Good morning, Distinguished professors.

It is a great pleasure and honor to have you attend my thesis presentation. My name

Thank you for your participation.

The content is divided into the following 6 parts. Let us address the introductory segment, since the outbreak of the pandemic, social distancing as a valid physical measure to restrict the spread of the virus has been used in many places.

For instance, in the dining hall and office, the social distancing tapes are pasted on the floor to remind people to keep social distancing. In the restaurant, plastic boards have been used to separate the adjacent groups. In the park, the square lines are drawn to confine the scope of group activity. Social distancing has also been used in seating areas, such as in amusement parks, shopping malls, restaurants and theaters or music concert.

Then we will discuss the requirements for social distancing, which will introduce the seat planning and seat assignment we are going to talk about. The policy regarding social distancing usually requires a limit on the size of each group, with people in the same group sitting together and different groups maintaining distance.

We clarify the two terms, seat planning and seat assignment used in the following part.

Seat planning refers to planning of seats for the groups. Blue squares represent the social distancing. Here are two different seat plannings for one row.

The seat assignment refers to the process of assigning the seats to the incoming group. It emphasizes the dynamic process.

For example, here is a group of 2, we assign 3 seats to it, then three seats will be occupied and will not be used in the future.

This thesis basically includes two parts, seat planning and seat assignment. In the seat planning part, we consider to obtain the seat planning with the deterministic demand, known specific demand. We also consider the stochastic demand, that is, we know demand distribution before the realization of demand.

For the seat assignment part, we consider to assign seats under the seat planning. We mainly focus on the real-time seat assignment, and the late assignment and assignment under the flexible seat planning are also discussed.

Regarding the contribution of the seat planning, we propose a new model and develop the corresponding technique for the stochastic demand situation. The model can provide the seat planning as a guidance or basis for seat assignment.

In the seat assignment part, we propose the new model for this problem and provide practical policies and insights.

We explore the existing literature on this point, there have been many works about seat planning with social distancing, including seat planning on airplanes, in classrooms, trains. There are also a few literatures about the group-based seat planning that can be applied in airplanes and theaters. However, they mainly concentrate on the static model and the specific groups are known.

In terms of the dynamic seat assignment, we model the problem as a dynamic multiple knapsack problem. This is related to the well-studied multiple knapsack problem and dynamic knapsack problem. However, the dynamic multiple knapsack problem itself has not been extensively researched in the literature.

This problem is also related to the area of group-based network revenue management. However, revenue management typically focuses on the decision of whether to accept or reject a group, without considering the actual seat assignment. In contrast, our problem has the additional feature of assigning groups to specific seats. In a word, our work considers the group-based seat assignment.

Now, we incorporate social distancing into the seat planning problem by introducing several concepts.

There are M types of groups, type i group contains i people. The seat layout contains N rows, row j has Lj0 seats. Set delta seats as the social distancing. We do the following conversions, i.e., for each i, let n\_i equal i plus delta. The value, ni, indicates the number of seats occupied by type i group. For each row, let Lj equal the number of physical seats plus delta.

We use the following picture to illustrate the conversion. In the top row, the blue squares represent the social distancing, here it is one seat. There are 10 physical seats. In the bottom row, the grey square is the added virtual seat. For the first group, And we use a size of 3 seats to represent the group of 2 with one seat as the social distancing. Then we don't need to consider the social distancing separately after the conversion. In the following part, we only consider the new size of type i and row.

To better understand this problem, I introduce the concept of pattern. Pattern represents the seat planning for one row, denoted by h, where hi is the number of type i groups. A feasible pattern should satisfy this constraint. And the number of people can be accommodated is the size of h, the summation of this term.

Still use the above example to explain, here L = 11. This pattern contains two type 2 groups, one type 1. The size of h is 7, i.e., the number of people accommodated is 7.

Then we define largest and full patterns.

h is a largest pattern if the size h is no less than the size of any feasible pattern.

h is a full pattern if the total size of all groups equals the size of the row.

Since the largest and full pattern can utilize as many seats as possible, meanwhile we

For the type i less than i tilde, we don't plan seats for these groups; for the type larger than i tilde, we plan seats for the groups; then the remaining seats are planned for type i tilde.

We have the following programming to help generate the full or largest patterns.

Regarding the first set of constraints, we present the specific form as follows: The number of type M groups in the new seat planning must be greater than or equal to the number in the original seat planning.

The same constraint applies to the summation of the number of type M and M-1. So on and so forth…

The same constraint applies to the summation of all group types.

In this way, all group type in the original seat planning are fulfilled by the new seat planning.

First, we present the model of real-time seat assignment.

the expected value difference between acceptance and rejection of type i

To have a shorter computation time./to save computation time

Solving/Addressing dynamic programming encounters the curse of dimensionality.

Now we move on to the numerical results, first we describe some common parameters.

Have the aid of …

Then we investigate/examine the impact of social distancing.

We set an even probability distribution. There are two figures, in the left one, x axis is the period, y-axis is the percentage of accepted individuals relative to total seats. In the right one, x-axis is the percentage of expected demand relative to total seats.

Introduce the gap point to refer to the first period when there is difference between accepted individuals with social distancing and without social distancing.

Here, the gap point is 58, the corresponding occupancy rate is 71.3%.

