, than from the no purchase option. As expected, price is negative and statistically significant, indicating that as price increases, consumer utility decreases. The estimated coefficients for types of cuts are statistically significant at the 0.01 critical level. Respondent utility for whole carcasses and half carcasses is negative. Respondent utility for chops and cubes is positive; however, chops are more preferred than cubes. The estimated coefficients for meat color, light pink and dark red, are small and statistically significant at the 0.10 and 0.05 critical levels, respectively. Light pink is preferred over dark red. The estimated coefficient for medium red is small and has a positive sign, but is statistically insignificant. Fresh and domestically produced goat meat has a positive effect on utility and is preferred over imports, which have a negative effect on utility; both are

statistically significant. Frozen domestic goat meat carried a positive sign but was statistically insignificant.

Table 5. Estimates from Conditional Logit Model for Goat Meat Consumers

Coefficient	Estimates	Standard Errors
Choice A	1.4324*** <sup>a</sup>	0.0922
Choice B	1.3492***	0.0753
Price	-0.1567***	0.0143
<u>Cuts</u>		
Whole carcass	-1.0898***	0.0306
Half carcass	-1.0946***	0.0305
Chops	1.1793***	0.0274
Cubes	1.0052*** <sup>b</sup>	0.0239
<u>Color of Meat</u>		
Light	0.0393*	0.0231
Dark	-0.0583**	0.0240
Medium	0.0191	0.0265
<u>Source</u>		
Frozen domestic	0.0305	0.0218
Import	-0.2660***	0.0208
Fresh domestic	0.2355***	0.0217
Pseudo R <sup>2</sup>	0.2793	
Log Likelihood	-9026.63	
$\chi^2$	6995.11	

Notes: These respondents indicated that they purchased goat meat cuts. Number of respondents: N=1900. Number of Observations = 34,200 (1900 respondents x 6 questions x 3 choices)

<sup>a</sup>One asterisk indicates statistical significance at the 0.10 level; two asterisks indicates statistical significance at the 0.05 level; three asterisks indicates statistical significance at the 0.01 level.

<sup>b</sup>Standard errors for "omitted" variables in the effects coding were calculated using the Delta method.

The relative importance for each attribute was calculated. To calculate relative importance, the range of each attribute's levels is taken, which is the difference between the highest and lowest estimated coefficients for the attribute, and is divided by the sum of all the ranges across all attributes. Following the example from Mayen et al. (2007), the following equation shows the relative importance (R.I.) for the attribute, cut

$$R.I. = \beta_5 - \beta_4 / [\beta_2 (3.89) - \beta_2 (6.89)] + [\beta_4 - \beta_5] + [\beta_6 - \beta_7] + [\beta - \beta_9],$$

where the  $\beta$ 's refer to estimated coefficients for each level and the numbers in the parentheses refer to the lowest price per pound and the highest price per pound for goat meat.

Measure of the relative importance for goat meat attributes are shown in Figure 6. Cut was the most important attribute to respondents, with 68 percent relative importance. This indicates that the attribute, cuts, had the most influence on consumer choice. The second-most important attribute was source, with 15 percent relative importance, closely followed by price, with 14 percent relative importance. The attribute, color, had very little importance in respondent choice, with three percent relative importance. This could be due to consumers' lack of knowledge about the correlation between color and age/ sex of the goat.

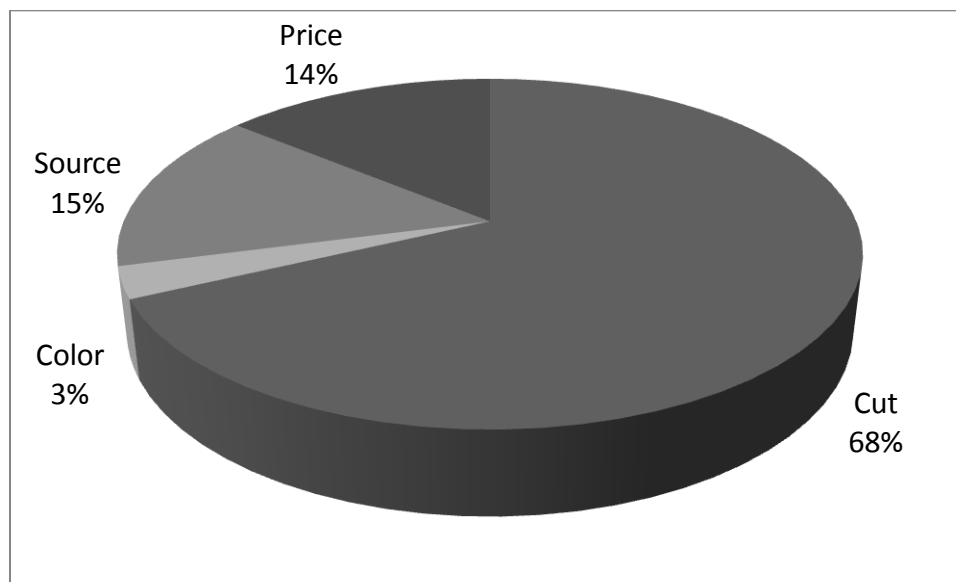


Figure 6. Relative Importance for Goat Meat Attributes

The estimates from the conditional logit model give some insight on whether the attributes have a negative or positive effect on consumer utility; however, to quantify that effect, the marginal willingness to pay (WTP) is calculated. The marginal WTP is calculated by taking the negative ratio of the partial derivative of the utility function with respect to the attribute of interest, divided by the derivative of the utility function with respect to the coefficient for price

(Gracia et al., 2009). Therefore, the corresponding ratio is (Morrison, Bennett, Blamey, and Louviere 2002):

$$WTP_{\text{attribute}} = - \frac{\frac{\partial U_j}{\partial \text{Attribute}}}{\frac{\partial U_j}{\partial \text{Price}}}$$

The willingness to pay is interpreted as price per pound, indicating the dollar amount that consumers are willing to pay to obtain the specific goat meat attribute. The estimated marginal WTP for each goat meat attribute is shown in Table 6. Overall, consumers placed a greater value on chops and cubes versus whole and half carcasses. Consumers are willing to pay \$7.52 per pound for chops and \$6.41 per pound for cubes, indicating that consumers valued chops more than cubes. Whole carcass and half carcass have a negative WTP of \$6.95 and \$6.98 per pound, respectively. However, consumers valued whole carcasses than for half carcasses as indicated by the greater negative WTP value for half carcasses. Overall, these WTP values indicate that consumers valued retail cuts more than carcasses signifying that industry should put more focus on providing chops, cubes, loin, etc.

Consumers valued goat meat that was light pink or medium red meat over goat meat that was dark red, but are not willing to pay that much extra for it. The WTP for light pink goat meat and medium red goat meat is \$0.25 and \$0.12 per pound, respectively. Dark red goat meat has a negative WTP of \$0.37 per pound. Consumers valued fresh domestic goat meat more than imports. Fresh domestic goat meat has a WTP of \$1.50 per pound; imports have a negative WTP of \$1.70 per pound. Frozen domestic has a positive WTP of \$1.50 per pound, but its WTP is statistically insignificant.



Table 6. Marginal Willingness to Pay for Goat Meat Attributes from Conditional Logit Model

Attribute Level	WTP (\$/lb.)	95% Confidence Interval
<u>Cuts</u>		
Whole carcass	-6.95	[-8.23 to -5.68]
Half carcass	-6.98	[-8.27 to -5.70]
Chops	7.52	[6.14 to 8.91]
Cubes	6.41	[5.27 to 7.56]
<u>Color of Meat</u>		
Light	0.25	[-0.04 to 0.55]
Medium	0.12	[0.10 to 0.14]
Dark	-0.37	[-0.67 to -0.07]
<u>Source</u>		
Frozen domestic	0.19	[-0.08 to 0.47]
Fresh domestic	1.50	[1.23 to 1.77]
Import	-1.70	[-2.06 to -1.33]

Note: The 95% confidence intervals were estimated using the Delta method.

Overall, the conditional logit model for goat meat buyers revealed that consumers placed the greatest importance on the attribute, cut. Consumers preferred chops and cubes over carcasses, supporting the hypothesis that retail cuts are desired. The marginal willingness to pay revealed that consumers placed greater value on retail cuts versus carcasses; consumers were willing to pay more for chops and cubes. Consumers valued carcasses less as indicated by the large negative willingness to pay for whole and half carcasses. Carcasses require extra processing after purchase, such as cutting and trimming, for preparation to be stored. The additional labor involved with further processing of carcasses may dissuade some consumers; hence, the preference for chops and cubes. In addition, 65 percent of the respondents were white, and ethnic groups are thought to prefer carcasses; therefore, non-ethnic groups may prefer more familiar cuts such as chops and cubes. An increase in the availability of smaller cuts of goat meat may increase consumption among non-traditional goat meat consumers. The estimated coefficients for the attribute, color, were small; and light pink and dark red were statistically significant. Consumers preferred goat meat that was light pink; its estimated coefficient was

positive. Overall, consumers placed the least relative importance on the attribute, color. Therefore, it was not as important to the consumers as compared to the other attributes. Imports were negative, indicating that consumers preferred domestic over imports. Consumers did not value imports as indicated by the large negative willingness to pay of \$1.70 per pound.

#### 4.3 Results from Random Parameters Logit Model for Goat Meat Consumers

The results from the random parameters logit model are presented in Tables 7 and 8. The following model was estimated:

$$U_{njt} = \beta_0 + \beta_1 + \beta_2 \text{Price}_{njt} + \beta_3 \text{Whole}_{njt} + \beta_4 \text{Half}_{njt} + \beta_5 \text{Chops}_{njt} + \beta_6 \text{Light}_{njt} + \beta_7 \text{Dark}_{njt} + \beta_8 \text{Frozen}_{njt} + \beta_9 \text{Import}_{njt} + \sum_{k=10}^K \beta_k X_{njk} + \varepsilon_{njt},$$

where  $n = 1, \dots, N$  is the number of respondents;  $j$  = number of alternatives in the choice set  $J$ ;  $t$  = number of choice occasions; and  $X_{njk}$  is a set of  $k$ th interaction terms between individual consumers' characteristics and attributes (Gracia et al., 2009). There is no standard criterion for choosing the distribution; all of the distributions have desirable properties (Hensher et al., 2005). For the random parameters logit models, all of the variables except price were assumed to be normally distributed. A normally distributed price could lead to a positive coefficient due to heterogeneous preferences. Therefore, price was fixed to allow for easy derivation for the distribution of the willingness to pay (Revelt and Train, 1998). The normally distributed variables have a mean coefficient and a standard deviation. A statistically significant standard deviation indicates heterogeneous preferences in the sample population for the given attribute.

In Table 8, the random parameters logit model for the goat meat consumers was estimated using 2000 Halton draws. The model is statistically significant as indicated by the likelihood ratio test rejecting the null hypothesis that all the coefficients are equal to zero. For the goat meat model, the chi-squared statistic of 723 is greater than the critical value of  $\chi^2$  with 7

degrees of freedom. The pseudo  $R^2$  is 0.31 which would translate into a  $R^2$  of 0.6 which is a decent fit model (Hensher et al. 2005). The likelihood ratio test (722) calculated between the conditional logit and random parameters logit models is greater than the critical chi-squared value of 14.07 with seven degrees of freedom therefore; the conditional logit model is rejected in favor of the random parameters logit model, indicating that the random parameters logit model fits the data better. The pseudo  $R^2$  in the random parameters logit model is 0.31 which is greater than the CL model's 0.28, suggesting that the RPL model does a better job of explaining consumer choice.

