

Simulation Report

SUPPLY OPTIMIZER & SALES CHANNLE DECISION TREE MADE
FOR UNIQUE MELODY

Heng Li
UNIQUE MELODY |

Project Background/Problem Statement

In February and March, I was in charge to initiate online survey for Unique Melody—a Chinese high-end headphone company. I designed the survey to ask potential customers about what their preferred music genres are and whether they are interested in our potential new product — “MEST International Edition (MEST IE)”.

There are **33** participants who have taken the survey. **32** of them are interested in MEST IE. However, I did not directly count this number as the last reference, because the design of MEST IE might not complement all participants’ music taste. Based on their preferred genres, I believe **27 out of the 33 participants are potential buyers of MEST IE**.

Most of the data comes from the survey and some supporting data comes from the past experience or historical data provided by Unique Melody and Musicteck.com (the main distributor).

The project is trying to figure out **whether Unique Melody should launch this new product and how many headphones they should make for the first batch**. In this project, I will first assume that Unique Melody will launch the MEST IE, then I will calculate what is the optimal supply Unique Melody should make and I will use that number in the tree model to determine whether Unique Melody should use distributors or self-marketing if MEST IE will eventually be launched.

Parameter and Variable Definition

In the optimizer model, there are 3 fixed parameters:

1. Sale Price: The retail price of MEST IE is set to \$1399 per unit.
2. Production Cost: The production cost is 30% of the retail price.
3. Fixed Cost: The fixed cost involves 2 parts, one is laboring cost \$20,000, and in the developing process, Unique Melody used 12 MEST sample in measuring and testing which will be count into fixed cost, so the total would be \$20,000+ 12*production cost.

There are 2 input variables:

1. Demand: Because MEST IE is a high-end headphone which is selling at an exorbitant price. Therefore, the sales volume is relatively low, so I believe it follows Poisson distribution (which is usually used to measure niche goods). From the survey result, I believe the sales follow Poisson (32).
2. Supply: Supply is the adjustable variable for this optimizer model. I am looking for the optimal supply that can maximize the profit.

And 1 output variable:

1. Profit: Profit is calculated as: $\min \{ \text{supply}, \text{demand} \} * \text{sales price} - \text{fixed cost} - \text{supply} * \text{production cost}$.

In the decision tree model, there are 7 parameters:

1. Research Cost is \$25, 000, which is the approximate value of the fixed cost.
2. Probability that MEST IE will be launched: From the survey I observed that 27 out of 32 respondents are classified as potential buyers, thus, I calculate the probability of launching from there, which is approximately 80%.
3. Self-marketing cost: If Unique Melody sells products directly in the US audio market, they will need to hire a sales representative in the US or China. The monthly salary will be \$1200, based on the experience, I assume the first batch will be sold out within 3 months, so the self-marketing cost is \$3600 total.

There are 3 scenarios for self-marketing, high demand, medium demand and low demand. In high demand scenario the sales volume would be 50, 32 for medium demand, 15 for low demand. Under current COVID 19 situations, the sales probability is adjusted downwardly. The probability of high demand is 20%, the medium demand probability is 45%, and the low demand probability is 35%.

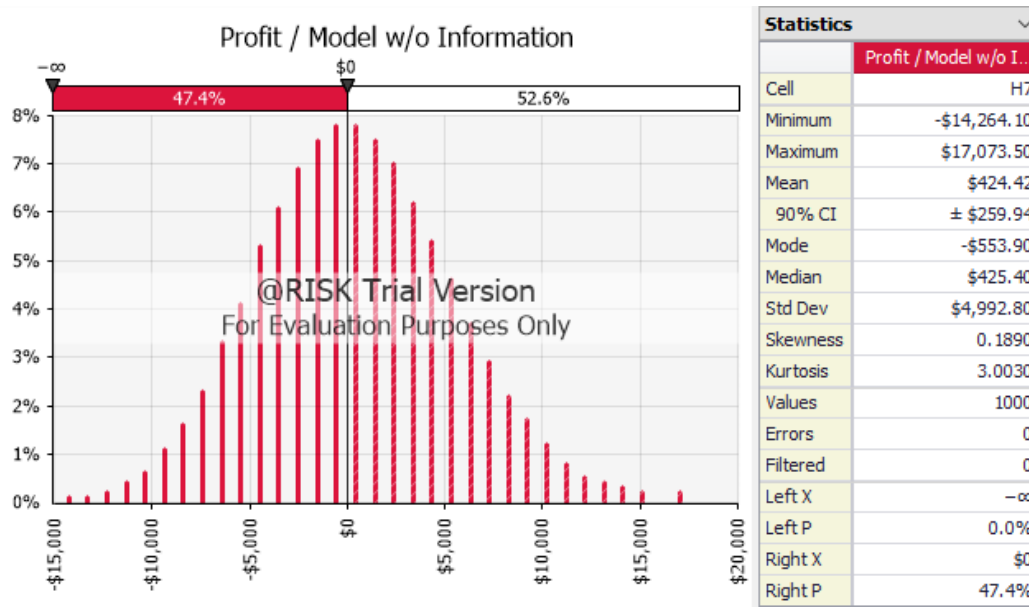
Model 1—Supply Optimizer

Previously, Unique Melody was using “Make to Order” strategy for their supply chain system. Where the supply is equal to the demand. However, because of the time-consuming manufacturing progress, as well as the increasing competition in the high-end headphones market, Unique Melody has suffered about 20% lost on sales because of long waiting time and high stock-out frequency.

