Estimating the Impact of the National Mango Board's Programs on the U.S. Demand for Mangos

An Application of Discrete Choice Modeling using both the Board Program Expenditures and Household Promotion Awareness

Dr. Ronald W. Ward
Emeritus Professor
University of Florida
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Preface

From the outset of the National Mango Board (NMB), a system was put in place to maintain an ongoing process for understanding the U.S. demand for mangos. From the start there were no consistently reported data on retail purchases of mangos and almost nothing on who does and does not buy mangos. Early in the program, plans were implemented for collecting household data on mango buyers and potential buyers through a private company specializing in collecting consumer data through household panels. As of this evaluation, the NMB now has a rich data set from thousands of households covering the months from February 2008 through December 2015. Unique to the data set are variables measuring who did and did not buy mangos and how many among those buying. The data are rich in that considerable information about the demographics, attributes, behavior, and health of each household is known. At this point there are more than 100,000 observations in the data set and more than 1,200 variables.

The data are maintained by this author and used for creating monthly reports; for modeling; and for addressing special issues. The system is complex but any part of the data set can be reasonably accessed with the appropriate guidelines. Each month an additional 1,000 plus household data are added.

This evaluation is based on fairly advanced modeling techniques for measuring mango demand. Specifically, models are set forth to estimate the impact on market penetration (i.e., who buys) and market intensity (how many mangos per buying occasion per buyer). These models are binary in that market penetration is either YES or NO or did you buy mangos and the number of mangos is ordered in that the measurement is 0, 1, 2,3,...., hence the need for discrete choice modeling techniques.

In 2013, additional information about household awareness of promotions was added to the database. These awareness data have added considerably to the overall ability to evaluation the mango programs. In the following discussion, you will see how that added dimension to promotion studies has been included in the overall evaluation process.

This evaluation was completed independently by me without any undue influence by the Board or staff. Any mistakes or oversight(s) are sole my responsibility.

Ronald W. Ward
Emeritus Professor
University of Florida
rward@ufl.edu

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Introduction

In 2000 the U.S. imported approximately 518 million pounds of whole mangos for a FOB value of $140.7 million. Sixteen years later (2015), mango imports reached nearly 861 million pounds and were valued at $401.1 million at the point of imports (FOB). That is a 1.66 fold increase in volume and a 2.83 fold increase in economic value. On a pound value basis, average FOB prices increased from 27.4 cents per pound to nearly 46.6 cents through 2015. Since both prices and volumes have increased over these years, it is clear that positive shifts in U.S. demand for mangos have taken place. Shifts in demand occur for many reasons ranging from normal population growth to changes in consumer awareness and preferences. In the later part of the 2000's, the mango industry started a major effort to have a voice in changing the demand for mango through the establishment of the checkoff program for promoting mango consumption (Ward, Ortega and Watson). With the start of the National Mango Board (AMS-USDA), a program was put in place to generically promote mangos.

Demand changes occur to two primary ways. One can attract new consumers to the marketplace and encourage greater consumption among existing consumers. For some foods, the level of market participation may already be quite high so most gains would likely come from the level of consumption among established consumers. When market penetration is lower, an expectation of achieving gains through attracting new consumers would be reasonable. Two key terms in this process are *market penetration* and *market intensity*. Penetration refers to attracting new consumers to the marketplace while intensity denotes the volume of consumption. We will see later in this report, that these two terms

are essential to understanding and modeling the U.S. demand for mangos.

What drives the demand for mangos? Is it just my chance or can the industry have a role in shifting the demand curve? Measuring the demand drivers for mangos is the heart of this report with a goal of separating any impact for the generic promotion of mangos from all of the other measurable demand drivers. That is, can we measure the potential role that the National Mango Board's programs have had in shifting the demand for mangos over the last several years?

Three processes are required in order to scientifically measure demand with each being equally important. There must be an underlying theory to guide the development of demand models without which one cannot have a framework for judging the reasonableness of the analyses. Second, measurement requires data about those who are the potential or existing consumers. That data must be representative of the underlying population and include essential facts about households (i.e., the buyers). Third, appropriate statistical procedures must be used in order to draw empirical inferences about what drives demand.

By definition, the evaluation process is technical, requiring the use of statistics and economic modeling. Hence, the subsequent discussion will include both the technical details and general insight into what we know about the demand drivers for mangos. The statistics and models are essential to providing confidence in any conclusions while the general discussion is essential to providing a clear picture of the economic impact from the National Mango Board's (NMB) demand enhancing efforts. The report will first lay out a

theoretical framework for illustrating how the NMB could impact retail (or household) demand for mangos. Using that framework, then both the empirical models and economic inferences are presented. Following the discussion of the NMB impact, an additional section is devoted to showing the empirical role of several other demand drivers. Finally, the mango checkoff impact is place in perspective to those other factors that move the demand for mangos in the U.S. marketplace. With this introduction, we turn to the theoretical setting.

Theoretical Structure for Measuring Household Demand for Mangos

The term *demand* is frequently used without being specific as to its meaning. Yet one has to be very specific when the goal is to quantitatively measure demand and to show the impacts of identified demand drivers and, in this analysis, the impact of the mango checkoff programs on the U.S. demand for mangos. Across all demand studies there is a common thread of analysis and before going into the depth for mangos, it is useful to lay out that concept in its basic terms. Whether it is the demand for mangos or say beef, the concepts are quite similar with the focus being on the household (or the buyer or potential buyer).

Define Q as the quantity of whole mangos purchased in the U.S. for a defined time period. Q is equal to the number of U.S. households (Hwd) times the percent of households buying mangos (*MP or market penetration*) times the number of whole mangos bought by the average household during a buying occasion (*MI or market intensity*). Then Q = Hwd

× MP × MI. Many studies address the impact of various demand drivers on just Q. A more insightful approach is to show the impacts on both MP and MI when possible. The number of U.S. households is outside the control of the mango industry (or any industry) or for a given time period that number is fixed and cannot be influenced by industry policies. Hwd is exogenous to the industry.

Let P be the prevailing mango price that households face within a defined time period. Since we are considering households as the decision maker, they face a price P during the defined time (often referred to as a shopping window.) For that same shopping window, there are a larger number of other factors influencing the purchasing process. Those range from the characteristics of the households to the characteristics of the product being considered such as the ripeness of available mangos. Household buying decisions may be spontaneous or influenced by information often in the form of promotions. Such promotions are intended to have a positive impact on demand and measuring that impact is central to the checkoff evaluation process. Using quantity (Q), price (P) and the promotions (CK), the entire theoretical concept can be easily illustrated (Ward, 2006; Ward, 2012).

For the moment, let's set all demand drivers to some average conditions and deal with just Q, P and CK. Any of those other conditions can be easily relaxed as needed. While the demand concept is most often expressed with a typical x/y axis, with a little innovation we can quickly bring the checkoff (or promotions) into the structure. Turning to Figure 1, let y-axis be the retail price (P) that households face using P_0 as the initial

reference point. Next, the horizontal or x-axis depicts the quantity of mangos (Q) purchased at a given point in time. Thus in Figure 1, we have the typical P/Q relationship

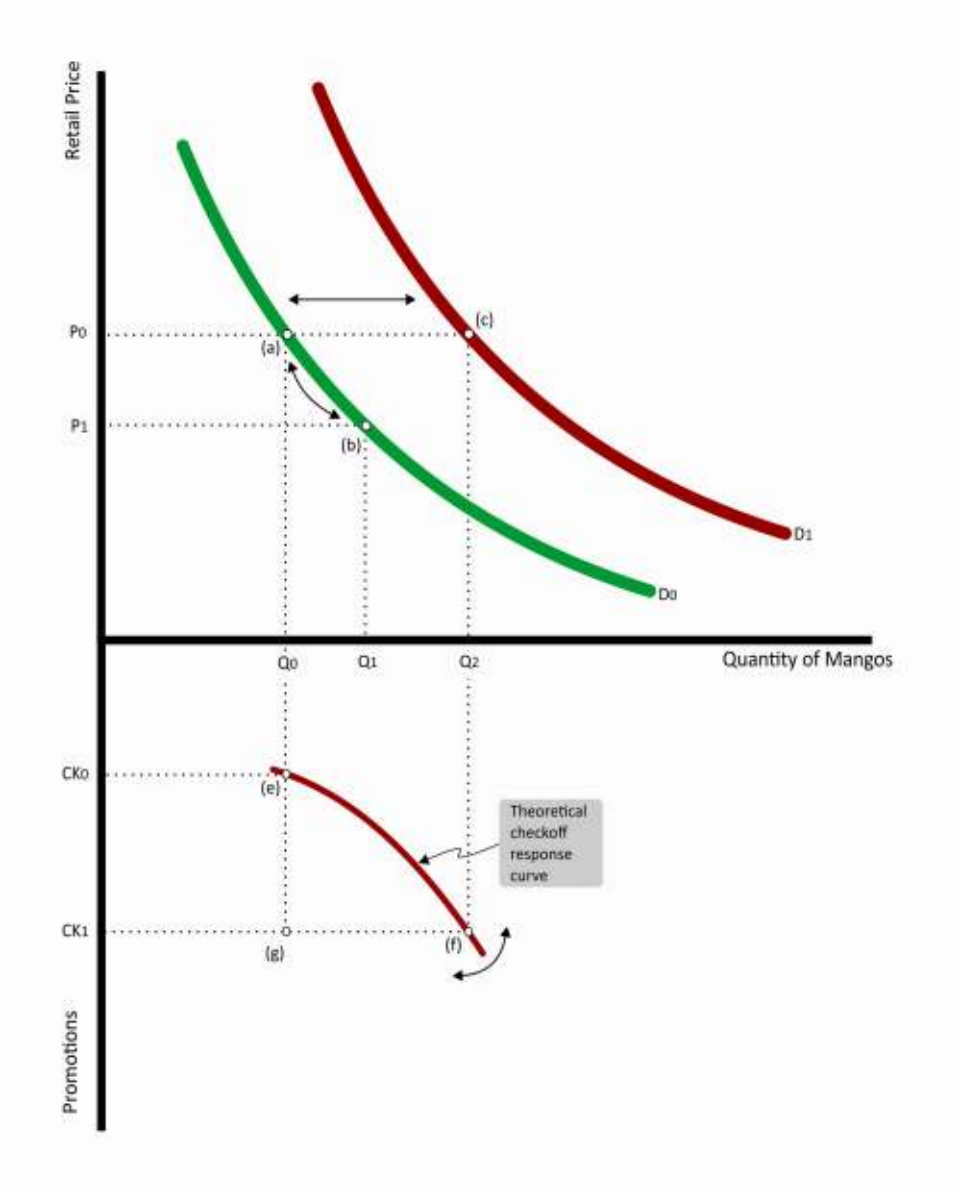

Figure 1. Theoretical demand structure with checkoff programs.

so often used for depicting demand. D_0 shows coordinates of P and Q as one moves along the curve. For price P_0, households buy Q_0 mangos. If prices drop to P_1, demand increases

to Q_1. All the coordinates along D_0 are for a fixed set of conditions for all demand drivers. Movements along D_0 are sometimes expressed in terms of a price elasticity (ε_p) or a percentage change in price produces a percentage change in the quantity demand but in the opposite direction of the price change (Forker and Ward).

Now assume that D_0 exists for a given level of promotions (CK_0). In Figure 1, the typical concept has been expanded with a third z-axis assuming that promotions increase in the lower portion of the figure. Movement from CK_0 to CK_1 reflects an increase the checkoff efforts via program expenditures (or other program promotion measures). At point (e) there exists a given checkoff effort, yielding the demand curve D_0 while again holding all other demand drivers at predefine levels. Price changes from (a) to (b) for example, yield changes in the quantity demand from Q_0 to Q_1 for that fixed checkoff effort CK_0.

Now increase the checkoff efforts to CK_1. If the checkoff program had no impact on demand, the new point would be (g) and the prevailing demand curve would remain at D_0. Commodity checkoff programs are theoretically designed to have a positive impact on demand and if that impact is realized the response could look similar to the curve labeled *checkoff response curve*. That is, with the increase in checkoff dollars, we move from point (e) to point (f) in the lower quadrant in Figure 1 and demand shifted from D_0 to D_1 in the upper part of the figure. With the increase in checkoff programs from CK_0 to CK_1 and the same price P_0, mango demand has now increased from Q_0 to Q_2 or from point (a) to (c) on D_1. Expenditures on mangos then have increased by $P_0 \times (Q_2-Q_0)$. If we knew the nature

of the checkoff response curve or the points between (e) and (f), we would have the elements needed to draw inferences about the effectiveness of the checkoff programs. Determining the empirical counterpart to the checkoff response (CKR) is at the heart of all checkoff evaluations.

There are many dimensions to a checkoff response curve and what determines its coordinates. Program timing, targeting, media use, message and creativity all impact the location of the response curve. Likewise, the checkoff response curve may change over time simply because of greater initial awareness, burnout, and change in the product attributes. Unforeseen product scares related to food safety and quality could negate promotion effectiveness and hence change the curve. Message improvements, better targeting and even improved message delivery could also lead to greater effectiveness with the promotions. In the context of Figure 1 what this means is that the coordinates from (e) to (f) could change. For example, if CKR pivoted upward around point (e) say over time that would imply that the promotions are becoming more effective. A pivot to the left around (e) implies the opposite. The most important point is that the coordinates of CKR are critical to the evaluation and monitoring a checkoff program at a point in time and over time. From the mango industry perspective, they would like to see a response curve as suggested in Figure 1 and to see that curve rotating upward over time. In contrast, a downward rotation suggests the need to revisit the underlying program content. Finally, if CKR were simply the points from (e) to (g), the programs could be judged to be ineffective in shifting demand.

While Figure 1 is conceptual, it does prove the framework for building empirical models to draw inferences about the overall effectiveness of the checkoff. With the empirical models one can also see how much of the checkoff response curve is attributed to attracting new households to the marketplace (i.e., market penetration) versus increasing the mangos per buyer (i.e., market intensity). In the following empirical analyses these responses will be shown.

Mango Consumer Database

Evaluating the economic impact of commodity checkoff programs is an essential part of most of the current federally authorized programs. If that legal authority is through the Commodity Promotion, Research and Promotion Act 1996 (AMS-USDA, 2014), then the programs must have an evaluation plan in place. The logic is that if a commodity industry has the power to enforce assessments on producers and/or suppliers, they must show scientifically the benefits from the use of those assessments. That is, have the promotions enhanced the demand for the commodity? Since the National Mango Board exists under the 1996 Act, they too had to have an evaluation plan established early into the operations of the mango program (AMS-USDA). Conceptually, the evaluation entails knowing the nature of the checkoff response curve first suggested in Figure 1. Since that figure is conceptual, there has to be a means for empirically measuring the response. Essential to any such measurement is having data about the potential consumers of the commodity. As part of the NMB evaluation plan, the Board contracted with a national data

collection company to start collecting data on household purchases of mangos (MetrixLab, 2016). From the outset, raw household data were collected through the company's large household panel and forwarded to the NMB Research Director. As of December 2015, the database includes 104,912 household data points extending from February 2008 through December 2015. Those data points form the foundation for the empirical modeling for the mango demand illustrated in Figure 1.

The household (panel) questionnaire is set forth in Appendix A and is self-explanatory. Those questions can generally be grouped into the following categories: (1) Demographics of the household; (2) Household behavior and attitudes; (3) Health status; (4) Buying behavior including purchasing mangos and then how many; (5) Prices paid; (6) Product preferences; and (7) Promotion awareness and information sources. Category (4) is particularly important in that we know who did and did not purchase mangos so can immediately estimate market penetration and market intensity. With those two measures, we can determine how much of the checkoff response curve is from *market penetration* and how much is attributed to changing the numbers of whole mangos actually purchased (*market intensity*)? That knowledge is essential to designing effective marketing strategies.[1]

Since market penetration and market intensity are so critical to the evaluation of the

[1]Again Appendix A includes the specific questions fitting into the above categories of the questionnaire. From the outset of the data collection considerable emphasis was placed on making sure the households included in the data collection were representative of the U.S. population (i.e., the data was demographically balanced according to the U.S. census).

NMB's programs, it is worth showing those data points before delving into the actual demand modeling and results. Figure 2 includes both measures with the upper part of the graph showing the market penetration. Those monthly data points are based on the average household weighted according to established procedures for dealing with the household sampling weights. Most apparent in the market penetration is the strong seasonality in buying mangos and the upward trend in market penetration. Likewise the seasonal peaks have grown considerably more than the seasonal lows. Much of that is expected given the seasonal nature of the supplies of mangos flowing into the U.S. markets.

Lower in Figure 2 is the market intensity and the numbers are clear that market intensity is considerable more stable than market penetration. In fact, the number fluctuates around about 2.8 mangos per buyer and there is very little if any upward trend in that level. Comparing the relative volatility of the two demand measures suggest that market penetration is at least three times as volatile as market intensity.[2] What this means in terms of the demand curves in Figure 1 is that most of the changes in demand arise from changes in market penetrative relative to market intensity. That is, households move in and out of the mango market considerably more than changes in the volume per mango buyers.

