Consumer Characteristics Influencing the Consumption of Nut-containing Products

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The study estimates the influence of consumer characteristics on the consumption of four nut-containing products, that is, the consumption of nuts as a snack, in salads, covered in chocolate, and in ice cream. Gender, age, and education are among the characteristics that frequently influence nut consumption. Female, older, and non-white respondents consumed nuts as a snack more often than male, younger, and white consumers did. Chocolate-covered nut consumption was associated with higher income and rural consumers while nut-flavored ice cream was consumed more frequently by older rather than younger respondents and respondents from larger households.

Introduction

Nuts have contributed to the human diet for thousands of years (Woodroof, 1979). Modern agriculture reduced humans' dependency on nuts as a food source, but nuts remain an important component of the human diet. Despite variable production, the domestic per capita consumption of nuts and nut products increased sharply between 1977, and the volume consumed stabilized at the level of about 2.2 pounds per capita annually (Figure 1).

Past studies have examined demand and supply for a specific nut (Nuchols, 1963; Mo, 1965; and Dhaliwal, 1972), nut marketing order (Loyns, 1968) and the international tree nut trade (Farrell, 1964; Bushnell and King, 1984). Since the completion of these studies, several new issues have emerged. Changing lifestyles and increased health concerns are forcing changes in food production, processing, and the distribution system. Increasing incomes have led to changing consumption patterns influenced by the widely available information about food and food eating habits in other regions and countries. Regional dishes, ethnic cuisine, and modern variations, which combine traditional fares and new ingredients, have expanded the uses of edible nuts. The popularity of Mediterranean cuisine—especially Italian dishes, Spanish, Middleastern, and Provençal cooking—has been especially important for edible nut industries because many of these dishes contain nuts. However, no research study has addressed the consumption of edible nuts in specific forms, or food products.

This study identifies consumer characteristics that influence the frequency and form of nut consumption. The preference for a particular nut product is hypothesized to be affected by the demographic and socioeconomic characteristics of consumers. This objective is accomplished by developing a random utility maximization consumption model. The analysis, based on data from a nationwide nut consumption survey, provides insights into the factors influencing nut consumption. Results of this study fill a gap in the existing literature written on the subject of edible nut consumption.

The food pyramid—based on the Dietary Guideline for America developed by the U.S. Department of Agriculture (USDA) to promote healthy eating habits—advocates the moderate use of edible nuts. Nuts are classified in the same segment that includes meals. To facilitate the simple communication of dietary guidelines to the food industry and consumers, a food pyramid was developed. This graphic presentation of nutritional importance and consumption frequency was based on the average American diet. Some experts, however, argue that the food pyramid is not a uniform concept for all cultures or ethnic groups and that the relative importance of some types of food varies. Specifically, edible nuts are used most frequently in dishes originating from the Mediterranean countries, and Asian dishes more frequently contain edible nuts than the typical American diet does. These differences are related to the varied use of meat, fats, and oils by people in various parts of the world. Furthermore, various edible nut uses, based on regional and ethnic cooking, include dishes that mix vegetable, dairy, meat, grain, and fruit ingredients. Edible nuts can

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Figure 1. Per Capita Edible Nut Consumption in the United
States, 1975/76 through 1994/95.
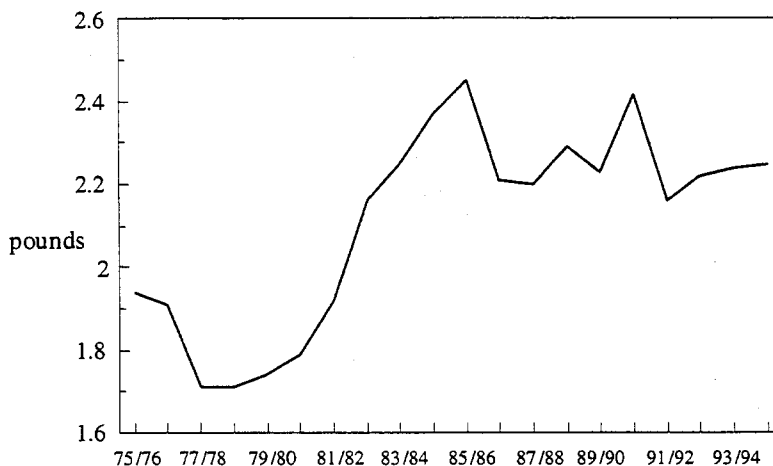
Source: USDA/ERS (1995).

also be substituted for animal fat and protein in vegetarian diets.