Price is statistically significant at 0.01 critical level and as expected has a negative sign indicating that consumer's utility decreased as price increased. As expected, both alternative-specific constants are positive and statistically significant, indicating that consumers receive greater utility for Choice A or Choice B than the no purchase option. The estimated standard deviations from the random parameters logit model are all statistically significant except for light pink. This indicates that heterogeneity exists among the sample population for all the attributes; however, the parameters do not vary in the sample population for the attribute, light pink. The estimated coefficients are the mean for the sample population. The estimated coefficient for whole carcasses is statistically significant and negative indicating that on average consumers has a disutility for whole goat carcasses. The estimated coefficient for half carcasses is statistically significant and also has a negative effect on utility. The estimated coefficient for chops is statistically significant and has a positive sign indicating that on average consumers preferred chops. The estimated coefficient for cubes is statistically significant and has a positive effect on consumers' utility. Overall, the results suggest that chops and cubes are preferred over carcasses; however, heterogeneous preferences exist in the sample population.

The attribute, color, is statistically insignificant in the random parameters logit model. This would suggest that color is not as important to goat meat consumers as hypothesized. Also, it could be an indication about the lack of knowledge goat meat consumers have about goat meat color. The color can be an indication of the goat's age or sex, which might be unknown to novice goat meat consumers. The estimated coefficient for frozen domestic is statistically insignificant and negative. The estimated coefficient for imports is statistically significant and carries a negative coefficient indicating a decrease in consumers' utility for imported goat meat. The estimated coefficient for fresh domestic is positive and statistically significant indicating that consumers preferred fresh goat meat, domestically produced versus imports.

The coefficients are assumed to be normally distributed, which implies some individuals will have a negative coefficient and others will have a positive coefficient. The RPL model implies that approximately nine percent of the population had a positive coefficient for whole carcasses and three percent of the population had a positive coefficient for half carcasses (Revelt and Train, 1998). For imports, the RPL model implies that approximately 29 percent of the population has a positive coefficient. As Revelt and Train (1998) explained, these percentages could be a reality or could be an artifact of the assumption of normally distributed coefficients. The random parameters logit model identifies heterogeneous preference. To understand the source of different taste preferences, interactions were included in the model to see how socioeconomic, demographic, geographic and consumption frequency influence preferences. Several interactions were tested with select demographic, socioeconomic, and geographic variables. The statistically significant interactions were included in the final model, which was estimated using 2000 Halton draws. The results are shown in Table 8. The model is statistically significant with a chi-squared statistic of -8546.2074, which is greater than the critical value of

$\chi^2$  (0.05). A likelihood ratio test rejects the RPL model relative to the RPL model with interactions, indicating that the inclusion of interactions provides a better fit for the data. In addition, the RPL model with interactions has a higher overall fit with a pseudo  $R^2$  of 0.3176 versus the RPL's pseudo  $R^2$  of 0.3081.

As expected, the alternative-specific constants are positive and statistically significant, indicating that respondents received greater utility from Choice A or B than the no purchase option. The coefficient for price is negative as expected, and statistically significant indicating that respondent utility decreased as price increased. The estimated coefficients for chops and cubes are both positive and statistically significant. The estimated coefficients for whole and half carcasses are both negative and statistically significant. As found in the CL model and RPL model, chops and cubes are preferred over whole and half carcasses. However, in the RPL with interactions, cubes are preferred to chops. The estimated coefficients for both light pink and medium red were small and statistically significant at the 0.05 critical level. The estimated coefficient for medium red is negative. The estimated coefficient for light pink is positive; indicating that on average consumers prefer goat meat that is lighter in color. These results suggest that lighter colored goat meat is preferred over darker colored goat meat. The estimated coefficient for fresh domestic is statistically significant and positive; indicating that, on average consumers prefer goat meat from the U.S. The estimated coefficient for imports is statistically significant and negative. The estimated coefficient for frozen domestic is statistically insignificant. The results suggest that domestic is preferred over imports.

Table 7. Estimates from Random Parameters Logit Model for Goat Meat Consumers

Coefficient	Estimates	Standard Errors
Choice A	1.3532*** <sup>a</sup>	0.1137
Choice B	1.3540***	0.0950
Price	-0.1677***	0.0182
<u>Cuts</u>		
Whole carcass: Mean	-1.5686***	0.0599
Standard deviation	1.1640***	0.0610
Half carcass: Mean	-1.3814***	0.0524
Standard deviation	0.7331***	0.0645
Chops: Mean	1.5006***	0.0418
Standard deviation	0.4947***	0.0667
Cubes: Mean	1.4494*** <sup>b</sup>	0.0527
Standard deviation	N/A	N/A
<u>Color of Meat</u>		
Light pink: Mean	0.0368	0.0297
Standard deviation	0.0040	0.0559
Dark red: Mean	-0.0014	0.0329
Standard deviation	0.2622***	0.0718
Medium Red: Mean	-0.0354	0.0327
Standard deviation	N/A	N/A
<u>Source</u>		
Frozen domestic: Mean	0.0433	0.0315
Standard deviation	0.3731***	0.0663
Import: Mean	-0.3079***	0.0305
Standard Deviation	0.5649***	0.0425
Fresh Domestic : Mean	0.2646***	0.0327
Standard deviation	N/A	N/A
Pseudo R <sup>2</sup>	0.3081	
Log Likelihood	-8665.10	
$\chi^2$	723.05	

Notes: These respondents indicated that they purchase cuts of goat meat. Number of respondents: N=1900. Number of Observations = 34,200 (1900 respondents x 6 questions x 3 choices)

<sup>a</sup>One asterisk indicates statistical significance at the 0.10 level; Two asterisks indicates statistical significance at the 0.05 level; Three asterisks indicates statistical significance at the 0.01 level

<sup>b</sup>Standard errors for "omitted" variables in the effects coding were calculated using the Delta method.

Consumers showed heterogeneous preferences for all the attributes except for the attribute, light pink, indicating consumers' preferences for light colored goat meat did not vary in the population. To understand the source of the heterogeneous preferences, select interactions were included in the model. Age, gender, race, children in the home, region, and consumption frequency were all found to have some level of significance with the attributes. The interaction between age and type of cut revealed that older consumers have a positive utility for chops and a negative utility for whole carcasses. However, both coefficients are rather small. Older consumers' preferences for smaller cuts could be due to the extra labor involved in preparing carcasses for storage which may be an inconvenience. Male is a dummy variable with 1 indicating male and 0, otherwise. The interaction between male and whole carcass is positive and statistically significant, indicating that males prefer whole carcasses. The interaction between male and frozen domestic is positive and statistically significant, indicating that males prefer frozen goat meat from the U.S. Those with children in their households have a positive utility for half carcass, possibly due to having more family members to feed. The interaction between children in the household and chops is negative and statistically significant, indicating that those with children do not prefer chops. This is an interesting finding, assuming that those with children would want pre-cut meat for convenience. The interaction between non-Caucasians and half carcasses is statistically significant and positive. The interaction between non-Caucasians and chops is negative. This indicates that non-Caucasians including Africans, Hispanics, and Asians prefer carcasses possibly due to the lack of availability of retail cuts. The interaction between non-Caucasians and light pink is negative. However, both the RPL and the RPL model with interactions indicate homogenous preferences for the attribute, light pink. The interaction

between non-Caucasians and imports is statistically significant and positive, indicating a preference for imports.

Regional dummy variables were created from the question, ‘In which state of the U.S. do you live?’ The states were divided into regions based on the U.S. Census Bureau. There were four regions including the Northeast, Midwest, South, and West. All of the regional dummies were interacted with the attributes with the Midwest as the reference level. The only statistically significant interaction was the regional dummy variable, West, and whole carcass. The estimated coefficient is positive, indicating that those who live on the west coast have a greater utility for whole carcasses. This could be due to a large Hispanic population located on the west coast, which prefer carcasses for barbecuing.

The dummy variable indicating consumption frequency was created from the question, ‘How often do you eat goat meat?’ The population was divided into heavy, medium, and light consumers based on their responses. For heavy consumers, 1 indicated that they ate goat meat about once a month or more than once a month; 0 otherwise. For medium consumers, 1 indicated that they ate goat meat at least 3 to 11 times per year; 0 otherwise. For light consumers; 1 indicated that they ate goat meat less than once a year or 1 to 2 times per year; 0 otherwise. The consumption dummy variable was interacted with the attributes and several statistically significant interactions were revealed.

Light consumers are the reference level. The interaction between medium consumers and half carcass is statistically significant and positive. The interaction between medium consumers and chops is statistically significant and negative. The interactions between heavy consumers and whole and half carcasses is statistically significant and positive. The interaction between heavy consumers and chops is statistically significant and negative. These results revealed that those



who consume goat meat more than twice a year preferred carcasses over retail cuts. A lack of availability or traveling long distances to purchase goat meat may prompt frequent goat consumers to purchase in bulk.

The marginal willingness to pay for both the random parameters logit model with and without interaction is shown in Table 9. In the random parameters logit model without interactions, consumers' willingness to pay for whole and half carcass is negative. Consumers are willing to pay \$8.95 per pound for chops and \$8.64 per pound for cubes, indicating that they value retail cuts more than carcasses. Consumers value lighter colored meat more than darker colored meat but are not willing to pay that much more for it. The willingness to pay for light pink or medium red goat meat is \$0.22 and \$0.21 per pound, respectively. Dark red goat meat has a negative marginal willingness to pay of \$0.01, indicating that consumers do not value darker colored goat meat. The willingness to pay for color is small, indicating that consumers do not value the color attribute as much as the other attributes. Consumers valued domestic goat meat more than imports. The willingness to pay for fresh domestic meat is \$1.58 per pound. The willingness to pay for imported goat meat is \$1.84 per pound and negative. The marginal willingness to pay for frozen domestic goat meat is \$0.26 per pound; however, it is statistically insignificant.

In the random parameters logit model with interactions, the marginal willingness to pay for whole and half carcasses is negative at \$9.01 and \$9.87 per pound, respectively. Consumers are willing to pay \$8.40 per pound for chops and \$10.48 per pound for cubes. Both the RPL model and RPL model with interactions indicates a strong preference for retail cuts versus carcasses. However, the RPL model with interactions shows that consumers value cubes more than chops and are willing to pay almost 25 percent more for cubes. The willingness to pay for

light pink goat meat is \$0.52 per pound. The willingness to pay for medium and dark red goat meat is negative indicating that consumers valued lighter colored goat meat more than darker colored goat meat. Consumers valued domestic over imported goat meat. Consumers are willing to pay \$2.40 per pound for fresh domestic goat meat. Imported goat meat has a negative willingness to pay of \$2.14 per pound, indicating that consumers' non preference for imports. The willingness to pay for frozen domestic goat meat is negative but statistically insignificant.

The results from the models reveal similar findings; however, the RPL model with interactions was a better fit for the data. Consumers preferred chops and cubes over carcasses. In the RPL with interactions, cubes were preferred over chops, a different result from the RPL without interactions. This could be because of the inclusion of interactions. Both models revealed heterogeneous preferences for all of the attributes except for light pink. Interactions between socioeconomic, demographic, geographic, and consumption frequency revealed some possible sources for the heterogeneity. Interesting findings were that non-Caucasians preferred whole and half carcasses. Non-Caucasian preferences for carcasses might have to do with religious holiday and other ceremonies. With large gatherings the purchase of carcasses would feed more people and be less costly versus buying individual cuts. Also a lack of availability might influence the purchasing of carcasses. In other countries, goat meat is readily available and frequently consumed however; in the United States goat meat is not as popular or as widely available. Therefore, those who eat goat meat frequently would purchase carcasses due to lack of availability and store it. Also the preference for carcasses could be due to the lack of availability for retail cuts such as chops and cubes.

