World Academy of Science, Engineering and Technology
International Journal of Economics and Management Engineering
Vol:10, No:4, 2016

Market Segmentation and Conjoint Analysis for Apple Family Design

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***Abstract*—**A distributor of Apple products' experiences numerous difficulties in developing marketing strategies for new and existing mobile product entries that maximize customer satisfaction and the firm's profitability. This research, therefore, integrates market segmentation in platform-based product family design and conjoint analysis to identify iSystem combinations that increase customer satisfaction and business profits. First, the enhanced market segmentation grid is created. Then, the estimated demand model is formulated. Finally, the profit models are constructed then used to determine the ideal product family design that maximizes profit. Conjoint analysis is used to explore customer preferences with their satisfaction levels. A total of 200 surveys are collected about customer preferences. Then, simulation is used to determine the importance values for each attribute. Finally, sensitivity analysis is conducted to determine the product family design that maximizes both objectives. In conclusion, the results of this research shall provide great support to Apple distributors in determining the best marketing strategies that enhance their market share.

***Keyword*—**Market segmentation, conjoint analysis, market strategies, optimization.

I. Introduction

IN an effort to meet the growing demand for a broad range of complex, customized goods and services and the evolution of worldwide competitive markets for the production and consumption of them, many companies are utilizing product families and platform-based product development to increase variety, shorten lead times and reduce costs [1]-[5].

A product family refers to a set of products that have been derived from a common product platform to satisfy a variety of market niches [6]-[8]. Typically, customers differ in their values and needs. Market segmentation helps firms to better understand their customers and target their marketing efforts efficiently and effectively. The information of the segments helps the decision makers to reach all customers effectively, as well as deploy resources more effectively and efficiently and determine particular competitive strategies; *i.e*. differentiation, low cost, or focus strategy [9].

Globally, firms face numerous difficult decisions directed at assessing and maximizing future profitability, sales, and market share for new product entries or modifications of existing product attributes, including price, play a significant role in the success or failure of new products. Further, conjoint analysis is considered to be one of the best methods for achieving the fulfillment of customers' needs in a profitable way. Conjoint analysis is considered to be one of the best methods for achieving the fulfillment of customers' needs in a profitable way and requires that companies understand which aspects of their product and service are most valued by the customer. It consists of generating and conducting specific experiment attributes among customers with the purpose of modeling their purchasing decision [10]-[12]. The objective of conjoint analysis is to determine the combination of a limited number of attributes that is most influential on customers' choice or decision making and determine if pricing or other attributes of current products should be modified in response to competition.

In Jordan, distributors of iSystem products are faced with numerous difficult tasks directed at assessing future profitability, sales, and market share for new mobile product entries or modifications of existing products or marketing strategies. Therefore, this research aims at increasing iSystem profitability using market segmentation, enhancing customer satisfaction (market share) using conjoint analysis, and maintaining a balance between profit and customer satisfaction.

II. Market Segmentation

The widespread use of the market segmentation grid (MSG) is the inevitable consequence of the increase in competition and the global nature of today's market place. In MSG, the total market for a product family is defined through a matrix of market niches that identify particular user groups and price/performance tiers. The implementation of market segmentation is outlined in the following steps:

A. Step 1: Creation of Market Segmentation Grid

Data on the existing market is required to create an 'enhanced' MSG that includes information not only about the market segments and the performance/price tiers but also about the competitors in each niche (*i.e*., the market segment and performance/price combination). Collecting market data involves gathering sales data and information on the performance characteristics of competitors' products in the market must. An important consideration is the choice of the performance attribute to include in the grid as the vertical axis of the market segmentation. The high performance characteristics and flexibility of Apple products have led to a wide range of applications; such as, personal, military and business, where they are found in products; such as, iPod,

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iPad and MacBook. A market segmentation with three market segments; iPod, iPad, and MacBook, is depicted in Fig. 1.

Performance, capacity and cost are used as the differentiating attributes for defining tiers within each segment with the understanding that products with higher performance and capacity cost more. The segment for iPod includes iPod Shuffle, Nano and touch. The iPad segment includes, iPad 8GB, 16GB and 32GB. MacBook includes, MacBook Air and MacBook Pro with different hard disk capacities. The size of the market is 4,246 items, where iPod occupies the highest annual demand of 3,561 items; iPad demand of 444 items and 241 for MacBook across all users. The users are assumed to choose among different items based on the products' attributes; *i.e.,* Price (P), Capacity (C_p), Screen width for MacBook (Sc).