Dietary recommendations (based on the food pyramid) have been popularized and used in the promotion of selected food groups. Consumers have recognized that the benefits of eating some foods extend beyond satisfying hunger and/or enjoying taste. However, the awareness of scientific evidence, which links nutritional needs and health maintenance from eating edible nuts, has been limited because such studies are relatively new. Several studies provide evidence that edible nuts may lower the risk of coronary heart disease associated with the presence of cholesterol in animal products. Dutch healthcare providers recommended that animal and hard or hardened plant fats should be substituted by polyunsaturated and monounsaturated fats (Erkelens, 1989) found in edible nuts. Another study (Fraser et al., 1992) concluded that frequent nut consumption may protect against coronary heart disease. A six-year study of walnut consumption concluded that eating moderate quantities of walnuts decreased serum cholesterol levels in normal men on a cholesterol-lowering diet (Sabate et al., 1993). An Australian study (Abbey et al., 1994) provided further evidence—on the benefits of eating nuts in lowering the risk of the coronary heart disease—that directly compared the effects of eating walnuts and almonds. A recent study provided preliminary evidence about a potentially beneficial effect of including pecan

meal in the swine diet on serum lipids in animal experiments (Dove, Worley, and Dove, 1995). This study and studies of other edible nuts led to the initiation of a nutritional study of pecans with human subjects.

Edible nuts satisfy consumer desire for variety, can have beneficial health effects, and fit into today's lifestyles, emphasizing convenience and reflecting the perceived lack of time for food preparation. With decreasing cooking skills and a lower frequency of in-home meal preparation, nuts offer an attractive solution in snacks, desserts, and salads. Edible nuts can be served in different forms—for example, raw, roasted, salted, and in different sizes (that is, whole, halves, or pieces). Furthermore, just a few nuts can add or enhance the flavor of many dishes, turning an ordinary dish into a festive fare. The ease of serving and versatility in use coincide with the many consumers' expectations concerning taste, convenience, and variety.

The knowledge of factors that influence the frequency of edible nut consumption and the form of dishes that contain nuts can improve the ability of growers, shellers, handlers, end users, nutritionists, and health providers to understand the current behavior of consumers. Knowledge of the relationships between consumption frequency, the type of dishes or products, and consumer characteristics will enable the interested groups to make informed decisions about product development using edible nuts,

strengthen promotion efforts, and identify needs in consumer education concerning the use of edible nuts. By learning about consumer nut-eating habits, growers and shellers can become more responsive by providing the volume and quality of nuts suitable for specific uses, while food manufacturers can efficiently target product development, which has been a limiting factor in edible nut sales. Finally, given the nutritional and health benefits of edible nuts, dieticians can design dishes that contain nuts yet meet the recommended dietary standards required for maintaining health.

Theoretical Framework

The theoretical framework for this study is random utility maximization (McFadden, 1974). The consumer maximizes personal satisfaction by choosing among available alternatives (Eastwood, 1985). Consider a random sample of N individuals, indexed $n = 1, 2, ..., N$. Each individual—facing a set of B discrete alternatives where B is indexed $b = 1, 2, 3, ..., B$—is said to maximize utility by choosing one alternative from the available set. Each alternative b provides the nth consumer a specific amount of utility, U_{bn}. Different consumers may derive different levels of utility from the same alternative because the utility is subjective. That is, for a specific alternative b, it is possible that $U_{bn} \neq U_{bk}$, where n and k denote two different consumers.

The maximum utility that an individual can derive from consuming an alternative b can be written as

$$(1) \qquad U_{bn} = U(S_n),$$

where U_{bn} is the maximum utility attainable to individual n when he chooses to consume alternative b and S_n is a vector of J observed attributes associated with individual n. In this study, S_n represents a vector of J consumer attributes, such as age, gender, marital status, and educational attainment. This vector is considered to affect the utility that a consumer can attain from consuming a particular nut product. For the purpose of the empirical estimation, U_{bn} is postulated to be a linear function of S_n.

U_{bn} can be decomposed into deterministic and stochastic components. Let $f(S_n, \theta)$ denote the deterministic component and (ε_{bn}) denote the stochastic component. Then equation (1) can be rewritten as

$$(2) \qquad U_{bn} = f(S_n ; \theta) + \varepsilon_{bn},$$

where S_n and U_{bn} are as described before and θ is a vector of parameters associated with S_n.

In practice, consumers evaluate and compare the utility derived from consuming each available alternative. A rational consumer is expected to choose the alternative $c \in B$ if and only if it provides the highest utility. The utility-maximizing alternative can be expressed as

$$(3) \qquad U_{cn} \geq \max (U_{bn} \mid b = 1, 2, ..., B, \ b \neq c).$$

The probability that a consumer will choose the alternative c is

$$(4) \qquad P_{cn} = P[\ U_{cn} \geq \max (U_{bn} \mid b = 1, 2, ..., \ B, \ b \neq c)].$$

U_{bn} is unobservable but is reflected in the outcome of the consumer's decision. Let Y be the observed variable that is ordinal in nature. Denoting $Y = c$ when the individual chooses alternative c, an individual's choice function can be written as

$$(5) \qquad U_{bn} = X_n \beta + \varepsilon_{bn}.$$

In equation (5), U_{bn} is the unobserved dependent variable, which is approximated by a linear function of X_n; X_n is a matrix of explanatory variables composed of S_n in equation (2); β is a vector of unknown parameters to be estimated; and ε_{bn} is a vector of stochastic disturbances that are independently, identically, and normally distributed. Further, let $\mu_0, \mu_1, \mu_2, ..., \mu_B$ be category thresholds for the underlying response variables, where $\mu_1 \leq \mu_2 ..., \mu_{B-1} \leq \mu_B$; $\mu_0 = -\infty$ and $\mu_B = +\infty$.

