A Concept on Seat Assignment Systems

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Abstract: This paper presents a concept on seat assignment systems. The concept is based on the assumption that customers or passengers prefer to select seats at their own choosing and allowing them to do so would fragment remaining seats. This undesirable condition may make a group of people intending to be seated together unable to find a sufficient number of consecutive seats. The concept proposed is to set aside a number of seats when the map of available seats is shown for customer's selection. A number of functions are created to allot seats to be visible for choosing according to the number and locations of the remaining seats and the number in the group of the passengers. Passengers' preferences such as window or aisle seating, front seating are taken into accounts. A primitive example of seat assignment system of a Boeing 717 aircraft, assuming the number of passengers in a group being 1, 2 or 3, is given based on the concept.

Keywords: Seat assignment, Seat allocation, Seating simulation, Customer satisfaction

1. INTRODUCTION

Seats assignment is an important application in many businesses such as cinemas, theatres, rail, bus and aviation systems. Allowing customers to freely select their own seats may cause seat fragmentation problem, which makes groups of people unable to find seats to sit together or at their wills. Using an automated system to assign seats may unnecessarily pack all customers in an area, leaving all remaining seats unoccupied. This may frustrate customers who value their freedom to choose seats at their own choices. This paper proposes a concept to develop seat assignment systems according to the seat layout as well as the usual requirements of the customers. In this system, each customer is allowed to select seat(s) from part of the available seats, instead of from all available ones. Each customer sees different seats that he or she can choose depending on how many seats are available at that time as well as the number of people in his or her group. An algorithm is developed to select available seats that can be chosen by a customer in order to optimize the satisfaction of the present customer as well as those who might come later. This algorithm separates seats into categories according to customers' demand and calculates the number of seats available in each category every time a seat is taken. Information about customers' behaviors is collected to take part in the decision making system. Queuing technique is used for customers who don't mind being seated anywhere as long as they are sitting next to no one.

2. THE ALGORITHM

Recent research about seat assignment usually concerns about the seat allocation, scheduling and routing to generate maximal revenue for airlines [2][3]. This includes the decision to overbook, reassign passengers on another flight or another airline, or upgrade passengers to the next class of service [1]. Since the concept is to display only some seats for customers or passengers to choose, we must first develop an algorithm to allot the seats reserved for next customers or passengers. The algorithm chooses seats according to a specified seat value of each seat. The seat value can be calculated using the following criteria:

1. The level of fragmentation that will occur if the seat is chosen. If taking the seat creates fragmentation of a higher level than taking other seats, the system should try to hide this seat from the display. The level of fragmentation that will occur if the seat is taken depends on the location of the seat as the status (free or taken) of the nearby seats.

2. The type of the seat. In some cases, for example, on an aircraft or a train, there are window seats, aisle seats, etc. Some passengers prefer a specific type of seats. The system should account for the demand of each seat type and maintain a balance of the remaining seats of each type.

3. In some cases, people prefer to sit in the front. In other cases, people prefer to sit in the back for which the system should be accountable and a parameter is assigned to take charge of this problem.

4. The group size of the current customers or passengers also takes part in the calculation of the seat value. Whether or not a seat should be displayed does not depend only on the characteristic of the seat but also the characteristic of the people who are selecting it.

The value of each seat that has not been taken must be calculated every time there is about to be a seat selection. Then seats are sorted according to the seat values. The system must specify the percentage of seats to be displayed. This number is the proportion of the seats that can be chosen by a customer or a passenger to the number of all remaining seats. Seats that are to be displayed are seats that have highest values in the specified percentage.

A suggested improvement is to make the seat map look random. Customers or passengers would have a better feeling to perceive that unavailable seats are taken, not reserved for next selections. To make the seat map appear so, we use a random factor to take part in the seat value calculation. This random factor will scatter the reserved seats throughout the entire area. The more significance the random factor has in the seat value calculation, the more randomly looking the seat map appears to the customers. However, this would also reduce other desirable characteristics of the reserved seats. So the significance of the random factor should be limited.

