Economic and Demographic Factors Affecting the Propensity to Consume Specialty Eggs in the United States

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Abstract

In recent years, the United States has seen an increase in the popularity of specialty eggs as a good source of healthy fats and proteins. This is due to an increased focus on healthy eating habits and the positive perception of natural and organic foods. In order to capitalize on this new trend, producers must strategize their marketing efforts to sell most directly to the appropriate target market. Using 2015 Nielsen Homescan database and probit regression model analysis, we were able to determine the estimated likelihoods of purchasing specialty eggs on several different household demographics. Also, we were able to determine the same information for consumers of eggs in general, for consumers of regular eggs, and for the consumers of both regular and specialty eggs. By using the information from this data, we are able to develop a consumer profile for consumers of specialty eggs that can be used by producers and their marketing team to determine the allocation of their respective resources. Results found that the average consumers of specialty eggs are young couples with a high income, an increasing income, a high education, and no children. The best areas in which to sell specialty eggs were found to be areas in the Pacific region of the United States that have high part time employment and small household sizes.

JEL Classification: D11, D12

Key words: Specialty eggs, Nielsen data, probit model

Background Information and Literature Review

The Specialty food market in the United States is a relatively new phenomenon, organic being the most popular category of specialty products. Specialty foods are defined as "Foods or beverages of the highest grade, style, and/or quality in their respective categories. Their specialty nature derives from uniqueness, origin, processing method, design, limited supply, unusual application or use, extraordinary packaging, or channel of distribution or sales" ("The State of the Specialty Food Industry, 2015"). The U.S. food market has recently been flooded with specialty varieties of everyday products. Phil Kafarakis, President of the Specialty Food Association, stated "Consumer preferences for specialty food products are growing at double digits, outpacing mainstream food staples" (Specialty Food Association, 2017). The increased demand for these products may be the result of American people embracing a lifestyle that places importance not only on health, but the origins of food and their ingredients. New health trends have placed extreme importance in high protein, low carb, minimally processed diets, which have significantly altered the buying habits of U.S. consumers. It is this demand that has caused an increase in specialty and organic purchases in retail outlets across the country. According to the latest SFA report, retail sales of specialty foods grew 19% from 2012 to 2014 ("The State of the Specialty Food Industry 2015"). Previous studies on the specialty market state that the core group of specialty food consumers is 62% men, 58% women, and are between the ages of 25 and 44. In the Pacific region, 71% of the population was found to be specialty food consumers. In the Mountain states, the number is 66% , while in the Mid Atlantic it is 62%. 85% of these consumers nationwide earn more than $150,000 per year. Millennials were also found to be more likely to buy organic produce, which indicates that the specialty market will continue to increase as the millennials become adults and have their own families ("Today's Specialty Food

Consumer 2016). The goal of this study is to identify economic and demographic factors affecting the propensity to consume specialty eggs by the U.S. consumer.

Organic products are the most recognizable category of the specialty food market. In the days before commercial farming and mechanized processing, everything was technically speaking, "organic". For poultry, these were the days of backyard farms where eggs were collected daily by hand, and the extras were sold at the local farmers' markets. As selling eggs became profitable, some farms started building up flocks of about 400 hens who were still allowed to roam outside the coop ("History of Egg Production",n.d). This introduced a new set of issues to poultry farmers. Disease, weather, predators, and social problems began to become a problem within the flock. Farmers began administering medicines and controlling the diet of the hens, however the American Egg Board estimates that hens only laid around 150 eggs per year and had a mortality rate of around 40% ("*History of Egg Production," n.d).* As technology advanced, methods for more efficient and profitable production were created. Moving the hens to indoor facilities produced healthier birds than when they were left outside to face the weather and potential predators. Additional research showed that putting each hen into its own individual cage achieved a more consistent feeding regimen, a more consistent egg quality, and reduced disease. These methods aided producers in maintaining the maximum number of healthy hens, produce more eggs, and obtain more profit. The result of this progression was the widely popular cage system that many conventional egg producers use today. The US had made the final switch from small poultry farms to a commercial industry by 1960 (Nationwide, n.d). Today, major poultry farms commonly house from 100,000 to up to a million laying hens on a single farm. This contributes to the production of around 75 billion eggs per year in the United States, which is about 10% of the world's supply (*History of Egg Production, n.d).*

Current per capita egg consumption as a whole has recovered significantly from the late 1900's.The high point for per capita egg consumption was 402 eggs in 1945. Consumption had been steadily declining due to lifestyle changes and to health concerns such as increased cholesterol. Per capita consumption reached its lowest point in 1995 at 232 eggs per person ("Eggs Profile",n.d). However, today, eggs are marketed to be a good source of protein, a healthy breakfast that gives you energy throughout the day and keeps you fuller longer, good for mental energy, and a good source of vitamin D. This has allowed them to regain their popularity in the American diet. In 2016, the number of eggs sold as table eggs totaled 88.4 billion, the average American consuming a total of 268.4 eggs per year ("Bureau of Labor Statistics, 2017).