Table 8. Estimates from Random Parameters Logit Model with Interactions for Goat Meat Consumers

Coefficient	Estimates	Standard Errors
Choice A	1.3794*** <sup>a</sup>	0.1125
Choice B	1.3708***	0.0937
Price	-0.1707***	0.0179
<u>Cuts</u>		
Whole carcass: Mean	-1.5379***	0.1374
Standard deviation	1.0999***	0.0590
Half carcass: Mean	-1.6853***	0.0715
Standard deviation	0.7118***	0.0626
Chops: Mean	1.4344***	0.1073
Standard deviation	0.4311***	0.0706
Cubes: Mean	1.7889*** <sup>b</sup>	0.1437
Standard deviation	N/A	N/A
<u>Color of Meat</u>		
Light pink: Mean	0.0885***	0.0342
Standard deviation	0.0060	0.0545
Dark red: Mean	-0.0077	0.0324
Standard deviation	0.2610***	0.0701
Medium Red: Mean	-0.0808**	0.0367
Standard deviation	N/A	N/A
<u>Source</u>		
Frozen domestic: Mean	-0.0446	0.0446
Standard deviation	0.2312**	0.0989
Import: Mean	-0.3659***	0.0353
Standard Deviation	0.5343***	0.0422
Fresh Domestic: Mean	0.4105***	0.0490
Standard deviation	N/A	N/A
Age*Whole carcass	-0.0071***	0.0027
Age*Chops	0.0096***	0.0020
Male*Whole	0.2095***	0.0803
Male*Fresh domestic	0.1440***	0.0532
Child*Half carcass	0.1950**	0.0818
Child*Chops	-0.1523**	0.0697
Nonwhite*Half carcass	0.1631**	0.0809
Nonwhite*Chops	-0.2311***	0.0687
Nonwhite*Light Pink	-0.1398***	0.0474
Nonwhite*Import	0.1454***	0.0530
West*Whole carcass	0.3365***	0.0871
Medium*Half carcass	0.4948***	0.0886
Medium*Chops	-0.4389***	0.0756
Heavy*Whole carcass	0.6705***	0.1338
Heavy*Half carcass	0.5631***	0.1244
Heavy*Chops	-0.8431***	0.1066
Pseudo R <sup>2</sup>	0.3176	
Log Likelihood	-8546.2074	
$\chi^2$	643.85	

Notes: Number of respondents: N=1900. Number of Observations = 34,200 (1900 respondents x 6 questions x 3 choices)

<sup>a</sup>One asterisk indicates statistical significance at the 0.10 level; Two asterisks indicate statistical significance at the 0.05 level; Three asterisks indicate statistical significance at the 0.01 level.

<sup>b</sup>Standard errors for "omitted" variables in the effects coding were calculated using the Delta method.

Table 9. Marginal Willingness to Pay for Goat Meat Attributes from Random Parameters Logit Models

Attribute Level	RPL Model	RPL Model Interactions
<u>Cuts</u>		
Whole carcass	-9.35 [-11.41 to -7.30]	-9.01 [-11.42 to -6.60]
Half carcass	-8.23 [-10.08 to -6.40]	-9.87 [-12.04 to -7.70]
Chops	8.95 [6.99 to 10.90]	8.40 [6.27 to 10.53]
Cubes	8.64 [6.81 to 10.48]	10.48 [8.32 to 12.64]
<u>Color of Meat</u>		
Light	0.22 [-0.13 to 0.57]	0.52 [0.11 to 0.93]
Medium	0.21 [0.17 to 0.26]	-0.47 [-0.57 to -0.38]
Dark	-0.01 [-0.39 to 0.38]	-0.04 [-0.42 to 0.33]
<u>Source</u>		
Frozen domestic	0.26 [-0.12 to 0.64]	-0.26 [-0.77 to 0.25]
Fresh domestic	1.58 [1.24 to 1.91]	2.40 [1.91 to 2.90]
Import	-1.83 [-2.34 to -1.33]	-2.14 [-2.72 to -1.56]

Note: The 95% confidence intervals were estimated using the Delta method.

Cooking method may also play a part in non-Caucasians' preferences for carcasses. Carcasses are better for roasting and barbecuing (APHIS 2004) which is the preferred method of cooking for Hispanics and other ethnic groups, particularly during large gatherings (Geisler, 2009). Frequency of consumption indicated that consumers who eat goat meat more than twice a year were more likely to prefer carcasses versus retail cuts. Because of high consumption frequency, it is probably more economical to purchase carcasses which are relatively cheaper per

pound versus chops or cubes. However, the willingness to pay indicated that consumers were willing to pay a premium of \$8.95/lb. from the RPL model and \$8.40/lb. from the RPL with interactions for chops indicating that there is a demand for retail cuts.

As previously mentioned, ethnic groups are thought to be the largest group of goat meat consumers, and Hispanics are one of the fastest growing ethnic populations that consume goat meat. The U.S. Census Bureau (2012) projects that the Hispanic population will more than double, from 53.3 million in 2012 to 128.8 million in 2060. Therefore, it is important to understand Hispanic preferences for goat meat. The random parameters logit model was estimated with interactions between the attributes and a dummy variable representing the ethnic group, Hispanic. The dummy variable, Hispanic, is 1 if the respondent specified their ethnicity as Hispanic, and 0, otherwise. The results are shown in Table 10. The model is statistically significant as indicated by the likelihood ratio test rejecting the null hypothesis that all the coefficients are equal to zero. Price is statistically significant at 0.01 critical level and as expected has a negative sign indicating that consumer's utility decreased as price increased. As expected, both alternative-specific constants are positive and statistically significant, indicating that consumers receive greater utility for Choice A or Choice B than the no purchase option.

The estimated coefficients for whole carcasses and half carcasses are statistically significant and negative indicating that on average consumers has a disutility for carcasses. The estimated coefficients for chops and cubes are statistically significant and has a positive sign indicating that on average consumers preferred retail cuts over carcasses. But consumers preferred chops more than cubes as indicated by the estimated coefficients. The attribute, color, is not statistically significant indicating that it is not as important to consumers' choice for goat meat as hypothesized. The estimated coefficient for imports is statistically significant and

negative indicating that consumers do not have a preference for imported goat meat. The estimated coefficient for fresh domestic is statistically significant and positive indicating consumers have a preference for domestic goat meat. Overall, consumers prefer domestic over import.

The estimated standard deviations from the random parameters logit model are all statistically significant except for light pink. This indicates that heterogeneity exists among the sample population for all the attributes; however, the parameters do not vary in the sample population for the attribute, light pink. Therefore, to understand the possible source of this heterogeneity, interactions between the attributes and the dummy variable, Hispanic, is included in the model. The interactions between Hispanic and whole carcass, and Hispanic and half carcass, are both statistically significant and positive indicating Hispanics' preferences for carcasses. The interaction between Hispanic and chops are statistically significant and negative indicating that Hispanics do not prefer chops. Overall, the results indicate that Hispanics preferred carcasses over retail cuts. Hispanics prepare goat meat for barbecuing, and carcasses are better for this cooking method. Also, Hispanics consume goat meat during the holidays such as Cinco de Mayo and other group gatherings which require large quantities of meat.

The interactions between Hispanics and the attribute, color, are statistically insignificant indicating that color is not important to Hispanics' choice for goat meat. The interaction between Hispanics and frozen domestic is statistically insignificant. The interaction between Hispanics and imports is statistically significant and positive indicating that Hispanics prefer imported goat meat. Hispanics preference for imports could be due to greater availability and lower price versus domestic goat meat.

The results from the RPL model with Hispanic interactions show that Hispanics prefer carcasses and imported goat meat. Hispanics prefer to barbecue or roast meat which may contribute to their preference for carcasses, in most part because these cuts are considered ideal for the preferred cooking methods. Hispanics make up a large portion of the goat-consuming population. And the Hispanic population in the United States is growing rapidly and they spend a large portion of their disposable income on food; therefore, it is important for the meat goat industry to address the Hispanic market. Hispanics indicated a preference for imported goat meat possibly due to lack of availability of domestic goat meat. There needs to be a concerted effort from the industry to increase the supply of domestic goat meat.

The results from the RPL model with Hispanic interactions are relative to other ethnicities. There was some concern over this model due to the question asked in the survey. Respondents were asked to indicate their ethnicity and were given several choices including a 'none' option. Nearly 47 percent of the respondents chose the 'none' option for the question regarding ethnicity. There are several possible interpretations of this response including those of Caucasian race might not consider themselves a part of an ethnic group. One possible way to check this hypothesis is to determine of those who indicated the race, Caucasian, how many considered themselves of Hispanic ethnicity. In addition, some respondents may have preferred not to indicate their ethnicity. However, the results from the model support other studies on ethnic preferences (Gipson, 2000; Sande et al., 2005; Geisler, 2013). Additional interactions may be included in the model to test the preferences of other ethnic groups.

Table 10. Estimates from Random Parameters Logit Model with Hispanic Interactions for Goat Meat Consumers

Coefficient	Estimates	Standard Errors
Choice A	1.3231*** <sup>a</sup>	0.1098
Choice B	1.3227***	0.0913
Price	-0.1594***	0.0175
<u>Cuts</u>		
Whole carcass: Mean	-1.5615***	0.0595
Standard deviation	1.1265***	0.0582
Half carcass: Mean	-1.3681***	0.0507
Standard deviation	0.6261***	0.0630
Chops: Mean	1.4932***	0.0405
Standard deviation	0.3887***	0.0704
Cubes: Mean	1.4364*** <sup>b</sup>	0.0508
Standard deviation	N/A	N/A
<u>Color of Meat</u>		
Light pink: Mean	0.0262	0.0316
Standard deviation	0.0246	0.0492
Dark red: Mean	-0.0006	0.0336
Standard deviation	0.1521*	0.0821
Medium Red: Mean	-0.0256	0.0333
Standard deviation	N/A	N/A
<u>Source</u>		
Frozen domestic: Mean	0.0481	0.0325
Standard deviation	0.2975***	0.0831
Import: Mean	-0.3280***	0.0315
Standard Deviation	0.5156***	0.0455
Fresh Domestic: Mean	0.2799***	0.0332
Standard deviation	N/A	N/A
Hispanic*Whole carcass	0.3793***	0.1164
Hispanic*Half carcass	0.4334***	0.0981
Hispanic*Chops	-0.3614***	0.0855
Hispanic*Light pink	0.0057	0.0718
Hispanic*Dark red	0.0105	0.0710
Hispanic*Frozen domestic	-0.0361	0.0748
Hispanic*Import	0.1453**	0.0722
Pseudo R <sup>2</sup>	0.3079	
Log Likelihood	-8667.2913	
$\chi^2$	649.93	

Notes: Number of respondents: N=1900. Number of Observations = 34,200 (1900 respondents x 6 questions x 3 choices)

<sup>a</sup>One asterisk indicates statistical significance at the 0.10 level; Two asterisks indicate statistical significance at the 0.05 level;

Three asterisks indicate statistical significance at the 0.01 level.

<sup>b</sup>Standard errors for "omitted" variables in the effects coding were calculated using the Delta method.



