Homework: Conjoint Analysis

Most research pertaining to purchase decision making primarily focuses on consumers making individual decisions. However, purchase decision making often involves a group of consumers making decisions jointly. For example, a husband and a wife usually make joint decisions in purchasing household appliances. Thus, it is imperative for a firm selling such products to understand how husbands and wives evaluate different attributes of the products.

For this homework, the product and levels of attributes considered are presented in the table below.

Product Attributes and Levels

Product	Attributes	Levels
Push-Type Lawn Mower	Horse Power	5 H.P.
		4 H.P.
	Brand	Toro
		Sears
	Swath	22 inches
		20 inches
	Price	$250
		$400

In a conjoint study, 29 husband-wife dyads were asked to independently rate 8 profiles of lawn mowers on the following scale of 1 to 100.

Extremely Neutral
Extremely Unappealing
Appealing
|----------|----------|----------|----------|
1 50
100

Both husbands and wives are exposed to the same 8 profiles.

Alternative 1

5 H.P. engine; Sears brand; 22 inches swath; Priced at $250

On a scale of 1100, how would you rate this lawn mower?_____

Alternative 2

4 H.P. engine; Toro brand; 22 inches swath; Priced at $400

On a scale of 1100, how would you rate this lawn mower ?_____

Alternative 3

5 H.P. engine; Toro brand; 20 inches swath; Priced at $250

On a scale of 1100, how would you rate this lawn mower ?_____

Alternative 4

4 H.P. engine; Sears brand; 20 inches swath; Priced at $400

On a scale of 1100, how would you rate this lawn mower ?_____

Alternative 5

5 H.P. engine; Sears brand; 22 inches swath; Priced at $400

On a scale of 1100, how would you rate this lawn mower ?_____

Alternative 6

4 H.P. engine; Sears brand; 20 inches swath; Priced at $250

On a scale of 1100, how would you rate this lawn mower ?_____

Alternative 7

4 H.P. engine; Toro brand; 22 inches swath; Priced at $250

On a scale of 1100, how would you rate this lawn mower ?_____

Alternative 8

5 H.P. engine; Toro brand; 20 inches swath; Priced at $400

On a scale of 1100, how would you rate this lawn mower?_____

In this homework, you will perform a regression analysis on ratings obtained from both husbands and wives (provided in the rating.xls file). Next you will conduct a market simulation based on individual utility estimates given to you in the utility_husbands.xls file.

1. Given rating data from 29 husband-wife dyads (in rating.xls) and the description of different profiles used in the conjoint study,
   a) create dummy codes for different lawn mower profiles in order to subsequently perform a regression analysis on rating data;
   b) fit a regression model for all the husband ratings (i.e., a single regression model for all husbands) to obtain husband utilities for different lawn mower attribute levels at the aggregate level;

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            Estimate Std. Error t value Pr(>|t|)
(Intercept)   21.133      3.305   6.394 9.10e-10 ***
HP5           16.972      3.176   5.345 2.20e-07 ***
Brand_Toro    16.666      3.176   5.248 3.52e-07 ***
Inches_22     20.747      3.305   6.277 1.73e-09 ***
Price_250     13.064      3.305   3.953 0.000103 ***
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Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 22.08 on 227 degrees of freedom
Multiple R-squared:  0.3786,    Adjusted R-squared:  0.3676
F-statistic: 34.57 on 4 and 227 DF,  p-value: < 2.2e-16
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   c) repeat b) for all the wife ratings;

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Coefficients:
            Estimate Std. Error t value Pr(>|t|)
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(Intercept)   23.422          3.440   6.809 8.71e-11 ***
HP5          3.776   3.305   1.142   0.254
Brand_Toro          17.569          3.305   5.316 2.54e-07 ***
Inches_22 14.026          3.440   4.077 6.31e-05 ***
Price_250 21.784          3.440   6.333 1.28e-09 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 22.98 on 227 degrees of freedom
Multiple R-squared:  0.312, Adjusted R-squared:  0.2998
F-statistic: 25.73 on 4 and 227 DF,  p-value: < 2.2e-16
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d) interpret and compare the regression outputs obtained from both husband and wife ratings.

The utility of HP5 which indicate that Husband are more like to purchase a higher Horse power machine than wife, or in another word, wife doesn't care as that much as their husband on machinery power.

The utility of brand indicate that husband and wife both have brand preference in Toro.

The utility of Inches indicate that husband and wife both prefers longer scale, and husband care much than their wife.

The utility of price indicate that husband prefers cheaper machine than their wife. Or we could say that wives don't care that much on price as their husband does.