Therefore, the first model I have built is a supply optimizer model, which will guide Unique Melody to change their current supply chain strategy and prepare timely replenishment. The aim of this model is trying to figure out how many headphones we should make to maximize the profit. Meanwhile, one of the model outputs—optimal supply is used to guide the decision tree model. The optimal supply will be used as the demand from distributors if we are going to use distributors as the primary sales channel.

The demand of high-end headphones is usually very low. Only a certain niche group (audiophile) would pay a high premium on these products. Therefore, the sales volume is likely following a Poisson distribution. From the online survey I started, I believe the lambda for the Poisson distribution is equal to 32. With the given distribution, a simulation model is made accordingly. I will generate the optimal supply from this simulation.

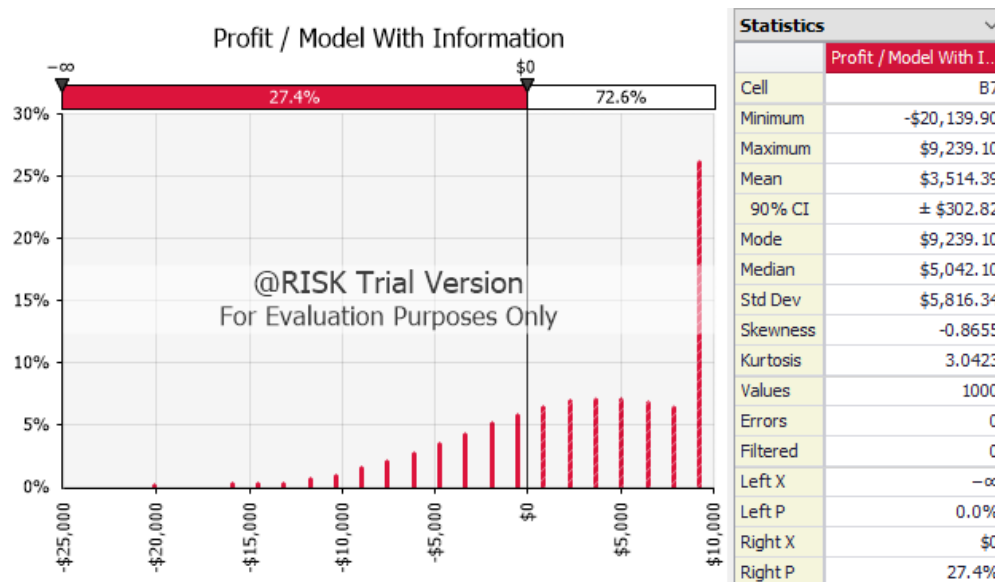
Simulation with “Make to Order” strategy:



Under Unique Melody's previous "Make to Order" strategy, as I declared previously, the demand was set to **80%** of the original. The profit then follows a normal pattern with mean=**\$424.42** and the probability of losing money is as high as **47.4%**.

However, if Unique Melody can apply the supply optimizer to have a specific production plan, they are about to avoid that 20% lost on sales, and the estimated mean profit will increase significantly:

Simulation with Supply Optimizer:



With the supply optimizer, the optimal supply was selected at **35**, given Poisson (32) distribution for demand. The mean profit increased to **\$3514.39**, and the chance of losing money is lower to **27.4%**. Therefore, we can observe a significant improvement from the "Make to Order" strategy if we apply the optimizer.