#### 4.4 Results from Latent Class Logit Model for Goat Meat Consumers

The latent class model was estimated using the Pacifico and il Yoo (2012) Stata module for the EM algorithm. As previously stated, the number of classes is unknown to the researcher; therefore, multiple numbers of classes are estimated. The standard criteria for choosing the number of latent classes is the Bayesian Information Criterion (BIC), Akaike Information Criterion (AIC), and the consistent Akaike Information Criterion (CAIC) (Pouta et al., 2010; Hynes et al., 2008; Ouma et al., 2007; and Birol et al., 2006). The AIC equals  $-2 \ln L + 2m$ , where  $L$  is the maximized sample log likelihood and  $m$  is the total number of estimated model parameters (Pacifico and il Yoo, 2012). Both the BIC and CAIC penalize models with extra parameters more, by using penalty functions increasing in the number of choice makers,  $N$ :  $BIC = -2 \ln L + m \ln N$  and  $CAIC = -2 \ln L + m(1 + \ln N)$  (Pacifico and il Yoo, 2012). Whichever model minimizes the values for these criteria is considered the optimal number of classes. However, the researcher must consider the statistical significance and interpretation of the parameters as well in choosing the optimal number of classes. The criteria for choosing the optimal number of classes in this study are presented in Table 11. The results show that the addition of multiple classes in the sample is supported by the subsequent improvement in the log likelihood. As seen in Table 11, moving from two classes to six classes, it can be seen that the addition to each class decreases the values for both the BIC and CAIC until seven classes where the values start to increase. Based on this information, it can be concluded that the optimal number of classes is less than seven. Considering the BIC and CAIC values, the model with six classes was chosen as the optimal number of classes since this is where the criteria were minimized.

Table 11. Criteria for Choosing Optimal Number of Latent Classes

No. of Classes	Log Likelihood	No. of Parameters	CAIC	BIC
2	-7776.01	31	15817.06	15786.06
3	-6892.56	52	14229.69	14177.69
4	-6779.45	73	14183.02	14110.02
5	-6682.74	94	14169.15	14075.15
6	-6520.24	115	14023.66	13908.66
7	-6451.28	136	14065.31	13929.31
8	-6429.80	157	14201.89	14044.89
9	-6415.57	178	14352.97	14174.97

The latent class logit model assumes that the respondents' characteristics indirectly affect class membership (Birol et al., 2006). Therefore, many demographic, socioeconomic, and geographic variables were tested and it was found that many of the same variables statistically significant in the latent class logit model were also statistically significant in the RPL model with interactions (Birol et al, 2006). The results from the six-class latent class logit model are presented in Table 12. As previously described, the membership coefficients for the sixth segment are normalized to zero in order to identify the remaining coefficients which are interpreted relative to this class. To see how well the model does in predicting heterogeneous classes, the highest posterior probability of class membership is obtained. The mean highest posterior probability was about 0.88, meaning the model does fairly well in distinguishing among different underlying taste patterns for the observed choice behavior (Pacifico and il Yoo, 2012). The pseudo  $R^2$  for the latent class logit model is 0.4794, an indicator that the model does well in fitting the data. This pseudo  $R^2$  for the latent class logit model is larger than both the RPL model and RPL model with interactions, indicating that the latent model is a better fit for the data.

In Class 1, the alternative specific constants, price, type of cuts, and imports are all statistically significant. Class 1 prefers chops over carcasses. However, they have a relatively strong dislike for carcasses and a relatively weak preference for chops. Class 1 does not value

imports as indicated by the negative coefficient. The attribute, color, is relatively unimportant in Class 1. The class membership for goat meat consumers indicate that the probability of being in a class is strongly related to frequency of goat meat consumption as determined by the magnitude and statistical significance of the coefficients. The membership coefficients indicate that being an older female not from the West and consuming goat meat less than twice a year increases the probability that a respondent belongs in Class 1.

Class 2 has a relatively strong preference for chops and a relatively strong dislike for carcasses. Class 2 do not value imported goat meat. Price is positive for Class 2; however, it was statistically insignificant. The membership coefficients in Class 2 indicate that the probability of being in this class is increased by being an older female, not from the West and being a seldom goat meat eater. Also, having children decrease the probability of being in Class 2. The membership coefficients in Class 2 indicate similar characteristics as Class 1 but the marked difference is that Class 2 exhibits a relatively stronger preference for chops.

In Class 3, all of the estimated coefficients are statistically significant. Class 3 exhibits a preference for chops. Class 3 shows preference for goat meat that is light pink compared to the other classes which color is relatively unimportant except for Class 6. Goat meat that is dark red is not preferred in Class 3. Class 3 shows a relatively weak preference for frozen domestic goat meat and no preference for imports. The statistically significant membership coefficients for Class 3 are degree, child, consumption frequency and region. This indicates that individuals, who are heavy goat meat consumers, do not live in the Northeast and have no children and no college degree increases the probability of belonging to Class 3.

Class 4 shows a relatively strong preference for chops. Class 4 has no preference for either whole or half carcasses, but a stronger dislike for half carcasses. The membership

coefficients indicate that older Caucasian women who are not medium or heavy goat meat consumers increased the probability of being in Class 4.

Price is the only statistically significant coefficient in Class 5, with the other attributes being relatively unimportant. The class membership coefficients indicate that being an older white female, consuming goat meat less than twice a year, having no college degree, and having no children decrease the probability of being in Class 5.

Compared to the other classes, Class 6 shows the most discernible differences in goat meat preferences. Class 6 prefers whole and half carcasses, and does not prefer chops. Class 6 prefers goat meat that is dark red, and does not prefer goat meat that was light pink. Compared to the other classes, the members in Class 6 are most likely non-white male and heavy to medium goat meat consumers with children in the household.

The latent class logit model supports the existence of heterogeneous preferences among the sample as indicated by the differing statistical significance and magnitudes of the estimated coefficients in the classes. However, the demographic, geographic and consumption variables did not seem to provide much distinction among the classes with the exception of consumption frequency, which varied in magnitude and statistical significance. Most of the classes showed a preference for chops, but they differed in magnitudes. Class 2 showed a strong preference for chops but most interestingly they showed the strongest dislike for carcasses. This class also made up the largest proportion of the sample with 39 percent of the consumers. Class 6 was the only class to show preference for carcasses. Aside from Class 3's preference for light pink goat meat and Class 6's preference for dark red goat meat, color was relatively unimportant.

Table 12. Estimates from Latent Class Logit Model for Goat Meat Consumers

	Latent Class Logit with six classes					
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
Choice A	2.0996*** <sup>a</sup> (0.4740)	-1.5572 (2.5124)	5.9313*** (0.7727)	0.5652 (0.8141)	-2.2130 (1.5645)	3.9982*** (0.4840)
Choice B	1.6741*** (0.4097)	-0.3214 (1.7366)	5.7774*** (0.7721)	0.6013 (0.9095)	-2.4753* (1.4127)	3.7475*** (0.4593)
Price	-0.5117*** (0.0957)	0.5053 (0.4949)	-0.2141*** (0.0368)	-0.4003*** (0.1321)	-0.4322* (0.2566)	-0.1557*** (0.0451)
Whole Carcass	-1.4817*** (0.2847)	-5.3660*** (0.8704)	-1.0477*** (0.1334)	-1.8143*** (0.4740)	-1.7488 (1.1453)	0.4814*** (0.1665)
Half Carcass	-1.0972*** (0.2800)	-4.4700*** (0.9297)	-0.9980*** (0.1129)	-3.4178*** (0.8463)	0.1491 (1.1492)	0.3846*** (0.1272)
Chops	0.8746*** (0.2238)	5.3439*** (0.8589)	1.1431*** (0.1574)	4.5449*** (0.5368)	0.7710 (0.5690)	-0.7229*** (0.1859)
Light Pink	-0.0251 (0.1208)	0.2670 (0.4680)	0.2069*** (0.0658)	-0.0787 (0.3749)	-0.6154 (0.6142)	-0.2996*** (0.0825)
Dark Red	-0.2504 (0.1636)	-0.4118 (0.4644)	-0.2203*** (0.6284)	0.0745 (0.2486)	0.0920 (0.8885)	0.1881** (0.0792)
Frozen Domestic	0.0292 (0.1057)	-0.3452 (0.6606)	0.0887* (0.0501)	0.3488 (0.3577)	-1.1502 (0.8812)	-0.0622 (0.0690)
Imports	-0.5015*** (0.1341)	-0.4361*** (0.0677)	-0.3056*** (0.441)	-0.0885 (0.2597)	0.3450 (0.6013)	-0.3548*** (0.0684)
Class Membership Coefficients						
Constant	0.6183 (0.7005)	2.0284*** (0.5835)	2.1907*** (0.6521)	-0.9450 (0.7577)	-0.1526 (0.7083)	-
Age	0.0285*** (0.0098)	0.0238*** (0.0080)	-0.0028 (0.0094)	0.0511*** (0.0109)	0.0427*** (0.0106)	-
Male	-0.7624*** (0.2874)	-0.6216*** (0.2206)	-0.0203 (0.2501)	-0.6893** (0.3003)	-1.1088*** (0.3013)	-
Degree	-0.3062 (0.2731)	-0.1628 (0.2145)	-0.4526** (0.2333)	-0.1510 (0.3096)	-0.5125* (0.2906)	-
Child	-0.2764 (0.2787)	-0.5376*** (0.2079)	-0.4785** (0.2304)	-0.4088 (0.3236)	-0.5173* (0.3118)	-
Non-white	-0.0682 (0.2794)	-0.2807 (0.2133)	-0.2898 (0.2391)	-0.6775** (0.3389)	-0.5923* (0.3233)	-
Midwest	0.2785 (0.3950)	0.1675 (0.3255)	0.0111 (0.3681)	0.1247 (0.4379)	0.3605 (0.4570)	-
Northeast	-0.2456 (0.3604)	-0.3260 (0.2854)	-0.6751** (0.3243)	-0.3751 (0.4162)	-0.3800 (0.4082)	-
West	-0.9669*** (0.3693)	-0.4965* (0.2623)	-0.3934 (0.2848)	-0.2539 (0.3628)	-0.1789 (0.3639)	-
Medium Consumers	-1.3086*** (0.3120)	-1.2274*** (0.2281)	-0.4003 (0.2688)	-1.4727*** (0.3497)	-2.0618*** (0.4004)	-
Heavy Consumers	-2.1586*** (0.4474)	-1.8542*** (0.2786)	-0.6863** (0.2900)	-2.6134*** (0.6647)	-3.0500*** (0.7620)	-
Class share	0.108	0.394	0.265	0.065	0.058	0.110
Pseudo R <sup>2</sup>	0.4794					
Log likelihood	-6520.226					

Note: Standard errors are in parentheses. <sup>a</sup>One asterisk indicates statistical significance at the 0.10 level; Two asterisks indicates statistical significance at the 0.05 level; Three asterisks indicates statistical significance at the 0.01 level.