3. THE APPLICATION

In this section, we demonstrate how to apply the concept of seat assignment mentioned in the previous section on a Boeing 717 aircraft. The application assumes that all passengers come in group with sizes 1, 2 and 3 only. Since the first class cabin is much smaller and there is little need for a seat assignment algorithm, we are interested in only the main cabin. There are 23 rows of seats, with five seats in each row. Three seats are on one side and the remaining two on the other side. So in each row, there are two window seats, two aisle seats and one middle seat. Each seat has different characteristics described below.

- Window seats on the 3 side: For a passenger who prefers a window seat, this seat is less desirable than the window seats on the 2 side because it is less convenient to get out. Selecting the seat can cause fragments by possibly reducing three consecutive seats to two consecutive seats (if the aisle seat has not been taken) and two consecutive seats to just one middle seat (if the aisle seat has been taken).

- Middle seats: Normally this is the least desirable seat on the aircraft for a sole passenger. Choosing the seat for a sole passenger can create the worst case fragmentation by reducing the consecutive seats of three to one window and one aisle seat.

- Aisle seats on the 3 side: For a passenger who prefers an aisle seat, this seat is less desirable than the aisle seats on the 2 side because there are more people having to pass the seat get out. Selecting the seat can cause fragments by possibly reducing three consecutive seats to two consecutive seats (if the window seat has not been taken) and two consecutive seats to just one middle seat (if the window seat has been taken).

- Window seats on the 2 side: This is the most desirable window seat. Selecting the seat can cause fragments by possibly reducing two consecutive seats to an aisle seat (if the aisle seat has not been taken).

- Aisle seats on the 2 side: This is the most desirable aisle seat. Selecting the seat can cause fragments by possibly reducing two consecutive seats to a window seat (if the window seat has not been taken).

So we order the level of fragmentation that may occur from the highest as follows.

1. Splitting 3 to 1,1
2. Splitting 3 to 2
3. Splitting 2 to 1
4. Splitting 3 to 1 (for a group of 2)
5. No Splitting

From the above information, the parameters of the seat value function can be adjusted as shown in Figure 1. The Best Seat parameters are the value of undesirability of each type of seat. For example, the middle seat is normally unwanted by a sole passenger. However, when combined with the low value of seat splitting, the middle seat is usually not offered to a sole passenger when seats next to it are still free. The system can keep good seats for future use if needed using the weight specified in the weight field to indicate how important the matter is. The Separation window takes care of the Splitting parameters.

Seat values are calculated from the combination of the Seats Separation parameter and the Best Seat parameter. The significance of the Best Seat parameter is indicated by the Weight parameter. The system can be biased toward showing the front or the back by adjusting the Back Row Incentives parameters If the parameter is positive, the system will give rows in the back more priority in being displayed than rows in the front. If the parameter is negative, the priority is the opposite and there's no difference among rows if the parameter is zero.

The Grouping parameter is added to a seat when the selection is for a group of two or three and the seat is a part of consecutive seats that are available for the group. The Degree of Randomness parameter is the parameter that will make the displayed seats look random and create a feeling that the unavailable seats are not actually withheld.

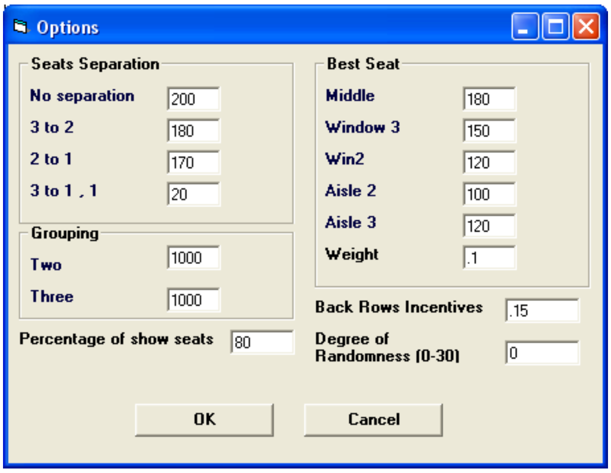

Fig1 Adjusting parameters of the seat value function

From the described method, seat value of seats can be calculated according to the seat request (single, double or triple). Then seats are sorted according to the calculated seat values. If the Percentage of Shown Seats is p, then the number of seats being displayed is equal to

$$n = (p / 100).v$$

where v is the number of unoccupied seats.

