

**An Investigation into Reusable Cutlery**

**A Triple Bottom Line Assessment**

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**APSC 261**

**November 24, 2011**

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# ABSTRACT

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Due to a significant amount of waste generated through the use of disposable cutlery at the Student Union Building (SUB), a “green” vending machine has been proposed to reduce waste. This paper discusses the triple bottom line assessment of two reusable cutlery options, a bamboo cutlery set manufactured by Bamboo Studio and a plastic Spork manufactured by Light My Fire. A full investigation into these two products will result in a final recommendation to sell one of two products in “green” vending machines located in the new Student Union Building.

The triple bottom line assessment consists of an environmental, economic, and social evaluation. The environmental indicators include the materials used, transportation, energy consumption, and compostability. The economic assessment consists of a financial cost analysis while the social assessment discusses the ethical and human rights implications, social impacts of the selected product on future SUB users, and the products ability to raise awareness of sustainability. Furthermore, we conducted a small-scale student survey. Due to the limited surveyed population, the findings may not reflect the overall outlook of the entire student population.

This report presents the results of the triple bottom line assessment of the two selected brands, which indicates that the bamboo cutlery is preferable considering the environmental and social aspects. Conclusively several recommendations were provided including the discontinuation of the supply of all disposable utensils at the SUB, the Bamboo Studio Cutlery set as the retail product, and the price to be set to \$1.50.

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# GLOSSARY

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Bisphenol A – is an organic compound that is commonly used to make plastics. This compound has a hormone disrupting effects and may lead to many other health conditions.

Copolyester- is a modified polyester and is a thermoplastic that may change shapes with heat.

Compostability- The ability of an object to breakdown and decompose into its basic organic components under natural conditions.

Responsible Care®- Chemistry industry's commitment to sustainability- They focus on the ethics and principles allowing companies to be safer and more develop more environmentally friendly products and processes.

# LIST OF ABBREVIATIONS

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APSC- Applied Science

BSC – Bamboo Studio Cutlery

CO<sub>2</sub>e- Carbon Dioxide Emissions

GHG – Green House Gasses

kWh- Kilowatt Hour

LMF – Light My Fire

SUB – Student Union Building

UBC-University of British Columbia

USD- United States Dollar

# 1.0 INTRODUCTION

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In this modern age, the growing need of sustainability is necessary for the protection of our precious planet earth. University of British Columbia (UBC); a pioneer of sustainability, is currently designing a new Student Union Building that will introduce many sustainable projects creating a model for future buildings around the world. Students in APSC 261 are involved in contributing to the many small existing projects that will be implemented in the design of the new SUB. Our team of four chose to focus on the developing project of a Green Vending Machine which dispenses reusable cutlery.

Every day in the food court, students use and throw away countless plastic utensils which neither degrade nor get reused. This creates large amounts of excess waste in the city landfill where it will remain for centuries. There are many approaches to this problem. One way is to use biodegradable materials for the utensils; however, as long as people throw away the used items, garbage is produced and workers still need to pick up unnecessary garbage and process it according to regulations. Using biodegradable materials does not entirely resolve the issue. Therefore, rather than using alternate materials, the idea of reusable cutlery is introduced and it should help solve the issues of accumulating waste along with the unnecessary use of energy and labor for repeated manufacturing production.

Many materials are available, and the goal of this project is to find the most suitable one using the triple bottom line assessment. The triple bottom line assessment takes into account the environmental, economic, and social impacts. Despite the various choices of materials; bamboo and hard plastic were chosen after comparing metal, wood, bamboo, and plastic. We select bamboo products for its environmental friendly qualities and hard plastic because of its reliability and durability. The two products come in different designs. The bamboo utensils are supplied by Bamboo Studios located in California, USA. These utensils are an ordinary fork, knife, and spoon which come in a prepackaged degradable paper bag. The hard plastic spork supplied by a Swedish company called Light My Fire (LMF), is a single utensil that combines the feature of a fork, spoon, and knife. Conclusively, this report will focus on the triple bottom line assessment to determine the suitable brand as the final product.

## 2.0 ENVIRONMENTAL FACTORS

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The triple-bottom-line assessment of the Bamboo Studio Cutlery (BSC) set and the LMF spork includes assessing the environmental impacts of each product. We based our environmental assessment on 4 different indicators which includes transportation, materials used, ecological footprint, energy consumption, and the compostability.