#### 4.5 Results from Conditional Logit Model for Live Goats

The following conditional logit model was estimated for live goat buyers

$$U_{ij} = \beta_0 + \beta_1 + \beta_2 X_1 + \beta_3 X_2 + \beta_4 X_3 + \beta_5 X_4 + \beta_6 X_5 + \beta_7 X_6 + \beta_8 X_7 + \varepsilon_{ij},$$

where  $i = 1, \dots, N$  is the number of respondents, and  $j$  is the number of alternatives in choice set  $J$ . The dependent variable is the actual choice that respondents made for each choice set evaluated. The alternative-specific constants,  $\beta_0$  and  $\beta_1$ , are dummy variables indicating either Choice A or Choice B with respect to the no purchase option. Price was \$75 per head, \$130 per head, or \$195 per head. The levels for the attributes, sex, age, and slaughtered method are effects coded. As stated before, in contrast to dummy coding which uses 1 to represent the level appearance and 0, otherwise; effects coding uses -1, 0, and 1. The reference level is coded -1 1 represents the level appearance, and 0, otherwise. In effects coding, the effects are uncorrelated with the intercept (Bech and Gyrd-Hansen 2005); therefore the reference level can be calculated by taking the negative sum of the estimated coefficients. The variables  $X_2$  and  $X_3$  define the levels for the attribute, sex; where  $X_2 = 1$  and  $X_3 = 0$  represents a castrated male goat,  $X_2 = 0$  and  $X_3 = 1$  represents a female goat, and  $X_2 = -1$  and  $X_3 = -1$  represents an intact male goat. The variables  $X_5$  and  $X_6$  define the levels for the attribute, age; where  $X_4 = 1$  and  $X_5 = 0$  represents a one year old goat,  $X_4 = 0$  and  $X_5 = 1$  represents a two year old goat, and  $X_4 = -1$ ,  $X_5 = -1$  represents a goat less than one year old. The variables  $X_6$  and  $X_7$  define the levels for the attribute, slaughtered; where  $X_6 = 1$  and  $X_7 = 0$  represents a purchased goat slaughtered by the buyer,  $X_6 = 0$  and  $X_7 = 1$  represents a purchased goat slaughtered at a commercial plant, and  $X_6 = -1$  and  $X_7 = -1$  represents a purchased goat slaughtered by the farmer.

The results from the conditional logit model for goat buyers are shown in Table 13. The model is statistically significant at the 0.01 critical level as indicated by the likelihood ratio test, where the chi-squared statistic of 139.95 is greater than the critical value of  $\chi^2$  with 10 degrees of

freedom, rejecting the null hypothesis that all the coefficients are equal to zero. The pseudo  $R^2$  is 0.07, which is low and many of the coefficients in the model are statistically insignificant.

The alternative specific constants are positive and statistically significant, indicating that respondents received greater utility from Choice A or Choice B than the no purchase option. The estimated coefficient for price is small and negative, but statistically significant at the 0.05 level. The estimated coefficients for the attribute, sex, are not statistically significant. This indicates that the sex of the goat is not important in consumer choice as hypothesized. The estimated coefficient for two years of age is statistically significant at the 0.05 critical level and has a negative sign indicating a decrease in consumer utility. The estimated coefficient for a goat less than one year old is statistically significant at the 0.05 critical level and has a positive sign indicating consumer preferences for younger goats. The estimated coefficient for one year old goats is positive, but statistically insignificant. The estimated coefficient for goats slaughtered at a commercial plant is negative and statistically significant indicating that consumers do not prefer commercially-slaughtered goats. The estimated coefficient for goats slaughtered by a farmer is positive and statistically significant, indicating consumers prefer a farm slaughter over a commercial slaughter. The estimated coefficient for goats slaughtered by the purchaser is negative, but statistically insignificant.

The relative importance for each live goat attribute was calculated. To calculate relative importance, the range of each attribute's levels is taken, which is the difference between the highest and lowest estimated coefficients for the attribute, and is divided by the sum of all the ranges across all attributes. Once again following the example from Mayen et al. (2007), the following equation shows the relative importance (R.I.) for the attribute, sex,

$$R.I. = \beta_4 - \beta_3 / [\beta_2 (75) - \beta_2 (195)] + [\beta_4 - \beta_3] + [\beta_6 - \beta_7] + [\beta_{11} - \beta_{10}],$$

where the  $\beta$ 's refer to estimated coefficients for each level and the numbers in the parentheses refer to the lowest price per pound and the highest price per pound for live goats.

Table 13. Estimates from Conditional Logit Model for Live Goats

Coefficient	Estimates	Standard Errors
Choice A	1.0383*** <sup>a</sup>	0.1082
Choice B	0.5493***	0.1309
Price	-0.0015**	0.0007
<u>Sex</u>		
Castrated male	-0.0683	0.0677
Female	0.1156	0.0751
Intact male	-0.0473 <sup>b</sup>	0.0690
<u>Age</u>		
One year	0.0015	0.0645
Two year	-0.1695***	0.0676
Less than one year	0.1680***	0.0678
<u>Slaughter Method</u>		
Buyer	-0.0880	0.0679
Commercial	-0.1313**	0.0647
Farmer	0.2192***	0.0659
Pseudo R <sup>2</sup>	0.0745	
Log Likelihood	-869.34	
$\chi^2$	139.95	

Notes: These respondents indicated that they purchase live goats. Number of respondents: N=285. Number of Observations = 2565 (285 respondents x 3 questions x 3 choices)

<sup>a</sup>One asterisk indicates statistical significance at the 0.10 level; two asterisks indicates statistical significance at the 0.05 level; three asterisks indicates statistical significance at the 0.01 level.

<sup>b</sup>Standard errors for "omitted" variables in the effects coding were calculated using the Delta method.

Measure of the relative importance for the live goat attributes are shown in Figure 6. The most important attribute to consumers is slaughter method, with 33 percent relative importance. The second most important attribute is age, with 32 percent relative importance. The attribute, sex, is the third most important, with 18 percent relative importance. The fourth important attribute is price, with 17 percent relative importance. Based on the relative importance, age and slaughter method are the two most important attributes consumers consider when purchasing live goats.



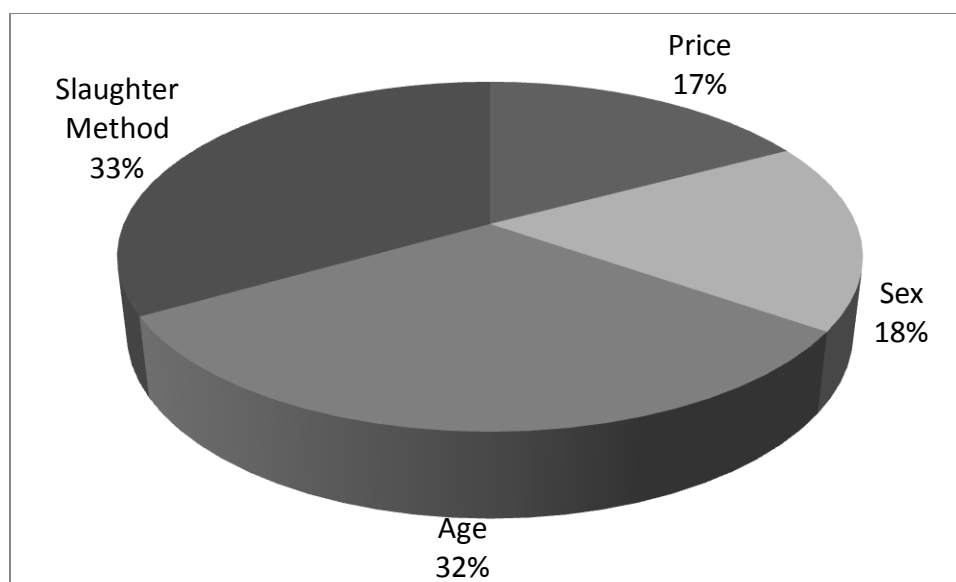


Figure 7. Relative Importance for Live Goat Attributes

The marginal willingness to pay estimates (WTP) for meat goats are shown in Table 14. Overall, the marginal willingness to pay estimates revealed that consumers value younger goats more so than older goats. The marginal WTP for goats that are less than one year old is \$111.38 per head. Two year old goats have a negative marginal WTP of \$112.39 per head. Consumers' marginal WTP for one year old goats is \$1.01 per head, but is statistically insignificant. The WTP estimates revealed that female goats are valued more than male goats. Consumers are willing to pay \$76 per head for a female goat; however, the WTP estimate is statistically insignificant. Both intact male goats and castrated male goats have a negative WTP. However, intact males are valued more than castrated males and the WTP for an intact male is statistically significant. The marginal WTP for a castrated male is statistically insignificant. Consumers preferred having their goats slaughtered by the producer rather than at a commercial plant or having to slaughter the goat. Consumers are willing to pay \$145.37 per head to have a goat slaughtered by the producer. Both commercial and buyer have a negative WTP and are statistically insignificant.

Table 14. Marginal Willingness to Pay for Live Goat Attributes from Conditional Logit Model

Attribute Level	WTP (\$/head)	95% Confidence Interval
<u>Sex of Goat</u>		
Intact Male	-31.39	[-61.56 to -1.23]
Castrated Male	-45.30	[-144.43 to 53.83]
Female	76.69	[-50.11 to 203.49]
<u>Age</u>		
One Year	1.01	[-82.76 to 84.78]
Two Year	-112.39	[-247.13 to 22.35]
Less than one	111.38	[4.35 to 218.41]
<u>Slaughter Method</u>		
Buyer	-58.33	[-170.49 to 53.83]
Commercial Plant	-87.04	[-194.97 to 20.90]
Farmer	145.37	[5.68 to 285.05]

Note: The 95% confidence intervals were estimated using the Delta method.

For those who purchase live goats, the results from the conditional logit model revealed that the sex of the goat was not important in their choice, and that goat consumers valued younger goats and preferred for them to be slaughtered by a farmer versus a commercial plant or having the goat slaughtered by the buyer. Consumer preferences for younger goats may be due to older goats being less tender. Also, younger goats, less than a year old, are leaner and do not have as much fat as older goats, which may be a reason why they are preferred. Consumers preferred for the producer to perform the slaughter, but the producer would have to provide accommodations such as safe and clean facilities and tools required to perform the slaughter, which could require extra costs for the producer. However, the WTP revealed that consumers were willing to pay a premium for on-farm slaughter.

Abattoirs are often located far from the point of production. Many consumers may find that the extra cost of transportation to these slaughter facilities is a hindrance and finding an abattoir that perform religious slaughters, such as Halal and Kosher, would prove to be even more difficult and costly; for this reason they may prefer the farmer to do the slaughter. Goats

are covered under the U.S. Federal Meat Inspection Act of 1906 stating that any goat meat sold for consumption must be from goats slaughtered in a federally or state inspected facility which may cause a problem for many producers that allow on-farm slaughters. However, this varies by state and local regulations. Therefore, producers that are not in line with state and federal inspection guidelines would possibly open up more problematic issues in the future as the market grows. Also the lack of tracking on-farm slaughters prevents accurate accounts of consumption and price data. Therefore, more slaughter facilities closer to point of production and those that allow for Halal and kosher practices would be beneficial to both producers and consumers.

#### **4.6 Results from Random Parameters Logit Model for Live Goats**

The results from the random parameters logit model for live goat buyers are presented in Tables 8. The following model was estimated:

$$U_{njt} = \beta_0 + \beta_1 + \beta_2 \text{Price}_{njt} + \beta_3 \text{Castrated}_{njt} + \beta_4 \text{Female}_{njt} + \beta_5 \text{OneYear}_{njt} + \beta_6 \text{TwoYear}_{njt} + \beta_7 \text{Buyer}_{njt} + \beta_8 \text{Commercial}_{njt} + \varepsilon_{njt},$$

where  $n = 1, \dots, N$  is the number of respondents;  $j$  = number of alternatives in the choice set  $J$ ; and  $t$  = number of choice occasions. All of the variables were assigned a normal distribution except for price. Price was fixed to allow for easy derivation for the distribution of the willingness to pay (Revelt and Train, 1998). The normally distributed variables have a mean coefficient and a standard deviation. A statistically significant standard deviation indicates heterogeneous preferences in the sample population for the given attribute.