With the above assumptions and conditions, the selection probability can be expressed as

$$(6) \qquad \begin{aligned} P_{bn} &= P(Y_n = b) \\ &= \Phi[(\mu_b - X_n \beta) / \sigma] - \Phi[(\mu_{b-1} - X_n \beta)/\sigma], \end{aligned}$$

where $\Phi(.)$ stands for the standard normal cumulative distribution function and σ is the standard deviation of the error terms. Since $B > 2$ discrete alternatives are available for choice, the above ordered probit model (equation 6) provides an appropriate technique for estimation.

However, equation (6) is underidentified. To identify the model, it is assumed, without loss of

generality, that $\mu_1 = 0$ and $\sigma = 1$. As a result, the log-likelihood function can be written as

$$\sum_{n=1}^{N} \sum_{b=1}^{B}$$

(7) $L(\beta, \mu_2, \mu_3, ..., \mu_{B-1}) = C_{bn} \log [\Phi (\mu_b - X_n \beta) - \Phi(\mu_{b-1} - X_n \beta)]'$,

where $C_{bn}=1$ if $\mu_{b-1} \le U_n \le \mu_b$ and $C_{bn}=0$ otherwise, $\mu_0=-\infty$, $\mu_1=0$, and $\mu_B= +\infty$. The value of the log-likelihood function can be maximized over the parameters β and the thresholds μ_b. The estimated values of β and μ_b can then be used to draw conclusions and implications.

Data and Preliminary Analysis

The general paucity of data regarding the consumption of edible nuts required the design and implementation of the data collection scheme. Due to cost considerations and following a well-accepted practice in empirical consumer research, the data was gathered through a mail survey. After the survey instrument was drafted, it was pretested on a small group of consumers. The self-administered nature of a mail survey required the elimination of the possible misunderstanding of questions leading to flawed answers. However, the pretest resulted only in minor editorial changes and the questionnaire was mailed nationwide in the summer of 1993. The timing of the survey implementation avoided the holiday season, the primary period of marketing edible nuts. Therefore, the expected answers were indicative of consumption outside the traditional time and generated knowledge that can be used to lower the dependence on holiday sales, a limitation frequently mentioned by retailers and the edible nut industry.

The mailing list used in the survey was provided by two companies located in the southeastern United States. The in-kind assistance from the industry allowed the survey to be conducted and the expenses to be minimized. The selection of respondents from company databases occurred at random, but at even intervals; for example, a firm could draw every fifth address. The final list was a combination of addresses obtained from both companies. Because the companies were involved in the nationwide business operation, the sample was presumed to accurately reflect the population of edible nut consumers.

The first mailing of the questionnaire was followed by a postcard, which served as a reminder. The postcard also thanked those who had already returned their completed questionnaires for their cooperation. The second mailing addressed to nonrespondents followed after two weeks. Both mailings of the questionnaire included pre-addressed and postage-paid envelopes for easy return. The questionnaires were initially mailed to 861 consumers; however, 111 consumers could not be reached because of address changes and the lack of forwarding addresses. A total of 430 completed, usable questionnaires were returned, a response rate of 57.3 percent. A third mailing of the questionnaire is recommended for mail surges, (Dillman, 1978) but given the focus of this survey and cost constraints, the total number of returns was considered adequate.

In the survey, a question asked the participants how often they ate nuts in specific forms. Responses to this question were of particular interest to this study. In a separate part of the questionnaire, respondents were asked about their sociodemographic characteristics. Specific information was collected about respondents' educational attainment, gender, age, ethnic background, place of residence, gross annual household income, family size, and employment status. Compared with that of the U.S. Census, the sample had a similar percentage of individuals with some college or college degree (19.5 percent in the sample versus 22.1 percent in the U.S. Census); widowed persons; urban and rural residents, but relatively more respondents were older than was indicated by Census results.

Table 1 summarizes the frequencies of nut consumption in different forms. The summary of responses suggests that nuts as a snack were consumed more frequently than other nut products; chocolate-covered nuts were next, followed by nuts in ice cream and nuts in salads.

Only a small percentage of consumers reported eating any nut product daily. Therefore, in the empirical analysis, the frequencies referring to daily and weekly consumption were combined into a single category "at least once a week." Similarly, the reported consumption of "once a year" was considered rather infrequent and combined with responses marked in the category "never." Hence, the final number of categories used to classify dependent variables was four.

Ordered Probit Estimation Results

Four dependent variables (Table 2) were created using responses to a question concerning frequencies of nut consumption in specific forms.