### 2.1 MATERIALS USED

The material used to manufacture the reusable cutlery was one of the key determining factors we considered when selecting our specific brand. BSC uses bamboo grown in southern China as their primary manufacturing material where each utensil is hand crafted from the bamboo sheath. Because bamboo is one of the fastest growing plants on earth with the potential of growing up to 100cm in 24 hours, it is a highly renewable raw material. P. van der Lugt et al states that “due to the favourable mechanical properties, the high flexibility, the fast growing rate, the low weight and the low purchasing costs, bamboo is a building material with many opportunities.” Bamboo Studio exploits these inherent bamboo qualities and handcrafts cutlery that is strong, durable, and splinter-free.

Light my Fire plastic sporks are made with Bisphenol A(BPA)-free copolyester material called Eastman Tritan. BPA is an organic compound commonly used to make polycarbonate plastics and was classified as a toxic material in Canada in September 2010. There are many health concerns with BPA exposure, some of which include obesity, and reproductive system abnormalities. Eastman Chemical Company; a chemicals, fiber, and plastic manufacturing company, took this health issue into account and supplies LMF with their own BPA-free material, Eastman Tritan. Eastman Tritan is marketed to be tough, and extremely durable, with a resistance to heat and various chemicals.

## 2.2 TRANSPORTATION

The means of transportation and the distance from the manufacturing site to UBC is a major factor in determining the product's environmental impact on society. The increase in distance travelled results in higher greenhouse gas (GHG) emissions. Bamboo Studio is a California-based company distributing bamboo cutlery in North America. Each bamboo utensil is manufactured in southern China and needs to be shipped over 10,000 km to San Juan Capistrano, California and transported another 2,000 km to reach UBC. In comparison, Industrial Revolution is a Washington-based company, and is the main distributors of LMF sporks in North America. Each of the LMF sporks are manufactured in Sweden and shipped over 7,000 km to Redmond, Washington before being transported 200 km to reach UBC.

Bamboo Studio and Industrial Revolution both rely on package delivery services such as UPS consisting of marine vessel and land-based transportation. GHG emissions due to marine vessel are caused by the usage of heavy fuel oil, also known as bunker fuel, for powering combustion engines. The carbon dioxide emissions contributing to the greenhouse effect directly correlates to the amount of fuel consumption in the combustion process (S.J.Bijlsma, 2008).

To calculate the GHG emissions for transportation, we needed the energy consumed travelling by ocean freight and by ground. Based on Lee's findings, we calculated the energy consumption of travelling by ocean freight and ground using a rate of 0.2 kJ/kg km and 0.6634kJ/kg km respectively (Lee, 2009). Table 1 - Shipping Distance, Energy Usage, GHG Emission below summarizes the calculated total energy consumption and the equivalent GHG emissions. The GHG emissions were calculated by, first, converting the total energy usage to kilowatt hours, and then applying EPA's CO<sub>2</sub> output emission rate equation (U.S. Environmental Protection Agency, 2011).

**Table 1 - Shipping Distance, Energy Usage, GHG Emission**

Product	Truck	Ocean Freight	Total
Distance in km(Approx.)			
Bamboo	2140	10800	12940
LMF Spork	200	7200	7400
Energy Usage(KJ/kg)			
Bamboo	1420	2160	3580
LMF Spork	133	1440	1573
GHG Emission(g CO2e)			
Bamboo	272	414	686
LMF Spork	25.5	276	301.5

### 2.3 ENERGY CONSUMPTION

The total energy used to acquire/manufacture the raw material and the product is very important in assessing the environmental impacts. A product that requires higher energy will contribute towards a higher GHG emission. The bamboo harvested from the southern regions of China requires minimal energy to be manufactured into bamboo utensils. Specifics on the exact amount of energy required to produce one piece of cutlery was not found, but there has been research done on the energy and emissions associated with manufacturing and transportation of one-ton of bamboo flooring from Hunan Province to Denver, Colorado refer to Figure 1 - Energy and Emissions below.

Material			Transportation				Cumulative Impact	
Item	Energy, MJ/ton	Emissions, lb CO2e	Mode	Distance, mi.	Energy, MJ	Emissions, lbs CO2e	Energy, MJ	Emissions lbs CO2e
Bamboo Flooring	15	4.5	Truck	500	1645.0	280.0	4943.1	809.4
			Ship	7,362	2061.4	368.1		
			Rail	1,221	451.8	73.3		
Concrete**	1452.3	446.7	Truck	177	32	12.0	1537.3	475.4
			Ship	58	53	16.3		

**Figure 1 - Energy and Emissions**

Although this data relates to the energy required in the manufacturing and transporting of one-ton bamboo flooring rather than bamboo utensils, we can see the relative impacts of the bamboo material manufacturing process. From Figure 1 - Energy and Emissions, we

observe that harvesting and processing one-ton of bamboo flooring only contributes to 0.5% of the total carbon dioxide emissions.

