Describe analytics models and data that could be used to make good recommendations to the retailer. How much shelf space should the company have, to maximize their sales or their profit? Of course, there are some restrictions – for each product type, the retailer imposed a minimum amount of shelf space required, and a maximum amount that can be devoted; and of course, the physical size of each store means there's a total amount of shelf space that has to be used. But the key is the division of that shelf space among the product types.

For the purposes of this case, I want you to ignore other factors – for example, don't worry about promotions for certain products, and don't consider the fact that some companies pay stores to get more shelf space. Just think about the basic question asked by the retailer, and how you could use analytics to address it.

As part of your answer, I'd like you to think about how to *measure* the effects. How will you estimate the extra sales the company might get with different amounts of shelf space – and, for that matter, how will you determine whether the effect really exists at all? Maybe the retailer's hypotheses are not all true – can you use analytics to check?

Think about the problem and your approach. Then talk about it with other learners, and share and combine your ideas. And then, put your approaches up on the discussion forum, and give feedback and suggestions to each other.

You can use the {given, use, to} format to guide the discussions: Given {data}, use {model} to {result}.

One of the key issues in this case will be data – in this case, thinking about the data might be harder than thinking about the models.

My Solution:

The homework prompt here poses three main questions: These include:

1) How much shelf space is necessary for the business to maximize profit or sales?
2) How do you calculate the potential increase in sales that the company could receive from varying shelf space quantities?
3) How are you going to ascertain whether the effect even occurs?

Goal 1: Eliminate the effects of seasonality and random fluctuations to calculate the average units of a product sold on a weekly basis.

Given: {Data over a time period that represents the amount of units sold of a product)
Use:{ Exponential Smoothing}
To: {Maximize the amount of shelf space used as well as the profit}

In our pursuit of utilizing an optimization model to determine the most effective allocation of shelf space, particularly for a year-round retailer dealing with seasonal products like

Halloween costumes or greeting cards, it is crucial to employ time series modeling techniques such as Exponential Smoothing. These products experience significant demand spikes during specific seasons, and if we fail to remove the inherent seasonality and random variance from their sales volumes, it could distort the optimization model. Without deseasonalizing the data, the model might mistakenly allocate excessive shelf space to these products even during off-seasons, potentially leading to missed opportunities to allocate that valuable space more strategically for products with higher demand during those periods. By applying Exponential Smoothing, we ensure a more accurate representation of the underlying trends, allowing the optimization model to make informed decisions based on the true product demand patterns throughout the year.

Goal 2: Fine-tune the distribution of shelf space for every product available in the store to achieve an optimal allocation.

Given: { Our data from the previous step, product per unit sold, product surface area, shelf space in store product name, etc}
Use: { Either Multiple Linear Regression OR Optimization Models}
To: { maximize shelf space and profit}

The total number of products, the number of units to be sold, and the areas (of the products and the shelves) should all be taken into account by our objective function. Constraints like the total amount of shelf space used as well as the minimum and maximum shelf space for each product (to stay within a certain threshold) must also be taken into account. This step's output will indicate how many units of each product are required to stock the store while taking into account any area constraints.

An alternative to an optimization model for optimizing shelf space allocation, considering exponentially smoothed sales volume, product price, area unit per shelf, total shelf space in the store, product name, product surface area per unit, and product profit per unit sold, could be a machine learning approach, particularly a regression model. You can train a regression model using historical data with the mentioned variables as features and the desired outcome (e.g., product sales or profit) as the target variable. The trained model can then be used to predict the expected outcome based on different shelf space allocations.

Goal 3: Find products that are highly correlated with one another.

Given :{complimentary product sales and sales of those individual products}
Uses: {Bayesian Modeling}
To: { Determine how likely it is that a customer will purchase a complementary product in addition to our target product?}

To evaluate whether placing a complementary product alongside the target product increases sales using a Bayesian model, we formulate hypotheses: the null hypothesis suggests no effect, while the alternative proposes an increase in sales. Employing a Bayesian model, we specify a prior distribution to represent our beliefs before observing data. After collecting sales data in both conditions, we apply Bayes' theorem to update the prior and obtain a posterior distribution. Analyzing the posterior distribution, if the credible interval excludes zero or Bayes Factors support the alternative hypothesis, it implies a significant impact on sales. A decision is then made based on this analysis, and optional sensitivity analyses can be conducted for robustness testing. Bayesian methods provide a probabilistic framework for informed decision-making regarding the impact of complementary product placement on sales.