# MKT 282: Data Analytics & Dynamic Pricing
# (Raghunath Rao: Fall 2021)
# Assignment #4

*This assignment is due by midnight on 11/17/2021. Please paste your answers within this file and save it as "HW4_DP_SOLN" on Canvas at the appropriate place. If you used M.S. Excel/R (or any other statistical software) to arrive at your answers, please submit the relevant files/annotated code as well (so that you can get partial credits for your work even if your answer is incorrect). The scores from your submissions will be reweighted, and you can earn up to 75 points from this exercise.*

*Only one submission per team, please- one person from each team should upload the solution. It is the responsibility of each group to get together and finish the assignment. The team information is available under announcements on Canvas.*

*Late assignments are NOT acceptable.*

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**Write the names of your team members here**: Chloe Estrin, Carter Cowman, Demetri Whitsett, Nihit Parikh

## Part 1: Revenue Maximizing Bundling

Refer to the datasets “Bundling 1.xls”, “Bundling 2.xls” and “Bundling 3.xls” to answer the questions to this part. Each of these datasets contain “reservation prices” (utilities) in dollars for two products sold by a company for 500 representative consumers (obtained through a conjoint study).

**Q1a**/. For the dataset “Bundling 1.xls”, obtain the revenue maximizing “separate pricing”, “pure bundling” and “mixed bundling” prices. (20 points)

Separate Pricing:

| | | | | | | |
|---|---|---|---|---|---|---|
| **P(A)** | **$** | **52.97** | Demand (A) | 254 | Rev(A) | 13453.48 |
| **P(B)** | **$** | **50.09** | Demand (B) | 259 | Rev(B) | 12974.09 |
| **Total Profits** | $ 26,427.57 | | | | | |

Pure Bundling:

| | | | | |
|---|---|---|---|---|
| **p(A+B)** | **$** | **87.25** | Demand (A+B) | 327 |
| Profits | $ | 28,529.84 | | |

Mixed Bundling:

| | | | | |
|---|---|---|---|---|
| **p(A)** | **$** | **57.10** | Demand(A) | 62 |
| **p(B)** | **$** | **75.64** | Demand(B) | 14 |
| **p(A+B)** | **$** | **87.25** | Demand(A+B) | 282 |
| Profits | $ 29,202.79 | | | |

**Q1b**/. For the dataset "Bundling 2.xls", obtain the revenue maximizing "separate pricing", "pure bundling" and "mixed bundling" prices. (20 points)

Separate Pricing:

| | | | | |
|---|---|---|---|---|
| **P(A)** | **$** | **52.97** | Demand (A) | 254 |
| **P(B)** | **$** | **45.84** | Demand (B) | 263 |
| Total Profits | $ 25,510.58 | | | |

Pure Bundling:

| | | | | |
|---|---|---|---|---|
| **p(A+B)** | **$** | **97.50** | Demand (A+B) | 262 |
| Profits | $ 25,544.70 | | | |

Mixed Bundling:

| | | | | |
|---|---|---|---|---|
| **p(A)** | **$** | **71.11** | Demand(A) | 0 |
| **p(B)** | **$** | **72.64** | Demand(B) | 0 |
| **p(A+B)** | **$** | **97.50** | Demand(A+B) | 262 |
| Profits | $ 25,544.62 | | | |

**Q1c**/. For the dataset "Bundling 3.xls", obtain the revenue maximizing "separate pricing", "pure bundling" and "mixed bundling" prices. (20 points)

Separate Pricing:

| | | | | |
|---|---|---|---|---|
| **P(A)** | $ | 52.97 | Demand (A) | 254 |
| **P(B)** | $ | 34.88 | Demand (B) | 293 |
| Total Profits | $ 23,672.52 | | | |

Pure Bundling:

| | | | | |
|---|---|---|---|---|
| **p(A+B)** | **$** | **81.41** | Demand (A+B) | 494 |
| Profits | $ 40,215.74 | | | |

Mixed Bundling:

| | | | | |
|---|---|---|---|---|
| **p(A)** | **$** | **81.51** | Demand(A) | 0 |
| **p(B)** | **$** | **77.02** | Demand(B) | 23 |
| **p(A+B)** | **$** | **82.25** | Demand(A+B) | 475 |
| Profits | $ 40,838.09 | | | |

**Q1d./** Calculate the percentage revenue gain in going from separate pricing to pure bundling and from separate pricing to mixed bundling in each of the three cases. Explain the reason behind the pattern of percent changes estimated by you. (30 points)

**Percent Improvement Calculations**

**Bundling Data 1**

| Pricing Technique | Profit | Percent Improvement | |
|---|---|---|---|
| Separate Selling | $ 26,427.57 | | |
| | | 7.95% | *From separate to pure |
| Pure Bundling | $ 28,529.84 | | |
| | | 2.36% | *From pure to mixed |
| Mixed Bundling | $ 29,202.79 | | |
| | | 10.50% | *From separate to mixed |