As mentioned above the LMF sporks are made with Bisphenol A(BPA)-free copolyester material called Eastman Tritan. Energy is needed to synthesize this raw material and in 2010, Eastman Chemical Company reported their greenhouse gas intensity (lbs CO<sub>2</sub> per lb of product sold) as 1.764 refer to Table 2 - Greenhouse Gas Intensity.

**Table 2 - Greenhouse Gas Intensity**

<b>Year</b>	<b>Greenhouse Gas Intensity (lbs CO<sub>2</sub> per lb of product sold)</b>
2010	1.764

If we do some basic computations, we see that for a bulk order of 500 sporks, it equates to approximately 15.5 lbs of CO<sub>2</sub> emissions. No documentation on the total energy and the equivalent GHG emissions of the manufacturing process within the LMF factories were found, but they would include the greenhouse effects from the melting process of the pellets of polymer, and the thermoforming process.

#### **2.4 COMPOSTABILITY**

Our purpose for investigating these different types of reusable cutlery is to reduce our carbon footprint by purchasing reusable cutlery. One aspect that we must also consider when doing this environmental assessment is the compostability of the cutlery.

The BSC is primarily made of the bamboo sheaths and this organic material is 100% biodegradable and compostable. Because of BSC's natural ability to degrade, disposing this product is environmentally friendly. This product has an average lifetime of 36 uses but this can be extended if the cutlery is properly washed and taken care of (Cochran, 2011). In comparison, because the LMF sporks are composed of a copolyester plastic material, Eastman Tritan, it is not biodegradable. Eastman Tritan is marketed as an extremely durable material and as a result the products are made to have a longer product

life resulting in less waste. Nonetheless, disposing the product is imminent with prolonged use, and because Eastman Tritan is not biodegradable, the only way of disposing this product is at a land fill or through incineration. However, Eastman Chemical Company ensures that the copolyester material does not contain any elements such as sulfur, lead, mercury and cadmium and the potential of hazardous emissions during incineration has been considered and reduced. Vancouver's Waste-to-Energy facility, located in Burnaby, has been in service since 1988 and incinerates 285,000 tons of garbage into steam and electricity (Waste To Energy, 2011). At this site, the LMF spork could be incinerated and the energy produced can be recycled.

## 3.0 ECONOMIC ANALYSIS

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Economic analysis is important for understanding the commercial viability of a product. This also applies to making the decision of materials used in the reusable cutlery. In this section, the prices between the BSC set and the LMF spork will be compared.

### 3.1 PRICE COMPARISON

The price per specified amount is listed below in Table 3 - Price List.

**Table 3 - Price List**

<b>Item description - Single unit</b>	<b>Price (USD)</b>
Bamboo Studio Cutlery set	\$3.99
Light My Fire Spork	\$2.99
<b>Item Description - Bulk purchase</b>	<b>Price (USD)</b>
Bamboo Studio cutlery set (5000 pc.)	\$1.19
Bamboo Studio cutlery set (10000 pc.)	\$1.09
Light My Fire Spork (500+ pc.)	\$1.39

These prices are obtained from the information provided by the vendors. When purchasing the cutlery in bulk, we found that the bamboo cutlery is cheaper than the spork making it an economical choice for the reusable cutlery solution. An average student on campus eats 3 meals at the SUB on a weekly basis. From this we calculated that, because the bamboo utensils is less durable with an average life span of 36 uses (Cochran, 2011), a student will be required to replace the cutlery every 3 months. On the other hand, the Light My Fire spork is advertised to be exceptionally durable and has an extended life span of more than a year. As a result, the annual cost for a student purchasing the bamboo is approximately 4 times more than purchasing the plastic spork.

## 4.0 SOCIAL IMPACTS

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This section discusses important aspects of the project including the ethical and human rights implications and public responses to reusable utensils. The social assessment shows whether or not the product will be economically successful within the public domain and delivers an investigation, assuring the manufactured goods are supplied by a morally justified business. This section highlights the ethical and human rights research on the people involved, impacts on the public, and includes an analysis of a survey we solicited on 50 arbitrary students attending UBC.