2015 saw a slightly lower number of egg consumption (252.9 eggs per person) due to the turmoil caused by an outbreak of Avian Influenza. Although the virus is not transferable to humans, the disease resulted in thousands of laying hens being euthanized and severely impacted egg and poultry production. There are two different views when it comes to analyzing egg consumer behavior in 2015. One group believes that after the price increases caused by the Avian Flu, the lower price of conventional eggs were just too tempting for the average consumer and caused a greater demand for conventional eggs than cage-free. This trend continued as the prices of conventional eggs dropped considerably in the following 2 years, resulting in the lowest prices in the last decade. This has led to a decrease in purchases of cage-free eggs (Hirch, 2017). The second group believed that "A sharp drop in U.S. egg production due to impacts from an outbreak of avian influenza would increase sales of specialty eggs such as cage-free and organic because the price between conventional eggs and specialty eggs narrowed" (Lee, 2015). Several organic egg producers saw an increase in the demand for their products as supply tightened and conventional egg prices increased. Producer David Will stated that, "There's definitely a point

where consumers will trade up to cage-free or organic based on price point." Specialty eggs are priced differently than conventional eggs. While traditionally produced eggs are volatile and subject to price swings based on production cost, many specialty egg producers set their prices quarterly, making a more reliable and steady price (Lee, 2015). To the average consumer, this more consistent reliability could make the extra cost worthwhile.

The term "organic farming" was started in the 1940's by J.I Rodale, founder of the Rodale Research Institute. He is considered to be the father of the modern organic farming movement, and helped develop the organic production methods. Despite this, it wasn't until 1990 that Congress passed the Organic Foods Production Act, which required the USDA to establish national standards that would assure consumers of consistency when purchasing organic items. However, it wasn't until 2000 that the first standards were implemented (GEORGIA). From 2000 to 2005, organic egg sales grew by an average annual rate of 19% (NBJ, 2006). In fact, since the implementation of national standards, the organic market has grown "Five times faster than food sales as a whole" (OCA article). Using Nielsen Homescan data, the USDA-Economic Research Service estimated that organic eggs accounted for 1% of the fresh egg market in 2004 (Oberholtzer et al., 2006). The USDA-Economic Research Service has determined that growth in the specialty egg market is rapid and that organic eggs represent the fastest growing item in this category (Oberholtzer et al., 2006). However, specialty eggs go beyond just organic, and have expanded to include products such as: cage-free, free-range, nutrient-enhanced, omega-3, vegetarian, and all-natural. For the purposes of this research, any non-traditionally produced egg is considered specialty. This distinction is due to the extra production costs that are associated with choosing to forgo the conventional production process for the sake of satisfying the customer. Following the United States consumer trends, companies found that the consumers

allowed them to charge premium prices for goods with special nutritional claims on their labels. The Agricultural Marketing Resource Center believes that this consumer behavior is a result of a combination of a focus on consumer health, environmental concerns, and issues from animal welfare groups. Organic eggs, range eggs, cage-free eggs and omega 3 eggs are some examples of niches that are of interest and have experienced growth in the marketplace. ("Eggs Profile") According to the New Hope Network, "About 60 percent of consumers are buying specialty eggs" (Cowan, 2014). Sales of specialty eggs at retail stores in the US increased from $28 million in 2014 to $78 million in 2016 ("Specialty Food Association"). A response to this increase in consumer demand has led about 100 grocery chains, 60 restaurant chains, and dozens of other major food businesses to promise to switch to cage-free in the next decade (Wong, 2017).

The organic and specialty market can be very confusing for new customers. Companies have taken advantage of the lack of consumer education by trying to charge premium organic prices by labeling it "Natural" or "Fresh". This allows them to raise their prices without having to deal with the increased cost of production that is associated with raising organic produce. These struggles have not stopped the Organic movement from making specialty eggs the popular new trend. It is important to define the claims in the different egg varieties. The Egg Nutrition Center's Guide to Egg Carton Labels and the American Egg Board define these claims as follows:

Conventional Eggs **-** Eggs laid by hens living in cages with access to feed, water, and security. The cages serve as nesting space as well as for production efficiency. In this type of hen house, the birds are more readily protected from the elements, from disease and from natural and unnatural predators.

Cage-free/Free-roaming Eggs — Eggs laid by hens at indoor floor operations, sometimes called free-roaming. The hens may roam in a building and have unlimited access to fresh food and water. Cage-free systems vary and include barn-raised and free-range hens. Many believe that labeling cage-free eggs as such means that the hens get unlimited freedom and space, however, each cage-free hen gets an average of one square foot of space. They are still just as tightly packed, just outside of individual cages. In fact, a three year study showed that while only 5% of hens died in conventional cages, 11% of cage-free hens died, prominently due to pecking by other hens (Kelto, 2014).