Table 1. Consumption Frequencies of Nuts in Different Forms.

| Form of Consumption | Frequency of Consumption | | | | | |
	Once a Day	Once a Week	Once a Month	Once in Few Months	Once a Year	Never
	--percent--					
As a snack	10.8	44.3	24.8	15.4	2.2	2.4
In salads	1.8	13.7	22.8	28.6	9.6	23.5
Chocolate-covered	3.0	26.5	31.8	24.0	8.8	6.0
With ice cream	2.2	14.7	26.9	32.0	13.2	11.0

Table 2. Definitions and Descriptive Statistics of Dependent Variables.

Variable Name[a]	Code Definition	Number of Observations	Minimum Value	Maximum Value	Mean	Standard Deviation
Snack	0 if at least once a week 1 if once a month 2 if once in few months 3 if once a year or never	415	0.000	3.000	0.69	0.89
Salad	0 if at least once a week 1 if once a month 2 if once in few months 3 if once a year or never	395	0.000	3.000	1.79	1.07
Chocolate	0 if at least once a week 1 if once a month 2 if once in few months 3 if once a year or never	400	0.000	3.000	1.24	1.03
Ice cream	0 if at least once a week 1 if once a month 2 if once in few months 3 if once a year or never	409	0.000	3.000	1.64	1.03

[a]Variable names are abbreviated names of the consumption forms listed in Table 1.

Frequencies of consuming nuts in different forms were hypothesized to be affected by demographic and socioeconomic characteristics of consumers. The demographic and socioeconomic characteristics include educational attainment, gender, age, place of residence, race, the annual household gross income, household size, and employment status. Definitions and descriptive statistics of the independent variables are provided in Table 3.

The four equations were estimated using the ordered probit approach (Maddala, 1983). The dependent variable is the utility derived from nut consumption. Although utility is unobservable, it is reflected in the reported frequency of nut consumption. This utility increases in the direction opposite to the sign of the estimated coefficient because of the applied coding of the consumption frequency (see Table 2). This approach does not change the estimated coefficients and the size of marginal probabilities.

Nuts as a snack. The results suggest different nut-snacking habits between genders (Table 4). Males were more likely to eat nuts as a snack than were female respondents. Snacking nuts are a convenient, ready-to-eat product; however, recent retail reports indicate that the consumption of snacking

Table 3. Definition and Descriptive Statistics of Independent Variables.

Variable Name	Code Definition	Mean	Std. Dev.	Min. Value	Max. Value
Education	Actual number of years of schooling reported by participants	14.77	2.63	7	24
Female	Male = 0, female = 1	0.65	0.47	0	1
Age	Actual age of the participants	58.67	13.80	21	90
Rural resident	Urban = 0, rural = 1	0.319	0.467	0	1
Nonwhite	White = 0, nonwhite = 1	0.05	0.23	0	1
Income	1 if annual household gross income was less than $10,000 2 if annual household gross income was from $10,000 to $19,999 3 if annual household gross income was from $20,000 to $29,999 4 if annual household gross income was from $30,000 to $39,999 5 if annual household gross income was from $40,000 to $49,999 6 if annual household gross income was from $50,000 to $59,999 7 if annual household gross income was from $60,000 or more	5.10	1.84	1	7
Single	1 if one person in the household; 0 otherwise	0.12	0.32	0	1
Employment status	1 if retired, disabled, or not employed 0 if employed full time, part-time, or a student	0.51	0.50	0	1

Table 4. Ordered Probit Estimation Results for the Equation Representing the Frequency of Consuming Nuts as a Snack.[a]

Variable	Estimated Coefficient	Asymptotic t-ratio	P-value
Constant	-0.1060	-0.167	0.8621
Education	0.0321	1.164	0.2445
Female	0.3672	2.673[b]	0.0075
Age	-0.0121	-1.689[b]	0.0911
Rural resident	0.0511	0.360	0.7190
Income	-0.0190	-0.450	0.6527
Nonwhite	-0.3939	-1.456	0.1453
Single	0.2365	0.245	0.3335
Employment status	-0.0089	-0.044	0.9647
Mu (1)	0.7762	10.430[b]	0.0000
Mu (2)	1.6017	12.324[b]	0.0000

[a]For the coding of the dependent variable values, see Table 2.
[b]Significant at $\alpha = 0.1$.

nuts has been decreasing. Although the motives may differ between genders (for example, men may be concerned about the fat content while women may be concerned about their energy level), it is possible that both genders perceive nuts as high in fat and thus choose to limit their consumption.

Age had a significant and positive effect on the consumption of nuts as a snack. Consequently, older consumers tend to eat snacking nuts more often than younger consumers do. Research news describing the benefits from eating an adequate volume of vitamin E, which is found in relatively large volumes in nuts, may provide a justification for the consumer behavior. However, consumers may not be willing to exchange one type of snack for another but may add a new snack to the food they already consume. Older consumers lead a different lifestyle than younger consumers, and the type of lifestyle may influence this result. Additional studies that may link lifestyle, disposable income, and consumption frequency may help to better understand the identified relationship.