### 4.1 *THE PEOPLE HARVESTING, MANUFACTURING, AND SHIPPING*

As mentioned above, both of the products are manufactured internationally. The bamboo utensils made in southern China have an economically sound operation because the materials are grown, processed, and finally manufactured into utensils all within one country (Cochran, 2011). This provides many reliable jobs to people in the country however, obtaining information on the fairness of labor wages were beyond our capabilities and available resources. The plastic spork is a dissimilar process because it does not receive all of its raw materials from the same country. LMF receives its material from a company called Eastman Chemical Company which is a Responsible Care® company that closely monitors the laws and regulations that apply to operation and products around the world (Eastman, 2011). Eastman meets and exceeds the local labour practices at all of its global sites. We have minimal information on how the factory workers are treated at the Light My Fire factories, but we are aware of their efforts in educating people of the production process through factory tours. In this way, people within the community have an increased awareness and respect of the complexity and amount of work put into every product (Light My Fire, 2011).

### 4.2 *IMPACTS ON THE PUBLIC*

Regardless of our final recommendation on which utensils should be used at UBC the public will be able to benefit from this project when it is put in place. Awareness of sustainability will be raised significantly with the opportunity to purchase reusable items

from the “green” vending machines. According to a recent study performed in 14 cities across China “consumers who intend to purchase environment friendly products and report having done so score higher on life satisfaction” (Jing Jian Xiao, 2010). This study shows that students can live a more satisfactory life given the opportunity to invest in sustainable reusable products. In addition, the stakeholders involved in this decision will benefit socially by purchasing the bamboo because they will not have to make decisions or consult people who are concerned about the non-biodegradable plastic in the Light My Fire Spork. Furthermore, after the bamboo’s lifetime is up it can be put into a composter because it is fully biodegradable; this characteristic is accepted by the public and industry as a much more sustainable product.

#### 4.3 PUBLIC RESPONSES TO OUR SPECIFIC PRODUCTS

From our survey, we were able to expand our knowledge on the social perception of reusable cutlery helping us make our recommendation. The survey was given to 50 arbitrary participants who were interested to take part in this survey after we mentioned that it was a research project for the new SUB. To better engage the participants we opted to deliver the questionnaire orally rather than on paper. The project background was explained informing the students that the new SUB will contain green vending machines dispensing reusable utensils and its purpose. The prepared set of questions touched on a variety of topics from the participant’s thoughts on the current disposable cutlery system to the amount of money they are willing to spend on reusable cutlery. The two different brands of utensils, Bamboo Studio and LMF, were presented as viable options and the participant’s preference is charted below in Figure 2 –Spork Vs. Bamboo.

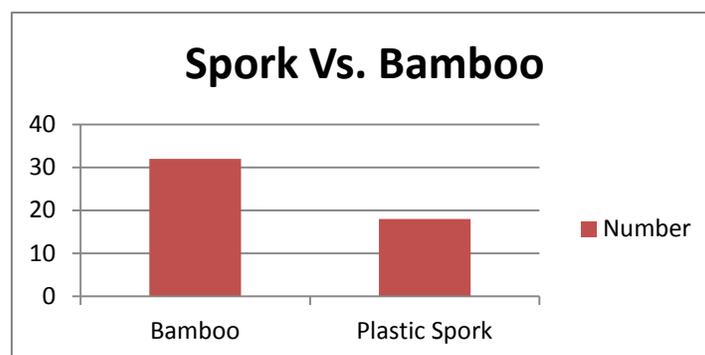
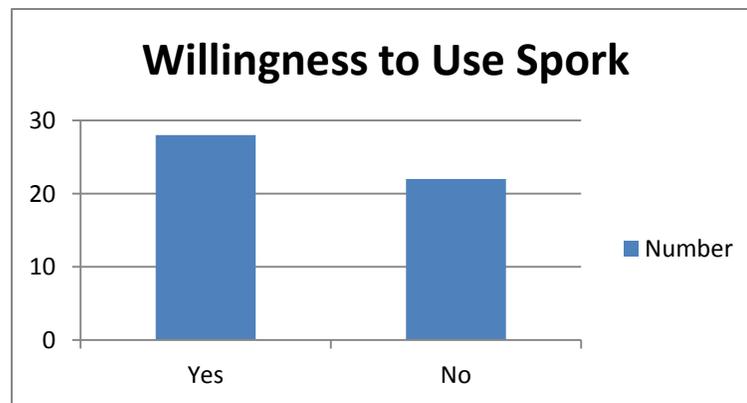