[2]Coefficient of variation (CV) is the standard measure of volatility. CV = StdDev/Mean where the StdDev for market penetration and intensity are 3.11 and .44 and the means, 6.17 and 2.75. Then CV_{MP}=.50 and CV_{MI}=.16 and (CV_{MP}/CV_{MI}) = 3.12.

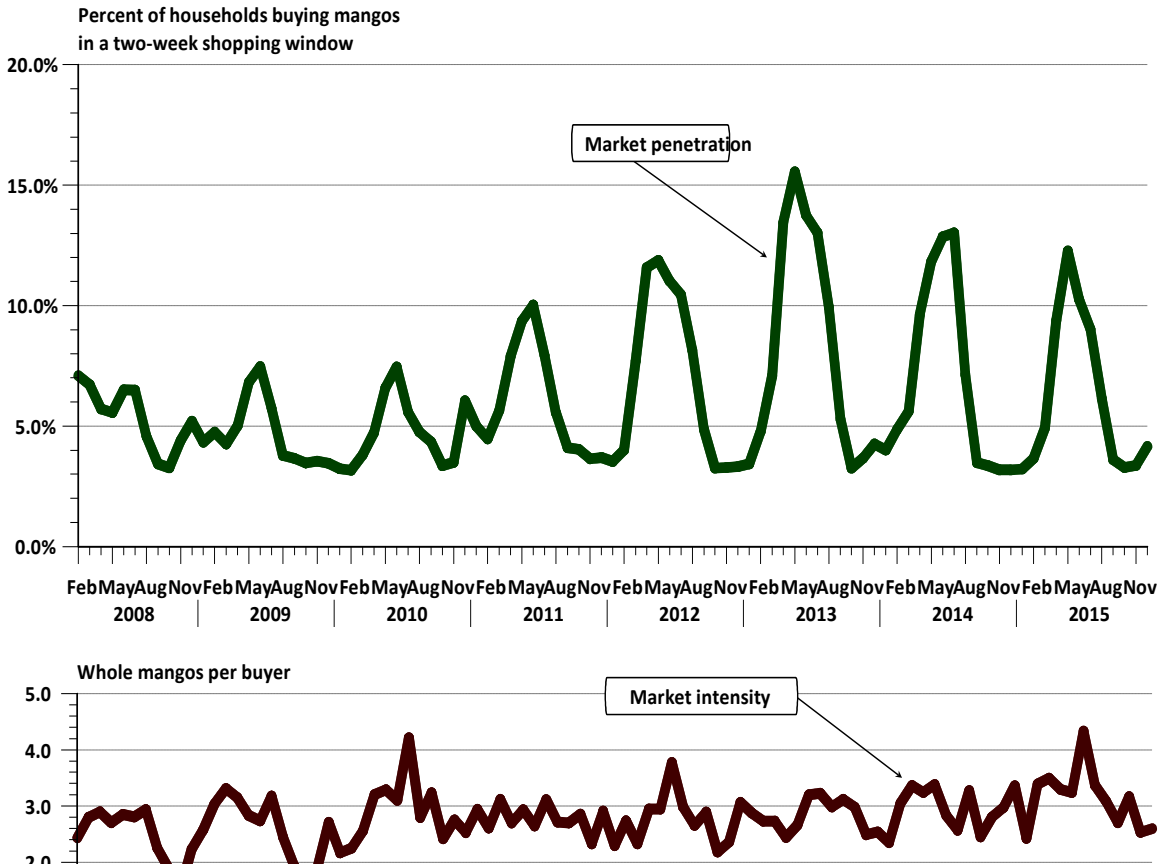

Figure 2. Mango market penetration and m market intensity.

Mango Demand Models

With the theoretical framework and database, we now turn to the evaluation model specification and empirical counterparts to Figure 1. Many factors influence a household's decision to purchase and consume mangos. Some buying decisions are just random at a point in time and that creates the normal noise in any demand model. That is, there are things that simply cannot be quantified and is a normal part of daily decisions. As shoppers, part of our decision making is spontaneous not driven by a particular identifiable reason.

Yet for almost every good, one can identify and measure demand drivers that play an important role in making purchasing decisions. In Figure 3 the more important factors expected to influence households' decisions to purchase mangos are suggested. These factors are what determine the demand coordinates outlined in Figure 1. They are the mango demand drivers.

As already illustrated, demand is a product of the decision to buy (*market penetration*) and how much (*market intensity*) once a positive buying decision is made. With each household's report, that household indicates if they purchased any mangos in the defined period with a YES or NO to the question. This is a binary response coded with 1 or 0 and requires the use of specialized estimation techniques knows as Probit analysis. With these techniques one predicts the probability of buying mangos and estimates how that probability changes with each of the demand drivers set forth in Figure 3. The probability of buying mangos would rise or fall with each variable depending on the impact of the specific variable(s). Market Intensity is a separate measure reported as the number of mangos purchased in a buying event and additional drivers are included in Figure 3 for the intensity. Market Intensity is measured in discrete units according to the mangos purchased ranging from 1, 2, 3, 4, ... and again specialized models known as Ordered Probit models are the appropriate technique for estimating the impacts of the demand drivers in Figure 3 on market intensity.[3]

[3]Both Probit and Ordered Probit modeling are too technical to include in the text of this report but are well understood among researchers who deal with these estimation techniques. Hence, the estimation methods are not presented and rather the focus is later

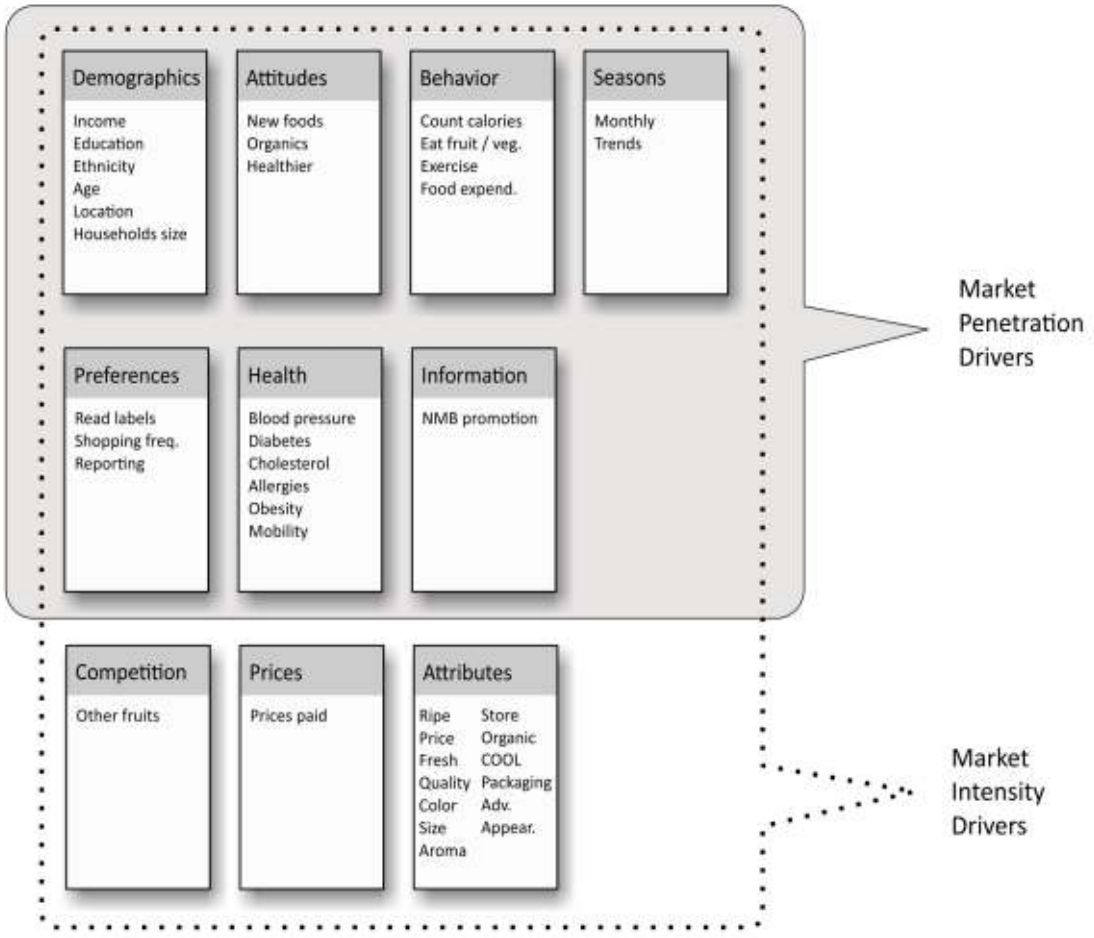

Figure 3. Mango demand drivers.

Ten boxes are drawn in Figure 3 with each illustrating categories of expected demand drivers. Household demographics are captured with measures of income, education, ethnicity, head-of-household age, household residency, and household size. These are reasonably standard demographics and are recorded in the database described in

on the empirical results (Long).

the previous section. Some attitudes expected to influence mango shoppers are I like to *"purchase new foods*", "*I seek out organic foods*", and I think I am *healthier than my peers*. These variables were coded using a 5-point agreement scale (Likert Scale) with one being completely Disagree to 5 being completely Agree with the question (see Appendix A for more detail).[4]

Household behavior attempts to capture household activities that theoretically should influence buying decisions. Counting calories; eating more fruits and vegetables than the norm; exercising; and food expenditures all reflect a general buyer shopping behavior with the expectation that these variables likely shift the demand curve in Figure 1 to the right. Yet, the empirical counterpart is required in order to test these effects.

The fourth top box in Figure 3 is labeled seasons and denotes the strong seasonal demand for mangos as seen with the market penetration in upper part of Figure 2. Embedded in seasonality is weather, calendar occasions such as holidays, product availability, and buying habits in general. What is clear from the outset is that one cannot model the demand for mangos without including the seasonal impact.

The second row of boxes in Figure 3 continues with the drivers. Household preferences include the propensity to inquiry more about the product via read labels and shopping frequency. The willingness to participate in the panel over time is measured with the Reporting variable. This variable attempts to determine if the number of times

[4]The 5-point scale is: 1-completely disagree; 2-somewhat disagree; 3-neutral; 4-somewhat agree; and 5-completely agree.

reporting to the questionnaire influences the households responses. Unique to the data set are direct measures of the health status of the reporting household and provide a direct empirical way to see any linkage between buying mangos and the household health situation. The actual health issues are self-explanatory and illustrated in Appendix C.

Information and specifically the NMB promotions in the last middle row of variables is the primary variable of interest to evaluation. With this variable, one determines the checkoff response curve presented in Figure 1. Without the data suggested with the Information box, it would be impossible to measure the checkoff response curve (CKR) so is of the utmost importance to the entire study. In addition, households were asked about their awareness of mango promotions, thus providing another way to measure information exposure. Later the models will be estimated using both promotion measurements.

Finally, the lower three variable boxes include measures of the competing fruits potential impact of the number of mangos purchased, the role of price when determining the number of mangos bought, and the importance of a number of mango attributes. Each of these variables will be explained in detail once the empirical sections are developed.

In summary, Figure 3 captures the content of the demand models and provides the means for statistically developing models to empirically show the demand structure first laid out in Figure 1. Some of the variables may be statistically significant but numerically not very important. Others may be of major numerical importance. In particularly, the role of the checkoff promotions on both market penetration and market intensity are of the

first order of importance since determining the statistical and numerical properties of the promotion impacts is the key to calculating the rate-of-return from the NMB's efforts to enhance the demand for mangos.

The actual empirical models in a later section use the details of Figure 3 and the specific variables in the following series of definitions:

Demographics:

Income (INC):
(1) $49,999 or less
(2) $50,000-$74,999
(3) $75,000-$99,999
(4) $100,000 Plus

Education (EDU):
(1) High School or less
(2) College
(3) Graduate/Professional
(4) Other

Ethnicity (RACE):
(1) White/Non-Hispanic
(2) White/Hispanic
(3) Black
(4) Asian
(5) All Other

Age of Household Head (AGE):
(1) Under 25 yrs.
(2) 25 to 44 yrs.
(3) 45 to 55 yrs.
(4) Over 55 yrs.

Variables using the 5-point Likert Scale with 1 being completely disagree to 5 representing the completely agree (see footnote 4):

Count Calories (CAL): *I try to count the number of calories I eat each day.*
Organics (ORG): *I seek out organic foods.*
Eat Fruit/Veg (FRVG): *I eat fruits and vegetables more than other people my age.*
Healthier (HLTH): *I feel that I am healthier than my peers.*
Exercise (EXER): *I exercise at least 3 times a week.*
New Foods (EXPR): *I frequently experiment with new foods.*
Read Labels (LABELS): *I read ingredients on labels of the foods I buy.*
The remaining variables all have unique definitions as outlined next:

Shopping Frequency (FREQ):
(1) Grocery stores once a week or more

(2) Grocery stores once every few weeks
(3) Grocery stores once a month
(4) Grocery stores once every few months
(5) Grocery stores less often than once a year
(6) Grocery stores never

Head Status (HHTH_*xx*): Someone in my household has the following health issue.
(1) Blood Pressure (*xx*=BP) (Yes=1/No=0)
(2) Diabetes (*xx*=DB) (Yes=1/No=0)
(3) Cholesterol (*xx*=CL) (Yes=1/No=0)
(4) Allergies (*xx*=AG) (Yes=1/No=0)
(5) Obesity (*xx*=OB) (Yes=1/No=0)
(6) Mobility (*xx*=MB) (Yes=1/No=0)
(7) Sight/Hearing (*xx*=SI) (Yes=1/No=0)

Location (REGION): (Yes=1/No=0 for the regions)
(1) Regions 1 = (Division =1 Northeast(1):New England)
Regions 1 = (Division =2 Northeast(1):Middle Atlantic)
(2) Regions 2 = (Division =3 Midwest(2): East North Central)
Regions 2 = (Division =4 Midwest(2): West North Central)
(3) Regions 3 = (Division =5 South(3): South Atlantic)
Regions 3 = (Division =6 South(3): East South Central)
Regions 3 = (Division =7 South(3): West South Central)
(4) Regions 4 = (Division =8 West(4): Mountain)
Regions 4 = (Division =9 West(4): Pacific)

Frequency of Household Reporting (TFREQ): Number of times reporting in the household panel questions
(1) Reported one time =1
(2) Reported two times =2
(3) Reported three times =3
(4) Reported four times =4
(5) Reported five times =5
(6) Reported six or more times =6

Competition (FRUITS): Number of Other fruits purchased excluding mangos
(1) No fruits other purchased in the shopping period (FRUITS=0)
(2) One fruit (excluding mangos) purchased in the shopping period (FRUITS=1)
(3) Two fruit (excluding mangos) purchased in the shopping period (FRUITS=2)
(4) Three fruit (excluding mangos) purchased in the shopping period (FRUITS=3)
(5) Four or more fruits (excluding mangos) purchased in the shopping period (FRUITS=4)

Price Paid for Mangos (PRICE): actual price paid for a whole mango

Food Expenditures (HFOODEXP): Food expenditures per capita in a shopping period.

Product Attributes (ATTRIB): Reasons for choosing mangos ranking a 1st, 2nd, or 3rd choice in the ranking of attributes with 0=not ranked; 1=3rd place; 2=2nd place; and 3=1st place

Price	Cool	Packaging
Color	Store	Ripeness
Size	Advertising	Aroma
Organic	Fresh	Appearance
		Quality

Information (CCKTOT): Monthly expenditures by the NMB (*details explained later*).
Awareness (AWARE): Determine if the household reporting was aware of mango promotions.

Mango Promotions and Promotion Awareness

Since the primary focus of these analyses is measuring the impact of the NMB programs, it is useful to see some indication of the programs before turning to the empirical models. External to the household data, we know the actual dollars spent on demand enhancing efforts by the NMB. Internal to the database, we also know each household's awareness or lack of awareness of the mango promotions as well as where each household acquired their information.

Why are these two independent information sources so important? Basically, with these two promotion measures, one can estimate the demand models and derive two separate checkoff response functions first suggested in Figure 1. If the checkoff responses provide similar conclusions, that adds considerable confidence in the overall results. We

will see later that, in fact, both approaches give similar conclusions about the overall impact of the NMB's efforts to impact the demand for mangos.

One can turn directly to the NMB website to see the breath of their programs in terms of focus and message (National Mango Board), hence those details are not included in the current discussion. However, Figure 4 does show the actual pattern of expenditures and awareness over the last several years. The upper half of the figure shows monthly total expenditures and expenditures on marketing programs. From March 2008 through November 2015, total expenditures equaled $36.88 million and marketing, $21.22 million. While both, the total and distribution of expenditures, will differ from year to year, in total marketing accounted for 58%; research, 18%; Industry Relations, 9%; and All Others, 15%. The All Others includes both USDA oversight and Administrative costs. As with almost all checkoff programs, one cannot just talk about the marketing program in isolation since those programs cannot exist without the underlying support via research, administration, and oversight.