Free-range Eggs — Eggs produced by hens that have access to outdoors in accordance with weather, environmental or state laws. The birds have continuous access to fresh food and water and may forage for wild plants and insects. They are also provided floor space, nesting space and perches. However, unlike in poultry production, there's no government oversight of the term "free range" when it comes to eggs, so companies can more or less interpret it as they see fit (Kelto, 2014).

Organic Eggs **-** Eggs produced according to national U.S. Department of Agriculture organic standards related to methods, practices and substances used in producing and handling crops, livestock and processed agricultural products. Organic eggs are produced by hens fed rations with ingredients that were grown without most conventional pesticides, fungicides, herbicides or commercial fertilizers. By definition, organic hens are also required to be free-range (Kelto, 2014).

Vegetarian Eggs — Produced by hens fed a vegetarian diet, which is not their natural omnivore state.

Pastured Eggs — Pastured eggs originate from hens free to roam and forage on a maintained pasture area. The USDA does not recognize a labeling definition for pastured eggs as no standards are established. However, since these birds spend most of their life outdoors with plentiful space and access to a barn, pasture-raised is considered the "gold standard" when it comes to replicating chicken's natural environment (Kelto, 2014).

Nutrient- Enhanced Eggs — Eggs which are produced by hens fed a special diet that may include things like flax seed, marine algae or fish oils. Includes: Vitamin D, Protein, Lutein, Omega-3, Vitamin E.

Fertile Eggs — Eggs which, if not refrigerated, can be incubated and hatch into chicks.

The difficulty with egg claims such as these is the fact that, besides organic eggs, there is little to no regulation for the customer to verify the claims made by these producers. Additionally, some labeling terms are designed solely to make a particular carton obtain premium pricing, but actually have no special qualification compared to regular eggs. For example, claims like "Antibiotic-Free", "Gluten Free", and "Natural" are misleading due to the fact that all eggs are produced without antibiotics, no eggs contain gluten, and the USDA identifies all shell eggs as natural ("Guide to Egg Carton Labels"). Organic eggs are by far the most regulated group of specialty eggs. Egg producers are required to abide by strict procedures to obtain certification for organic claims. All organic feed qualifications must include paperwork capable of verifying the organic origins. Knowingly selling or labeling a product as Organic without complying to the set standards can result in a civil penalty of up to $10,000 ("U.S Regulation", n.d). There are multiple types of organic certifications that follow varying levels of compliance.

Problem statement

So what kind of consumer has the desire to purchase specialty eggs despite the premium prices and confusing labeling? The increased focus on health and natural eating in the United States and a negative perception of commercially raised products has created a unique opportunity for specialty egg producers. In order to capitalize on this advantage, it is important to target the places that specialty eggs will have the most sales by identifying the economic and demographic information of common specialty egg consumers. This information will also provide the potential to grow their target market and create new customers who are willing to pay premium prices to purchase organic and other specialty eggs. Additionally, once the target market is identified, marketers and advertisers of specialty eggs can use this information to position and promote specialty eggs among those who buy as well as those who did not buy (those who did not buy is the potential market for specialty eggs).

Objectives

The broad objective of this study is to delineate economic and demographic factors affecting the propensity of the U.S. consumer to purchase specialty eggs. The specific objectives are as follows:

1. To explain qualitatively, the economic and demographic factors of the buyers of regular and specialty eggs in the United States.
2. To determine quantitatively, the propensity of consumption of specialty eggs in the United States delineated by economic and demographic factors of households.
3. To provide marketers of specialty eggs, recommendations on where and how to market to create maximum sales efficiency.

Data

The data used in this research is the Nielsen Homescan panel for year 2015[1]. The table included product information like the product UPC (Universal Product Code), the product description, the product module code and description, product group code and description, department code and description, brand code and description, and size. The process of sorting through the hundreds of thousands of raw data points in this file was made possible through the Statistical Analysis System (SAS 9.4) program. Beginning with the raw data that had 3,946,374 points of entry, we isolated the products that were under the "EGGS" classification. Next, the data was separated into the two categories that would be analyzed: Regular and Specialty. The Control brands, otherwise known as private label brands or house brands, are "in-store" brands were identified separately from the other brands due to their uniform brand description. Stores that practice private label production benefit by providing a cheaper option to the consumer while also saving on advertising and production costs. Examples of these brands include HEB, Kroger, and Walmart's GreatValue brand that are found in their respective stores. The control brands were identified by the product description, which had descriptors such as: CTL BR EGGS B MDM, CTL BR BRN EGGS AA LG OG, or CTL BR B-E AA LG. We isolated all of the control brands with generic descriptions that would define traditionally produced eggs. The justification for this process was due to the limited possible description a traditionally produced egg can be given by USDA grading guidelines. While specialty eggs may have unique qualities that make putting them in groups difficult, regular eggs are put into a category of either, Grade AA, Grade A, and Grade B.