Figure 2 - Spork Vs. Bamboo

The next relevant question posed was, would they use the plastic spork; the results are indicated in Figure 3 - Willingness to Use Spork. We observed a fairly even distribution between students who would use to spork to those who would not, but out of these students over half would not purchase the spork if the bamboo utensil set were an option. Each brand of utensils has its own issues and was presented as a scenario to the surveyed student. The main issue for the bamboo utensil was it should only be hand washed and on the other hand for the LMF spork, it was made of non-biodegradable material. After discussing these issues, students who were more environmentally aware leaned in support of the bamboo utensils whereas those who were less aware swayed towards the plastic spork. In addition, there was a raise in the concern regarding the usability of the multi-feature spork and this was another determinant reason for the student's dislike of the spork. As a result, if we apply this small scale survey as a general model of the UBC student body, we can conclude students have a greener perception on bamboo utensil and that selecting the BSC would raise the social awareness of sustainability.



**Figure 3 - Willingness to Use Spork**

## 5.0 CONCLUSION

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After completing the assessment on the environmental, economic, and social issues of the BSC and LMF spork, there are many different factors that influenced our decision in determining the suitable brand and material as our recommended product. For the environmental assessment we based our research on 4 main indicators, for the economic assessment we analyzed the financial cost, and for the social assessment we discussed some ethical issues and investigated the social impacts on the public and their perception of the specific products. Based on this triple bottom line assessment, we concluded that the Bamboo Studio cutlery is superior environmentally because of the organic natural ability to degrade and socially because it raises sustainability awareness and increases the quality of life. As for the economic costs, the initial costs of the Bamboo Studio cutlery were lower than the LMF sporks. However, in the long run because the bamboo cutlery were not as durable as the sporks and must be replaced quicker, the annual cost of the bamboo cutlery becomes approximately 4 times more than the sporks.

In addition, after completing the student survey about the two specific brands of cutlery, we have several recommendations for the new SUB and the green vending machines. Firstly, in order for students to purchase reusable cutlery from the green vending machines, we recommend a discontinuation of the supply of all disposable utensils at the SUB. This is because we observed that 45% of the surveyed students would rather spend \$0.11 with each purchase on disposable cutlery rather than spend more money on reusable cutlery. By not supplying the disposable cutlery, UBC will not only spread sustainability awareness but also promote students to bring their own reusable cutlery from home. Secondly, we recommend the bamboo cutlery set from Bamboo Studio because of the environmental and social superiority. Furthermore, we also observed that 65% of the surveyed students would choose the bamboo utensils over the plastic spork. As for determining the selling price for the reusable bamboo cutlery, we found that on average a student will be willing to spend a maximum of \$2.00 for reusable cutlery. We recommend setting the price of the bamboo cutlery at \$1.50. At this price, not only will the students be willing to purchase the reusable cutlery, but UBC will be able to match or exceed the break-even point.

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# APPENDIX

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## *Alternative disposable cutlery Recommendation*

In doing this research we came across another potential solution to UBC's current disposable utensil problem. We are aware that UBC has tried finding alternative cutlery to "give" students at the SUB. We are aware of the recent changes from cutlery made of "biodegradable corn" which did not break down in UBC's composter back to plastic because it is a more economical choice.

We received quotes from Bamboo studios not only on reusable utensils but on disposable utensils as well. If UBC was to make bulk orders of disposable utensils from Bamboo Studio they would receive a quoted price of 0.065\$ per utensil which is comparable to the 0.11\$ students are currently paying in the SUB today. This is a viable choice for UBC if they continue to supply disposable utensils.

## *Pictures*

Additional information included is pictures of the reusable bamboo utensils and the packaging it would come in sent to us by the vendor.



### *Additional Pricing Information*

BULK – 5,000 of each utensil for a total of 15,000 (5,000 forks, 5,000 knives, 5,000 spoons)  
\$0.35 per utensil

BULK – 10,000 of each utensil for a total of 30,000 (10,000 forks, 10,000 knives, 10,000 spoons)  
\$0.33 per utensil

5,000 3-Piece Sets in Brown Kraft Bags (each set comes with 1 fork, 1 knife, 1 spoon)  
\$1.19 per 3-piece set

10,000 3-Piece Sets in Brown Kraft Bags (each set comes with 1 fork, 1 knife, 1 spoon)  
\$1.09 per 3-piece set