Fig. 1 Market segments

TABLE I
MARKET SHARES OF NICHES

Segment I			Segment II			Segment III		
	Code	Q		Code	Q		Code	Q
1	A13	450	7	A23	278	10	A33	15
2	A12	274	8	A22	101	11	B33	9
3	B12	131	9	A21	65	12	C33	7
4	A11	116					D33	12
5	B11	71					E33	6
6	C11	26					A32	40
							B32	29
							A31	22
Total		1068			444			140

B. Step 2: Estimation of the Demand Model

The MSG consists of three market segments along the horizontal axis (corresponding to iPod, iPad and MacBook. and three performance/cost tiers on the vertical axis, leading to a total of nine niches. The demand model establishes the relationship between the customer desired attributes, **A**, price, P, and the demand, Q, *i.e.*, Q (**A,** P). Once the demand model is estimated, it can be used repeatedly to estimate the impact of design changes or the effect of adding/removing products from the line using a choice simulator program that simulates the demand model and uses the market data as inputs to estimate changes in market share for each product as a function of engineering and customer attributes and price values. Table I illustrates the difference in market share of the existing products (corresponding to eight products with serial numbers one to 12, where A, B, C… indicate different products in the same niche.

Profit is modeled as a function of demand (Q), Price (P) and cost (C), which is divided to variable cost (C_v) and fixed cost (C_f). In this research, the fixed cost is divided into labor cost (C_L), management costs (C_M), and overhead costs (C_{OH}).

$$C_f = C_{L+} C_{M+} C_{OH} \quad (1)$$

The total annual fixed costs are calculated for C_L, C_M and C_{OH} and found equal to 19,200, 3,600 and 2,000 JOD, respectively. It is assumed that the total annual fixed cost (=24,800 JOD) is divided equally on all the nine niches with a portion of 2,755.5JD for each niche. After the MSG is transformed to a matrix, (M) represented by x_{ij}, where i denotes the column and j the row. The first column stands for iPod segment, the second for iPad, and the last one for MacBook segment. The matrix components will be used as decision variables in the optimization model. Table II shows the profit parameters (Price, demand, and variable cost). The total profit for each segment is expressed as:

$$V_1 = 6583.05x_{11} + [-8.4036\times C_{pn}^{\ 2} + 51.46C_{pn} + 3370.75]x_{12} + [-0.768\times C_{pt}^{\ 2} - 97.92\times C_{pt} + 12474]x_{13} \quad (2)$$

$$V_2 = 22518x_{21} + 10453.5x_{22} + 6459.05x_{23} \quad (3)$$

$$V_3 = [\,90\times C_{pu}^{\ 2} - 0.016\times C_{pm}^{\ 2} + 6\times Sc^2 - 8.85\times RAM^2 + 3.0779\times C_{pu}\times C_{pm} + 51C_{pu}\times Sc + 72.5\times C_{pu}\times RAM + 1.33\times C_{pm}\times Sc - 0.805\times C_{pm}\times RAM + 21.35\times Sc\times RAM + 378\times C_{pu} + 14.7\times C_{pm} + 63\times Sc + 247.8\times RAM - 3447.186]x_{31} + [-93145.5 + 7100\times Sc + 100.8911\times HD + 33660\times C_{pu} + 210\times Sc^2 - 0.016572\times HD^2 - 3120\times C_{pu}^{\ 2} - 7.9857\times Sc\times HD - 1460\times C_{pu}\times Sc - 17.9906\times HD\times C_{pu}]x_{32} + 25443x_{33} \quad (4)$$

D. Step 4: The Ideal Product Family Design

The objective function is formulated as:

$$Max\ V_t = V_1 + V_2 + V_3$$
$$x_{ij} = \{0,1\}, \quad i=1,\ldots,3;\ j=1,\ldots,3 \quad (5)$$

The factor levels are displayed in Table II.

TABLE II
FACTOR LEVELS

Factor	Level		
	1	2	3
C_{pn}	8	16	
C_{pt}	8	32	64
C_{pu}	1.4	1.6	1.7
C_{pm}	64	128	256
Sc	11	13	
RAM	2	4	

TABLE III
NICHES PERCENTAGES

Niche	Max Profit	% Seg.	% Niche
x_{11}	20,718.12		38.7477
x_{12}	28,955.62	14.8	54.1538
x_{13}	3,795.53		7.0985
x_{21}	75,203.46		33.754
x_{22}	54,775.86	61.7	24.5854
x_{23}	92,819.22		41.6606
x_{31}	22,670.63		26.6658
x_{32}	42,927.44	23.5	50.4924
x_{33}	19,419.51		22.8418

Solving the optimization model, the obtained percentage of the segments and their niches are displayed in Table III.