[1] based on data from The Nielsen Company (US), LLC and marketing databases provided by the Kilts Center for Marketing Data Center at The University of Chicago Booth School of Business. The conclusions drawn from the Nielsen data are those of the researchers and do not reflect the views of Nielsen. Nielsen is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein.

They are then further identified by size of the eggs. This list includes all of the possible size references that were in the Nielsen Data. They are, SML, MDM, LRG, LG, X-L, and JMB. The final descriptor that was included in this data was to classify the egg as white or brown, which included these combinations, EGGS, B-E, and BRN.

This method resulted in a table of regular (or traditionally produced) control brand eggs, and a specialty control brand table that included the remaining product descriptions. 38 data points were removed from the data due to not having product descriptions. Being unable to categorize the data into regular or specialty made it useless for the purposes of this research. The control brands ended up having 1538 entries in the regular egg table, which was 81.1% of the total. The specialty egg table had 367 entries, which was 18.9% of the total.

The entire list of eggs with brand names (3,551 entries) was exported into an excel document. We used a binomial process in which the number "0" defined the entry as a regular egg, and the number "1" identified the entry as a specialty egg. The excel document was then re-imported into the SAS program, and a table was made for all the regular brands as well as a table for all the specialty brands. The 2 regular tables were merged into one “Regular” file and one “Specialty” file. Results found that after getting rid of the blank description in the data, there were 5455 total egg data points in the data. Of these, 3822 were found to be regular eggs, which added up to 70.1%. The specialty eggs had 1633 points in the data, putting it at 29.9%.

After the brand information was identified, the next step was to merge the purchase information and trips information from the same Neilson Homescan panel. The 3822 regular egg brands were found to have a total of 500,340 purchases. The 1633 specialty egg brands had a total of 112,775 purchases. This means that of the total 613,115 purchases of eggs, 81.606% of the purchases are regular, and 18.394% are specialty according to the data. The households that

had no trips information were deleted, leaving 498,047 regular purchases and 111,807 specialty purchases to analyze. This changed the percentages to 81.67% regular and 18.33% specialty, not a significant change. Merging the trip data gives us the total number of trips that each household made for their total egg purchases, as well as the amount that the household spent on their purchases. Using this data, we are able to determine the market penetration for eggs in general, specialty eggs, regular eggs, and both regular and specialty. This information is shown in Table 1 below.

Household demographic information was then added to the data. This data was used in the regression analysis of this research. We merged four separate dataset with the panelist info: All households that purchased eggs, households that purchased only regular eggs, households that purchased only specialty eggs, and households that purchased both regular and specialty eggs. The final analysis was done on the dataset that included all of the households that purchased eggs. The different household classifications were kept distinct with dummy variables that indicated with a 0 or 1 whether the household made that particular purchase (eggs, specialty only, regular only, or both). Additional dummy variables indicated the prices per dozen that each household spend on their eggs. A weighted average of the eggs was used if the household bought both regular and specialty. This involved taking the sum of the dozens of regular eggs purchased and the dozens of specialty eggs purchased, then dividing by the sum of the amount spent on regular eggs and the amount spent on specialty eggs. This gave us a weighted average of the total eggs purchased by the household.

Methodology

Regressions were then run on the price of eggs for households that bought any type of eggs, the price of regular eggs, the price of specialty eggs, and the weighted average of the price

of eggs in households that purchased both. The variables that were used to find the price were household income, household size, and the region the household is located. The regression was done using a 95% confidence interval. This step was conducted to forecast prices for those households that did not purchase aforementioned types of eggs. These forecasted prices were used in the next set of regressions that generated household's propensity to purchase eggs, done through the probit model. The regression results are found in Table 2.

The PROBIT procedure calculates maximum likelihood estimates of regression parameters. Many response variables are binary by nature (yes/no), as is the case in this study for each probit regression.