*Student Survey*

<b>Sex</b>	<b>Less/More</b>	<b>If free-spend money</b>	<b>Plastic/Bamboo</b>	<b>Willing to spend</b>	<b>Spork Price</b>	<b>Bamboo Price</b>	<b>Use Spork?</b>
F	M	Y	S	\$3.00	\$5.00	\$5.00	Y
F	M	Y	S	\$3.00	\$5.00	\$4.00	Y
F	L	N	B	\$2.00	\$5.00	\$2.00	N
M	M	Y	S	\$2.00	\$5.50	\$3.00	Y
M	M	Y	S	\$2.00	\$3.00	\$7.00	Y
M	M	N	S	\$2.00	\$1.00	\$6.00	Y
F	M	N	B	\$2.00	\$5.00	\$3.00	Y
F	M	N	B	\$2.00	\$2.50	\$3.00	N
F	M	N	B	\$2.00	\$0.50	\$10.00	N
F	M	N	B	\$0.25	\$1.50	\$2.00	Y
M	L	N	B	\$0.00	\$0.25	\$0.50	N
M	M	N	B	\$0.50	\$1.00	\$2.00	N
F	M	N	S	\$1.00	\$1.00	\$2.00	Y
F	M	N	B	\$2.00	\$1.00	\$3.00	N
F	L	N	B	\$1.50	\$0.75	\$2.00	N
F	L	N	B	\$1.50	\$0.75	\$2.00	N
F	L	N	B	\$0.75	\$0.75	\$1.00	N
M	L	N	B	\$0.50	\$2.00	\$2.50	N
M	M	N	B	\$7.00	\$3.00	\$5.00	Y
F	M	Y	B	\$8.00	\$3.00	\$5.00	N
M	M	N	B	\$3.00	\$3.00	\$5.00	Y
M	M	N	B	\$3.00	\$3.00	\$6.00	Y
M	L	N	S	\$1.00	\$2.00	\$1.50	Y
M	L	N	S	\$2.00	\$4.00	\$3.50	Y
M	L	N	S	\$2.50	\$3.00	\$2.50	Y
F	L	N	B	\$3.00	\$5.00	\$5.00	Y
M	M	N	S	\$2.00	\$1.00	\$2.00	Y
M	M	N	S	\$2.00	\$2.00	\$2.00	Y
F	L	N	B	\$1.00	\$5.00	\$3.00	Y
F	L	N	B	\$1.50	\$5.00	\$5.00	N

M	L	N	B	\$1.50	\$3.00	\$4.00	N
M	L	N	B	\$0.50	\$5.00	\$1.00	N
M	L	N	B	\$1.50	\$1.00	\$3.00	N
F	L	N	B	\$1.00	\$1.00	\$2.00	N
F	L	N	B	\$1.00	\$0.50	\$1.50	Y
M	L	N	B	\$0.50	\$2.00	\$2.25	Y
F	M	Y	S	\$2.00	\$5.00	\$3.00	Y
M	L	N	S	\$2.00	\$5.00	\$3.00	N
M	M	N	S	\$2.00	\$3.00	\$2.00	N
F	M	N	B	\$1.50	\$3.00	\$3.00	Y
M	M	Y	B	\$1.00	\$1.00	\$1.00	Y
M	M	N	B	\$2.00	\$4.00	\$4.00	Y
M	L	N	S	\$2.00	\$4.00	\$3.00	Y
M	M	N	S	\$1.00	\$2.00	\$3.00	Y
F	L	N	S	\$4.00	\$3.00	\$2.00	Y
F	M	N	B	\$2.00	\$3.00	\$4.00	N
M	L	Y	B	\$4.00	\$5.00	\$5.50	Y
M	M	N	S	\$2.00	\$3.00	\$2.00	N
F	M	N	B	\$1.50	\$3.00	\$3.00	Y
F	L	N	B	\$3.00	\$4.00	\$4.50	N

### Column Headings

- (1) Sex – Male(M) or Female(F)
- (2) For multiple visits to the SUB, would you rather pay more for reusable cutlery (M) or less on disposable cutlery (L) each time?
- (3) If free cutlery was available at the SUB, would you pay for reusable cutlery? Yes (Y) or No (N).
- (4) If you had a choice between bamboo and plastic which would you pick? Bamboo (B) or Plastic (P)
- (5) How much would you be willing to spend on reusable cutlery?
- (6) Show student(s) the spork. Ask for the student's estimate on the price.
- (7) Show student(s) the bamboo cutlery set. Ask for the student's estimate on the price.
- (8) Would you use the spork? Yes (Y) or No (N)