In Table 15, the random parameters logit model for the live goat buyers was estimated using 2000 Halton draws. The model is statistically insignificant as indicated by the likelihood ratio test failing to reject the null hypothesis that all the coefficients are equal to zero. The likelihood ratio test (8) calculated between the conditional logit and random parameters logit models is less than the critical chi-squared value of 15.51 with six degrees of freedom; therefore,

the random parameters logit model for live goats is rejected in favor of the conditional logit model, indicating that the conditional logit model fits the data better. The pseudo  $R^2$  in the random parameters logit model is 0.0782 which is larger than the CL model pseudo  $R^2$  0.0745. Considering only the pseudo  $R^2$ , the RPL model would be a better fit than the CL model. However, the likelihood ratio test rejects the RPL model in favor of the CL model.

The alternative specific constants are positive and statistically significant at the 0.01 critical level. Price is negative, as expected, and statistically significant at the 0.05 critical level. The estimated coefficients for the attribute, sex, are statistically insignificant indicating that it was not important in consumers' choice for live goats. Goat consumers prefer younger goats. The estimated coefficient for goats less than one year old is positive and statistically significant at the 0.01 critical level. The estimated coefficient for two year old goats is negative and statistically significant at the 0.01 critical level. The estimated coefficient for one year old goats is statistically insignificant. Goat consumers prefer to have the farmer perform the slaughter. The estimated coefficient for farm slaughters is positive and statistically significant at the 0.01 critical level. The estimated coefficient for commercial slaughters is negative and statistically significant at the 0.10 critical level. The estimated coefficient for slaughters performed by the purchaser is negative but statistically insignificant.

The random parameters logit model was estimated to see if heterogeneous preferences existed for live goat attributes. As mentioned in previous sections, a statistically significant standard deviation indicates heterogeneous preferences. All of the standard deviations in the random parameters logit model for live goats are statistically insignificant except for the attribute, buyer. This indicates that heterogeneous preferences exist in the sample population regarding goat slaughters performed by the buyer.

Table 15. Estimates from Random Parameters Logit Model for Live Goats

Coefficient	Estimates	Standard Errors
Choice A	1.0741*** <sup>a</sup>	0.1176
Choice B	0.5592***	0.1396
Price	-0.0021**	0.0009
<u>Sex</u>		
Castrated male: Mean	-0.0910	0.0758
Standard deviation	0.2781	0.2166
Female: Mean	0.1282	0.0829
Standard deviation	0.0004	0.2064
Intact male: Mean	-0.0372 <sup>b</sup>	0.0787
Standard deviation	N/A	N/A
<u>Age</u>		
One year old: Mean	0.0154	0.0713
Standard deviation	0.0004	0.2005
Two year old: Mean	-0.2175	0.0823
Standard deviation	0.3100	0.2086
Less than one year: Mean	0.2022***	0.0814
Standard deviation	N/A	N/A
<u>Slaughtered</u>		
By buyer: Mean	-0.1146	0.0836
Standard deviation	0.5894***	0.1511
At commercial plant: Mean	-0.1190*	0.0724
Standard Deviation	0.0073	0.4732
By farmer: Mean	0.2336***	0.0828
Standard deviation	N/A	N/A
Pseudo R <sup>2</sup>	0.0782	
Log Likelihood	-865.84	
$\chi^2$	7.00	

Notes: These respondents indicated that they purchase cuts of goat meat. Number of respondents: N=285. Number of Observations = 2565 (285 respondents x 3 questions x 3 choices)

<sup>a</sup>One asterisk indicates statistical significance at the 0.10 level; Two asterisks indicates statistical significance at the 0.05 level; Three asterisks indicates statistical significance at the 0.01 level

<sup>b</sup>Standard errors for "omitted" variables in the effects coding were calculated using the Delta method.

Overall, the results from the RPL model for live goats are the same as the conditional logit model. Goat consumers had a preference for younger goats versus older goats. Goat

consumers preferred to have a farmer perform the slaughter versus taking the goat to a commercial plant. However, the RPL model did reveal heterogeneous preferences for goat slaughters performed by the buyer. This could be further explained by including interactions in the RPL or conditional logit model to detect any possible source of heterogeneous preferences for slaughter method. In particular, interactions with race, age, and the occasion which the goat is purchased for may give some insight as well. However, from the likelihood ratio test, it was concluded that the conditional logit model does a better job in fitting the data than the RPL model. This means that the conditional logit model does a good job in explaining choice for live goat attributes.

## **CHAPTER 5: CONCLUSIONS**

### **5.1 Summary**

The primary purpose of this study was to determine consumer preferences for attributes associated with goat meat and live goats. A national consumer survey was conducted from April 27, 2012 to May 4, 2012, including a choice experiment where respondents evaluated pairs of hypothetical products for goat meat and/or live goats. A total of 2000 surveys were completed where respondents were asked about demographics, and consumption and purchasing behavior for goat meat. The target population was goat meat consumers who had consumed goat meat in the past year and at least 18 years of age. The sample profile of goat meat consumers was male, white, and 41.5 years of age who ate goat meat on average 1 to 2 times per year. Respondents had on average an associates' degree and the average income was between \$50,000 and \$74,999. Regional background included: 33.85 percent from the South, 26.3 percent from the West, 20.4 percent from the Northeast and 19.45 percent from the Midwest.

Another 2000 surveys were collected from the general population. In the general population, the average respondent was female, white, and 48 years of age. In the general population, about 13 percent had eaten goat meat in the past year. Eighty-seven percent indicated that they had not eaten goat meat in the past year. Of those who had not eaten goat meat in the past year, 24 percent had eaten goat meat in their lifetime and 76 percent had never eaten goat meat.

### **5.2 Procedures**

The conditional logit model was estimated and used as the base model. The conditional logit assumes homogenous preferences and exhibits the IIA property. If the IIA property is

violated, it can lead to biased estimates. Therefore, the random parameters logit model and latent class logit model were estimated because they relax the IIA assumption and allow for the detection of heterogeneity. The random parameters logit model allows for the parameters to vary in the population, revealing heterogeneity, and does not suffer from the restrictive IIA property. Based on the log likelihood ratio test, the conditional logit model was rejected in favor of the random parameters logit model, indicating it was a better fit for the data. The random parameters logit model revealed heterogeneity for all of the attributes except light pink. To examine the source of heterogeneity, the random parameters logit model was estimated with several socioeconomic, demographic, geographic, and consumption variables. A log likelihood test revealed that the RPL model with interactions did a better job fitting the data. In the random parameters logit model, there are no set guidelines; therefore, the researcher must assign a distribution pattern and there is the possibility of choosing the wrong distribution. Therefore, recent studies have noted gains from specifying a discrete distribution (Pacifico and il Yoo, 2012). The latent class model estimates a finite number of classes that have similar preferences within the classes. However; the number of classes is unknown to the researcher and is treated as a missing variable in the data. The optimal number of classes is chosen where the Bayesian Information Criterion and the Akaike Information Criterion are minimized. Characteristics of the respondents were also included in the model, which indirectly affects membership probability within each class.

### **5.3 Findings**

#### **Goat Meat Choice Experiment**

Overall, type of cut was the most important attribute to consumers. The results from the models suggest that chops and cubes are preferred over whole and half carcasses. Marginal willingness to pay estimates revealed that consumers valued retail cuts over carcasses. This



provides evidence that preferences for retail cuts exist. The RPL model with interactions revealed that older individuals had a greater preference for chops and younger individuals preferred carcasses. This could be due to the extra labor involved with preparing carcasses for storage, which older consumers may view as an inconvenience. However, the market including whole and half carcasses cannot be ignored and the results suggest that preference for type of cuts is strongly linked to consumption frequency. The RPL model with interactions revealed that medium to heavy consumers of goat meat preferred carcasses. Also the preference heterogeneity for carcasses could be linked to ethnicity. The RPL model with Hispanic interactions revealed that Hispanics preferred carcasses over chops. Hispanics preferences for carcasses could be due to preferred cooking methods such as barbecuing and roasting.

The latent class logit model revealed that the probability of being in a class that preferred chops decreased as consumption frequency increased. Possibly those who consume goat meat regularly prefer to purchase goat meat in large quantities, i.e. carcasses, due to inconsistent goat meat supply or having to travel significant distances to purchase goat meat. By purchasing goat meat carcasses, it reduces the time and miles associated with locating places that sell goat meat. Nonetheless, by providing more traditional cuts of meats such as chops, cubes, steaks, ribs, etc., in convenient places such as grocery stores and meat markets, consumption among less frequent goat meat eaters or nontraditional consumers may increase. The results from the RPL models with interactions and the latent class logit model suggest that carcasses are more preferred among non-Caucasian consumers. This finding is consistent with other studies and reports that found that ethnic groups prefer carcasses especially for religious celebrations and family gatherings (Geisler, 2009). Americans are more familiar with traditional cuts of meat such as chops, steaks, loin, etc. Providing these types of cuts for goat meat may increase consumption among

Americans. However, additional analysis would need to be done. Possibly including interactions between specific events and type of cut may reveal more information on ethnic groups' preferences for retail cuts and carcasses.

The results from all four models revealed a weak preference for color, suggesting that it was not as important to consumer choice as originally hypothesized. This could be due to a lack of knowledge concerning the color of goat meat. Generally, older goats tend to have darker colored meat and be less tender, but juicer and more flavorful. This information would be relatively unknown to novice goat meat consumers. However, the results from the latent class logit model revealed that Class 6 preferred dark red goat meat which would suggest based on information known about goats that they would prefer older goats. For example, some ethnic groups, such as Caribbean-born, have a preference for older goats (Coffey, 2006; Sande et al., 2005). Compared to the other classes, Class 6 was most likely males, non-Caucasian, and medium to heavy goat meat consumers with children in the home.

Despite the steady increase in goat meat imports, overall, consumers valued domestic goat meat over imports. However, the random parameters logit models and the latent class logit model revealed that heterogeneous preferences exist. The results from the RPL model with interactions and the latent class logit model suggest that non-Caucasians are more likely to prefer imported goat meat. Many ethnic groups consume goat meat during holidays and religious events, therefore; much of their demand is seasonal and they are more likely to purchase imports if domestic goat meat is unavailable. The supply of goat meat is seasonal as well, with most goats beginning to cycle with the shorter and cooler days of fall, therefore; most goats will kid in February if bred in September (Coffey, 2006). Peak demand for goat meat is during Christmas, Easter, Ramadan, etc., when supply is short leading to non-Caucasians preference for imported

goat meat. In addition, the RPL model with Hispanic interactions revealed that Hispanics had a preference for imported goat meat. Hispanics consume goat during the holiday, Cinco de Mayo, which is in May when goat meat supply may be short, hence their preference for imports.

As the slaughter numbers for goats have decreased, as shown in Figure 3, imports have increased, as shown in Figure 4. This suggests that domestic production cannot keep up with demand. However, more research would need to be done to see if there is indeed a correlation. In addition, producers would need to experiment with alternative breeding plans to supply the market with domestic goat meat during peak demand. Among non-traditional consumers, assuming that there is no quality difference between domestic and imports, it would be a great marketing opportunity for producers to appeal to those involved in the local food movement by providing country of origin labeling and highlighting fresh vs. frozen. It would distinguish their product from imports and attach a premium to it. Moreover, the willingness to pay estimates revealed that consumers valued fresh domestic over imports.