Following is a technical note on probit model and its estimation (borrowed from Dharmasena, 2010). A dichotomous dependent variable can be regressed on a host of explanatory variables (continuous or discrete) to obtain an index value for each observation, where the index value is Z_i, i.e. Z_i where $Z_i = X'\beta$. In this equation, explanatory variables are depicted by X and associated regression coefficients are represented by β. This index value Z_i lies on the real number line between negative infinity and positive infinity, i.e. $-\infty < Z_i < \infty$. However, we regressed a variable that had only two outcomes, thus, 0 for non-purchase and 1 for purchase. This index value, Z_i, puts us out of the range giving predictions that are positive and negative and does not fall in to 0-1 range. If we squeeze our index values through a standard normal cumulative distribution function, $F_P(Z_i)$, we get at probabilities that are bounded by 0-1 interval, hence giving rise to probit model. Therefore, probit model can be depicted as follows:

$$P_i = F_P(X_i'\beta) = F_P(Z_i) = \int_{-\infty}^{Z_i} \frac{1}{\sqrt{2\pi}} e^{Z_i^2/2}\, ds \qquad (1)$$

hence we can write, for our dichotomous event,

$$\Pr(Z = 1 \mid X, \beta) = F_P(Z_i) \qquad (2)$$

$$\Pr(Z = 0 \mid X, \beta) = 1 - F_P(Z_i) \qquad (3)$$

Unknown parameters β in the above probit model are estimated via maximum likelihood estimation technique (maximizing a log-likelihood function and obtaining β s at the maximum of log-likelihood function)[2].

Let us take a sample of *n* individual observations (in our study this is *n* number of households who purchased eggs, regular and/or specialty) on individual choices y_i. First step toward the maximum likelihood estimation of unknown parameters β of the probit model is to specify probability density functions of the observable variables y_i. They can be specified as follows:

$$g(y_i) = P_i^{y_i}(1 - P_i)^{1-y_i} \qquad (4)$$

Maximum likelihood estimation is based on the following relationship. Joint probability density function of the sample of *n* independent observations is the product of the *n* probability density functions $g(y_i)$. Mathematically,

$$g(y_1, y_2, y_3, ..., y_n) = \prod_{i=1}^{n} g(y_i) \qquad (5)$$

Substituting (4) in (5) gives us the following:

$$g(y_1, y_2, y_3, ..., y_n) = \prod_{i=1}^{n} P_i^{y_i}(1 - P_i)^{1-y_i} \qquad (6)$$

However, we know that

$$P_i = F_P(Z_i) = F_P(x_i'\beta) \qquad (7)$$

[2] We use maximum likelihood estimation technique because of discrete nature of dependent variable, and the nonlinear in the parameters functional relation between choice probability and the explanatory variables.

Substituting (7) in (6) gives us the following likelihood function;

$$g(y_1, y_2, y_3, ..., y_n) = \prod_{i=1}^{n} F_P(x_i'\beta)^{y_i}[1 - F_P(x_i'\beta)]^{1-y_i} \qquad (8)$$

$$l(\beta) = \prod_{i=1}^{n} F_P(x_i'\beta)^{y_i}[1 - F_P(x_i'\beta)]^{1-y_i} \qquad (9)$$

In probit model estimation either the researcher can maximize (9) and solve for β s or can maximize the log of the likelihood function stated below (equation 10):

$$l(\beta) = \sum_{i=1}^{n} y_i \ln(F_P(x_i'\beta)) + \sum_{i=1}^{n}(1 - y_i)\ln(1 - F_P(x_i'\beta)) \qquad (10)$$

Above maximum likelihood estimator for probit model has large sample properties where, with large *n*, the maximum likelihood estimator $\hat{\beta}$ has a sampling distribution that is approximately normal with mean β and covariance matrix

$$\text{cov}(\hat{\beta}) = (X'DX)^{-1} \qquad (11)$$

where *X* is the $(n \times k)$ design matrix of observations on *k* explanatory variables for *n* individuals. Design matrix has diagonal elements as depicted in equation 12 below.

$$d_i = \frac{[f(x_i'\beta)]^2}{F(x_i'\beta)[1 - F(x_i'\beta)]} \qquad (12)$$

Where $f(x_i'\beta)$ and $F(x_i'\beta)$ are the probability density function and cumulative distribution function for standard normal random variable, respectively.

The explanatory variables that were used for the probit model were: price, income, household size, race (Black, White, Asian, Other), Hispanic, education (no high school, high school graduate, some college, college graduate), age (under 35, 36-50, 51-75, 75 plus), child presence, employment (part-time, full-time, not-for-pay), and region (New England, Mid-Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South

Central, Mountain Region, Pacific Region). We chose a base category for all of the discrete variables. The base category for race was white, the base for education was no high school, the base for age was under 35, the base for employment was not-for-pay, the base for Hispanic is the household being Hispanic, the base for child is the household having a child presence, and the base for region was New England (Maine, Vermont, New Hampshire, Massachusetts, Connecticut and Rhode Island). All continuous variables, income, price and household size were converted into natural logarithm since it improved the model fit and statistical significance of parameter estimates.