2. The individual utility estimates for different lawn mower attribute levels for husbands are provided in utility_husbands.xls. I used a hierarchical Bayes method to obtain these estimates. What additional insights do these individual level estimates provide compared to the aggregate estimates obtained from your analysis in 1(b)?

The intercept in individual excel informing that most of husbands are positive to the product. And compare the value in the 5 HP bucket with the value in Toro suggests that Husbands are more care about the horse power than the brand when they purchase the product. Because the average of utilities in HP5 are Much higher than Brand.

And what we found next is we found out that the relationship between house power and price. We could found that there is a negative relationship between price and house power. It seems like that husband are more prefer higher house power and lower price.

3. Let us assume that Toro and Sears constitute the entire market and each brand offers only one model of lawn mower:

	Toro (P1)	**Sears (P2)**
Horse Power	5 H.P.	4 H.P.

Swath	20 inches		22 inches
Price	$400	$250	

Please compute predicted market share for Toro using the share of utility rule for husband utilities. Briefly comment on the findings. (Hint: (i) Look up formulae that I use in the coffeemaker example. The excel spreadsheet is on the course website. (ii) Note that you will have an intercept term in your calculations that the coffeemaker example does not. Use the intercept term in all calculations for this homework).

The market share are 49% for Toro.

Interpretation:

1. Coefficients and Significance:
   - HorsePower4:
     - For husbands, the coefficient is -24.17, significantly affecting the rating ($p < 0.001$). It indicates a strong negative preference compared to the baseline (likely HorsePower5).
     - For wives, the coefficient is -20.09, also significant ($p < 0.001$), showing a similar strong negative preference compared to the baseline.
   - BrandToro:
     - For husbands, the coefficient is -3.621, but this is not statistically significant ($p = 0.117$), suggesting a slight but not significant disfavor.
     - For wives, the coefficient is -2.026 with a p-value of 0.394, indicating an even weaker and non-significant disfavor.
   - Swath22:
     - For husbands, there is a positive coefficient of 5.983, which is significant ($p = 0.010$), indicating a preference for this feature.
     - For wives, the coefficient is 2.922 with a p-value of 0.219, suggesting a weaker and non-significant preference for this feature.
   - Price400:
     - For both husbands and wives, the coefficients are effectively zero with a p-value of 1.000, indicating no effect on the rating based on this price attribute.

2. Model Fit and Overall Significance:
   - Husbands' Model:
     - The model explains about 20.63% of the variability in husbands' ratings (Adjusted R-squared = 0.1994), and the overall model is statistically significant (F-statistic $p < 0.001$).
   - Wives' Model:
     - The model explains about 13.87% of the variability in wives' ratings (Adjusted R-squared = 0.1312), which is lower than that of husbands. The model is also statistically significant, albeit less strongly so (F-statistic $p < 0.001$).

Comparison:

- Preference for HorsePower4 is strong and negative for both husbands and wives, but it is slightly more pronounced for husbands.
- Brand preference for Toro is slightly negative for both, but it is not statistically significant for either group.

- Swath22 is preferred by husbands significantly, while wives show a non-significant slight preference.
- Price400 does not influence the ratings for either group, suggesting that the price increase to $400 is not a deterrent in their rating the product.

Conclusion:
Husbands seem to be slightly more sensitive to certain attributes (HorsePower and Swath size) than wives, as indicated by the higher coefficients and the greater proportion of variance explained in their ratings. However, for both groups, the most negative impact comes from the lower horsepower, indicating a preference for higher horsepower models.

This kind of analysis helps in understanding consumer preferences and can guide marketing strategies and product development to tailor products more closely to the preferences of different demographic groups.

4. In order to better compete with Sears, Toro plans to launch another model in the market. Toro is considering two options for its new model:

	NP1	NP2
Horse power	4 H.P.	4 H.P.
Swath	22 inches	20 inches
Price	$400	$250

Please compute predicted market share for the following two options using the share of utility rule:

(i) Option 1: Market comprises of P1, P2 and NP1
(ii) Option 2: Market comprises of P1, P2 and NP2

Which option results in a higher market share for the new Toro product? For each option please comment on the cannibalization effect of the new product on the existing Toro product.

utility share	**Situation1**	**P1**	**P2**	
		49%	51%	
	Situation2	**P1**	**P2**	**NP1**
		37%	39%	24%
	Situation3	**P1**	**P2**	**NP2**
		37%	39%	25%

Market share	**Situation1**	**P1**	**P2**	
		60%	40%	
	Situation2	**P1**	**P2**	**NP1**
		43%	28%	28%

	Situation3	P1	P2	NP2
		48%	32%	20%

When comparing the introduction of NP1 and NP2 to the market already containing P1 and P2, you can observe the following:

1. Current Market Shares:
    - P1 holds 49% and P2 holds 51%.
2. With NP1 Introduced:
    - Market Shares change to P1: 37%, P2: 39%, NP1: 24%.
3. With NP2 Introduced:
    - Market Shares adjust to P1: 37%, P2: 39%, NP2: 25%.