Many of the covariates included in the RPL model were also statistically significant in the latent class logit model. Even though the latent class logit model revealed heterogeneous preferences, some of the classes were not truly distinct in their preferences or the characteristics of its members. However, some distinct groups such as Class 6 were identified, which can obviously be considered as the carcass-loving class, as they preferred both whole and half carcasses that were dark red in color. Compared to the other classes, this class is most likely males, non-Caucasian, and medium to heavy consumers. Although most of the demographic, geographic, and socioeconomic variables did not clearly define the classes, consumption frequency, age, and gender were statistically significant in most of the classes.

## Live Goat Choice Experiment

Results of the conditional logit model revealed that respondents received greater utility from younger goats. Goats that were two years or older had a negative effect on respondents' utility. Consumers were willing to pay more for a goat that was less than one year old. The willingness to pay for two year old goats was negative indicating that consumers did not value older goats. This suggests that younger goats are generally more preferred than older goats. Goats are very lean animals; some consumers may assume that older goats have more fat, which is not always desirable. The sex of the goat was not statistically significant, suggesting that it was unimportant to respondents. Even if goat consumers have a preferred sex for goats, the preference may not be as strong enough to influence their choice when considering the other attributes.

The conditional logit model also revealed that respondents preferred to have the farmer perform the slaughter versus a commercial slaughter. Respondents were willing to pay more for on-farm slaughters. This could be due to the local movement where consumers prefer food that has been produced closer to home. In addition, the inconvenience associated with transporting live goats and the extra costs incurred, as well as the lack of commercial plants that are close to areas of production may influence consumers' preferences for on-farm slaughter. The lack of slaughter facilities has been a hindrance for both consumers and producers; in particular, facilities which adhere to Halal or Kosher practices. This is an issue that must be addressed if the live goat market is to continue to grow, especially among the ethnic populations including Muslims. The random parameters logit model for live goats revealed similar findings. The RPL model for live goats was rejected in favor for the conditional logit model, indicating the CL

model fit the data better than the RPL model. However, the RPL model did reveal heterogeneous preferences for the attribute, buyer.

#### **5.4 Implications and Recommendations**

This research contributes to the limited literature on consumers' preferences for goat meat and live goats. Goat meat is not traditionally consumed in the United States, but as our nation becomes more diverse so does the foods people consume. This offers the unique opportunity for producers and farmers, specifically small-scale producers and farmers, to diversify and tap into new and emerging agriculture markets. This offers great growth potential for the meat goat industry. A growing ethnic population due to immigration is considered the main consumers of goat meat (Shiflett, 2007). According to a 2012 report from the U.S. Census Bureau, it projects that the U.S. will be more racially and ethnically diverse by 2060. That same report from the U.S. Census Bureau projects that the population of two of the biggest consumers of goat meat, Hispanics and Asians (Coffey, 2006), will more than double by 2060. To accommodate the increased demand for goat meat from an increasing ethnic population, the meat goat industry must address two big issues discovered in this study: carcasses versus retail cuts, and imports versus domestic.

The findings of this study suggest that there is a preference for retail cuts, but the market for whole and half carcasses should not be ignored. Both RPL models with interactions revealed that Non-Caucasians and Hispanics prefer whole and half carcasses. Therefore, the industry should focus on improving carcass characteristics and setting a standard in the industry regarding quality. Ethnic groups have diverse preferences regarding goats and if the industry considers the diverse needs for each ethnic group, it can tap into these various markets to increase demand beyond holidays and religious events. Increased demand can happen among non-traditional goat meat consumers as well. A lack of availability of goat meat in general is a big problem for the

meat goat industry. Many Americans have not been exposed to goat meat. One possible way to peak interest is by offering retail cuts such as chops and cubes, in grocery stores and meat markets. Also, the industry may need to address quality issues and developing a USDA grading system as for other species that would provide quality cues for consumers. In addition, educating consumers about goat meat is important. Goat meat is leaner than other red meats including beef and pork, which would appeal to health conscious consumers.

Despite consumer preferences for domestic goat meat, Figure 4 shows a steady increase in goat meat imports since the early 1990s and seems to be continuing on that trend. This indicates that domestic supply is not keeping up with demand. It is important that the industry focus on producing a consistent supply of domestic goat meat. The models estimated revealed that many consumers value domestic over imports. The willingness to pay revealed a strong preference for domestic goat meat, therefore; country of origin labeling would allow producers to distinguish their products and attach a premium to domestically produced goat meat. However, there are some heterogeneous preferences for imports. The RPL models with interactions showed that non-Caucasians and Hispanics prefer imports. Many ethnic groups demand for goat meat increases during specific holidays and religious events. If goat meat is unavailable during these events, ethnic groups will buy imported goat meat. Therefore, it would be beneficial to the meat goat industry to adjust breeding programs to supply the market during peak demand.

Overall, the findings from this study are favorable for the meat goat industry. The most significant finding is that goat meat consumers valued chops and cubes more than carcasses; and fresh domestic is valued over imports. The industry would benefit from a consistent domestic supply and more processing plants closer to the point of production.

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## APPENDIX A: SAS CODE FOR GOAT MEAT AND LIVE GOAT CHOICE DESIGNS

### Goat Meat Choice Design

```
%mktruns (3 ** 3 4 ** 1)
%mktx(3 ** 3 4 ** 1, n=72);
proc format;
value price 1 = 3.89 2 = 5.39 3 = 6.89;
value color 1 = 'light' 2 = 'medium' 3 = 'dark';
value source 1 = 'freshdom' 2 = 'frozendom' 3 = 'frozenimp';
value cut 1 = 'whole' 2 = 'half' 3 = 'cubes' 4 = 'chops';
run;
%mktlab(data=design,
vars=Price color source cut,
int=f1-f2,
out=final,
stmts=format price price. color color. source source. cut cut.)

proc print data=final(obs=72); run;

%choiceff(data=final,
          model=class(price cut color source/sta),
          nsets=18,
          maxiter=100,
          seed=121,
          flags=2,
          options=relative,
          beta=zero)
proc print; by set; id set; run;
%mkblock(data=best, nalts=2, nblocks=3, factors=price cut color source, seed=472)

%mkteval (data=best)
%mktdups(generic, data=best, nalts=2, factors=price cut color source)
```

## Live Goat Choice Design

```
%mktruns (3**4)
%mktx(3 ** 4, n=81);
proc format;
value price 1 = $75 2 = $130 3 = $195;
value age 1 = 'young' 2 = '1 year' 3 = '2 year';
value sex 1 = 'intact male' 2 = 'castrated male' 3 = 'female';
value slaughter 1 = 'by you' 2 = 'by farmer' 3 = 'commercial plant';
run;
%mkqlab(data=design,
vars=Price Age Sex Slaughter,
int=f1-f2,
out=final,
stmts=format price price. age age. sex sex. slaughter slaughter.)

proc print data=final(obs=81); run;

%choiceff(data=final,
           model=class(price age sex slaughter/sta),
           nsets=9,
           maxiter=100,
           seed=121,
           flags=2,
           options=relative,
           beta=zero)
proc print; by set; id set; run;
%mkblock(data=best, nalts=2, nblocks=3, factors=price age sex slaughter, seed=472)

%mkteval (data=best)
%mktdups(generic, data=best, nalts=2, factors=price age sex slaughter)
```

## APPENDIX B: GOAT MEAT QUESTIONNAIRE

### Study of Consumers' Attitudes and Consumption Behavior of Goat Meat

**PN: Group number=10; n=2000**

**US respondents 18 or older that have eaten goat meat in the past year.**

**PN: Quota "Goat Meat Eaters" = S2 is  $\geq 18$  years old and If S4 = Yes**

**PN: Group number=20; n=2000**

**US respondents 18 or older.**

**PN: Quota Gen Pop = S2 is  $\geq 18$  years old and S4=no**

#### **Goat Consumers' Screening Questions**

**S1. What is your gender? (Select One)**

Male

Female

**S2. Please indicate your age. <min 16><max99> (Type in a whole number)**

**S3. Please indicate the highest level of education you have completed. (Select One)**

Grade School

Some High School

Graduated High School/ GED

Some College-no degree

Graduated College-Associate's Degree (2 years)

Graduated College-Bachelor's Degree (4 years)

Post Graduate Degree

**S4. Have you eaten goat meat in the past year? (Select One)**

Yes

No

**Term if: S2 <18 years old**

**Q1. To the best of your memory, of the last 10 times you ate meat, how many times did you eat these meats? (Please enter a number for each item) <min 0><max 10>**

# Times ate beef \_\_\_\_\_

# Times ate pork \_\_\_\_\_

# Times ate chicken \_\_\_\_\_

#Times ate fish \_\_\_\_\_

#Times ate lamb \_\_\_\_\_

#Times ate goat \_\_\_\_\_

\_\_\_\_\_ total (must sum to 10)

**Consumer Preferences and Consumption Behavior for Goat in the United States –  
For client only**

**Goat Consumption and Purchasing Patterns – For client only**

Ask if: S4=yes

Q2. How often do you eat goat? **(Select one)**

- At least once a year
- 1-2 times per year
- 3-6 times per year
- 7 -11 times per year
- About once a month
- More than once a month

Ask if: S4=yes

Q3. To the best of your memory, of the last 5 times you ate goat meat, how many times did you eat it at home, how many times did you eat in a restaurant, and how many times did you eat at a place other than at home or in a restaurant? **(Please enter a number for each) <min 0><max 5>**

- |                 |       |                       |
|-----------------|-------|-----------------------|
| At home         | _____ |                       |
| In a restaurant | _____ |                       |
| Other           | _____ | please specify _____  |
|                 | _____ | total (must sum to 5) |

Ask if: S4=yes

Q4. Which of the following do you purchase for goat meat consumption? **(Select one)**

- Cuts of Goat Meat (cubes, chops, etc.)
- Live Goats (to be slaughtered)
- Both

Ask if: Q4 = codes 1,3

Q5a. In a typical year, how often do you purchase goat meat? **(Select one)**

- 1-2 times per year
- 3-5 times per year
- 6-11 times per year
- About once a month
- More than once every two weeks

Ask if: Q4 = codes 1,3

Q5b. Which cuts of goat meat do you buy? **(Select all that apply)**

- Chops
- Cubes
- Loin
- Whole carcass (cut up)
- Half carcass (cut up)
- Other (please specify)



**Ask if: Q4 = codes 1,3**

Q5c . In a typical year, how many pounds of goat meat do you purchase? **(Select one)**

Less than or equal to 1 pound

2- 5 pounds

6-10 pounds

11- 20 pounds

21- 30 pounds

31-40 pounds

41 – 50 pound

51 pounds or more

**Ask if Q4 = codes 1, 2**

Q6a. In a typical year, how often do you purchase live goats? **(Select one)**

1-2 times per year

3-5 times per year

6-11 times per year

About once a month

More than once every two weeks

**Ask if Q4 = codes 1, 2**

Q6b. How many goats do you generally purchase per trip? **(Select one)**

1 goat

2 -3 goats

4 -5 goats

6 goats or more

**Ask if Q4 = codes 1, 2**

Q6c. On average, how far do you travel from home to the farm(s) where you purchase live goats? **(Select one)**