The portion of each product is calculated using the total niche percentage and their best numbers for iPod Nano and Touch, MacBook Air and Pro. The percentages are calculated by dividing the total profit for each product by the overall niche profit. Fig. 2 summarizes the three stages of segmentation with niche percentages.

III. CONJOINT ANALYSIS IMPLEMENTATION

A fractional factorial design is selected to maximize the data that is collected while minimizing the number of used profiles. Only nine combinations are used for iPad, whereas there are eight for MacBook. The attributes and level values for iPad and MacBook are defined as given in Table IV.

TABLE IV
FACTOR LEVELS

Seg.	Factor	Level		
		1	2	3
iPad	Capacity	16 GB	32 GB	64 GB
	Price	450 JD	550 JD	650 JD
	3G	With	Without	
	Color	Black	White	
MacBook Pro	Hard Disk	500	750	
	Price	1,630	2,330	
	CPU	2.2	2.4	2.7
	Screen	13'	15'	

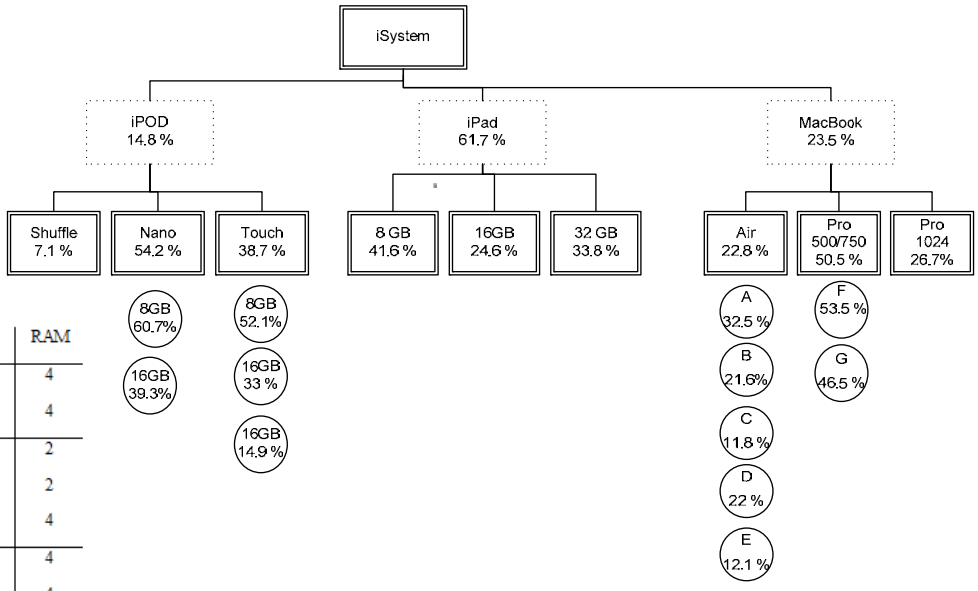
TABLE V (A)
SIMULATION TRIALS FOR IPAD

No.	Cap. (GB)	Price (JOD)	Color	3G	Score	Percent
1	16	550	Black	Yes	5.837	47.80%
2	32	550	Black	Yes	4.417	19.20%
3	64	550	Black	Yes	5.229	33.00%
1	32	450	Black	Yes	4.251	37.60%
2	32	550	Black	Yes	4.417	42.70%
3	32	650	Black	Yes	3.394	19.70%
1	32	550	Black	Yes	4.417	35.60%
2	32	550	White	Yes	5.265	64.40%
1	32	550	Black	Yes	5.837	64.60%
2	32	550	Black	No	3.989	35.40%

TABLE V (B)
SIMULATION TRIALS FOR MACBOOK PRO

No.	Hard Disk (GB)	Price (JOD)	CPU	Screen	Score	Percent
1	500	1,630	2.4	13'	5.479	62.50%
2	750	1,630	2.4	13'	4.038	37.50%
1	500	1,630	2.4	13'	5.479	53.70%
2	500	2,330	2.4	13'	5.164	46.30%
1	500	1,630	2.2	13'	5.051	23.00%
2	500	1,630	2.4	13'	5.479	41.20%
3	500	1,630	2.7	13'	4.695	35.80%
1	500	1,630	2.4	13'	5.479	65.10%
2	500	1,630	2.4	15'	4.549	34.90%