Results and Discussion

The 2015 Neilsen Homescan data contained a total of 61,380 households. Of those households, 56,697 bought eggs at some point during 2015. The market penetration for eggs is therefore found to be 92.4%. The market penetration for household that only purchase regular eggs out of those who bought eggs (conditional sample) was found to be 59.2%, a total of 33,571 households. The market penetration for households that purchased only specialty eggs out of those who bought eggs was found to be 6.7%, a total of 3,811 households. The market penetration for households that purchased both regular and specialty out of those who bought eggs was found to be 32.1%, a total of 19,315 households. Households that purchased only regular eggs bought an average of 14.3 dozen eggs at an average price of $2.22 per dozen. This means that the household spent an average total of$31.62 on regular eggs in 2015. Households that purchased only specialty eggs bought an average of 9.4 dozen eggs at an average cost of $3.44 per dozen. This means that the specialty households spend an average of $32.53 on eggs in 2015. Households that purchase both regular and specialty bought an average of 12.7 dozen regular eggs and 5.9 dozen specialty eggs at an average price of $2.33 per dozen for regular eggs

and $3.08 per dozen on specialty eggs. This means that the households that bought both regular and specialty spent a total average of $47.76 in 2015. This market penetration information, along with price paid for each type of egg is shown in Table 1. From this information we can see that although households that purchase only regular eggs buy more eggs, they spend about the same amount as households that buy only specialty eggs. However, the households that spend the most on eggs are those that purchase both regular and specialty eggs. It is also noteworthy that the average price per dozen of specialty eggs are higher in the households that purchase only specialty eggs compared to households that purchase both. This indicates that the households buying only specialty are the most willing to pay the premium prices for specialty eggs, while households that purchase both do not place as much importance on buying specialty eggs.

Also, we used probit model analysis to identify the demographic information of the different egg groups in terms of their propensity to buy. Using the data, we found that an increase in the price of eggs makes the household less likely to purchase eggs. This is consistent with the economic theory of demand, which states, "As the price of a good increases, the quantity demanded of that good decreases". The same rules applied to an increase in the price of regular eggs and the weighted average of both eggs. However, the price of specialty eggs behaved differently than the rest. An increase in the price of specialty eggs makes consumers of those products more likely to purchase them. This is due to the premium nature of specialty eggs, known as a luxury or Giffin good. Rather than seeing a decrease in demand, these products benefit from price increases because the consumers of these products perceive a higher price as a higher quality, which is the typical desire of specialty consumers.

An increase in household size makes the household more likely to buy eggs, more likely to buy only regular eggs, more likely to buy both regular and specialty, and less likely to buy

only specialty eggs. So more household members may make it necessary for a household to purchase eggs, but there is not a priority for those households to buy only specialty eggs. An increase in income was found to make a household more likely to purchase eggs, less likely to purchase only regular eggs, more likely to purchase both regular and specialty, and more likely to purchase only specialty eggs. This shows marketers that an increase in income not only indicates a household will buy more eggs, but will specifically have a greater chance of purchasing specialty eggs.

Race was not found to be a significant factor in the purchase of eggs in general. However, the results did show that when compared to the White population, the Black population was less likely to purchase only specialty eggs, and the Asian population was more likely to purchase only specialty eggs.

Compared to no high school education, both high school graduates and those with some college education were found to be more likely to purchase eggs. College graduates were less likely to purchase only regular eggs, and more likely to purchase only specialty eggs. This could indicate that more education leads to healthier buying habits, or it could be an association that higher education has to an increase in income, correlating the results.

The only significant results that could be found on age was that consumers under 35 years old are more likely to purchase eggs than 36-50 year olds, and consumers over 75 are the most likely to purchase eggs in general. The group that is most likely to purchase specialty eggs is the under 35 age group. This could be due to the emerging health trends that have become popular in the millennial generation.

The presence of a child was shown to make it less likely for a household to purchase eggs, more likely to only purchase regular eggs, and less likely to purchase both regular and

specialty eggs. So households with children, in the instance that they do purchase eggs, would most likely buy regular eggs.

Consumers who work not-for-pay were found to be most likely to purchase eggs. When compared to not-for-pay employees, full time workers are more likely to purchase only regular eggs, and part time workers are more likely to purchase only specialty eggs. These results could be associated with the fact that younger people purchase only specialty eggs, which is usually when part time employment would be more common.

The region that was found to be the most likely to purchase specialty eggs was the Pacific region (Alaska, California, Hawaii, Oregon, and Washington). However, the Pacific region is less likely than the other regions to buy eggs in general and less likely to buy only regular eggs. The other regions in the data are similar in their results when it comes to regular and specialty eggs.