For evaluation purposes, the considerable month-to-month changes are essential to the ability to measure the programs impact. If there had been no month-to-month differences in the efforts it would have been impossible to include the program expenditures in the demand models since it would have been a fixed number. Also, since we know the expenditures in the exact month, one can explore any lag effects that are

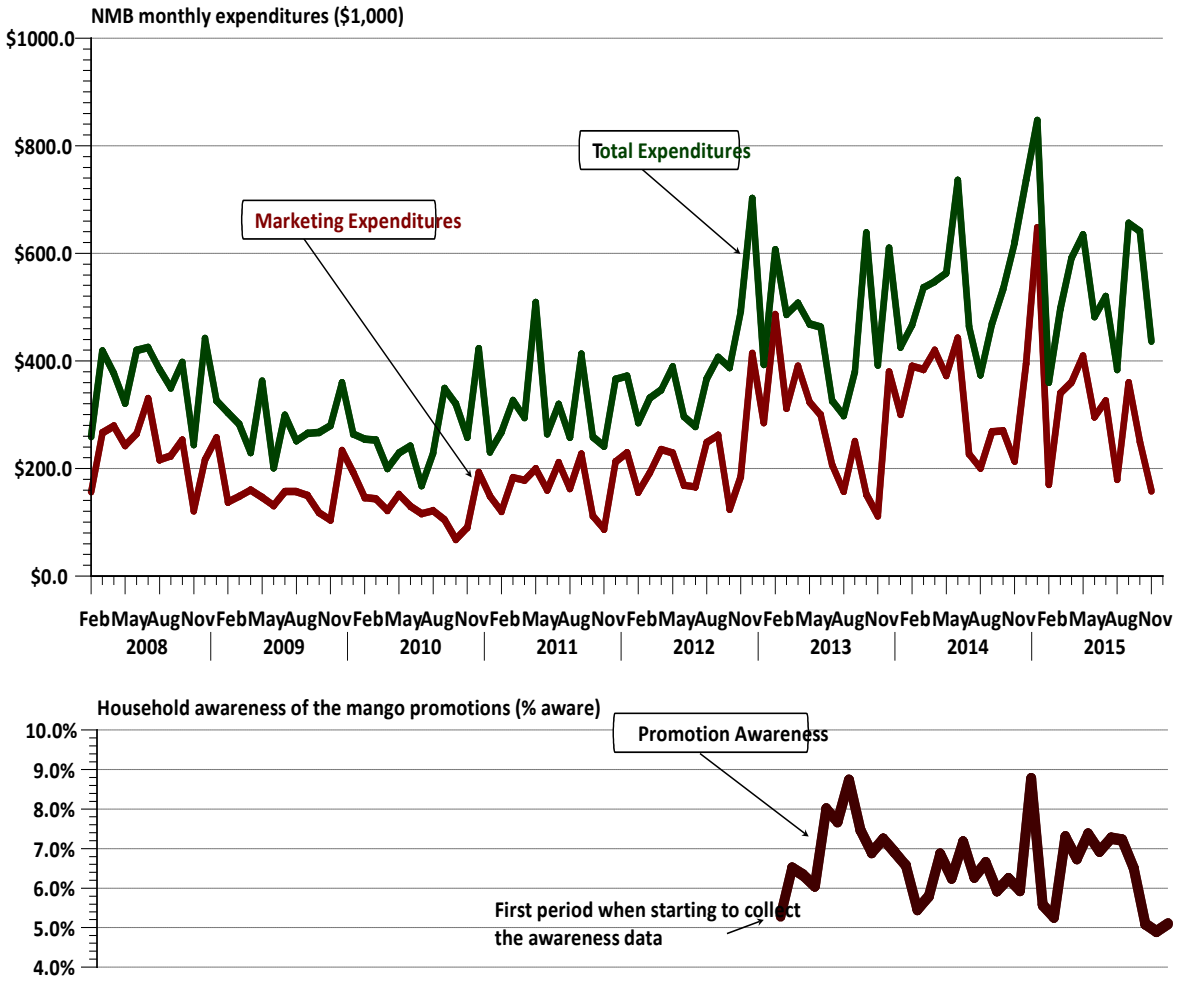

Figure 4. NMB expenditures on promotion awareness by households.

often seen in promotion and advertising effects. That is, the household may not respond immediately to the message or the message may linger as is often the case with printed media. Later in the models we will see the lingering or lag effects.

Promotion expenditures in the model are useful in that one can match any shifts in demand with the direct dollar cost. The disadvantage is that one is assuming that all households are somehow equally exposed to the information. That may not be a bad assumption if the message has a broad target audience as is usually the case with a lot of the generic advertising programs across the country. An alternative approach is to discover what the household was aware of in terms of promotion information. If that case, one knows who was and was not aware of the mango promotions and, concurrently, knows the buying behavior of each household. With the appropriate awareness measure, that demand driver can be included in the demand models in place of the expenditures. This is another way to estimate the checkoff demand response. From Figure 1, the demand is estimated with the actual level of awareness and then used to determine the level of demand without any awareness. The difference in demand times the price gives the revenue gains attributed to the awareness. Assuming the awareness is a product of the NMB programs (i.e., expenditures), then it is a relatively simple step to estimate the rate-of-return based on the awareness approach.

In the lower portion of Figure 4, the average monthly awareness is plotted while recognizing that the awareness differs with each household. Note that the data only start in March 2013, the point when the collection of the awareness data was started. Like the

expenditures there is considerable month-to-month variability in the averages and even more when looking at the individual households. On average, 6.58% of the households were aware of the promotions as illustrated in Figure 4. While not included in the current models, households were also asked where they acquire their information about mangos. In-Store was the single most importance source with 39.9% followed with Newspapers (16.7%), Internet (12.3%), Magazine (11.7%), and Menu (8.9%). While the in-store is the predominate source, importance of all of the other sources account for 60% of the total and it is spread across the sources. To emphasize again, Figure 4 is showing the monthly values while the actual models estimated later are based on 1,000's of households. For the expenditure models the observations are near 100,000 and for the awareness model the observations are around 32,000. Clearly, that provides richness in data not often found among other commodities with generic promotion programs.

Estimated Mango Demand Models

Using the theoretical model from Figure 1 and the variables defined above, we can now specify models that represent the two components in the demand curve (i.e., market penetration and market intensity). Let MANGOBUY to be zero or one according to if the household purchased any mangos in the shopping period and QT_WHOLE as the number of mangos purchased ranging from zero to twelve or more in discrete units. When QT_WHOLE=0, that means the mango buyer did not buy whole mangos but could have purchased some sliced or cut mangos. If QT_WHOLE=12, the buyer purchased at least

eleven or more mangos. Actually, within the large data set no household purchased just 11 mangos. Purchases were either (10 or less) or (12 or more).

The probability of buying mangos and the number of whole mangos are both functions of the variables identified above (i.e., the demand drivers first suggested in Figures 1 and 3). In order to estimate the impacts of each demand driver, specific demand models must be specified and estimated. Let X be all of those drivers impacting the likelihood of buying mangos in a define period and Z, those variables impacting the number of mangos purchased. Associated with X and Z are coefficients that statistically represent the influence of each driver. Specifying those models are essential to the checkoff evaluation but technical, hence the full model specifications are set forth in Appendices B1 and B2. The empirical counterparts of those models are presented in Tables 1 through 4.

In Appendix B1 the last variable captures the potential impact of the mango checkoff program and the specification is fairly technical. If $\delta = 0$, then the conclusion is that statistically the programs show no measurable economic impact on demand. In terms of Figure 1, the checkoff response curve would just be parallel to the left lower vertical axis. With large positive values for δ, gains attributed to the checkoff have occurred. Preliminary analyses show that 65% of the economic impact of the mango checkoff occurs in the same period and 35% in the subsequent period. That is, the impact of a promotion program extends over two months. Several lag structures were tested and this specification proved to be most robust. Also, a time adjustment is included in the promotion specification to allow for improvements in the effectiveness of the checkoff over time.

Note in the specification, if the .05 were instead zero then there would have been no adjustment in the effectiveness over time.

With the theory from Figure 1 and Appendixes B1 and B2, Tables 1-4 provide the resulting estimates of the market penetration (Probit) and market intensity (Ordered Probit) models. Rather than explaining each coefficient at this point, the models and coefficients will later be used to show each variable impact on the demand for mangos. However, the coefficients for the NMB programs deserve discussion at this point before showing the estimated checkoff response curve and any return-on-investment.

The promotion variable in Table 1 is TTCK and measures the NMB's efforts and the resulting coefficient is .000481. The numerical value has little intuitive meaning until it is used in the next major section. However, the coefficient sign and statistical properties provide immediate insight into the programs effectiveness. From Appendix B1, this coefficient was referenced as δ and in Table 1 δ is positive and statistically highly significant. The t-value of 12.85 indicates that we can be 99.9% confident the estimated impact of the NMB programs on attracting households to buy mango is statistically different from zero. Stated differently, there is almost no chance we are wrong in concluding that the promotion programs drive the demand for mangos by attracting households to buy mangos within a defined two-week shopping window. This in turn, tells us that the checkoff response curve will look something like that first presented in Figure 1. With this positive result, then the fundamental question is *how much of a response* do we see on market penetration?

Next in Table 2 (and Appendix B2) the checkoff impact on market intensity is shown with TTCK1, giving a positive coefficient but with little confidence that the estimate is different from zero (see the t-value of .986 while recalling that any value under about 2.0 is not statistically significant). From Tables 1 and 2, the first major conclusion is that the NMB's programs have impacted the demand for mangos with almost all of the impact through attracting households to buy mangos (or market penetration) and very little in changing market intensity.

Now let's take the same market penetration and market intensity models but include promotion awareness in the models instead of the NMB expenditures. Again, awareness is internal to each household where they indicated if they were and were not aware of the mango promotions. Tables 3 and 4 include the estimated models parallel to Tables 1 and 2 except for the inclusion of the awareness variable. Awareness identified as WASAWARE in Table 3 has an estimated coefficient of 1.36278 and a t-value of 35.1210. The very large t-value indicates that there is almost no chance that promotion awareness effect is zero. With the positive coefficient and large t-value, the evidence is undisputable that the promotions have a statistically significant impact on attracting households to buy mangos. Awareness was also included in the market intensity model reported in Table 4, giving the positive coefficient value of .048925 but a t-value of only .342774. Statistically, the awareness variable has no impact on the number of mangos bought once becoming a buyer.

Tables 1 through 4 provide the empirical foundation for drawing inferences about

the importance of promotions on the U.S. demand for mangos. One needs to turn to using the models to really see the impacts since the numbers alone are difficult to see the responses. Hence, in the next several sections those impacts are explored in considerable detail. At this point using both the expenditure and awareness measures, two extremely important conclusions are noted. First, mango promotions have a positive and statistically significant impact on attracting households to buy mangos. This is true with either measurement of promotions, thus providing even more confidence to the conclusion about market penetration. Second, with both variables the empirical evidences indicate little to no impact on the number of mangos purchased in a buying occasion. Promotions drive demand through attaching potential consumers and far less on the number of mangos purchased. Given the size of mangos and the shelf life of under two-weeks, this is not a surprising result.

As illustrated with Figure 1 and accompanying discussion, total demand is a product of the number of households, market penetration and market intensity. As promotions are changed and using the results from Tables 1-4, changes in penetration and intensity can be shown and subsequently the total demand estimated. That is, from Figure 1 the checkoff response can be shown. Once those demand changes are known, the return-on-investment from the promotions can be calculated. That is the task of the next section.

While the primary contribution of Tables 1-4 is getting the promotion responses, it is important to recognize that those responses are estimated while accounting for the demand drivers such as income, seasonality, etc. When inferences are drawn using the

promotion coefficients, those inferences are made after accounting for all of the other drivers that may influence the demand for mangos more or less than the promotions. Equally, we are not attributing something to promotions that is really due to other factors. As seen in the tables, the analyses become more complicated when accounting for those other drivers. Many of these other drivers are highly statistically significant such as demand differences across age or, say, race. Later many of these non-promotion responses will be explored in terms of their impact on the demand for mangos.

Table 1. Coefficients for the demand drivers in the market penetration model with NMB $.

	Market Penetration in NMB Expenditure Model								
	Coef	t-value		Coef	t-value		Coef	t-value
C	-31.4021	-7.0609	ZEXPR1	0.0242	0.8595	ZDIV2	0.1662	4.1567
ZINC2	-0.0422	-2.1498	ZEXPR2	-0.0651	-2.8698	ZDIV3	-0.0367	-0.9052
ZINC3	-0.0324	-1.3541	ZEXPR4	-0.0596	-2.8541	ZDIV4	-0.0599	-1.2692
ZINC4	0.0329	1.3806	ZEXPR5	0.1702	6.9477	ZDIV5	0.1333	3.3873
ZINC5	0.0508	1.6637	ZEXER1	-0.1138	-4.3897	ZDIV6	-0.0284	-0.5618
ZEDU2	0.0410	2.0233	ZEXER2	-0.0416	-1.6970	ZDIV7	0.0502	1.1680
ZEDU3	0.1637	6.0060	ZEXER4	-0.0491	-1.9944	ZDIV8	0.0828	1.8334
ZEDU4	-0.0226	-0.3556	ZEXER5	-0.1332	-5.6294	ZDIV9	0.1258	3.1307
ZRACE1	-0.5062	-19.3391	ZHLTH1	0.1525	5.0099	PRWHOLE1	-0.0257	-1.1035
ZRACE2	-0.1172	-3.7327	ZHLTH2	0.0027	0.1146	TFREQ1	0.1213	4.2167
ZRACE3	-0.0827	-2.7011	ZHLTH4	0.1002	4.6978	TFREQ2	0.1031	3.3963
ZRACE4	0.1813	4.7858	ZHLTH5	0.2709	9.6980	TFREQ3	0.0249	0.7723
ZAGE2	-0.2804	-12.7294	ZFRVG1	0.2339	7.5117	TFREQ4	-0.0041	-0.1177
ZAGE3	-0.4960	-18.1517	ZFRVG2	0.1124	4.6489	TFREQ5	0.0166	0.4481
ZAGE4	-0.7199	-27.6505	ZFRVG4	0.1162	5.4001	HFOODEXP	0.0389	13.1023
ZCAL1	-0.0674	-2.9099	ZFRVG5	0.1413	5.3677	DFRU1	1.1299	23.0746
ZCAL2	0.0417	1.8962	ZLABELS1	0.1354	4.6517	DFRU2	**1.2710**	**27.1636**
ZCAL4	0.0025	0.1089	ZLABELS2	0.0576	2.2384	DFRU3	1.4507	31.4917
ZCAL5	-0.0339	-1.2990	ZLABELS4	0.0309	1.3513	DFRU4	2.3339	56.9990
HWD	-0.0267	-0.8254	ZLABELS5	-0.0149	-0.6171	GOMP	28.1271	6.2825
ZMTH1	0.0934	2.3663	ZORG1	-0.0710	-3.0785	**TTCK**	**0.00048**	**12.85810**
ZMTH2	0.1914	5.0585	ZORG2	-0.1149	-5.1142			
ZMTH4	0.2852	7.6492	ZORG4	0.0457	1.9880			
ZMTH5	0.2886	7.9350	ZORG5	0.0713	2.7869			
ZMTH6	0.3142	8.6346	ZHLTH_BP	0.0002	0.0123			
ZMTH7	0.3308	8.7259	ZHLTH_DB	0.1043	5.0311			
ZMTH8	0.2910	7.4768	ZHLTH_CL	0.0321	1.6804			
ZMTH9	0.1908	5.0037	ZHLTH_AG	0.1336	6.7557			
ZMTH10	0.1258	3.1817	ZHLTH_OB	0.0048	0.2541			
ZMTH11	0.1897	4.7138	ZHLTH_MB	0.0605	2.7490			
ZMTH12	0.0742	1.8505	ZHLTH_SI	0.1276	5.8467			

Number of observations = 99908 Scaled R-squared = .214085
Number of positive obs. = 8383 LR (zero slopes) = 19672.1 [.000]
Mean of dep. var. = .083907 Schwarz B.I.C. = 19436.2
Sum of squared residuals = 5567.65 Log likelihood = -18958.4
R-squared = .275802 Fraction of Correct Predictions = 0.924450

Table 2. Coefficients for the demand drivers in the market intensity model with NMB $.