A total of 200 surveys were distributed randomly, while 175 surveys were returned, which contributes to about 87% of the targeted population. The survey data contains an orthogonal conjoint plan for both iPad and MacBook Pro. The simulation process is performed to analyze the data. Table V displays samples of the simulation trials. The utility values, standard errors, and percentages are then calculated for iPad and MacBook Pro and then displayed in Table VI.



	CPU	HD	SC	RAM
A	1.7	128	13	4
B	1.7	256	13	4
C	1.4	128	11	2
D	1.6	64	11	2
E	1.6	128	11	4
F	2.7	500	13	4
G	2.4	750	15	4

Fig. 2 Stages of segmentation with niche percentages

The negative utility sign implies a more preferable level because the data were entered inversely. The standard error for each utility is found small, which indicates good estimation of utility values.

IV. Sensitivity Analysis Using Market Simulation

Sensitivity analysis using market simulation offers a way to report preference scores for each level of each product attribute. Applying sensitivity analysis on iPad and MacBook Pro., abase case scenario contributes 10.5% of the market. The sensitivity analysis for iPad product is illustrated in Table VII. For MacBook Pro, a base case scenario contributes 16.4% of the market. Sensitivity analysis is performed on MacBook Pro and the results are shown in Table VIII.

TABLE VI
Utility Estimates

Seg.	Attribute		Utility Estimate	Std. Error	Percent
iPad	Capacity	16GB	0.676	0.081	32.22%
		32GB	-0.744	0.075	
		64GB	0.068	0.075	
	Price	450	0.516	0.081	26.58%
		550	0.254	0.081	
		650	-0.769	0.100	
	Color	Black	-0.424	0.057	21.85%
		White	0.424	0.057	
MacBook Pro.	Hard Disk	500GB	0.329	0.148	22.24%
		750GB	-0.329	0.148	
	Price	1,630	-0.172	0.200	17.66%
		2,330	0.172	0.200	
	Processor	2.2GH	-0.024	0.255	35.05%
		2.4GH	0.404	0.255	
		2.7GH	-0.38	0.378	
	Screen	13'	0.465	0.200	25.05%
		15'	-0.465	0.200	

TABLE VII
Sensitivity Analysis for iPad

No.	Capacity (GB)	Price (JOD)	Color	3G	Percent
	32	550	Black	without 3G	10.5%
1	32	550	White	without 3G	15.1%
2	32	450	Black	without 3G	7.4%
3	32	650	Black	without 3G	14.1%
4	32	550	Black	with 3G	9.9%
5	16	550	Black	without 3G	15.4%
6	64	550	Black	without 3G	24.1%

TABLE VIII
Sensitivity Analysis for MacBook Pro

No.	HD (GB)	Price (JD)	CPU (GH)	Screen	Percent
Base	500	2,330	2.2GH	13'	16.4%
1	500	2,330	2.2GH	15'	6.6%
2	500	2,330	2.4GH	13'	30.0%
3	500	2,330	2.7GH	13'	13.4%
4	500	1,630	2.2GH	13'	10.3%
5	750	2,330	2.2GH	13'	23.2%

V. Results and Conclusions

This research successfully implemented market segmentation combined with conjoint analysis to maximize customer satisfaction and company profits. The results of market segmentation showed that profit is increased by 28.5%, while revenues are increased by 0.99%. From the conjoint analysis for iPad, the capacity contributes the highest importance value with 32.215%, which indicates that customers have high preference for capacity. The importance values of the other attributes were 26.575, 21.846 and 19.365 for price, color and 3G service, respectively. Similarly, the importance values for MacBook Pro showed that the processor (CPU) is the most important factor with a value of

35.052%. For screen, hard disk, and price, the importance values were calculated as 25.047, 22.239, and 17.633, respectively. It is concluded that changing the capacity for iPad from 32 GB to 64 GB is the best scenario to exceed the base relative preference. For MacBook Pro, the replacement of the 2.2 GH processor with a 2.4 GH processor, which results in increasing the base relative preference from 16.4% to 30.0% is suggested.

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