Although statistically not significant at the predetermined probability level, the role of the ethnic background in snacking nut consumption is justified because of the importance of nuts in the diets of various ethnic groups. According to the sign of the estimated coefficient, non-white consumers were more likely to eat nuts as a snack than white consumers were. The comparison of the average income levels across ethnic groups suggests that non-white households trace white households; therefore, it is difficult to attribute the preference for edible nuts among non-whites to income. The income variable is insignificant. However, because the non-white population in this study consists, among others, of Asians and Hispanic respondents, it is likely that these groups, which use nuts more frequently in cooking than do whites, influence this result.

Nuts in salads. Nuts have been used in salads primarily in ethnic cuisine. However, over time a few recipes were developed that popularized the use of nuts as an ingredient in salads and vegetable side dishes that have become widely accepted by the public, for example, toasted almonds and green beans. The use of nuts in salads is not limited by the eating qualities of nuts but rather the nontraditional nature of such use. Nuts are marketed during the holiday season, during which the focus is on other dishes with nuts being used primarily in baked desserts. According to the results of this study, age

and education were the two significant factors influencing the frequency of nut consumption (Table 5).

Both variables represent knowledge; the age signifies experience reflecting the accumulated knowledge acquired over time. Education represents formal knowledge gained through schooling. The role of consumer knowledge in accepting a new use of nuts in dishes may be essential for broadening their use and limiting the industry's dependence on holiday sales. Salads with nuts offer a nutritious alternative, and the volume of nuts used can be easily adjusted by consumers.

Nuts in chocolate. This form of a nut-containing product has old traditions. Chocolate-covered nuts or nuts contained in chocolate candy bars have been well-recognized snacks or desserts. Chocolate products that include nuts fall into the category of sweets and desserts in any of the food pyramids developed for the American, ethnic, or vegetarian dietary guidelines. The combination of sugar, chocolate—which also contains fat—and nuts makes the product high in calories while relatively poor in the desirable nutrients. The recommendation is to only eat such products occasionally.

According to the results, rural residents consumed nuts in chocolate more often than urban dwellers. This result may suggest that rural residents remain more traditional in their consumption behavior and choose a product that has been familiar to them for a long period of time. Moreover, rural residents may have limited access to other nut-containing products because the grocery stores serving rural populations may offer few alternatives.

Households with more than one member consumed nuts in chocolate more frequently than single households did. This suggests that, with the trend toward a larger number of single-person households, manufacturers of chocolate products containing nuts may have to modify their products. It is likely that the identified relationship reflects the presence of children in the household and influences the consumption frequency of the product. Chocolate products, including chocolate- covered nuts, are popular with children and some are especially advertised for a young audience.

The gross annual household income was not statistically significant, but its sign suggested that the consumption frequency of nuts in chocolate increased with higher income levels. Such a relationship could reflect the dichotomy of the chocolate-covered nut products that include various types of

Table 5. Ordered Probit Estimation Results for the Equation Representing the Frequency of Consuming Nuts in Salads.[a]

Variable	Estimated Coefficient	Asymptotic t-ratio	P-value
Constant	3.2582	5.078[b]	0.0000
Education	-0.0680	-2.577[b]	0.0010
Female	-0.1016	-0.736	0.4620
Age	-0.0172	-2.736[b]	0.0062
Rural resident	0.0363	0.279	0.7802
Income	-0.0475	-1.058	0.2903
Nonwhite	0.2822	0.863	0.3882
Single	-0.2716	-1.265	0.2060
Employment status	0.2160	1.249	0.2116
Mu (1)	0.7738	9.755[b]	0.0000
Mu (2)	1.5995	16.173[b]	0.0000

[a]For the coding of the dependent variable values, see Table 2.
[b]Significant at $\alpha = 0.1$.

nuts; less expensive nuts and more expensive nuts are used in different chocolate products retailed at various outlets frequented by different consumer groups. A future study of the consumption of nuts in chocolate could address the link between income and eating frequency.

Nuts in ice cream. Ice cream is among the most popular snacks and desserts in the United States. Its taste can vary because of the composition of ingredients used by manufacturers and the use of various toppings. The increased awareness of the health implications of ice cream consumption led to the development of ice cream with reduced animal fat content or sweetened with low-calorie sugar substitutes. Among the many ice cream varieties, several include edible nuts, and nut pieces are used in toppings. Estimation results identified a positive relationship between the frequency of nut consumption with ice cream and age (Table 7); the older the respondent, the more frequently he/she reported eating nut-flavored ice cream. Ice cream is easy to serve, but convenience alone will not likely explain the observed result. This result seems to support the results of two other equations that relate to the im-

portance of older consumers' attitudes toward different kinds of nut-containing products.

The consumption of nut-flavored ice cream also increased if the respondent was a member of a household larger than a single-person household. This result indicates the importance of convenience and possibly the presence of children. Large households can be demanding in terms of the amount of food that requires preparation, and ice cream is a ready-to-serve item. Ice cream with nuts broadens the variety and complements the consumption of other flavors. The relative perception of the nutritional value of ice cream may justify its frequent use by larger households because they include children.