Market Intensity in NMB Expenditure Model

	Coef	t-value		Coef	t-value		Coef	t-value
C	-9.0959	-13.8839	ZEXER1	0.0878	1.8768	ZORGANIC	0.5012	22.3361
ZINC2	0.0927	2.8058	ZEXER2	0.0085	0.2000	ZCOOL	0.5216	20.2867
ZINC3	-0.0172	-0.4370	ZEXER4	0.0514	1.2146	ZSTORE	0.5001	22.4231
ZINC4	0.0232	0.6098	ZEXER5	0.1245	2.8652	ZADVER	0.4630	15.8276
ZINC5	0.0397	0.7482	ZHLTH1	0.1329	2.4897	ZFRESH	0.5284	28.9057
ZEDU2	0.0361	1.0399	ZHLTH2	0.1055	2.5804	ZPACKG	0.4888	18.6145
ZEDU3	0.0635	1.2934	ZHLTH4	-0.0214	-0.5501	ZRIPE	0.5506	30.6049
ZEDU4	0.3703	3.4457	ZHLTH5	-0.0706	-1.2540	ZAROMA	0.5439	24.4497
ZRACE1	-0.1973	-2.8454	ZFRVG1	0.0373	0.6265	ZAPPEAR	0.5299	28.1331
ZRACE2	0.0613	1.2554	ZFRVG2	-0.0370	-0.8268	ZQUALITY	0.5493	29.2659
ZRACE3	-0.0431	-0.9023	ZFRVG4	-0.0155	-0.3819	TFREQ1	0.0062	0.1386
ZRACE4	0.1110	1.9194	ZFRVG5	0.1172	2.3972	TFREQ2	-0.0251	-0.5216
ZAGE2	0.0340	0.7657	ZLABELS1	0.1466	2.7936	TFREQ3	-0.1003	-1.9322
ZAGE3	0.1574	2.2185	ZLABELS2	0.0508	1.1320	TFREQ4	-0.0503	-0.8756
ZAGE4	0.1880	2.0531	ZLABELS4	-0.0234	-0.5849	TFREQ5	-0.0081	-0.1274
ZCAL1	0.0813	1.9856	ZLABELS5	0.0511	1.1989	HFOODEXP	0.0402 ?	6.64191
ZCAL2	0.0415	1.1022	ZHLTH_BP	-0.0002	-0.0055	DFRU1	-0.3896	-1.8851
ZCAL4	-0.0177	-0.4504	ZHLTH_DB	0.0120	0.3127	DFRU2	-0.3640	-1.6867
ZCAL5	0.0008	0.0184	ZHLTH_CL	0.0547	1.5929	DFRU3	-0.4330	-1.8507
HWD	0.5245	10.3438	ZHLTH_AG	-0.0584	-1.5576	DFRU4	-0.6422	-1.9561
ZMTH1	0.0771	1.1605	ZHLTH_OB	-0.1054	-3.0809	**TTCK1**	**0.00007**	**0.9866**
ZMTH2	0.0977	1.4680	ZHLTH_MB	-0.0341	-0.8323	IMILLS	-0.2576	-1.6730
ZMTH4	0.0365	0.5228	ZHLTH_SI	0.0355	0.8572	MU2	0.7254	42.3106
ZMTH5	0.1209	1.7856	ZDIV2	0.0378	0.5182	MU3	1.3646	66.2750
ZMTH6	0.0823	1.2250	ZDIV3	0.0001	0.0020	MU4	1.6840	76.6373
ZMTH7	0.1389	1.9723	ZDIV4	-0.0096	-0.1113	MU5	2.0213	85.8400
ZMTH8	0.0736	1.0518	ZDIV5	-0.0123	-0.1737	MU6	2.2473	90.6570
ZMTH9	0.1017	1.4530	ZDIV6	0.0961	1.0773	MU7	2.5190	94.6444
ZMTH10	0.0751	1.1092	ZDIV7	-0.0360	-0.4803	MU8	2.5599	95.0497
ZMTH11	0.0601	0.8572	ZDIV8	0.0335	0.4181	MU9	2.6926	95.9829
ZMTH12	0.0968	1.3237	ZDIV9	0.0280	0.3900	MU10	2.7433	96.1698
ZEXPR1	-0.0022	-0.0449	WPRICE	-0.4540	-26.5273	MU12	3.0093	95.3832
ZEXPR2	-0.0207	-0.5026	ZPRICE	0.5071	27.6582	MU13	3.1682	93.5087
ZEXPR4	0.0048	0.1299	ZCOLOR	0.5020	24.8878			
ZEXPR5	0.0745	1.6237	ZSIZE	0.5575	27.4083			

Number of observations = 8383
LR (zero slopes) = 4455.45 [.000]
Mean of dep. var. = 3.00561
Schwarz B.I.C. = 16156.8
Std. dev. of dep. var. = 3.29288
Scaled R-squared = .433085

Choice	Frequency	Fraction			
0	1852	0.2209	5	432	0.0515
1	1471	0.1755	6	425	0.0507
2	1670	0.1992	7	55	0.0066
3	817	0.0975	8	163	0.0194
4	765	0.0913	9	56	0.0067
			...		
			13	329	0.0392

Table 3. Coefficients for the demand drivers in the market penetration model with promotion awareness.

	Market Penetration Awareness Model				
	Coef	t-value		Coef	t-value
C	-3.7482	-23.9685	ZHLTH1	0.2014	4.5625
ZINC2	-0.0879	-2.9146	ZHLTH2	0.0728	2.2112
ZINC3	0.0284	0.7853	ZHLTH4	0.1048	2.8944
ZINC4	0.0903	2.5295	ZHLTH5	0.2587	5.0878
ZINC5	-0.1022	-1.7153	ZFRVG1	0.1606	3.8361
ZEDU2	0.0564	1.7735	ZFRVG2	0.0795	2.3469
ZEDU3	0.1606	3.7406	ZFRVG4	0.1092	2.8981
ZEDU4	-0.1102	-0.7941	ZFRVG5	0.2586	5.2866
ZRACE1	-0.4354	-9.0678	ZLABELS1	0.0892	2.3319
ZRACE2	-0.0602	-1.1008	ZLABELS2	-0.0239	-0.6751
ZRACE3	-0.0835	-1.5572	ZLABELS4	0.0836	2.1637
ZRACE4	0.1091	1.6869	ZLABELS5	0.0202	0.4639
ZAGE2	-0.3220	-9.3711	ZORG1	0.0059	0.1602
ZAGE3	-0.5307	-11.9658	ZORG2	-0.0074	-0.2168
ZAGE4	-0.7903	-19.3876	ZORG4	-0.0444	-1.2341
ZCAL1	-0.0724	-1.9067	ZORG5	-0.0265	-0.6913
ZCAL2	0.0159	0.4656	ZHLTH_BP	-0.0421	-1.3545
ZCAL4	-0.0219	-0.6147	ZHLTH_DB	0.1838	5.3428
ZCAL5	-0.1071	-2.7972	ZHLTH_CL	-0.0047	-0.1465
ZMTH1	-0.1276	-2.0585	ZHLTH_AG	0.0957	2.9025
ZMTH2	-0.0491	-0.8937	ZHLTH_OB	0.0084	0.2582
ZMTH4	0.0636	1.1798	ZHLTH_MB	0.0489	1.3151
ZMTH5	0.0988	1.8433	ZHLTH_SI	0.0410	1.0877
ZMTH6	0.1043	1.9681	ZDIV2	0.1040	1.7346
ZMTH7	0.1080	2.0181	ZDIV3	-0.0096	-0.1567
ZMTH8	-0.0003	-0.0055	ZDIV4	-0.0984	-1.3465
ZMTH9	-0.0282	-0.5213	ZDIV5	0.0952	1.6275
ZMTH10	-0.1519	-2.6615	ZDIV6	0.0630	0.8459
ZMTH11	-0.0670	-1.1952	ZDIV7	0.0705	1.1013
ZMTH12	-0.2198	-3.8707	ZDIV8	-0.0864	-1.2217
HWD	0.2729	4.7562	ZDIV9	0.0273	0.4550
ZEXPR1	0.0897	2.3301	PRWHOLE1	-0.0237	-0.6526
ZEXPR2	-0.0197	-0.6050	HFOODEXP	0.0671	11.4497
ZEXPR4	-0.0754	-2.1091	DFRU1	1.6065	17.7160
ZEXPR5	0.1337	3.0203	DFRU2	1.7895	20.7539
ZEXER1	-0.1958	-5.1778	DFRU3	1.8940	22.0613
ZEXER2	-0.0527	-1.4158	DFRU4	2.8410	36.8411
ZEXER4	-0.0858	-2.1462	**WASAWARE**	**1.3628**	**35.1210**
ZEXER5	-0.1983	-4.8931			

Number of observations = 35504 Scaled R-squared = .328123
Number of positive obs. = 4466 LR(zero slopes) = 10981.6
Mean of dep. var. = .125789 Schwarz B.I.C. = 8343.83
Sum of squared residuals = 2386.94 R-squared = .388913
Fraction of Correct Predictions = 0.907701

Table 4. Coefficients for the demand drivers in the market intensity model with promotion awareness.

	Market Intensity Awareness Model							
	Coef	t-value		Coef	t-value		Coef	t-value
C	-9.9982	-10.9818	ZEXPR4	-0.0095	-0.1634	PRWHOLE1	-0.5829	-22.7507
ZINC2	0.0594	1.2892	ZEXPR5	-0.0256	-0.3617	ZPRICE	0.5364	18.0849
ZINC3	-0.0280	-0.5296	ZEXER1	0.1585	2.5051	ZCOLOR	0.5289	16.7756
ZINC4	-0.0589	-1.1430	ZEXER2	0.0382	0.6780	ZSIZE	0.5927	18.6214
ZINC5	-0.0914	-1.0144	ZEXER4	0.0691	1.0978	ZORGANIC	0.5361	16.1848
ZEDU2	0.0398	0.8431	ZEXER5	0.1095	1.6070	ZCOOL	0.5518	15.0995
ZEDU3	0.1604	2.4364	ZHLTH1	0.1513	2.1904	ZSTORE	0.5154	14.7759
ZEDU4	0.2254	1.0977	ZHLTH2	0.0731	1.4061	ZADVER	0.5377	12.9032
ZRACE1	-0.1149	-1.4039	ZHLTH4	0.0590	1.0064	ZFRESH	0.5866	20.0866
ZRACE2	0.0633	0.8915	ZHLTH5	0.1277	1.5553	ZPACKG	0.5548	14.4674
ZRACE3	-0.0228	-0.3217	ZFRVG1	0.0852	1.2825	ZRIPE	0.5715	19.6164
ZRACE4	0.1180	1.4359	ZFRVG2	0.0583	1.0522	ZAROMA	0.5854	17.0867
ZAGE2	0.0160	0.2902	ZFRVG4	-0.0649	-1.0592	ZAPPEAR	0.5716	18.8848
ZAGE3	0.0806	0.9172	ZFRVG5	0.0084	0.1042	ZQUALITY	0.5805	19.4021
ZAGE4	0.0505	0.4595	ZLABELS1	0.0745	1.2237	HFOODEXP	0.0521	5.1468
ZCAL1	-0.0107	-0.1895	ZLABELS2	0.0142	0.2523	DFRU1	-0.7617	-2.2909
ZCAL2	-0.0191	-0.3691	ZLABELS4	-0.0177	-0.2913	DFRU2	-0.5722	-1.6493
ZCAL4	-0.0010	-0.0189	ZLABELS5	0.0615	0.8687	DFRU3	-0.7012	-1.9495
ZCAL5	0.0291	0.4793	ZHLTH_BP	0.0320	0.6566	DFRU4	-0.8221	-1.7581
HWD	0.6639	7.6789	ZHLTH_DB	0.0007	0.0125	IMILLS2	-0.2226	-1.2233
ZMTH2	0.1774	1.9073	ZHLTH_CL	-0.0083	-0.1629	**WASAWARE**	**0.0489**	**0.3428**
ZMTH3	0.2189	2.3389	ZHLTH_AG	-0.0544	-1.0381	MU2	0.6416	29.2455
ZMTH4	0.1470	1.5713	ZHLTH_OB	-0.0190	-0.3570	MU3	1.2482	46.3417
ZMTH5	0.1799	1.9021	ZHLTH_MB	-0.0297	-0.4820	MU4	1.5619	54.0038
ZMTH6	0.1882	2.0402	ZHLTH_SI	0.0376	0.6231	MU5	1.8915	60.8186
ZMTH7	0.2085	2.2190	ZDIV2	0.0127	0.1330	MU6	2.1321	64.7546
ZMTH8	0.1903	2.0928	ZDIV3	-0.0301	-0.3114	MU7	2.3699	67.5918
ZMTH9	0.2098	2.2811	ZDIV4	-0.1048	-0.8925	MU8	2.4127	67.9721
ZMTH10	0.2067	2.1588	ZDIV5	-0.0232	-0.2492	MU9	2.5331	68.8220
ZMTH11	0.1277	1.3620	ZDIV6	0.0367	0.3193	MU10	2.5694	69.0132
ZMTH12	0.1439	1.5097	ZDIV7	-0.0596	-0.5941	MU12	2.8390	69.2687
ZEXPR1	-0.0366	-0.6117	ZDIV8	0.0417	0.3776	MU13	2.9487	68.7851
ZEXPR2	-0.0195	-0.3808	ZDIV9	0.0145	0.1539			

Number of observations = 4466
LR (zero slopes) = 2403.01
Mean of dep. var. = 3.22503
Schwarz B.I.C. = 8858.88
Std. dev. of dep. var. = 3.56657
Scaled R-squared = .437092

	Freq	Fraction		Freq	Fraction
0	1019	0.2282	5	251	0.0562
1	713	0.1597	6	208	0.0466
2	840	0.1881	7	33	0.0074
3	429	0.0961	8	86	0.0193
4	404	0.0905	9	24	0.0054
			...		
			13	261	0.0584

Mango Checkoff Response Curve

In Figure 1 the theoretical positive shift in mango demand was illustrated and Tables 1-4 showed the statistical coefficients used to quantify the promotion impacts on demand. What does this mean at the very grass-roots level? Using the guidance from the theory and the numbers from the empirical models, Figure 5 shows retail mango sales

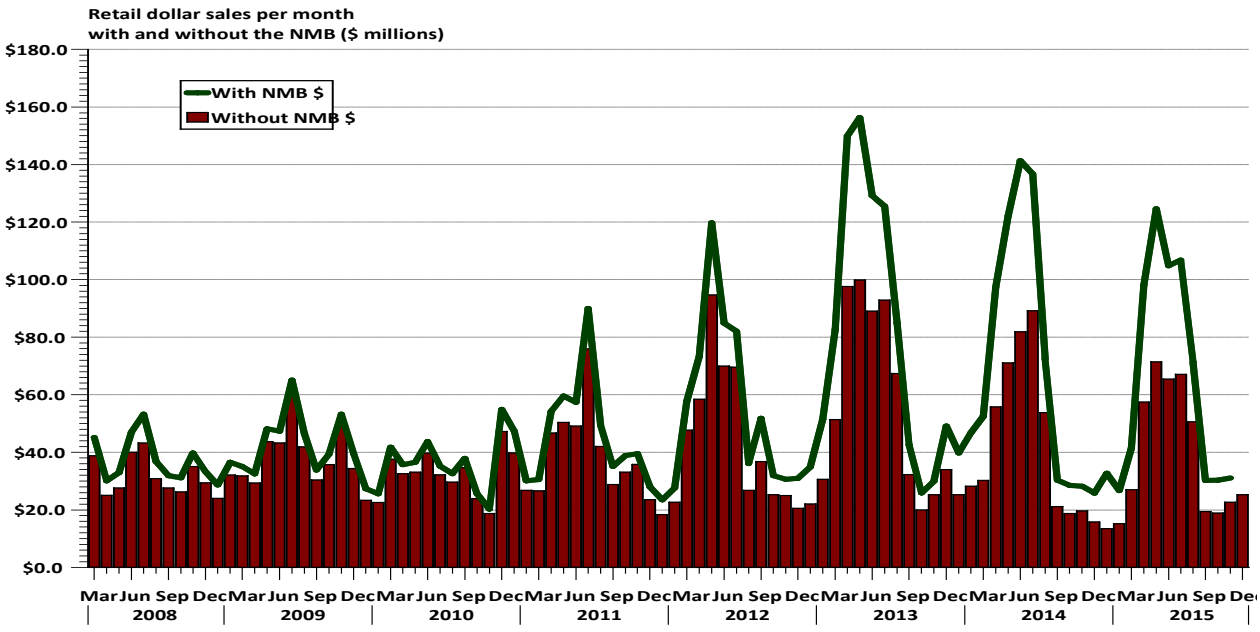

Figure 5. Estimates retail mango dollar sales with and without the NMB.

with and without the NMB. This is at the grass-roots level since it measures the aggregate buyer actions at the points of purchase on a period-by-period basis. From the model estimates, both market penetration and market intensity are estimated with the actual NMB programs and then assuming those programs did not exist. $\text{Hwd} \times \text{MP}_{\text{with}} \times \text{MI}_{\text{with}} \times \text{Price}$

= RS_{with} or retail dollar sales with the programs while Hwd × $MP_{without}$ × $MI_{without}$ × Price = $RS_{without}$ or retail dollar sales under the conditions of no NMB demand enhancing efforts. Over these months from March 2008 through November 2015, estimated retails sales totaled $4,996 million with the NMB programs in place and $3,750 million without the programs, giving a retail difference of $1,245 million over the 93 month period. Note again that this is at the retail level or a level considerably above the point of checkoff assessments.

