Hello everyone. We are presenting our analysis of Inventory Replenishment and Risk Management. We solved our problems in 3 steps:

We created replenishment and substitution pools, and considered manufacturing risk for short-term pool. Then, we built priority and substitution strategies separately. We used the priority model to order SKUs and found the tipping point for the monthly list of proposals. At last, based on current and new suppliers, we provided supplier management recommendations.

So, first, let’s jump into the replenishment pool.

Wholesale cost, demand quantities and size of parcel determine the deadlines of the delivery. Therefore, the recent proposals require a different strategy from the future proposals. We learned that the lead time in the furniture industry usually takes 6 to 10 weeks. Thus, we treated replenishment bases during the recent 2 months and later differently.

For more details, in the short term, we cut any proposals of large demand into a reasonable level. Here, we applied different cut off values according to different categories. Because, as we can imagine, simple and low cost products will have larger batch manufacturing capacity than complex ones. So, we classified categories based on its average cost. At last, we found different manufacturing capacities for each category and shrunk excess demand to its reasonable level to lower the risk of delay.

For proposals in the long term, we assumed all large demands can be satisfied if they were made in advance by 8 weeks. We also dropped low demand proposals because factories are not able to work for such a small demand due to batch manufacturing issues. And last, we used overstock SKUs as a substitution pool.

Due to limited resources, we want to target fewer SKUs but achieve higher coverage. So, first we built a priority model to measure SKU importance and sort the SKUs by priority score.

The model considered three factors. First, Missed sales: items with large missed sales make a more significant contribution to fill the gap. Second, the Adjusted demand: as a supplement to missed sales, it will cover those high-demands but low-missed sales items, such as bathroom accessories. Third, the Parcel effect: small parcels will have a special 1.5 parcel effect to gain more priority in the short term.

The next question is, how can we do little things but make a big difference? We can do this by investigating the relationship between the number of SKUs and the resulting effect on coverage. We found the tipping point for each month. On average, targeting the top 14% of SKUs will increase the coverage to 83%. We can see, the small red bar, representing the percentage of target SKUs, leads to a big lift on the coverage, from the blue line to the red line.

In addition, based on the priority score, we found seven all-time critical categories and several monthly high-demand categories. Wayfair should take better control of the business in these vital categories.

To make use of the overstock SKUs, we filtered the products and matched them with undersupplied ones according to three criteria: the same item class, same month, and similar price. The maximum potential coverage increase caused by this substitution strategy is 9.6%, from 83% to around 93%, the red coverage line will be further lifted to the yellow one.

For the supplier management: first, we want to address that Wayfair relies heavily on a very small group of suppliers. Especially for critical categories as mentioned earlier. The bar chart tells us that the top 10% suppliers in each category control the majority of forecast sales. This could be a potential supplier diversity issue because if something went wrong with one big supplier, it may significantly impact sales. So, don’t let your supply chain control your business. For the large suppliers, we recommend that Wayfair maintain good relationships with them and give enough time for product preparation. For the small suppliers, Wayfair can collaborate with best performers to promote marketing campaigns or encourage them to use Waymore to improve the conversion rate. Generally, Wayfair should outreach to more suppliers.

So, what categories need new suppliers? The 1st step here is to compute the percentage change of the unique suppliers’ in each category between history and prediction. The bar plot presents that the majority of categories suffer from a sharp decreasing of suppliers. Considering the importance of categories, we multiply the change percentage by the priority score to get the ranking metrics. As a result, we stratify all categories into 4 groups.

Here is the hierarchy of categories. Level 1 needs the most attention. For instance, Looking deeper into item class level，the average percentage decrease of all item classes in outdoor structure & SPA is only around 25%. However, the average percent decrease for accessory item classes is over 50%, this is way higher than others in outdoor structure & SPA. Similar stories happened on other levels, but at a different decrease rate.

Finally comes our takeaways. The overall goal is to maximize order coverage and lower the risk. We created replenishment and substitution pools. After considering the lead time risk in fulfilling orders, we decided to target the top 14% of products for replenishment, leading to an 83% coverage. Moreover, we substituted overstock SKUs with undersupply SKUs and will bring an additional maximum 9% coverage increase. To lower supplier risks, we suggest that Wayfair strengthen supplier management by keeping a tie with critical suppliers and outreach to new suppliers for targeted categories.

For future research, we hope to take possible errors in prediction data and uncertainty factors into account.

Thank you! We welcome any questions.