Calculation of marginal effects. The estimated equations identified the socioeconomic and demographic characteristics that significantly influence the consumption frequency of selected nut-containing products. The coefficient estimates for the ordered probit models (Tables 4–7) are not identical to the effects of a specific explanatory variable on consumption frequency. The positive or negative variable-specific effect on any of the four consumption frequency categories (at least once a year,

Table 6. Ordered Probit Estimation Results for the Equation Representing the Frequency of Consuming Nuts in Chocolate.[a]

Variable	Estimated Coefficient	Asymptotic t-ratio	P-value
Constant	-0.0386	-0.065	0.9479
Education	0.0106	0.400	0.6894
Female	0.1953	1.425	0.1541
Age	0.0091	1.457	0.1451
Rural resident	-0.2425	-1.778[b]	0.0753
Income	-0.0620	-1.567	0.1170
Nonwhite	0.0454	0.180	0.8571
Single	0.4451	1.868[b]	0.0618
Employment status	0.1269	0.722	0.4704
Mu (1)	0.8619	11.499[b]	0.0000
Mu (2)	1.6801	16.125[b]	0.0000

[a]For the coding of the dependent variable values, see Table 2.
[b]Significant at $\alpha = 0.1$.

Table 7. Ordered Probit Estimation Results for the Equation Representing the Frequency of Consuming Nuts with Ice Cream.[a]

Variable	Estimated Coefficient	Asymptotic t-ratio	P-value
Constant	1.8897	2.947[b]	0.0032
Education	0.0253	0.996	0.3195
Female	0.1369	1.031	0.3027
Age	-0.0176	-2.759[b]	0.0058
Rural resident	-0.1597	-1.250	0.2115
Income	-0.0468	-1.187	0.2354
Nonwhite	-0.4098	-1.414	0.1573
Single	0.5273	2.519[b]	0.0118
Employment status	-0.1110	-0.628	0.5300
Mu (1)	0.9037	11.036[b]	0.0000
Mu (2)	1.8238	17.424[b]	0.0000

[a]For the coding of the dependent variable values, see Table 2.
[b]Significant at $\alpha = 0.1$.

week, monthly, once in a few months, once a year or never) is not known. This effect—called marginal effect—its sign, and its magnitude (for example, the marginal effect of education on monthly consumption of nuts in salads) are calculated separately for each consumption frequency category in all four equations and provide valuable information for the effective selection, design, and implementation of promotion programs.

To compare the effects of the different variables, we calculated the first derivatives (marginal effects) of the probability of choosing among the four categories representing the consumption frequencies for all statistically significant coefficients shown in Tables 4–7. A change in the sign of an explanatory variable marginal effect implies a shift in distribution, for example, a shift from the weekly to monthly consumption frequency of eating nuts as a snack. A shift away from one category represents a gain in another frequency category because the number of observations used for the model estimation was already determined. The sign of the marginal effect provides an accurate portrayal of losses and gains in each category of consumption frequency of nut-containing products with regard to consumer characteristics and, therefore, has important implications for the content and target of promotional effort.

The marginal effects calculated at the means of the explanatory variables are shown in Table 8. The sum of all marginal probabilities calculated for a specific variable (such as education) on the consumption frequency of nuts (such as in salads) is zero. The sum implies that a shift from one category of consumption frequency—for example, a shift from weekly to monthly consumption—represents a decrease in the number of respondents who consumed nuts weekly and an increase in the number of respondents who consumed nuts monthly in a specific form. Therefore, in general terms, a negative (positive) marginal effect on the probability of choosing a certain category implies a shift from (into) that category to (from) other categories.

The effect of gender was more pronounced in the consumption of nuts as a snack than it was for the other forms (Table 8). Female respondents were more likely to eat nuts as a snack once every few months or less frequently. Nuts as a snack may not appeal to women because of the high fat content and the occasion of eating snacking nuts. A closer look at the use of nuts as a snack is warranted in the

future because nuts are a snack that is convenient to serve and is used as an appetizer when entertaining guests at home. Therefore, although women may snack on nuts less often than males, they may buy them more often than is suggested by the reported consumption frequencies if they are responsible for purchasing decisions regarding this type of product.

Older respondents seem to be more frequent consumers of nut snacks and nuts in salads than younger consumers (Table 8). The distinction among age groups in promoting various forms of using nuts is important because generations could vary in their perceptions of edible nuts. These two uses of nuts also capture differences in lifestyles and purchasing patterns. In the United States, snacking nuts fit more sedentary lifestyles and entertainment found among older consumers than among the younger generation. The use of nuts in salads is possibly related to the disposable income, search for variety in the diet, and accumulated culinary experience. However, because the popularity of salads, which include nuts as a substitute for other sources of fat and protein increases, they may appeal to various age groups.