**Bundling Data 2**

| Pricing Technique | Profit | Percent Improvement | |
|---|---|---|---|
| Separate Selling | $ 25,510.58 | | |
| | | 0.13% | *From separate to pure |
| Pure Bundling | $ 25,544.70 | | |
| | | -0.0003% | *From pure to mixed |
| Mixed Bundling | $ 25,544.62 | | |
| | | 0.13% | *From separate to mixed |

**Bundling Data 3**

| Pricing Technique | Profit | Percent Improvement | |
|---|---|---|---|
| Separate Selling | $ 23,672.52 | | |
| | | 69.88% | *From separate to pure |

| | | | |
|---|---|---|---|
| **Pure Bundling** | **$ 40,215.74** | | |
| | | **1.55%** | ***From pure to mixed*** |
| **Mixed Bundling** | **$ 40,838.09** | | |
| | | **72.51%** | ***From separate to mixed*** |

**Reason for Percentage Improvement:**
The pattern in percent increases in revenue as the pricing strategy moves from separate selling to bundling is due to the fact that bundling reduces the deadweight loss that occurs when separate selling causes total segments to be excluded as purchasers. Bundling also has the ability to completely take away consumer surplus, allowing the firm to capture more value. The reason that there is a much larger percent improvement in revenue for example three than the other two examples is likely due to the fact that the products offered are similar, and bundling works best when the overall product looks very homogenous.

## Part 2: Non-Linear Pricing

Congratulations! You have inherited the complete rights for ten songs from the late Prince's estate. You are planning to create a new website where users can pay and download these songs. How to price these songs?

As a good marketing analyst, you elicited 1,000 potential buyers' willingness to pay for these songs. These consumers are a very good representation of the potential market for these songs. Please look at MS Excel file "Songs Data.xls" that shows 1000 consumers' maximum willingness to pay for these 10 songs. For example, customer 5 is willing to pay up to $1.76 for song 3.

**2a**. Suppose you wish to come up with one single price for each song- determine the price that would maximize your revenue. How many songs will be sold to this population to these 1,000 consumers and what is the total revenue? (15 points)

| | |
|---|---|
| **Price** | **1.199858** |
| **Songs sold** | **5690** |
| **Revenue** | **6827.193** |

Songs sold: 5690

Total revenue: $6827.193

Single Price: $1.19

**2b**. Now suppose you could price each song individually (e.g., Song 1 @ $1.05, Song 2@ $0.95, and so on..). Determine the price for each song that maximizes the revenue. What is the percentage increase in revenue relative to the single price? (15 points)

| Price S1 | Price S2 | Price S3 | Price S4 | Price S5 | Price S6 | Price S7 | Price S8 | Price S9 | Price S10 |
|---|---|---|---|---|---|---|---|---|---|
| **$ 1.24** | **$ 1.18** | **$ 1.27** | **$ 1.20** | **$ 1.21** | **$ 1.22** | **$ 1.24** | **$ 1.24** | **$ 1.38** | **$ 1.21** |

| | | |
|---|---|---|
| **Total Revenue** | | **$ 6,875.76** |
| **Demand** | | **5560** |
| | | |
| **Revenue Improvement** | | **0.711%** |

**2c**. Determine a two-part tariff (TPT) that maximizes revenue. (e.g., before being allowed to download any song, a customer must first pay $3.50 to become a member and then pay 55 cents for each download). What is the revenue under TPT? How many songs get sold under TPT? What is the revenue improvement over the single price format in 2a? (50 points)

| | | | |
|---|---|---|---|
| **Fixed** | $ 9.13 | **Variable** | $ 0.16 |

| |
|---|
| **Revenue under TPT** |
| $ 9,897.49 |
| |
| **Songs sold under TPT** |
| 9,250.00 |
| |
| **Revenue Improvement over 2a** |
| $ 3,070.30 |
| or |
| 44.972% |

**2d**. Determine a quantity discount schedule that maximizes the revenue (e.g., if a customer buys up to 5 songs, she pays $ 2.5 per song and thereafter $0.75 per song). What is the revenue under quantity discount? How many songs get sold? What is the revenue improvement over the single price format in 2a? (40 points)

| Cutoff | $ 4.00 | High Price | $ 2.40 | Low Price | $ 0.20 |
|---|---|---|---|---|---|

| Revenue under Quantity Discount |
|---|
| $ 9,923.46 |

| Songs sold under Quantity Discount |
|---|
| 9177 |

| Revenue Improvement over 2a |
|---|
| $ 3,096.27 |

or

| |
|---|
| 45.352% |