From this data, it's clear that both new products, NP1 and NP2, reduce the market shares of P1 and P2 when introduced. This suggests a cannibalization effect where the new products are taking some of the customer base from P1 and P2.

Between NP1 and NP2, NP2 achieves a slightly higher market share (25% vs 24% for NP1). This might indicate that the lower price of NP2 ($250 compared to $400 for NP1) makes it more appealing, pointing out that customers are quite sensitive to price differences in this market.

So, if the goal is to capture the largest market share, NP2 might be the better option to launch, considering its effectiveness in gaining market share and its lower price point, which seems to attract more customers. However, the choice between NP1 and NP2 also depends on other factors like production costs and the company's strategic priorities.

5. The following information with regard to incremental cost of manufacturing different models of lawn mower for Toro is available.

Component	**Cost per Unit**
Base cost	$75
5 H.P.	$125

4 H.P.	$25
22-inches Swath	$85
20-inches Swath	$15

Please conduct a profit analysis using husbands' utilities. Based on your analysis, do you think Toro should introduce the new model of lawn mower at all? If yes, which model do you think is more desirable? Why?

Model	Cost	Price	Margin	Expected Profits
P1	$140	$400	$260	$13,737
P2	$110	$250	$140	$7,362
NP1	$185	$400	$215	$10,615
NP2	$115	$250	$135	$6,894

- Profit Margins:
  - P1: Highest margin at $260, with significantly high expected profits.
  - NP1: Second highest margin at $215 but with lower expected profits than P1 despite the same price, due to higher production costs.
  - P2 and NP2: Lower margins compared to P1 and NP1. NP2 has a slightly lower margin than P2 but higher expected profits.
- Cannibalization Concerns:
  - Introducing NP1 or NP2 will shift some market share from P1 and P2. If NP1 or NP2's addition doesn't substantially increase total market share or revenue, it might simply split the existing market more ways, affecting overall profitability.

Based on the data:

- NP1 appears to be a more profitable addition than NP2 when compared directly, because of its higher profit margin and expected profits, despite its higher cost. It competes directly in price with P1 but offers a newer alternative which might attract customers looking for something different without being overly concerned about price.
- Market Impact: NP1 might attract a new segment of customers who prefer its features over P1, or might shift some customers from P1, reducing the impact of cannibalization on overall profits.
- Risk: Introducing NP1 involves higher production costs, but its competitive pricing and feature set (like the larger swath) justify these costs given the higher expected profit margin.

Conclusion

Toro should consider introducing NP1. It aligns better with maintaining a higher price point and margin while potentially increasing market share or appealing to a new customer segment. Although NP2 has a lower price, its profitability and margin are less appealing, making it a less desirable option when considering the potential cannibalization of P2's existing market share. Thus, NP1 strikes a balance between cost, features, and profitability.

6. Please discuss the limitations of conjoint analysis in the context of this homework and suggest possible changes in order to enhance the accuracy and usefulness of the analysis for Toro's new product introduction decision.

Toro's new product introduction has some limitations:

1. Fixed Attribute Levels: The analysis might not fully capture how different combinations or levels of attributes like horsepower and swath size affect consumer preferences. It assumes linear utility, which might not reflect real-world nonlinear preferences.
2. Limited Scope: The analysis includes only a few attributes, potentially overlooking other important factors like brand loyalty, after-sales service, and product durability that could influence buyer choices.
3. Static Competition: It assumes a static competitive environment, not accounting for responses from competitors like price changes or new product launches.

To enhance accuracy and usefulness, I would suggest:

- Incorporating More Attributes: Adding more relevant attributes to the analysis could provide a deeper understanding of consumer preferences.
- Dynamic Scenarios: Including potential competitive responses in the scenario analysis can offer a more realistic view of market dynamics post-new product introduction.
- Real-Time Data: Utilizing up-to-date market data and consumer trends can help adjust the analysis to reflect current market conditions more accurately.

Please submit your homework on the course website. The main file should be a word or pdf document. In addition, include the excel spreadsheet you use to perform the required calculations for the conjoint simulator.

Have fun with this last homework!