The marginal effect of the educational attainment level suggested a higher use of nuts in salads by respondents who received more schooling than by those who attended school for fewer years. The more frequent use of nuts in salads was indicated by the shift away from the categories representing infrequent use to categories representing "monthly" or "at least once a week" consumption. The importance of education in the nontraditional use of nuts signals consumer willingness to try new uses and products. Such behavior often characterizes respondents with high education and income although income variable was found to be insignificant in this study. For promotional purposes, differentiation between groups that represent different levels of educational attainment is justified and supports the food industry observations that consumers search for new options in food preparation.

Rural residents were more likely to consume nuts in chocolate "at least once a week" than urban consumers were; this result was supported by the shift away from categories of less frequent consumption of chocolate-covered nuts. The identified direction of the shift for single households was opposite to that identified for rural households. The probability that singles would eat chocolate-covered nuts increased if such consumption occurred at best "once every few months" and decreased for catego-

Table 8. Marginal Effects of Selected Variables on the Frequency Consumption of Nut-containing Products.[a]

Nut-containing Product	Variable Name	$\frac{\partial P_0}{\partial X}$	t-ratio	$\frac{\partial P_1}{\partial X}$	t-ratio	$\frac{\partial P_2}{\partial X}$	t-ratio	$\frac{\partial P_3}{\partial X}$	t-ratio
Snack	Female	-0.1443	-2.663	0.0509	2.570	0.0630	2.580	0.0304	2.210
	Age	0.0047	0.852	-0.0017	-1.663	-0.0021	-1.670	-0.0010	-1.541
Salad	Education	0.0155	0.701	0.0106	2.447	-0.0026	-1.580	-0.0235	-2.547
	Age	0.0039	0.183	0.0027	2.509	-0.0006	-1.680	-0.0059	-2.690
Chocolate	Rural resident	0.0862	1.707	0.0037	0.704	-0.0428	-1.710	-0.0471	-1.791
	Single	-0.1582	-1.886	-0.0068	-0.682	0.0787	1.812	0.0864	1.842
Ice Cream	Age	-0.0324	-0.878	-0.0219	-1.016	0.0146	1.001	0.0396	1.032
	Single	0.0969	1.364	0.0655	1.398	-0.0437	-1.328	-0.1186	-1.423

[a] The calculation of marginal probabilities associated with the selection of jth category, where $j = 0,1,2,3$, required that probabilities be given by $P_j = \Phi(\mu_j - XB) - \Phi(\mu_{j-1} - XB)$, where $\mu_0 = -\infty$, $\mu_1 = 0$, $\mu_2 \le \mu_3$, and $\mu_4 = \infty$. The marginal probability due to change in variable (say) X_k is given by $dP_j / dX_k = \{\phi(\mu_{j-1} - X'B) - \phi(\mu_j - X'B)\}B_k$, $j=0,1,2,3$, where $\phi(t)$ and $\Phi(t)$ are the standard normal density function and distribution function, respectively.

ries describing more frequent consumption, according to the calculated marginal effects.

Marginal effects calculated for the statistically significant variables identified in the equation describing the frequency of ice cream support tailored promotion programs. Older respondents were less likely to eat nuts in ice cream more often than "once every few months." However, singles seemed likely to consume such ice cream "at least once a week." Singles represent a young generation of consumers, who often have not yet established families. The consumption pattern, meal preparation skills, and disposable income of this group are different than those of older respondents while the nutritional concerns and eating habits may be inconsistent. To successfully reach both generations, the promotion program may advocate the nutritional value of the product while indicating the link between the portion size, consumption frequency, and the importance of other foods for healthy living.

Summary and Implications

Edible nuts are eaten in larger quantities than they were in the past although their use generally involves a small volume of raw or roasted nuts added as an ingredient to manufactured foods and home-cooked dishes. Their role in the diet and cooking varies in response to the consumption habits and preferences of various consumer groups. As a high energy food, a small portion of edible nuts provides good nutrition and can be an alternative source of protein. Edible nuts are also a valuable source of many trace elements (for example, copper and zinc), and their fatty acid composition is more desirable than that of animal products. Because nuts are eaten in relatively small amounts, an increase in the consumption of nuts by a fraction could make a substantial difference in the edible nut industry's revenue while allowing them to be incorporated into a healthy diet. However, the form in which nuts are consumed in cooked or manufactured food could make an item nutritionally less desirable. This difference between edible nut attributes and the attributes of a nut-containing product has been recognized by the industry. The perception of nut high-fat content is reflected in the suggestion to eat nuts in moderation while the place of nuts in special diets related to chronic illness is still being researched.

This study focused on factors influencing the frequency of edible nut consumption as snacks, in salads, covered in chocolate, and in nut-flavored ice cream. Using the data from a consumer survey, we developed an empirical model identifying consumer characteristics that influence the consumption frequency of the four different products using the random utility framework. The empirical model was estimated using an ordered probit approach to obtain the coefficients applied to the calculation of marginal effects and probabilities. The signs and significance of coefficients, marginal effects, and probabilities were used to ascertain consumer characteristics important to the consumption frequency.