Model 2—Decision Tree

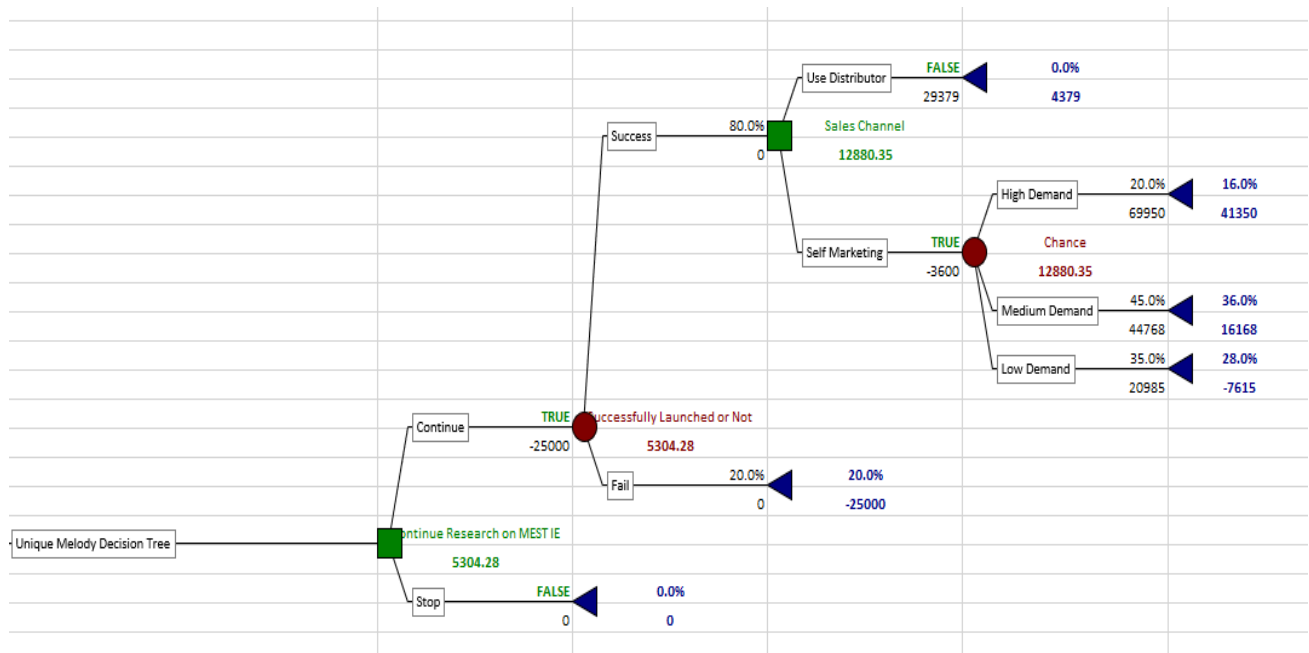
After determining the optimal supply, most of the work is to determine what sales channel should Unique Melody to choose. There are 2 options—use distributor or self-marketing. If Unique Melody sells through distributors, the demand from distributors will be set to the same as the optimal supply of 35. The revenue per unit sells to distributors would be 60% of the retail price. Therefore, the revenue of using distributors will be fixed to \$29,379. If Unique Melody chooses self-marketing, they will need to hire a sales representative in the US or China, with monthly salary equal to \$1200, so the full self-marketing cost will be equal to \$3600 (Unique Melody assume it will cost 3 months to sell out a batch). Also, there will be 3 scenarios Unique Melody is going to face if they select self-marketing. Unique Melody will have a 20% chance fall into high demand scenario with sales of 50 units; 45% chance fall into medium demand scenario with sales of 32 units; 35% chance fall into medium demand scenario with sales of 15 units. Please note, both probability of falling into these different scenarios was adjusted downwardly, because of the ongoing COVID-19 situation.

With all this given information, I built a decision tree model to specify which sales channel unique melody should use. Prior to that, the model will first return whether unique melody should continue research on making MEST IE, with \$25,000 research cost involved.

Here are the parameters for tree model:

Tree Model		
Research Cost	\$	(25,000.00)
Probability that the new product will be launched		80%
Revenue of selling by distributors	\$	29,379.00
Self-Marketing Cost	\$	(3,600.00)
Self-Marketing Outcome	Revenue	Probability
High Demand	\$	69,950.00
Medium demand	\$	44,768.00
Low Demand	\$	20,985.00

Here is the actual decision tree:



As the model shows, Unique Melody should launch MEST IE. With all situations considered, there is an estimated \$5304.28 profit that will be generated if they continue research on MEST IE. If the MEST IE is successfully launched, self-marketing will return higher profit. By choosing self-marketing, Unique Melody can generate an estimated profit of \$12,880.

Conclusion

From this 2 steps analysis, I recommend Unique Melody to launch MEST IE. Meanwhile, they should adjust their supply chain system from “Make to Order” to producing 35 headphones for each batch. In terms of business operation, I suggest them to self-marketing under this COVID-19 caused weaken market situation.

Appendix

In the appendix is the link of the survey I initiated:

<https://docs.google.com/forms/d/10XUw6aH2JDXAhPOPiFqsXREi1H4otcV39i-fdGYWF3s/edit#responses>

And here is the google excel link for the results: <https://docs.google.com/spreadsheets/d/1Y3E9inT6ZB-jwWMFjbsL7TbPJFwHKPz2p5F3RpC9-Bw/edit?usp=sharing>

Note: There are some more information I used for this project like transactions from distributors, it contains some business sensitive information and the personal information from customers, I'm not privileged share them publicly.