ISYE 6501 Course Project

1. Introduction

The project I have chosen to do my study on is “The fashionable side of analytics” that was done for Rue La La.
Rue La La is an online retailer that offers sample sales of designer apparel and accessories. They offer products for sale through events on their website. These events have a limited time, and samples are very low-inventory.

Usually, the maximum profit happens if an item is sold in the first event (first-exposure styles). If the product remains unsold, it will be offered in the next sale event.

Rue La La is offered a predetermined assortment of styles and sizes by designers. The buying decision is a yes or no to fixed quantities and sizes of products. So to make sure the purchase leads to profit, it must have a high probability of being in demand and getting sold out during the first sale event.

Therefore, the focus of analytic modeling is to predict demand and to determine an optimal pricing strategy that ensures maximum profit.

2. Analytic Models

I believe this project is a good candidate for using **descriptive** and **predictive** analytics, which then will be utilized for **prescriptive** analytics (optimization).

2.1 Descriptive Models:

The first step of the project would be:

- **Given:**
  - Past sale data
- **Use:**
  - Explanatory Data Analysis (EDA)
- **To:**
  - Understand customers behavior and demand for products.

The result of descriptive analysis can show:

- Sell-through distributions and demand curve
- Which departments have a higher demand
- What time of the day the traffic of the website is higher
- What items remain unsold during an event and lead to loss in revenue

EDA is the first step in exploring and understanding the data. We can use **data visualization tools** to help us search and learn about what happened during the past sale events.
By looking at the correlation between different variables with sell-through distributions, we get a sense of what factors might have a significant impact on sales and profit. We can develop some **hypothesis,** and later when we have the result of analytic models, we can test our hypothesis.

We can use **k-means clustering** model to uncover any hidden pattern or information in data set. For example, we can see what common factors there are in each cluster, and what factors drive the demand and pricing.

Using the results, some pricing strategies could be implemented to increase the profit, such as setting higher prices for popular products.

A **multi-armed bandit model** can be used to see whether increasing the price for popular products and styles affect the sale negatively or not.
Based on the probability of a customer buying a product, we can test to see if an increase in price has an impact on the customer's purchasing decision.
Other tests can be designed and implemented, such as different ratios/percentages of increase to find out what the maximum is without hurting the profit.

2.2 Predictive Models:

The next step would be:

- **Given:**
  - Past sale data with features such as department, color, size, brand and event time/length
- **Use:**
  - Regression model
- **To:**
  - Predict demand and sales for future styles.

For regression model, we can use different models and see which one delivers the best accuracy. If some models have similar accuracies, the preference is more simple and interpretable models, so that it can be explained to business people easily.

The data can be divided based on the department, such as women, men, and accessories.

For each department, we can build a regression model to predict the demand for each style and size.
Then, the inventory purchasing can be done based on the estimates obtained from the regression model. If most of the samples offered by a designer are estimated to be in high demand, Rue La La will accept the offer.

2.3 Prescriptive Model:

The third step would be prescriptive analytics, **optimization**, for setting optimal pricing for products.
An optimization model using the regression model can be built and utilized with the **objective function of maximizing the revenue**.
The constraints of the products are based on the inventory. Moreover, we can acquire pricing data of competing sellers and set the maximum price in constraints based on that.
We can use **clustering model** to find a range of prices of similar products and incorporate that in our optimization model.

3. Data

For all our analytic models, we need rich data to draw valuable results and make informed business decisions.
Since we are working with an online platform, collecting and obtaining data is very easy.
Types of data that can be collected and used in training our models are:

- Transactional
- Product data
- Past sales events
- Prices of similar products
- Website traffic
- Weather

Rue La La has sales events on a daily basis. Because of that, new data can be collected every day and fed to the analytic models.
In order to utilize **Game Theory**, we can do web mining every day to be informed of competitor's pricing and update the optimization model.
With automated dynamic models that are getting re-run, trained, and tuned with added new data in real-time, we can make sure that the outputs reflect the current trend and demand of the fashion market.

At the end, we must know that data analysis is not a linear process. Sometimes, when we get to the end, we have to go back and refine or change some procedures.

References:

https://www.informs.org/Impact/O.R.-Analytics-Success-Stories/The-Fashionable-Side-of-Analytics