Using the promotion awareness models, similar retail sales can be estimated, first with the actual awareness levels (see the lower portion of Figure 4) and then setting the condition of no awareness of the promotions. Recall that the awareness data started in Feb. 2013 so is considerably less than the sales shown in Figure 5. Those retail sales gains in this figure are based on econometric models estimated over a much shorter period than those from Figure 5. Therefore, even for the same periods, one would expect the estimates to differ but not by unreasonable amounts. For the exact same periods shown in Figure 6, retail sales using the expenditure model totaled $2,395 million with the NMB and $1,549

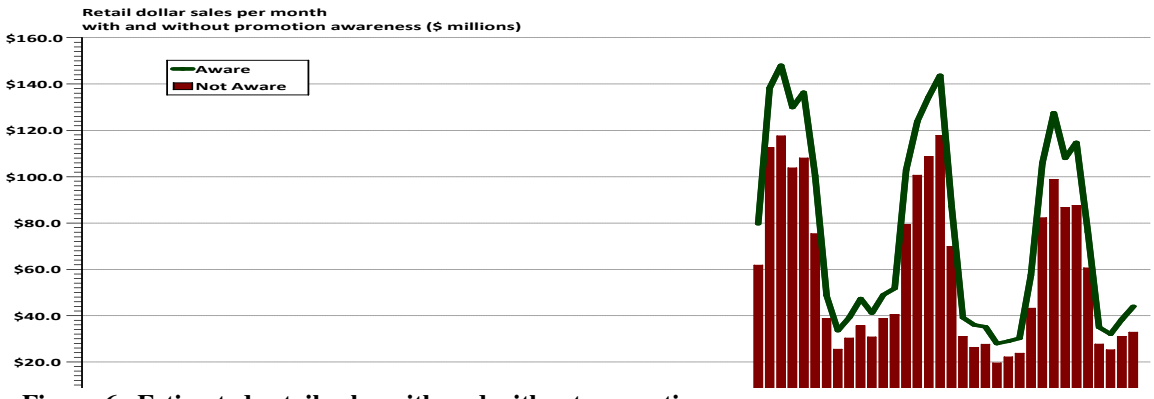

Figure 6. Estimated retail sales with and without promotion awareness.

without. In comparison for the same months, the awareness model gave estimates of $2,571 with awareness and $2,021 without awareness. For both models the retail gains are numerically large but do differ between the two models as one would expect. Yet both clearly point to significant positive gains directly attributed to the mango checkoff.

Figures 5 and 6 bring us from the theoretical abstract and statistical models to a point where one can figure out the benefits to those paying the mango assessments. If one model had pointed to positive and large numerical returns and the other to insignificant responses, that would add a level of skepticism to the analyses. Clearly, that is not the case since both approaches point to numerically large gains. With the significant statistical model results and the numerical gains shown in Figures 5 and 6, one can move forward in drawing inferences with a high degree of confidence.

All gains in both of the above figures arise from changes in both the market penetration and market intensity as discussed earlier. Over the full dataset starting with March 2008, market penetration increased by 29.8% on average directly attributed to the NMB programs. Whereas, market penetration increased by 19.2% with and without the awareness. Then for market intensity, the gain attributed to the NMB was 2.1% and for awareness, 7.1%.

Table 5. MP and MI with and without the promotions.

	With	Without	% Gain
Market Penetration			
NMB $	0.0623	0.0480	29.8%
Awareness	0.0738	0.0619	19.2%
Market Intensity			
NMB $	2.8731	2.8144	2.1%
Awareness	3.2575	3.0417	7.1%

Yet both intensity cases, the estimate intensity coefficients were statistically not different from zero. What this really means is that with both measures, statistically the retail sales gains are from attracting households to buy mango and much less so, the number of mangos per purchase.

Estimating the ROI (Return-on-Investment)

There are several ways to estimate the return on investment ranging from a simple calculation to discounting and consideration of supply adjustments. Since assessments are mandatory, considering the alterative use of the funds is of minimal interest unless one is considering abolishing the programs. Furthermore, since mangos are from tree fruits requiring long term investments, the supply response, while valid, is more likely due to prices, natural resources (e.g., water and land), capital available, and security/political situation. Given these two arguments, we will present the ROI from the two models using the more simplistic approach, thus requiring fewer numerical assumptions often found when supply responses are incorporated into the analyses (Carman, Saitone and Sexton).

Table 6 includes the ROI calculations for both the NMB expenditures and the promotion awareness models. Rows 1-6 are for the expenditures and Rows 8-13, for the awareness model. To emphasize, there are important difference in the two models. For the expenditure model, all of the variations in promotions are across time based on the monthly expenditures over 93 months (i.e., Mar 2008 through Nov 2015). For awareness, there is promotion variation over a shorter time period (i.e., Mar 2013-Dec. 2015) but the

Table 6. Estimated ROI with both the NMB $ and Awareness models.

	NMB Expenditure Model	($ millions)	($ millions)	($ millions)
	(Mar 2008 - Nov 2015)			
1	Retail Sales $	$4,996.14	$3,750.46	$1,245.68
2	Ratail/FOB Factor	0.3407	0.3407	
3	FOB $ Sales	$1,702.18	$1,277.78	$424.40
4	NMB Expenditures	$36.88	$0.00	$36.88
5	ROI (Row 3/Row 4)			**11.51**
6	Net ROI ((Row 3-Row 4)/Row 4)			10.51
	Awareness Model	Aware	Not Aware	
	(Mar 2013 - Dec 2015)	($ millions)	($ millions)	($ millions)
8	Retail Sales $	$2,571.66	$2,021.24	$550.43
9	Ratail/FOB Factor	0.3407	0.3407	
10	FOB $ Sales	$876.17	$688.64	$187.53
11	NMB Expenditures	-	-	$17.52
12	ROI (Row 10/Row 11)			**10.70**
13	Net ROI ((Row 10-Row 11)/Row 11)			9.70

promotion awareness differs with each reporting household and in total much more variation in the promotion measurement with the awareness model. An instinct would be to re-estimate the expenditure model for the same months as the awareness months, but by doing that you greatly reduce the variation in the expenditure data since it covers only 34 months. Recognizing these subtle differences, Table 6 reports the results from both models for their base time periods.

Row 1 of Table 6 corresponds to the numbers from Figure 5 or household expenditures at the retail with and without the NMB expenditures. Since the NMB assessments are recorded at the FOB level, the retail expenditures need to be expressed at that same level. For several years, an adjustment factor of .3407 between the retail and FOB price has proven correct. One can assume the mangos are the same between the

import level and retail outlets since there is little transformation in real form between the two points except for damage and presentation form. That is, the volume is basically the same between the two points with only minor differences expected. Thus a simplistic but very useful adjustment factor of .3407 can be applied to express the retail dollars at the FOB level. In Row 3, the mango dollar sales are now at the FOB or port-of-entry level. The difference with and without the NMB expenditures gives a total of $424 million over the period from Mar 2008 through Nov 2015. During those same months, the NMB spent $36.88 million on all of its activities in those months and not just marketing activities. That total is used since it requires the full Board efforts to support any demand enhancing efforts. Dividing those dollars into the sales gains (Row 5) yields an ROI of 11.51. For each dollar spent by the Mango Board, slightly over 11 times that was generated in FOB sales. The ROI is typically expressed as 1:11.51 or 11.5 to 1. A Net ROI gives the gains after subtracting out the expenditures or from Row 6, the net ROI=10.5. This ROI is substantial relative to that seen for many other commodities and clearly indicates the success of the National Mango Board in moving the demand for mangos (Ward, 2006).

In the lower portion of Table 6, the same calculations are completed using the awareness models. Since the time period is much shorter, the total retail sales are smaller. A total of $550 million retail dollar sales in Row 8 are attributed to the awareness of the promotions (see Figure 6 for the base numbers). During those same months the NMB spent $17.52 million on their programs and underlying support. Using the same methods noted above, that yields an ROI of 10.70 as seen in Row 12 and a net ROI of 9.70 in Row 13.

While differences between the two ROI are seen (e.g., 11.51 versus 10.70), they are quite similar in terms of the overall inferences that can be drawn. In both models, the overwhelming conclusion is that the promotions have enhanced mango demand in the U.S. market place and the rates of gain in terms of the ROI are reasonably close. That is, the story is basically the same with either approach. Furthermore, both gains are driven primarily by enhancing market penetration or attracting households to buy mangos and much less so in terms of market intensity (i.e., mangos per buyer).

Promotions Relative to the Other Demand Drivers

First in Figure 1, shifts in mango demand were illustrated with D0 and D1 denoting two demand curves with those shifts resulting from both market penetration and market intensity. The subsequent figure outlined many variables expected to contribute to shifts in demand. From Tables 1-4, we also know the empirical counterpart to the shifts where the impacts of the demand drivers were estimated. Some demand drivers impacted both the market penetration and market intensity while others were included just in the market intensity equations (see Tables 2 and 4). From earlier discussion, RS=Hwd × MP × MI and for the average set of conditions it is a straight forward process to create an index in demand changes based on the average RS or IndexRS:

$$IndexRS^0 = \left(Hwd \times MP^0 \times MI^0\right) / \left(Hwd \times MP^0 \times MI^0\right) = 1$$

Now with a change in demand driver say k, estimate a new RS and then express that RS

relative to the average. This index shows the shift in demand in terms of dollars (or volume) relative to the average demand driver conditions:

$$IndexRS^{k} = \left(Hwd \times MP^{k} \times MI^{k}\right) / \left(Hwd \times MP^{0} \times MI^{0}\right)$$

For example, suppose for the k variable the $IndexRS^{k}=1.25$. That implies with this specific demand driver retail sales are 1.25 times that of the average sales. Calculating the index for each variable in the models from Tables 1-4 provides a quick and clear way for showing the relative potential importance of each demand driver.

In Figure 7 these index values are shown listed in terms of their relative impacts ranked from the largest to smallest range. Each bar in Figure 7 shows the minimum and maximum with the average for the variable marked with a small vertical bar. Not surprising is the large impact from changes in household size with the largest range of values from the minimum to maximum. Figure 7 shows the relative impacts but does hide the direction of changes for each variable. As an example, race has a large impact on demand but from this figure you cannot see the difference across ethnicities. The purpose of Figure 7 is for expressing the drivers in relative terms and not the directional responses. For completeness those directional responses are included in Appendix C with only minimal discussion.

Household size, race, head-of-household age, and seasonality are generally conditions that

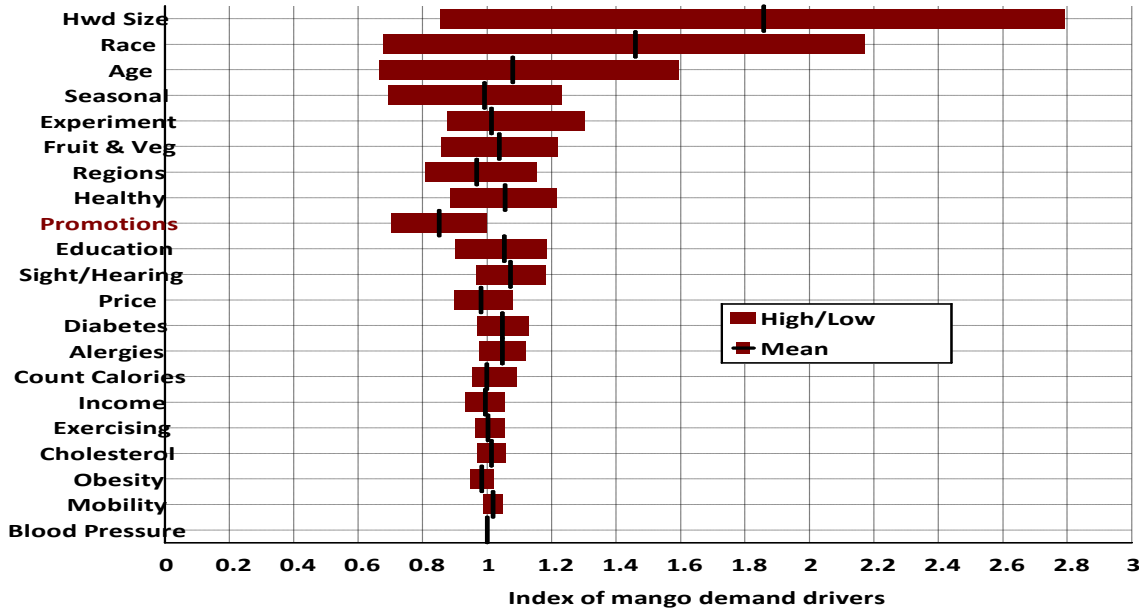

Figure 7. Relative impacts of the mango demand drivers.

are exogenous to the mango industry. They have major impacts on mango demand but are external to the industry. Experimenting with new foods, like eating fruits and vegetables, household geographic locations, and perception of health encompass the next level of important demand drivers. Each of these variables was defined immediately after Figure 2. Following the health perception is the promotion variable. Over the range from no NMB programs to the actual levels of expenditures, the range of impact on demand ranked around mid-point in the group of demand drivers listed in Figure 7. Below the Price variable, the remaining variables relate to health and weight. While many of these variables were statistically significant in moving demand, the range of movement is quite small relative to those drivers listed above the diabetes variable. Their impacts are numerically

small. Again, those impacts are also included in Appendix C for the reader interested in the precise effect of each variable.

So what does Figure 7 tell us? Demand changes as a combination of each of the drivers listed yet some are considerably more important than others. In fact, health issues while important do not have major numerical impacts on the demand for mangos. Secondly, there are many variables ranked higher than promotions. Promotions have a positive impact but demand could still decline depending on the values of the drivers mostly above promotions and somewhat less for those below in Figure 7. Empirically, a promotion program could have positive impacts yet demand still decline. It all depends on the values of the other demand drivers. The lower the ranking of the promotion variable, the more likely it would be that other demand drivers could negate (or add to) shifts seen with the promotions. Furthermore, these rankings give insight into areas to target in terms of expected gains. For example, highlighting blood pressure with mangos would likely have very little impact. Target weight would have a slightly larger expected benefit but still small in the overall scheme. Note that the rankings were based on the models from Tables 1 and 2, the expenditure models. Very similar responses in the drivers are seen in Tables 3 and 4 for the promotion awareness approach.

Food Expenditures and Buying Mangos

Theoretically, a household has a fixed food budget and makes his or her shopping decisions accordingly. Too many dollars on one food item may lead to reductions in the purchases of others. A lot of those substitutions among foods depend on the cost of each food item or category. We know the total food expenditures for each household and an obvious question is how does the demand for mangos change as the total food expenditures increase? Dollars spent on mangos are likely very small relative to the total food dollars and hence have little influence on the total expenditures. Yet it could be that as the food expenditures rise, households cut back on the less essential food categories, a category that mangos would fall into. In the models from Tables 1 through 4, household food expenditures (HFOODEXP) were included in the equations and were statistically positive and very significant in each model. Both market penetration and market intensity rise as households increase their food expenditures and is just the opposite from what might be expended given mango dollars contribute very little to the total household food expenditures.

Figure 8 shows the estimated responses in market penetration and market intensity across the index of food expenditures. For all other demand drivers at their observed values and for the average food expenditures or 1 on the x-axis, MP=7.79% and MI=2.89 mangos per buyer in a two-week buying occasion. If food expenditures were

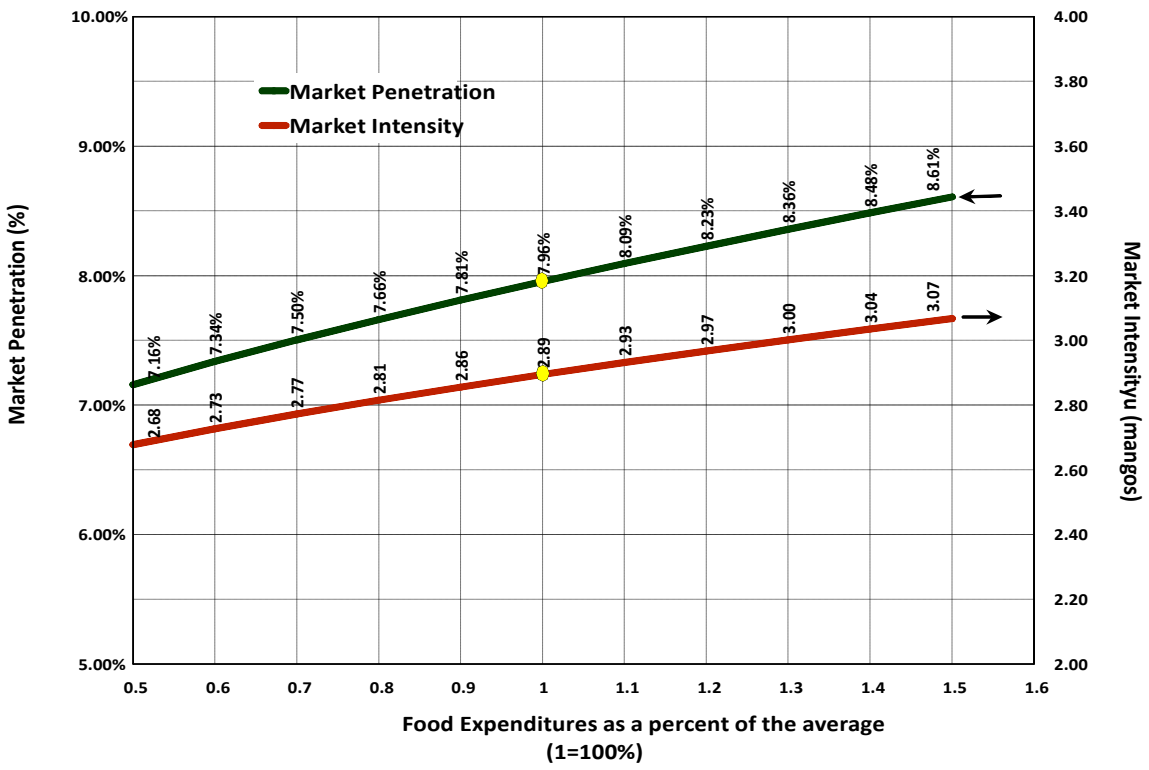

Figure 8. MP and MI across household food expenditures.

only 50% of the average both market penetration and intensity decline, and with 150% of the food expenditures, both penetration and intensity rise as seen with the positive slopes for both measures in Figure 8. Overall these responses indicate that households spending more are also likely to buy more mangos per buying occasion.