P40 For the managerial insight of the DSA policy, we examine the impact of implementing social distancing. We know that when the demand is small, we will accept all groups with social distancing constraints. As the demand increases, there will be a difference between the number of people accepted with social distancing and without social distancing. What interests us is when the difference starts to be larger than 0.

Let gamma be the expected number of people at each period.

The gap point represents the first period when we have the difference.

The gap points of different probabilities with the same gamma has little difference, which can be seen by the estimation of gap point.

Here we have a figure including the gap points under DSA with 200 probabilities, the blue points represent the period and red points represent the corresponding occupancy rate.

I will not go into details here.

Here we can get the conclusion that

We assume that the surplus supply for group type i can be occupied by smaller group type

The objective function is to maximize the expected number of people that can be assigned across multiple demand scenarios.

we could reformulate ssp in a vector form as problem 2, here for each scenario, problem 3 has the same form, if we can solve it efficiently which is helpful to solve problem 2. Fortunately, it is easy to solve problem 3 by the dual problem.

The solution to SSP can be obtained by solving the master problem iteratively. We develop other approach to obtain the seat planning composed of full or largest pattern.

Now we see how to do the dynamic seat assignment. It contains two parts, seat planning can be seen as the supply for each group type, when the supply is enough, we will accept the corresponding request, if there is no supply for small group, we should decide whether to use a larger group type supply to cover the smaller one. Let dij represent the expected difference between the acceptance and rejection of group type i on the supply of group type j.

For each j larger than i, we find the largest one, denoted as j star. It is a necessary condition based on the current planning, we also use the value of stochastic programming to make the final decision.

The optimal policy is to make the decision when we have complete knowledge of all future requests in advance.

Here we conclude DSA method.

Conclusion

Now, let's summarize the key points we have discussed

That concludes my presentation."

And that wraps up my presentation."

And that brings me to the end of my presentation."

And that's all for my presentation."

I would be delighted to address any questions, comments, or suggestions you may have. Please feel free to share your thoughts, and I will do my best to provide thorough responses. I value your insights and look forward to our discussion.

重述问题并直接回答：

Question: "What are the main advantages of your approach?"

Answer: "The main advantages of our approach include..."

感谢提问并回答：

Question: "How does your solution address scalability issues?"

Answer: "Thank you for that question. Our solution addresses scalability by..."

引入观点并回答：

Question: "Could you elaborate on the timeline for implementation?"

Answer: "Absolutely. In terms of implementation timeline, we are looking at..."

承认并提供解释：

Question: "Your data seems different from previous studies. Why is that?"

Answer: "Yes, you're right. The difference in the data can be attributed to..."

回应并提供进一步信息：

Question: "Can you clarify how your product differs from competitors?"

Answer: "Certainly. Our product stands out from competitors due to..."

总结回答：

Question: "In what ways will your project impact the community?"

Answer: "To summarize, our project will impact the community by..."

Some questions:

Q0: Why does the seat planning have the objective?

Q1：可不可以把一组拆开放在不同的排？

First reason is that if we place/put the group in different rows will incur extra social distancing, second reason is that follows/satisfy our setting/requirements, sit together.

The potential advantage is not that much.

顾客可能不满意？The customer may not be satisfied if we

Thanks for your question, maybe I can discuss it to deepen understanding

Q2: 排与排之间是独立的，怎么考虑两排？

In fact, we can pretreat this before we implement the approach. That is, we can delete the several rows from the seat layout at the beginning.

The picture can also show the application of this situation.

Some literatures also use the same way, treat/see the groups as a rectangle with two rows or more.

Q3: Why seat planning is for seat assignment? 能不能不用seat planning?

We improve the seat planning for seat assignment. If we only consider the basic seat planning, we can stop here, don’t need to improve it.

Because the DP is hard to solve, computationally complex.

We can use DP assign seats directly.

Q4: 不同group type 的拒绝率

I didn’t simulate it in our results. But the intuitive result is that when there are lots of seats compared with the demands, we tend to accept groups. And when the supply is near the demand, we may accept the larger group rather than smaller groups. In general, it will depend on the capacity and the futures demands, it is a dynamic process.

Q5: 不同方法的适用性，或者优缺点？

In general, this policy is better. But when the demand is comparatively low, first come first served will be easy to implement and will not cause any losses.

I can talk about the cons of other policies.

Regarding the decision on accepting or rejecting, Bid-price performs relatively well.

DP is similar to Bid-pricing, we can only assign the seats in the row arbitrarily.

Booking limit considers the static seat planning, but did not consider the nested relation. So the decision is not good.

Our policy combines both advantages, that is, we not only consider how to make a good decision, acceptance or rejection, also consider the assignment based on full or largest patterns, trying not to waste seats.

Q6: Insight?

What is the relation between seat planning and seat assignment?

Generally speaking, seat planning emphasizes the static form,

In our work, the seat assignment is based on the seat planning. In fact, the seat assignment can be made without the help of seat planning, but assigning it directly is difficult, so we consider assignment under the seat planning.

You mentioned the seat assignment is made under the seat planning. Why is it that?

In the assignment, can we put one group in different rows when there is no enough seats in one row?

If we put it in two rows, it will incur extra social distancing. Maybe in some cases, it can utilize more seats, but in general the impact or benefit may not be significant.

First reason is that if we place/put the group in different rows will incur extra social distancing, second reason is that follows/satisfy our setting/requirements, sit together.

Meanwhile, the requirement asks the group people sit together.

The potential advantage is not that much.