Less than or equal to 1 mile

2- 5 miles

6 -10 miles

11- 20 miles

21 miles or further

**Ask if Q4 = codes 1, 2**

Q6d. How do you locate farms that sell goats? **(Select all that apply)**

Word-of-mouth

Advertisement (i.e., newspaper, magazine, posters/signs)

Other (please specify) \_\_\_\_\_

Q7. Please indicate which breed of goat you prefer. **(Select one)**

Boer

Spanish

Kiko

Tennessee fainting goat

Other (please specify) \_\_\_\_\_  
No preferred breed

Q8. Please indicate which color of goats you prefer. **(Select one)**

White with red head  
White  
Black  
Spotted  
No preferred color

Q9. Please indicate which of the following live weights for goats you prefer. **(Select one)**

Goats that are 15-30 pounds live weight  
Goats that are 40-50 pounds live weight  
Goats that are 60-80 pounds live weight  
Goats that are 90 pounds or more live weight  
No preferred weight

**PN: Ask if Q4 = codes 1,2,3**

Q10. During which season do you most often purchase goat meat and/or live goats?  
**(Select one)**

Winter  
Spring  
Summer  
Fall  
No preferred season

**PN: Ask if Q4 = codes 1,2,3**

Q11. Please indicate the occasions when you purchase goat meat and/or live goats?  
**(Please select all that apply)**

Easter  
Ramadan  
Christmas  
Other Holidays (e.g. 4<sup>th</sup> of July, Cinco de Mayo)  
Family or Community gatherings (e.g. weddings, graduations)  
No specific occasion <exclusive>

**PN: Ask if Q4 = codes 1,2,3**

Q12. Where do you go to purchase goat meat and/or live goats? **(Select all that apply)**

Farm  
Specialty meat store  
Butcher  
Grocery store  
Ethnic food market  
Other (Please specify)

**PN: Ask if Q4 = codes 1,2,3**

Q13. In a typical year, how many times do you visit the following to purchase goat meat and/ or live goats? **(Please enter a number for each) <min 0><max 999>**

# Times at farm	_____
# Times at specialty meat store	_____
# Times at butcher	_____
# Times at grocery store	_____
# Times at ethnic food market	_____
#Times at other place	_____ please specify _____

**PN: Ask if Q4 = codes 1,2,3**

Q14. If goat meat is unavailable, how likely are you to substitute with lamb? Please indicate your answer using the 5-point scale where: **(Select one)**

- 1 = Not at all likely
- 2 = Slightly Likely
- 3 = Moderately Likely
- 4 = Very Likely
- 5 = Completely Likely

**Ask if S4=no**

Q15a. To the best of your memory, of the last 10 times you ate meat, how many times did you eat these meats? **(Please enter a number for each) <min 0><max 10>**

# Times ate beef	_____
# Times ate pork	_____
# Times ate chicken	_____
#Times ate fish	_____
#Times ate lamb	_____
_____ total (pn: must sum to 10)	

**Ask if S4=no**

Q15b. Have you ever eaten goat meat in your lifetime? **(Select one)**

- Yes
- No

**PN: Ask if Q15b= No**

Q16a. Please tell us why you have never eaten goat meat? **(Select all that apply)**

- Have never heard of eating goat meat
- Not available in my grocery or meat shop
- Told by others that it is not tasty
- Too expensive compared with other meats
- Only low class people eat goat meat
- Goats are pets, not intended for consumption
- I am a vegetarian
- I am vegan
- Other (Please specify)

**Ask if S4=no**

Q16b. Please tell us which of the following circumstances you would be willing to try goat meat.

**(Select all that apply)**

- As an appealing menu item served in an ethnic restaurant
- At a social gathering which includes goat meat as part of the meal
- As part of a meal served at a friend's home
- At a farmer's market or other food venue
- At a grocery store that is providing samples of cooked goat meat
- As part of a recipe I read in a food magazine
- As part of a recipe that I saw on a cooking show
- I would never try goat meat under any circumstance
- Other (Please specify)

**PN: Ask if Q15b= Yes**

Q16c. If you have tried eating goat meat, please tell us why you don't eat goat meat regularly? **(Select all that apply)**

- I didn't like the taste
- Not available in my grocery or meat shop
- Too expensive compared with other meats
- Just not part of my culture
- I don't know how to cook goat meat
- Other (Please specify)

**PN: Ask if Q15b= Yes**

Q16d. Please tell us under which of the following circumstances you would be willing to eat goat meat more often. **(Select all that apply)**

- As an appealing menu item served in an ethnic restaurant
- At a social gathering which includes goat meat as part of the meal
- As part of a recipe I read in a food magazine
- As part of a recipe that I saw on a cooking show
- I would never eat goat meat again under any circumstance
- Other (Please specify)

**PN: Ask 17a through 19 for all respondents.**

Q17a. Please read each of the following statements carefully and indicate the response that best reflects your opinion, where 6 indicates strongly agree and 1 indicate strongly disagree. **(Select one)**

**[[BANNER]**

- 1= Strongly disagree
- 2 = Somewhat disagree
- 3 = Neither disagree or agree
- 4 = Somewhat agree
- 5= Strongly agree

**[BANNER]**

6 = Strongly agree  
5=  
4 =  
3 =  
2 =  
1 = Strongly disagree

[STATEMENTS] <RANDOM>

Much of the goat meat consumed in the United States is imported from Australia  
Goat meat is leaner than other red meats  
Goat meat is healthier than other red meats  
Goat meat is a gourmet food  
Goat is an exotic meat  
Goat meat is an ethnic food  
Goat and lamb are the same  
Goat and lamb meat have a similar taste  
Goats are pets  
I drink goat milk  
I eat goat cheese  
I do not eat dairy products

Q17b. Please read each of the following statements carefully and indicate the response that best reflects your opinion, where 6 indicates strongly agree and 1 indicate strongly disagree.

[BANNER]

1= Strongly disagree  
2 = Somewhat disagree  
3 = Neither disagree or agree  
4 = Somewhat agree  
5= Strongly agree

[BANNER]

6 = Strongly agree  
5=  
4 =  
3 =  
2 =  
1 = Strongly disagree

[STATEMENTS] <RANDOM>

I buy local food products  
I am the kind of person who would try any new product once  
When I see a new product on the shelf, I often buy it just to see what it's like  
I like the challenge of doing something I have never done before  
I have at least one meal away from home per day  
I buy food products with recipes and cooking instructions included

Information about food ingredients is important  
I always read and compare food nutrition labels when buying food  
I notice when prices on food I buy change  
I look for coupons in the newspaper and plan to take advantage of them when I go shopping  
I find myself checking prices in the grocery store even for small items  
I use a lot of ready-to-eat foods in my household  
Fresh whole foods account for a large part of the food products I use in my household  
Frozen foods account for a large part of the food products I use in my household  
I use a lot of mixes, for instance, baking mixes and powdered soups  
I try to avoid food products with food additives  
I exercise regularly  
I often eat fresh fruits and vegetables  
I eat red meat only in moderation  
I avoid salty foods  
I have regular medical check-ups  
I prefer using products with recyclable packaging  
I have switched food products for ecologically-friendly reasons  
I try to balance my time between work and my private life  
Planning for meals takes quite a bit of my time  
Shopping for food takes quite a bit of my time  
I eat diet foods at least one meal a day  
I buy lower calorie foods  
I am careful about eating certain foods and beverages to control my weight

Q18. How important are the following statements when purchasing goat, or any other meats? **(Select one for each)**

**[BANNER]**

- 1= Not at all Important
- 2= Slightly Important
- 3 = Moderately Important
- 4 = Very Important
- 5 = Extremely Important

**[STATEMENTS] <RANDOM>**

Knowing that goat or any other meats I purchase has been federally inspected  
Knowing that goat or any other meats I consume has been slaughtered using Halal practices  
Knowing that goat or any other meats I consume has been slaughtered using kosher practices  
The meats that I purchase have a USDA grade

Q19. Goat meat is identified by different names; please indicate on the scale from 1 to 7 which of the following names is most appealing to you with 7 being very appealing and 1 being not at all appealing?

**(Select one for each)**

**[BANNER]**

1 = Not at all appealing

2

3

4

5

6

7 = Very appealing

**[STATEMENTS] <RANDOM>**

Goat

Chevon

Cabruto

**\*\*\*\*\*Insert Conjoint Instructions and Design  
here\*\*\*\*\***

**PN: Proceed with Conjoint A if question 4 = a.**

**PN: Proceed with Conjoint B if question 4 = b.**

**PN: Proceed with Conjoint A and Conjoint B if question 4 = c.**

**PN: Demographics – Ask for all respondents.**

D1. In what year were you born? **(Please enter the year) <min 1920><max 1994>**

D2. How many children under the age of 18 years are living in the home with you?  
**(Select one)**

0

1

2

3

4

5 or more

D3. In which state of the U.S. do you live? **(Select one)**

**[PN: insert state drop down list]**

D4. In which of the following groups would you place yourself? **(Select all that apply)**

Caucasian/ White

African-American/ Black

Asian

Native American

Native Hawaiian or Other Pacific Islander

Other (Please specify)

D5. Which of the following groups best describe your ethnic origin? **(Select all that apply)**

- Hispanic/ Latino
- African descent
- Caribbean
- Arabic descent
- Asian
- Other (Please specify)
- None

D6. Please indicate the country where your parents were born. **(Please write in the country)**

**[pn: insert text box]**

D7. Which of the following best describes your annual income? **(Select one)**

- Less than \$10,000
- \$10,000 - \$14,999
- \$15,000 - \$24,999
- \$25,000 - \$34,999
- \$35,000 - \$49,999
- \$50,000 - \$74,999
- \$75,000 - \$99,999
- \$100,000 - \$149,999
- \$150,000 - \$199,999
- \$200,000 or more
- Prefer not to answer



## APPENDIX C: SAMPLE GOAT MEAT AND LIVE GOAT CHOICE SETS

### Group 3

#### Choice Set 1.



**Product A:**  
**Cut:** Whole Carcass  
**Color:** Dark (Red)  
**Source:** Frozen Import  
**Price:** \$6.89/lb.



**Product B:**  
**Cut:** Chops  
**Color:** Light Pink  
**Source:** Fresh Domestic  
**Price:** \$3.89/lb.

Which product would you purchase: Product A, Product B, or I would not purchase either these products?

**Group 1**  
**Choice Set 1.**

<p><b>Product A:</b></p> <p><b>Sex:</b>            <b>Castrated Male Goat</b>  <b>Age:</b>            <b>1 Year</b>  <b>Slaughtered by:</b>    <b>Commercial Plant</b>  <b>Price:</b>            <b>\$75</b></p>	<p><b>Product B:</b></p> <p><b>Sex:</b>            <b>Female Goat</b>  <b>Age:</b>            <b>2 Years</b>  <b>Slaughtered by:</b>    <b>Buyer</b>  <b>Price:</b>            <b>\$195</b></p>	<p><b>I would not purchase either product.</b></p>
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Which product would you purchase: Product 1, Product 2, or no purchase?

## **VITA**

Jessica Irene Hill was born in Fort Rucker, AL and grew up in Luverne, AL. She graduated from Luverne High school in 2001. She attended Southern Union State Community College on the Presidential Scholarship obtaining her Associate Science degree. After one year, she transferred to Auburn University where she obtained her Bachelor of Science in animal science and a minor in agribusiness management in 2006. She continued her education at Auburn University by obtaining a Master of Science in Agricultural Economics in 2008 with a concentration in agricultural food marketing. In August of 2008, Jessica began the path to completing her academic career, pursuing a PhD in Agricultural Economics at Louisiana State University.