Furthermore, within the fruit purchasing category households indicated how many different fruits they purchased in a buying occasion. If there were strong substitution, an increase in one fruit may reduce the number of other fruits purchased. The variables DFRU indicate the number of other fruits purchased during buying occasions with the codes

indicating the number of other fruits (DFRU1-DFRU4). In Tables 1 and 3, the coefficients are positive and highly significant, indicating that households buying other fruits are also more likely to buy mangos. They are not substituting as much as including mangos as their fruit purchases increase. This result along with the overall food expenditures has important implications for promotions. Including other fruits in a message about mangos or even the location of in-store mango information near other fruits can be beneficial to enhancing the demand for mangos. In fact, in-store information is the single most important source of information for attracting households to buy mangos and it does not hurt to have those in-store promotions near other fruits.

Mango Attributes

Included in the market intensity models were variables dealing with reasons for buying mangos based on the attributes of the mangos. In Tables 2 and 4, these mango attribute variables were defined as: ZCOLOR, ZSIZE, ZORGANIC, ZCOOL, ZSTORE, ZADVER, ZFRESH, ZPACKG, ZRIPE, ZAROMA, ZAPPEAR, and ZQUALITY. Each household who purchased mangos in the defined period was asked to take these 12 attributes and rank their first, second, and third reasons for buying mangos. Each attribute was scored using 1= Did Not List Reason; 2=Third Priority; 3= Second Priority; or 4= First Priority. These rankings are particularly important in that the NMB's research efforts address many of these attributes and particularly ripeness (ZRIPE) and packaging (ZPACKG). Across all of the attributes, the rankings are statistically significant in both

the NMB expenditure model (Table 2) and the awareness model (Table 4). Note in particularly the very large t-values showing that statistically there is no question about the impact of ripeness on the number of mangos purchased per buying occasion.

Figure 9 shows the household rankings among the twelve attributes with the green lower portion of each bar giving the 1st place and the upper red, the 2nd place ranking. The total of the 1st and 2nd are noted at the top of each vertical bar. Consistent over the last several evaluations is the top importance of ripeness as the single most important factor among the attributes. Nearly 29 percent of the households ranked ripeness top followed then by price. Ripeness, freshness, quality and appearance were all ranked high as seen by the first five bars from the left in Figure 9. On the bottom end of the rankings are country-of-origin (COOL), packaging and advertising with these three all being below 5 percent. Also, note that ripeness and freshness, which households could be viewing similarly, had rankings of 12.8% and 12.3% respectively for the top place.

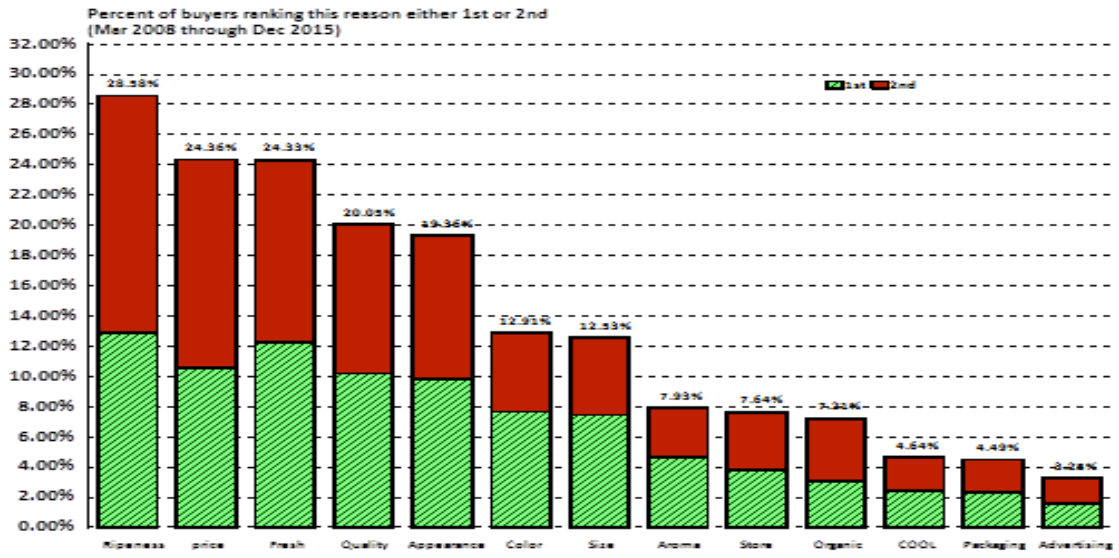

Figure 9. Household ranking of mango attributes in terms of reasons for buying mangos.

Clearly, ripeness is importance in terms of the ranking and impact on market intensity shown in Tables 2 and 4. To illustrate the potential impact, Figure 10 shows the estimated retail demand in terms of whole mangos and price under different ripeness preferences. For a retail price of say $1.29 per mango, households with no preference for ripeness would buy 2.13 mangos. With a 3rd and 2nd place ranking for ripeness, the mangos per buying occasion increase to 3.27 and 4.72 mangos. Then for those households with the strongest ranking for ripeness, the purchases increase to 6.36 mangos. That is almost a factor of 3 times more mangos between those not ranking preference and those with strong preferences for ripeness. Clearly, helping the household understand ripeness and making sure ripe fruit is available are condition for enhancing mango demand through market intensity. The NMB has invested consider resources into ripeness research and these

numbers point to major potential benefits in terms of the numbers per buying occasion.

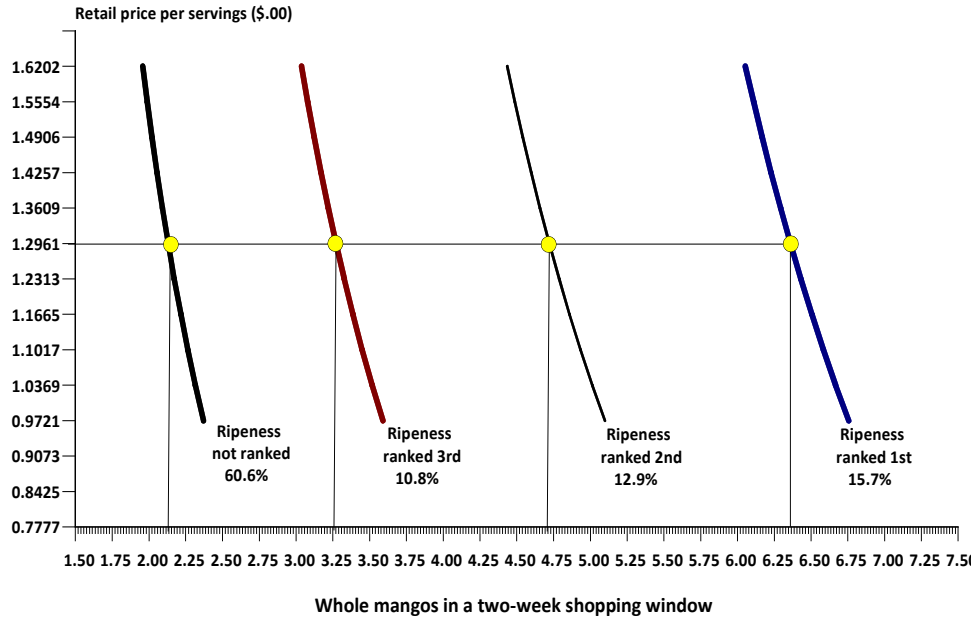

Figure 10. Mango demand across ripeness preferences.

Major Conclusions

Program evaluation, as required under the enabling legislation, requires a scientific approach where statistical inferences can be drawn. The content of this study is based on relying on the scientific approach. More broadly and beyond the quantitative measures, one also needs to look at the organizational structure; involvement in policy setting; creativity; networking; and staff when viewing the overall success of a commodity checkoff program. There is no question about the staff networking within the industry, in particularly, given the situation requiring travel and meeting throughout Central and South

America. That challenge is unique to the National Mango Board since almost all of the mango supplies original outside the U.S. Likewise there has been staff turnover with what seems to be minimal disruption to the programs. The website has been upgraded with innovative new points of interest. In fact, from the household database, we know that on average around 3.6% of the households in the database visited the website and almost 60% downloaded something from the website. In terms of buyer information sources, the internet was the third most important source of information, recognizing however that some of that could be information beyond the mango website.

Beyond the general observations above, the empirical models and scientific approach to evaluation establishes beyond any doubt that the NMB programs have enhanced the demand for mangos in the U.S. marketplace. The ROI or return-on-investment is someplace in the range of 11 to 12, depending on the models used. Even then, the ROI are very similar in the overall picture of the programs. As first suggested with Figure 1, mango demand has shifted to the right with the NMB programs and has been due mostly to attracting buyers and not the volume per purchase.

The two approaches for measuring the promotions have proven re-enforcing in showing the over positive conclusion about the program impact. The expenditure model does have an unique benefit in that we know the response to dollar levels instead of just the YES or NO in the awareness model. Knowing points along the checkoff response curve as presented in Figure 1 are particular useful if one were interesting in incremental adjustments to the program. For example, the expenditure model can be used to simulate

additional gains (or losses) if more (or less) monies were spent. The awareness model does not easily facilitate addressing those type questions. If an empirical link between awareness and dollars spent could be estimated, then the awareness models could also be beneficial to asking the "what if" type questions. As the awareness data points continue to increase, this empirical linkage can more likely be estimated.

While the empirical results are strong, there are many other demand drivers that move the demand needle. Figure 7 put all the demand drivers in perspective and that is important to the overall understanding of checkoff programs. Producers could see overall demand declining while still investing in substantial promotions. That does not mean the promotions were not working, it means that other drivers having negatives impacts on demand overwhelmed the benefits of promotions. The reverse arguments could also be made. If promotions were near the top of the scale in Figure 7, the offsetting effects would be less likely while if promotions were lower in the scale then most other drivers would create most of the demand shifts. At this point, we know that the mango checkoff programs are scaled somewhere in the middle of the demand drivers. If over time, one saw downward movement in the promotion scale that would signal need for concern since many other things would be moving the demand curve especially if those other factors were driving down the demand for mangos. A good example of this from several years ago was a major negative impact of health issues on beef demand even though the promotions were having positive effects (Ward, 1993).

Finally, the models address the attribute of mangos and how those attributes

consciously influence buyer volume (i.e., market intensity). The importance of ripeness was the most important attribute and several similar attributes were the key factors impacting the per occasion buying volume. Knowing empirically the importance of those mango attributes important and not important to the buyer are key pieces of information when developing promotion programs. As a finally example, the unimportance of country-of-origin to the household clearly suggest not highlighting that attribute.

The overall household database has been used to address many issues and provides an overall monitoring tool. Derived sole from the household data are a series of monthly reports on market penetration, market intensity, prices and total sales. These household data have been used to address pricing preference methods, comparisons between fruits, fruit irradiation, market shares, and information sources just to name a few. As long as these household samples continue to remain representative of the population, they provide reliable insight into the household base from which mango buyers originate. The NMB has continued to maintain this ongoing database as the primarily source for monitoring the demand for mangos.

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Appendix A: Database questionnaire

MarketTools

National Mango Board Study – June 2014
28039-103
QUESTIONNAIRE

Programmed Version Feb 2013

[illegible]

Changes for 2014-2015 are Q17b and Q17b

Total Sample:

- N = 1200
- Adults 18+
- [illegible]

[illegible]

- Age within gender and Ethnicity quotas
- Q1a, Q2, Q3, Q17a, Q17b, Q17c, Q17d, Q17e

P1 Welcome

Welcome to our survey!

[illegible]

[illegible]

Let's get started! Just click on the "CONTINUE" button to begin.

Create a weekly punch, to record which week the data is from.

Please update with most current list in Q.5

Q0 Device

Which best describes the device you are using right now to access the Internet?

- A traditional desktop computer
- A laptop/notebook computer
- A tablet computer (e.g. Apple iPad, Galaxy Tab, Blackberry Playbook)
- An e-reader device (e.g. Kindle, Nook, Sony Reader)
- [illegible]
- A large screen Smartphone (e.g. Apple iPhone, HTC Evo, Motorola Droid, Samsung Galaxy)
- A small screen (<3") mobile phone
- Other

SCREEN OUT IF ANYTHING BUT TRADITIONAL DESKTOP, LAPTOP OR TABLET

Q1 Age

Please click on the category that indicates your age.

- 17 or younger [Screen Out]
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65-70
- Over 70

Q2 Gender

Are you...

- Male
- Female

Create Dynamic Age/Gender Quota as follows:

Males (Q.2 = 1) by Age:	
18 – 24 (Q.1 = 2)	N = 65
25 – 44 (Q.1 = 3,4)	N = 200
45 – 64 (Q.1 = 5,6)	N = 150
65+ (Q.1 = 7,8)	N = 85

Females (Q.2 = 2) by Age:	
18 – 24 (Q.1 = 2)	N = 65
25 – 44 (Q.1 = 3,4)	N = 200
45 – 64 (Q.1 = 5,6)	N = 150
65+ (Q.1 = 7,8)	N = 85

Q21 State

In which state do you currently live?

AK	ID	MT	RI
AL	IL	NC	SC
AR	IN	ND	SD
AZ	KS	NE	TN
CA	KY	NH	TX
CO	LA	NJ	UT
CT	MA	NM	VA
DC	MD	NV	VT
DE	ME	NY	WA
FL	MI	OH	WI
GA	MN	OK	WV
HI	MO	OR	WY
IA	MS	PA	Outside the US

IF Q.21 = OUTSIDE THE US, SCREENOUT

Q4 Ethnicity1

Which one of the following best describes you? (Select one.)

- White/Caucasian
- Black/African American
- Asian
- Pacific Islander
- Native American
- Other
- Prefer not to answer

~~Create Ethnicity1 Dynamic Quota Variable as follows:~~

~~[illegible]~~
~~[illegible]~~

Q4 Ethnic2

Are you Spanish/Hispanic/Latino?

- Yes
- No
- Prefer not to answer

Create Ethnicity2 Dynamic Quota Variable as follows:

Black/African American: Q.3 = Punch 2 (Black/African American) [Quota=150]
Spanish/Hispanic/Latino: Q.4 = Punch 1 (Yes) [Quota=240]
~~[illegible] [Quota=840 scripted quota]~~
Non-Spanish/Hispanic/African American: punch [illegible] AND [illegible] [Quota=730 scripted quota]

Q5 Grocery Shopping Past 30 Days

Where have you personally shopped for food in the past 30 days? (Select all that apply)

Randomize all but none

- Grocery store
- Warehouse club store (Costco, Sam's Club, etc.)
- Internet grocery store (Peapod, Fresh Direct, etc.)
- Mass merchandiser (Wal-Mart, Target, etc.)
- Convenience Store (Gas station, 7-11, Quik Check, etc.)
- Farmer's market / Produce market (including farm standing stands)
- None of the above [Exclusive] [Screenout]

Q6 Products Purchased Grocery

When grocery shopping, which of the following products do you typically purchase? (Select all that apply)

Randomize first 12 choices

- Breads/Cereals/Grains/Pasta
- Cleaning products
- Whole or sliced fresh fruits
- Health and beauty products
- Beef or Pork
- Pet food or supplies
- Poultry or Fish
- Candy
- Salty Snacks
- Whole or sliced fresh vegetables
- Dairy
- Beverages
- None of the above [Exclusive] [Screenout]
- [illegible] [Exclusive] [Screenout]

Q7 Weekly Spending Food

In a typical week, about how much money do you spend on groceries? [illegible]

Weekly grocery spending $_________ [0-750]
Screen out if 0 or equals $0

Q7b Grocery Spend Categories

[illegible]

Randomize all except other (Other will be a hard prompt, not open)
[illegible]

Breads/Cereals/Grains/Pasta	_____$0-750
Cleaning products	_____$0-750
Whole or sliced fresh fruits	_____$0-750
Health and beauty products	_____$0-750
Beef or Pork	_____$0-750
Pet food or supplies	_____$0-750
Poultry or Fish	_____$0-750

Kiwis	____SD-TC
Stalk Fruits	____SD-TC
Whole or sec fresh vegetables	____SD-TC
Okra	____SD-TC
Rambutan	____SD-TC
Other	____SD-TC

Video instructions to interviewer – not to be read aloud to R: Interviewer should probe to clarify

MAIN QUESTIONNAIRE – From Tracker

Interviewer: Allowing Multi Picks
Instructions to interviewer: Now, we have a general list of fruits and vegetables. I am going to read you a list of fruits and vegetables and I want you to tell me which you purchased between **[Saturday, May 17th, 2014 and Saturday, May 31st, 2014]**? Select all that apply.