Conclusions and Recommendations

Based on the results from the probit models, we are able to develop a consumer profile for those that are most likely to purchase and consume only specialty eggs. We can develop similar profiles for those that buy eggs in general, only regular eggs, and both regular and specialty. However, the purpose of this research is specifically directed to benefit the marketers of specialty eggs, and will be the main focus. Table 3-6 below show the probit regression results. These tables are followed by a table of explanations of the different variables used in the probit analysis. The results show that producers and marketers of specialty eggs would benefit the most by placing their products in locations that have not only a higher income level, but ones in which the income level is increasing. They should also market their products in areas with a young population and small average household sizes. An area that has a higher percentage of single

adults or young couples would be most desirable. It is probable that these areas would also have a smaller number of children, which is another characteristic that matches the profile for a specialty egg consumer. This was the most surprising result from the data. Intuition would suggest that a household would make an attempt to purchase healthier products in the presence of a child, but this was not the case for specialty eggs. It could be that specialty eggs are too expensive for the average household with children. It is more economical for parents to spend less per dozen by purchasing regular eggs. Consumers with higher levels of education were found to be more likely to purchase specialty eggs, so areas with high level of education or towns where colleges are located would be the best places to sell specialty eggs. They should also be marketed in places that have a high level of part time employment. College towns could fit this description. The area of the country that is best to market specialty eggs is the Pacific region. These states include California, Hawaii, Washington, Alaska, and Oregon. Producers of specialty eggs can use this information to market their products in the areas that will create the most sales revenue and create the most profit.

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Table 1: Market Penetration for Eggs, Regular Eggs, Specialty Eggs, and Both Regular and Specialty Eggs

Categories	Total Households	Households Purchased	Market Penetration	Quantity Purchased (Doz)	Average Price ($/Doz)
Purchased Eggs	61,380	56,697	92.37%	15.41	$2.41
Regular Eggs Only	56,697	33,571	59.21%	14.3	$2.22
Specialty Eggs Only	56,697	3,811	6.72%	9.4	$3.44
Regular and Specialty Eggs	56,697	19,315	32.07%	18.6	$2.71

Sources: Calculated by authors

Table 2: Price Imputation Regression Results for Households that Purchased Eggs, Regular Eggs Only, Specialty Eggs Only, and Both Regular and Specialty Eggs

Variable	Eggs		Regular Eggs Only		Specialty Eggs Only		Regular and Specialty	
	Parameter Estimate	P-Value	Parameter Estimate	P-Value	Parameter Estimate	P-Value	Parameter Estimate	P-Value
Intercept	2.86646	<.0001	2.7605	<.0001	3.49689	<.0001	2.8385	<.0001
income	3.10E-06	<.0001	8.05E-07	<.0001	5.25E-06	<.0001	3.00E-06	<.0001
household_size	-0.0487	<.0001	-0.0182	<.0001	-0.10417	<.0001	-0.0528	<.0001
NewEng	-0.1636	<.0001	-0.2761	<.0001	-0.23	<.0001	-0.0028	0.7073
MidAtl	-0.2539	<.0001	-0.3549	<.0001	-0.21091	<.0001	-0.0897	<.0001
EaNCen	-0.6987	<.0001	-0.6749	<.0001	-0.2566	<.0001	-0.5123	<.0001
WeNCen	-0.5833	<.0001	-0.483	<.0001	-0.44617	<.0001	-0.521	<.0001
SouAtl	-0.4292	<.0001	-0.4957	<.0001	-0.13915	<.0001	-0.1547	<.0001
EaSCen	-0.6007	<.0001	-0.5895	<.0001	-0.21582	<.0001	-0.3699	<.0001
WeSCen	-0.5645	<.0001	-0.5901	<.0001	-0.10216	<.0001	-0.3449	<.0001
Mount	-0.4733	<.0001	-0.5187	<.0001	-0.02873	<.0001	-0.2558	<.0001

Sources: Calculated by authors

Table 3: Probit Regression Results for Households That Purchased Eggs

Eggs		
Parameter	**Estimate**	**p-value**
Intercept	0.023943	0.8587
ln_Price_Eggs	-0.266405	<.0001
ln_household_size	0.467205	<.0001
ln_income	0.120903	<.0001
Black	0.026133	0.304
Asian	-0.079287	0.0554
Other	-0.023192	0.5547
hispanic	0.024099	0.5029
hs_grad	0.11491	0.0326
some_college	0.105266	0.0492
college_grad	0.00229	0.9658
Age36to50	-0.075796	0.0397
Age51to75	0.033717	0.3437
Age75plus	0.189426	<.0001
child	-0.1242	<.0001
emphhpt	-0.061434	0.0059
emphhft	-0.123688	<.0001
MidAtl	0.082039	0.0397
EaNCen	0.095178	0.0154
WeNCen	0.055607	0.199
SouAtl	0.119691	0.0017
EaSCen	0.121918	0.0098
WeSCen	0.141612	0.0008
Mount	0.050583	0.2513
Pacif	-0.185923	<.0001

Sources: Calculated by authors

Table 4: Probit Regression Results for Households That Purchased Regular Eggs Only