Frequencies reported in this study indicate that edible nuts were used relatively often as snacks. Edible nuts served as snacks require little effort in terms of preparation on the part of a consumer and are recognized as a "finger food." According to the model estimation results, male respondents showed a particular preference for snacking nuts. However, recent market reports showed the decrease in the total value of snacking nuts sales. The edible nut industry may consider the development of new products, especially items that emphasize little known nutritional attributes of nuts.

The use of edible nuts in salads was reported by almost as many respondents as the consumption frequency of nuts with ice cream. The use of edible nuts in salads could become an important opportunity for the edible nut industries that wish to expand nut consumption. Salads appealed to educated or older consumers according to this study. Salads require little preparation time, include nutritionally desired ingredients, can be served as a side or main dish, seldom require cooking, and provide a meal alternative during the warm weather season. The nutritional value of salads can be enhanced by adding edible nuts that contain protein, vitamins, and trace elements, and improve the palatability by adding a crunchy, nutty taste. It is possible that the nut industry may find other less traditional but nutritionally desirable forms of eating nuts.

According to the results of this study, rural residents seemed to eat chocolate-covered nuts with greater frequency than urban residents did whereas singles ate such products less often than respondents from larger households did. This pattern of consumption suggests the possible limited knowledge or choice of nut-containing products among rural

populations. The occasion of eating chocolate-covered nuts, perhaps stimulated by the presence of children, may be responsible for consumption frequency differences across household size. Future research may further investigate the conditions associated with eating this type of product. Although the gross annual household income was insignificant, respondents with higher incomes might represent a potentially important group of buyers. The chocolate-covered nuts represent a wide group of products that include various nuts and other ingredients priced over a wide range. Higher income consumers may opt for gourmet chocolate products while consumers with less income may purchase manufactured chocolate and nut candy bars. Additional research is needed to verify the existence of subgroups consuming various chocolate and nut products.

Ice cream was reported as eaten once a week by about 17 percent of respondents. Ice cream is easy-to-serve and a nutritious dessert or snack that is very popular with consumers. Edible nuts can be added by a manufacturer or the consumer as an individual or mixed topping. According to the estimation results of the empirical model, the probability of consuming nut-flavored ice cream was increasing with the age of a respondent suggesting that (as in the case of eating nuts as a snack) ease of serving may have been responsible for the reported behavior. Larger households seem to consume nut-flavored ice cream more often than smaller households do. The difference in household size and consumption frequency warrants further research on the relevance of the household demographic structure (the number of children versus the number of adults).

No statistical differences in racial or ethnic background were identified in this study to suggest that different consumer groups ate nuts and nut-containing products with varying frequency. The influence of race or ethnic background may reflect different eating habits and preferences for different food types and should be addressed in future studies. The group is heterogeneous and includes several racial and ethnic groups that vary in their use of nuts. The number of non-white respondents in the data set did not permit a thorough examination of the relevance of ethnicity on nut consumption. Therefore, further investigation into the preferences of these consumers is warranted, especially with regard to placing nuts within the ethnically oriented food pyramid.

The differences in the influence of various consumer characteristics on the probabilities of consuming edible nuts in various dishes have different implications for the edible nut industry, food manufacturers, retailers, and dietitians. The utilization pattern of edible nuts revealed by this study suggests different habits in eating shelled nuts, raw or roasted, and nut-containing products. Serving nuts as a snack or using them in salads requires consumers to purchase nuts at a retail outlet. In order to increase sales of nuts, consumer education efforts may have to focus on linking edible nut use at home with consumption forms that offer convenience, good taste, and require little preparation time. The ultimate goal of the edible nut industries is to affect consumer preferences and to expand consumption.

Particular preference for chocolate-covered nuts by particular consumer groups provides insights about possible subjects of marketing efforts. On the other hand, dietitians may be concerned about the frequency of eating these products and may gear their message toward the same group, reminding them of moderation and the need for a balanced diet. Finding a middle ground between industry interests and nutritional needs should not be complicated because the long-term welfare of consumers is the primary objective. Modifications of the food pyramid may require additional information about the form in which nuts are eaten. Snacking or using nuts in salads may suggest that raw or roasted nuts are desirable food; however, once nuts become an ingredient in manufactured foods, they may become less desirable. The amount of nuts used in home-prepared foods is easily controlled by a consumer, but it is predetermined by the production formula in a manufactured product. Information and consumer education may increase the number of ways in which people use edible nuts and assure flexibility in the selection of the type of nut, quantity, and the form of consumption.

Promotion of edible nuts and nut-containing products is driven by the need for the industry to remain competitive. Many other commodities pursue consumers with strong promotion programs funded by private or public funds (for example, overseas market development programs). In the United States, the edible nut industry, representing several different groups growing and processing various types of nuts, has not made any effort to identify common promotion goals. Large industries, such as the almond or the walnut industry, have independently organized

their programs. Other industries have scaled down programs, corresponding to their size, while some have been involved in finding a method that could accommodate all industry segments (for example, the pecan industry). The future tracking of the change in nut use by consumers and institutional users will measure the balance between the need to maintain the industry's competitiveness and the welfare of the consumer.

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