Random rotation

- ☐ Whole or sliced fresh fruits
- ☐ Whole or sliced fresh vegetables
- ☐ Dried or Canned Fruits
- ☐ Nuts or Nuts
- ☐ Dairy
- ☐ Poultry or Fish
- ☐ Grains
- ☐ Baked goods
- ☐ Beverages
- ☐ None of the above [→SD-TC]

If none of the above is selected in Q1a, auto-punch 1 (did not buy) for each fruit/vegetable for all rows in Q2
If neither fruits nor vegetables is selected in Q1a, auto-punch 1 (did not buy) for each fruit/vegetable for all rows in Q2

Q2 Fruit Pack and Fruit Picks

The next question is about fruits you may have purchased between **[Saturday, May 17th, 2014 and Saturday, May 31st, 2014]**, please tell us where you bought each of the following fruits and vegetables in the form of a whole piece, sliced piece, or as part of a platter. Select all that apply in each row.

	I bought this fruit/vegetable whole. Selecting more than one individually	I bought this fruit/vegetable whole but sometimes in the store	I bought this fruit/vegetable cut/sliced/peeled (e.g. slices)	I bought this fruit/vegetable as part of a fruit or vegetable platter	I bought this fruit/vegetable at a restaurant Eaten at restaurant	I did not buy this fruit/vegetable [→SD-TC]
Apples	☐	☐	☐	☐	☐	☐
Artichokes	☐	☐	☐	☐	☐	☐
Avocados	☐	☐	☐	☐	☐	☐
Bananas	☐	☐	☐	☐	☐	☐
Cantaloupe	☐	☐	☐	☐	☐	☐
Cauliflower	☐	☐	☐	☐	☐	☐
Grapefruits	☐	☐	☐	☐	☐	☐
Honeydews	☐	☐	☐	☐	☐	☐
Kiwis	☐	☐	☐	☐	☐	☐
Mangos	☐	☐	☐	☐	☐	☐
Oranges	☐	☐	☐	☐	☐	☐
Papayas	☐	☐	☐	☐	☐	☐
Pears	☐	☐	☐	☐	☐	☐
Peppers (green/red/yellow)	☐	☐	☐	☐	☐	☐
Pineapples	☐	☐	☐	☐	☐	☐
Running berries	☐	☐	☐	☐	☐	☐
Watermelons	☐	☐	☐	☐	☐	☐

SKIP NOT UP TO MORE THAN 3 ITEMS FOR EACH WHOLE FRUIT/VEGGIE/WHOLE PREPACKAGED SLICED/PEELED ITEM (FIRST THREE COLUMNS). ALWAYS INCLUDE MANGOS AND LOW BUCKET FOR OTHER 3 FRUITS/VEGGIES.

IF MORE ARE SELECTED IN FIRST THREE COLUMNS SKIP TO LANDING PAGE 1

CREATE ONE SECTION FOR EACH PROMPT (1-13) CONTAINING Q3 TO Q10. [1 Question in total]

NOTE: WE ARE SETTING THIS UP SO THAT THE PROGRAM RANDOMLY CHOOSES THE NEXT ONE AND ASKS ADDITIONAL QUESTIONS ONLY FOR WHOLE FRUITS/VEGGIES, WHOLE FRUITS/VEGGIES PREPACKAGED, AND THOSE SLICED/PEELED, BUT NOT PART OF A PLATTER).

START OF SECTION

Q3 Where did you purchase

Where did you purchase the [Fruit/Vegetable name] you bought between **[Saturday, May 17th, 2014 and Saturday, May 31st, 2014]**? [Interviewer: Select all that apply.]

Random Order

- ☐ Grocery store
- ☐ Warehouse club store (Costco, Sam's Club, etc.)
- ☐ Farmer's Market (Farm stand, pick your own, etc.)
- ☐ Convenience Store (Circle K, 7-11, Quik Stop, etc.)
- ☐ Mass Merchandiser (Target, Wal-Mart)
- ☐ Other, please specify

IF MORE THAN 1 WAS SELECTED IN Q3 AND IT WAS NOT WHOLE OR WHOLE FRUIT PREPACKAGED, SKIP TO Q5
SHOW Q3 and Q4 and Q5a on the same page

Q4 How many

In total, how many [Fruit/Vegetable name] did you buy for yourself and your family? If you would like to, please give your best estimate.

Programmer: allow 1 to 99

Q5a How many were

In total, how many [Fruit/Vegetable name] did you buy for the whole [day of the week] you bought them for yourself and your family as a whole?

Programmer: allow 0.01-999.99

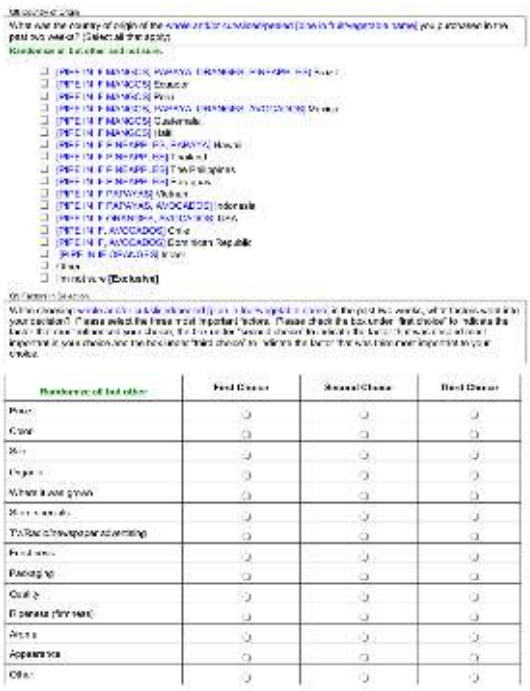
0	OR

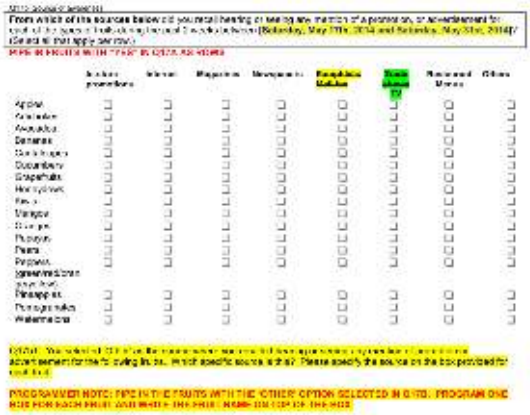
Q5b How many were

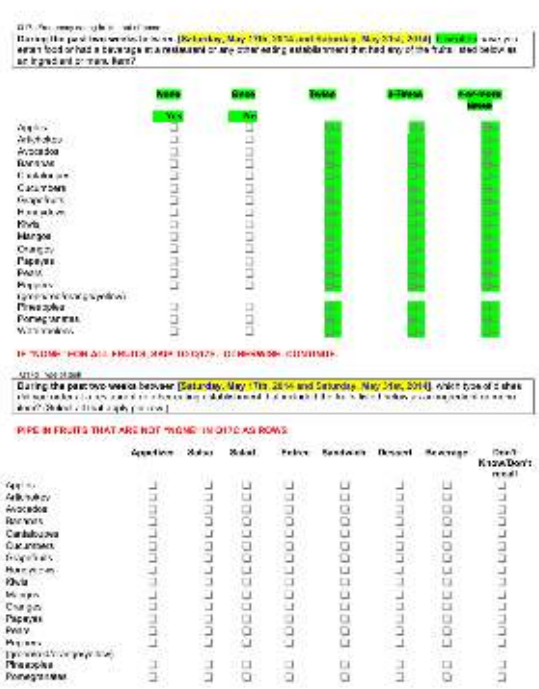
In total, how much did you pay for the whole [day of the week] you bought them for yourself and your family as a whole?

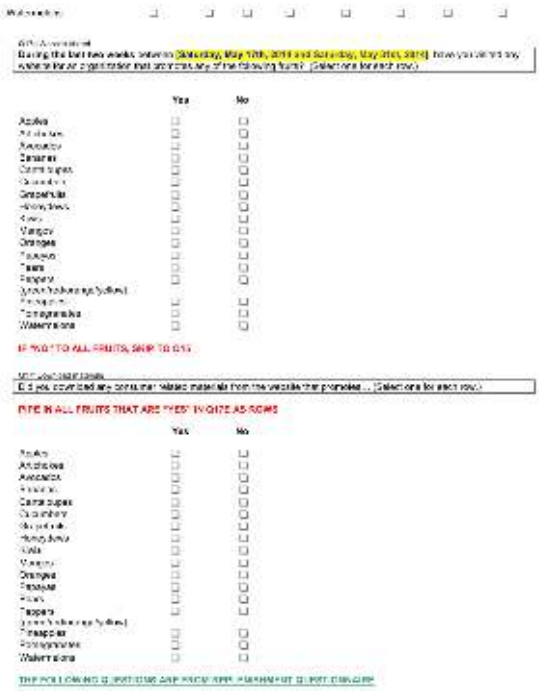
Programmer: allow 0.01-999.99

IF DID NOT BUY FRUIT SLICED/PEELED BY ITSELF, SKIP TO Q6
SHOW Q5 and Q6 on the same page









	Yes	No
Apples	☐	☐
Apricots	☐	☐
Avocados	☐	☐
Bananas	☐	☐
Cantaloupes	☐	☐
Cherries	☐	☐
Grapefruits	☐	☐
Honeydews	☐	☐
Kiwis	☐	☐
Mangos	☐	☐
Oranges	☐	☐
Peaches	☐	☐
Pears	☐	☐
Peppers (green bell or any hot peppers)	☐	☐
Pineapples	☐	☐
Tomatoes/salsa	☐	☐
Watermelons	☐	☐

IF YOU ATE ALL FRUITS, SKIP TO Q10

Did you download any consumer related materials from the website that promotes ... (Select one for each row.)

TYPE IN ALL FRUITS THAT ARE "YES" IN Q10 AS ROWS

	Yes	No
Apples	☐	☐
Apricots	☐	☐
Avocados	☐	☐
Bananas	☐	☐
Cantaloupes	☐	☐
Cherries	☐	☐
Grapefruits	☐	☐
Honeydews	☐	☐
Kiwis	☐	☐
Mangos	☐	☐
Oranges	☐	☐
Peaches	☐	☐
Pears	☐	☐
Peppers (green bell or any hot peppers)	☐	☐
Pineapples	☐	☐
Tomatoes/salsa	☐	☐
Watermelons	☐	☐

THE FOLLOWING QUESTIONS ARE FOR STATISTICAL PURPOSES ONLY.

Please tell me how much you agree or disagree with the following statements. Use the scale below, where 5 means you **Completely Agree** with a statement and 1 means you **Completely Disagree** with a statement.

Read statements	Completely agree (5)	(4)	(3)	(2)	Completely disagree (1)
I like to cook, but spending so much time in the kitchen is a hassle	☐	☐	☐	☐	☐
I am not a picky eater	☐	☐	☐	☐	☐
I would like to cook more often, but my family likes packaged foods	☐	☐	☐	☐	☐
I would like to cook more often, but all the ingredients are too expensive	☐	☐	☐	☐	☐
I prefer to have someone else do the cooking and cleaning	☐	☐	☐	☐	☐
I go out of my way to get certain types of foods	☐	☐	☐	☐	☐
I prefer to eat vegetables raw rather than cooked in any way	☐	☐	☐	☐	☐
I like fruit, but not as much as many other foods	☐	☐	☐	☐	☐
I exercise at least 3 times a week	☐	☐	☐	☐	☐
I frequently experiment with new foods	☐	☐	☐	☐	☐

Do you or does anyone in your household have any of the following health concerns? (Select all that apply.)

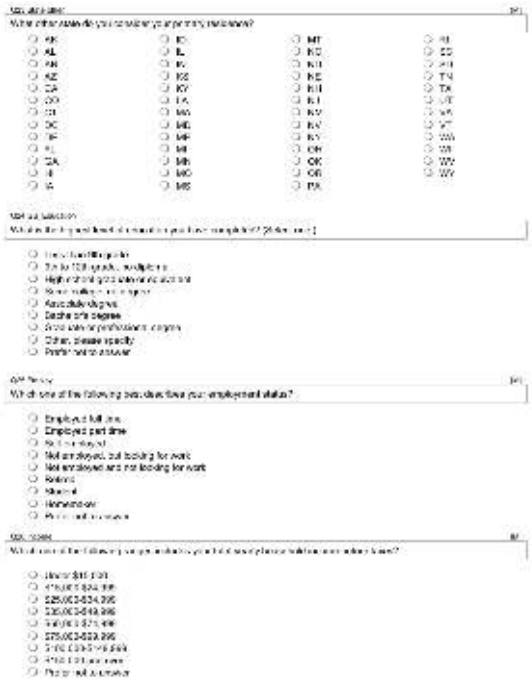
Randomize all rows	You	Your spouse / significant other	Other household member	No one (Exclusive)
High blood pressure	☐	☐	☐	☐
Diabetes	☐	☐	☐	☐
High cholesterol	☐	☐	☐	☐
Food allergies	☐	☐	☐	☐
Obesity	☐	☐	☐	☐
Limited physical mobility	☐	☐	☐	☐
Significant sight or hearing impairment	☐	☐	☐	☐

You've almost done! The next few questions are for classification purposes only. They will only be used to group your answers with others like yourself. Answers will be totally confidential.

How many **servings of fruit** do you **consume** in typical day?

How many **servings of vegetables** do you **consume** in typical day?


Which of the following would you say best describes your marital status?
Married
Living with partner
Separated
Divorced
Widowed
Prefer not to answer
ENTER A NUMBER FOR EACH AGE RANGE. IF THERE ARE NONE, ENTER 0.
0 - 10
0 - 10
0 - 10
0 - 10
Yes
No


Which of the following best describes your employment status?
Employed full time
Employed part time
Not employed, but looking for work
Not employed and not looking for work
Retired
Student
Homemaker

Appendix B1: Mango Probit Model specifications

For notation convenience, let y=MANGOBUY where

$$y = \begin{cases} 1 if\ \ yes\, to\, buying\, mangos \\ 0 if\ no\, to\, buying\, mangos \end{cases}$$

$$\Pr(y = 1 \mid x) = F(X\beta)$$

with *F* denoting the cumulative normal and then defining Xβ as follows:

$$X\beta = \beta_0 + \sum_{j=2}^{5} \beta_j \left(INC_j - INC_1 \right) + \sum_{j=2}^{4} \beta_{j+5} \left(EDU_j - EDU_1 \right)$$

$$+ \sum_{j=1}^{4} \beta_{j+9} \left(RACE_j - RACE_5 \right) + \beta_{14} AGE_2 + \beta_{15} AGE_3 + \beta_{16} AGE_4$$

$$+ \beta_{17} \mathrm{CAL}_1 + \beta_{18} \mathrm{CAL}_2 + \beta_{19} \mathrm{CAL}_4 + \beta_{20} \mathrm{CAL}_5 + \beta_{21} \left(HWD^{.33} \right)$$

$$+ \sum_{j=1,2}^{4,5..12} \beta_{j+21} \left(MTH_j \right) + \sum_{j=1,2}^{4,5} \beta_{j+32} \left(EXPR_j \right) + \sum_{j=1,2}^{4,5} \beta_{j+38} \left(EXER_j \right)$$

$$+ \sum_{j=1,2}^{4,5} \beta_{j+43} \left(HLTH_j \right) + \sum_{j=1,2}^{4,5} \beta_{j+48} \left(FRVG_j \right) + \sum_{j=1,2}^{4,5} \beta_{j+53} \left(ORG_j \right)$$

$$+ \sum_{j=2}^{9} \beta_{j+58} \left(DIV_j \right) + \sum_{j=1,2}^{4,5} \beta_{j+67} \left(LABELS_j \right) + \beta_{73} \left(HLTH\_BP \right)$$

$$+ \beta_{74} \left(HLTH\_DB \right) + \beta_{75} \left(HLTH\_CL \right) + \beta_{76} \left(HLTH\_AG \right)$$

$$+ \beta_{77} \left(HLTH\_OB \right) + \beta_{78} \left(HLTH\_MB \right) + \beta_{79} \left(HLTH\_SI \right)$$

$$+ \sum_{j=1}^{5} \beta_{j+80} \left(TFREQ_j \right) + \beta_{85} \left(HFOODEXP \right) + \sum_{j=1}^{4} \beta_{j+85} \left(FRU_j \right)$$

$$+ \beta_{86} \left(\exp^{-.01\left(\exp^{-12/HWDMAX} \right)} \right)$$

$$+ \delta \left(1 + \mathrm{atan} \left(.05(Period - 41) \mid Period > 41 \right) \right) \left(.65\, CHKTOT_0 + .35\, CHKTOT_1 \right)$$

The last two terms in the Probit Model (and in Appendix B2 the Ordered Probit Model) and particularly important properties for the evaluation models. First with β_{86} is estimated using a Gompertz curve which has the property of first increasing but up to some asympotic

level (ReliaSoft). HWDMAX in the function is the maximum number of times a household participates in the survey. If that participation has no effect on the buying decision, the β_{86} will be statistically not different from zero. Otherwise the sign and numerical magnitude of β_{86} determines if panel participation creates any bias in the demand modeling. Knowing β_{86} then allows for collecting for that potential bias associated with the household data base.