Regular Eggs Only		
Parameter	**Estimate**	**p-value**
Intercept	1.774503	<.0001
ln_Price_RE	-0.614145	<.0001
ln_household_size	0.115386	<.0001
ln_income	-0.125985	<.0001
Black	0.033355	0.0511
Asian	-0.187399	<.0001
Other	-0.089669	0.0008
hispanic	-0.046754	0.0475
hs_grad	-0.000423	0.9909
some_college	-0.063191	0.0871
college_grad	-0.151203	<.0001
Age36to50	-0.016285	0.5107
Age51to75	0.031563	0.19
Age75plus	0.052761	0.0797
child	0.041995	0.021
emphhpt	-0.004914	0.7395
emphhft	0.067973	<.0001
MidAtl	-0.042743	0.1181
EaNCen	0.284344	<.0001
WeNCen	0.274601	<.0001
SouAtl	0.260665	<.0001
EaSCen	0.378488	<.0001
WeSCen	0.246	<.0001
Mount	0.212442	<.0001
Pacif	-0.15909	<.0001

Sources: Calculated by authors

Table 5: Probit Regression Results for Households That Purchased Specialty Eggs Only

Specialty Eggs Only		
Parameter	**Estimate**	**p-value**
Intercept	-3.226266	<.0001
ln_Price_SE	0.013077	0.821
ln_household_size	-0.247053	<.0001
ln_income	0.180069	<.0001
Black	-0.147752	<.0001
Asian	0.105978	0.0078
Other	-0.015279	0.7149
hispanic	-0.052533	0.1559
hs_grad	-0.012474	0.8527
some_college	0.068368	0.3047
college_grad	0.207533	0.0017
Age36to50	0.004836	0.8978
Age51to75	-0.136023	0.0002
Age75plus	-0.179811	0.0001
child	0.012052	0.6799
emphhpt	0.065301	0.0049
emphhft	-0.0251	0.2104
MidAtl	-0.129876	0.0015
EaNCen	-0.284686	<.0001
WeNCen	-0.305002	<.0001
SouAtl	-0.163111	<.0001
EaSCen	-0.2394	<.0001
WeSCen	-0.178331	<.0001
Mount	-0.125022	0.006
Pacif	0.240663	<.0001

Sources: Calculated by authors

Table 6: Probit Regression Results for Households That Purchased Both Regular and Specialty Eggs

Both Regular and Specialty		
Parameter	**Estimate**	**p-value**
Intercept	-1.620386	<.0001
ln_Price_Both	-0.701488	<.0001
ln_household_size	0.112858	<.0001
ln_income	0.176646	<.0001
Black	0.027714	0.1185
Asian	0.110712	0.0002
Other	0.097219	0.0004
hispanic	0.087652	0.0003
hs_grad	0.048734	0.2106
some_college	0.094946	0.0144
college_grad	0.098776	0.0109
Age36to50	-0.024105	0.3486
Age51to75	0.016929	0.4989
Age75plus	0.076282	0.0145
child	-0.103057	<.0001
emphhpt	-0.040601	0.0079
emphhft	-0.111645	<.0001
MidAtl	0.079793	0.0041
EaNCen	-0.414195	<.0001
WeNCen	-0.357967	<.0001
SouAtl	-0.269041	<.0001
EaSCen	-0.461376	<.0001
WeSCen	-0.321174	<.0001
Mount	-0.287136	<.0001
Pacif	0.014203	0.6149

Sources: Calculated by authors

Table 7: Explanations of the Probit Regression Variables

Variable Explanations	
ln_Price_Eggs	natural log of the price of eggs
ln_Price_RE	natural log of the price of regular eggs
ln_Price_SE	natural log of the price of specialty eggs
ln_Price_Both	natural log of the weighted average of both regular and specialty eggs
ln_household_size	natural log of the size of the household
ln_income	natural log of the size of the income of the household
Black	race compared to base variable of White
Asian	race compared to base variable of White
Other	race compared to base variable of White
hispanic	race compared to base variable of Not Hispanic
hs_grad	education compared to base variable of No High School
some_college	education compared to base variable of No High School
college_grad	education compared to base variable of No High School
Age36to50	age compared to base variable of Under 35
Age51to75	age compared to base variable of Under 35
Age75plus	age compared to base variable of Under 35
child	child presence compared to base variable of No Child
emphhpt	employment compared to base variable of Not-For-Pay employment
emphhft	employment compared to base variable of Not-For-Pay employment
MidAtl	region of United States compared to base variable of New England
EaNCen	region of United States compared to base variable of New England
WeNCen	region of United States compared to base variable of New England
SouAtl	region of United States compared to base variable of New England
EaSCen	region of United States compared to base variable of New England
WeSCen	region of United States compared to base variable of New England
Mount	region of United States compared to base variable of New England
Pacif	region of United States compared to base variable of New England

Sources: Developed by authors