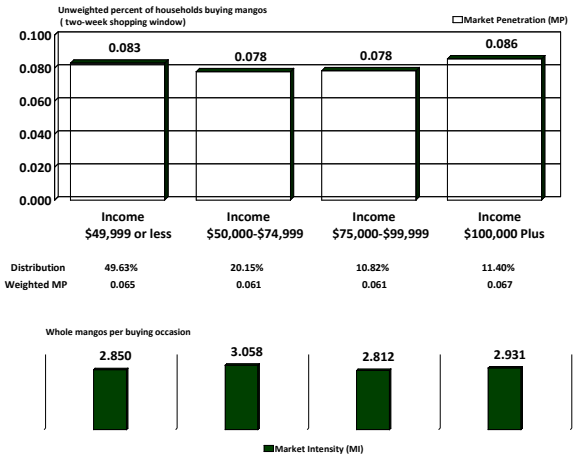
The last terms is the key variable for measuring the checkoff response curve first expressed in Figure 1. If δ in the equation is zero, then the checkoff promotions have not measurable impact on demand or the demand curve in Figure 1 does not shift with changes in the checkoff expenditures. Furthermore, preliminary model suggested that the checkoff response curve had shifted over time similar to the discussion about Figure 1. A arc-tangent function was used to capture any potential adjustment in the effectiveness of the programs. A nonlinear likelihood search was used to determine the .05 in the *atan* function. If that value had been zero, then no shift would be evident. Larger values point to a range of patterns in any potential adjustment. Since the process is fairly technical, the procedures will not be discuss except to note that the model allows for the potential changes in the checkoff response curve. Considerable behind the scene statistical testing was used to determine the function including even applying the Gompertz function to this part of the mango model(s). Finally, additional searching indicated that approximately 65% of the checkoff effect is realized in the same period and 35% in the subsequent period. That percentage distribution has been fairly robust over a number of periods.

Appendix B2. Mango Ordered Probit Model

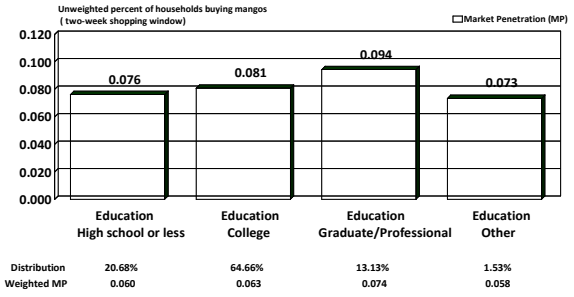
$$
\begin{aligned}
Z\beta = {} & \beta_0 + \sum_{j=2}^{5} \beta_j \left(INC_j - INC_1 \right) + \sum_{j=2}^{4} \beta_{j+5} \left(EDU_j - EDU_1 \right) \\
& + \sum_{j=1}^{4} \beta_{j+9} \left(RACE_j - RACE_5 \right) + \beta_{14} AGE_2 + \beta_{15} AGE_3 + \beta_{16} AGE_4 \\
& + \beta_{17} \mathrm{CAL}_1 + \beta_{18} \mathrm{CAL}_2 + \beta_{19} \mathrm{CAL}_4 + \beta_{20} \mathrm{CAL}_5 + \beta_{21} \left(HWD^{.33} \right) \\
& + \sum_{j=1,2}^{4,5..12} \beta_{j+21} \left(MTH_j \right) + \sum_{j=1,2}^{4,5} \beta_{j+32} \left(EXPR_j \right) + \sum_{j=1,2}^{4,5} \beta_{j+38} \left(EXER_j \right) \\
& + \sum_{j=1,2}^{4,5} \beta_{j+43} \left(HLTH_j \right) + \sum_{j=1,2}^{4,5} \beta_{j+48} \left(FRVG_j \right) + \sum_{j=1,2}^{4,5} \beta_{j+53} \left(ORG_j \right) \\
& + \sum_{j=2}^{9} \beta_{j+58} \left(DIV_j \right) + \sum_{j=1,2}^{4,5} \beta_{j+67} \left(LABELS_j \right) + \beta_{73} \left(HLTH\_BP \right) \\
& + \beta_{74} \left(HLTH\_DB \right) + \beta_{75} \left(HLTH\_CL \right) + \beta_{76} \left(HLTH\_AG \right) \\
& + \beta_{77} \left(HLTH\_OB \right) + \beta_{78} \left(HLTH\_MB \right) + \beta_{79} \left(HLTH\_SI \right) \\
& + \sum_{j=1}^{5} \beta_{j+80} \left(TFREQ_j \right) + \beta_{85} \left(HFOODEXP \right) + \sum_{j=1}^{4} \beta_{j+85} \left(FRU_j \right) \\
& + \beta_{86} PRICE + \beta_{87} ATT_{\mathrm{Price}} + \beta_{88} ATT_{\mathrm{Color}} + \beta_{89} ATT_{\mathrm{Size}} + \beta_{90} ATT_{\mathrm{Organic}} \\
& + \beta_{91} ATT_{\mathrm{Cool}} + \beta_{92} ATT_{\mathrm{Store}} + \beta_{93} ATT_{\mathrm{Adver}} + \beta_{94} ATT_{\mathrm{Fresh}} + \beta_{95} ATT_{\mathrm{Package}} \\
& + \beta_{96} ATT_{\mathrm{Ripe}} + \beta_{97} ATT_{\mathrm{Ripe}} + \beta_{98} ATT_{\mathrm{Aroma}} + \beta_{99} ATT_{\mathrm{Appearance}} + \beta_{100} ATT_{\mathrm{Quality}} \\
& + \lambda \left(1 + \operatorname{atan} \left(.05 (Period - 41) \mid Period > 41 \right) \right) \left(CHKTOT_1 \right)
\end{aligned}
$$

The awareness models are almost the same as above except a binary variable for awareness is included in place of the checkoff expenditures.

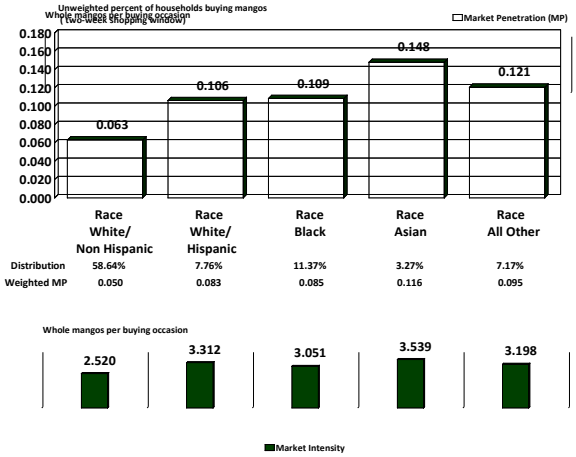
Appendic C: Selected responses to other demand drivers included in the models. These are shown for reference and are not discussed in any detail in the text.



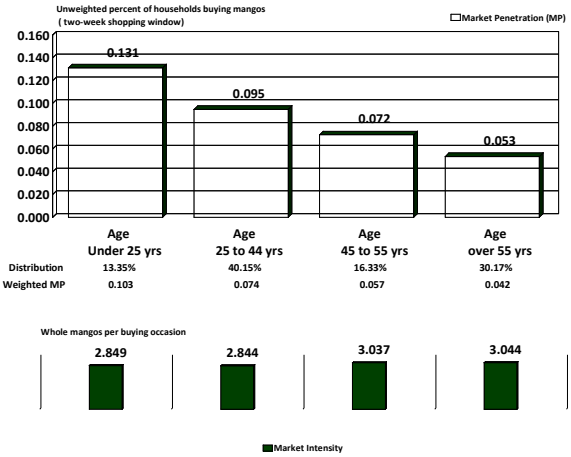
Income



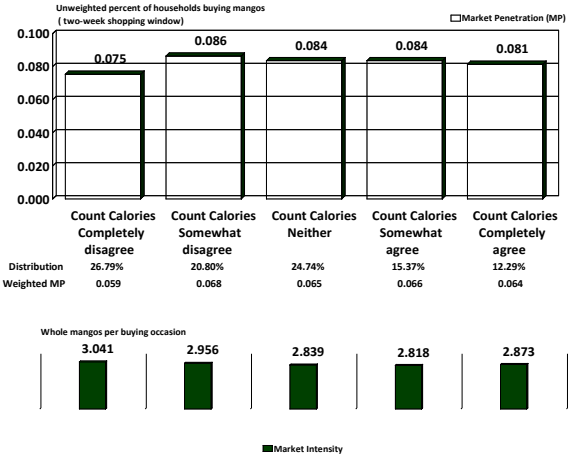
Education



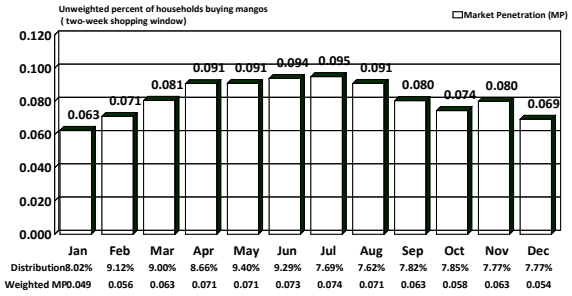
Ethnicity



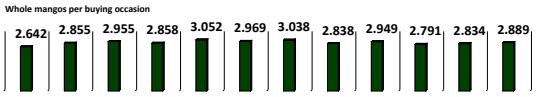
Age

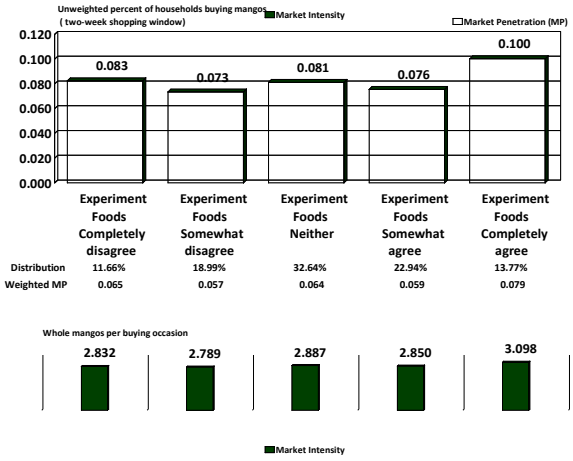


Counting Calories

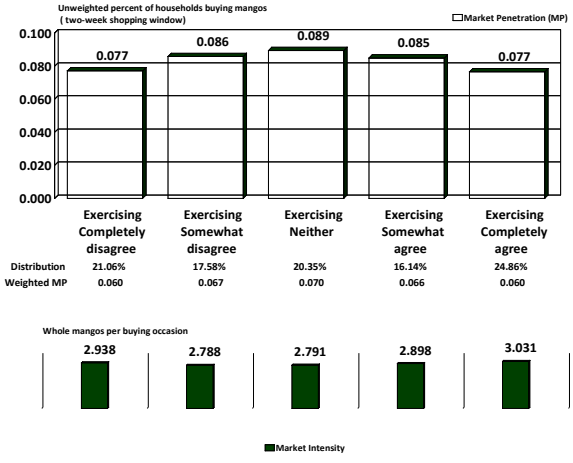


Seasonality

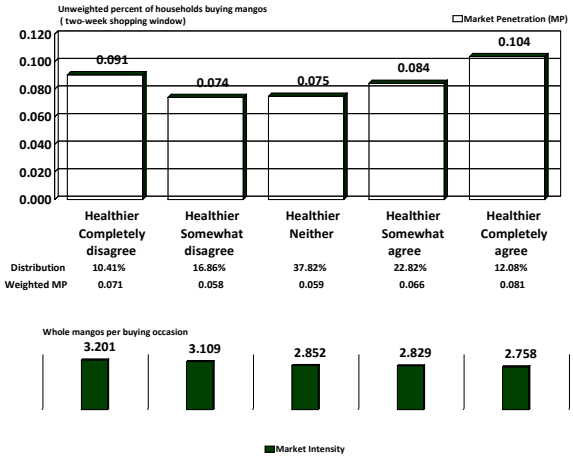




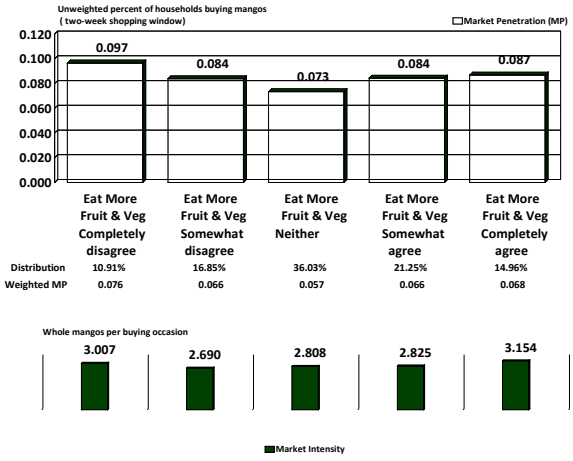
Experimenting with New Foods



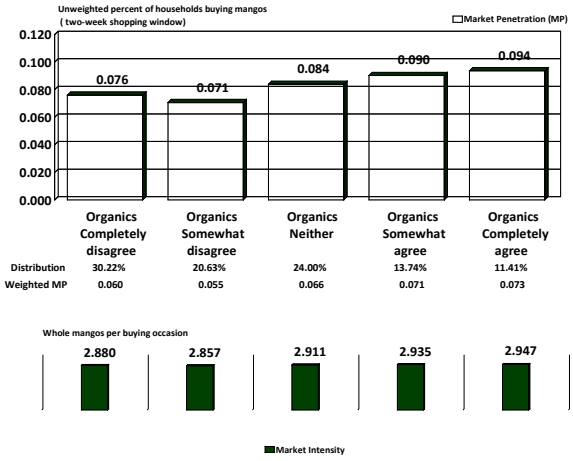
Exercising



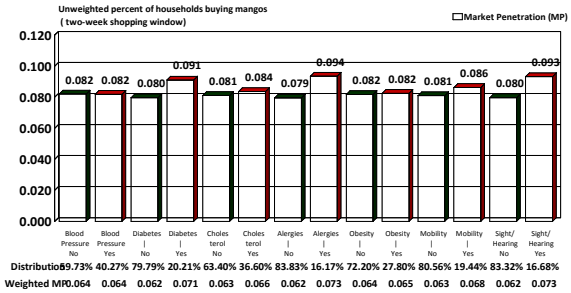
Health Perception



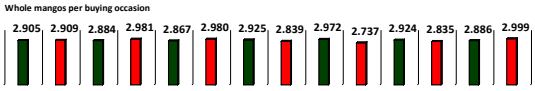
Preference for Fruits and Vegetables

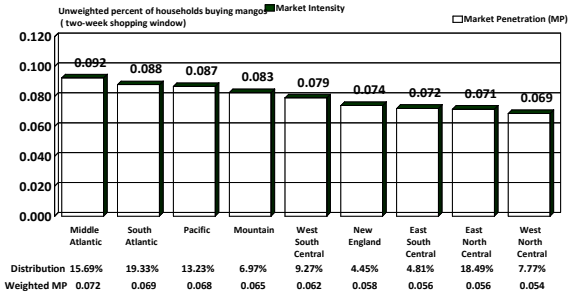


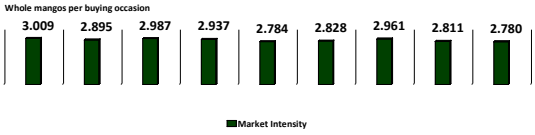
Search out Organics



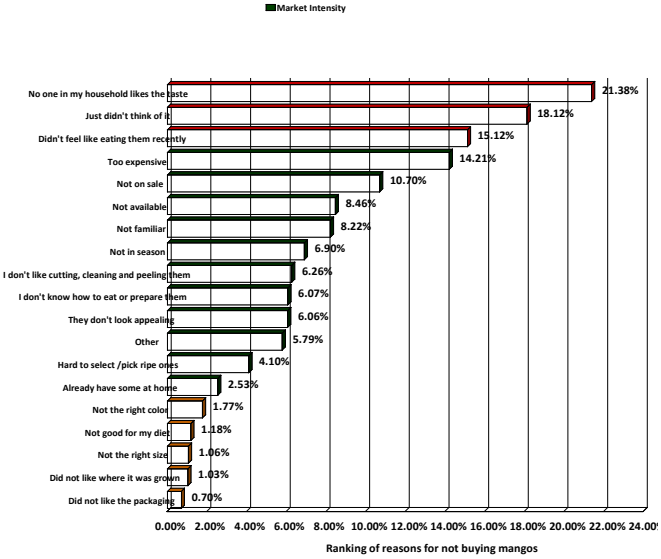
Household Health Status







Regional Location



Reasons for Not Buying Mangos