And seats that are displayed are the n highest seat value seats.

Figure 2 shows an example of seat map displayed for selection for a group of 2, with Percentage of Shown Seats equal to 80, and the Degree of Randomness is 20.

Fig2 The seat map displayed for 2-seat selection

In the real application, the seat values should be eliminated from the display. Since seat values are not calculated from a complicated equation, the calculation time is minimal and the user would hardly notice the delay.

In the system, passengers with specific requirements can request special assignment. These include passengers with disability, passengers with infants, etc. Moreover, it's possible for the system to maintain a queue for a passenger who does not mind sitting anywhere as long as he is sitting alone in the row or sitting next to no one. The passenger must acknowledge the risk of the request not being granted. The queue is cleared after seats of all other passengers are assigned including stand by passengers. The gate agent can then determine whether or not to accommodate the requests.

4. RESULTS

The result of using the application can be measured in term of passengers' satisfaction. We studied the passengers' preference to simulate the seat selection of passengers when the system is used and when passengers are allowed to select seats freely. The result is measured in term of the number of groups of two that cannot find two consecutive seats to set together and the number of groups of three that cannot find three consecutive seats to sit together. The Degree of Randomness is 0. The number of people selecting seats is equally divided into the group of one, two and three. The result of the simulation of 10000 full flights is shown in Figures 3 and 4.

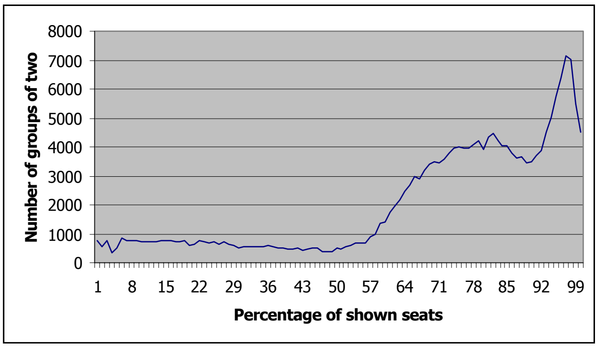

Fig 3 The number of groups of two that cannot find two consecutive seats in 10,000 flights

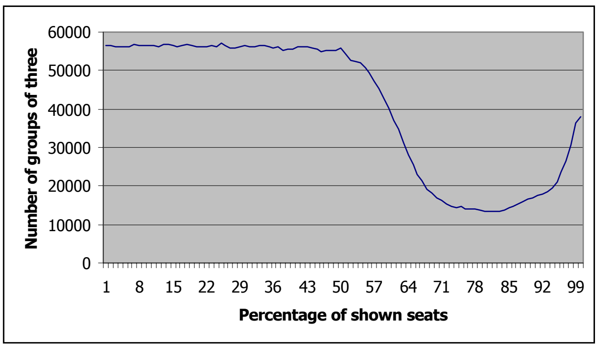

Fig 4 The number of groups of three that cannot find three consecutive seats in 10,000 flights

From the figures, it can be seen that groups of three suffer more in finding consecutive seats than groups of two. The system succeeds in reducing the number of groups of three that are unable to find consecutive seats by around 50% when the Percentage of Shown Seats is between 65 and 95. The algorithm substantially reduces the number of groups of two that cannot find two consecutive seats when the Percentage of Shown Seats is less than 55. From 55 to 90, it's slightly improved. If the overall passengers consist of mainly groups of three, the Percentage of Shown Seats of 90-95 is recommended. If the overall passengers consist of mainly groups of two, the Percentage of Shown Seats of 50-55 is recommended. If the overall passengers consist of mixed groups of two and groups of three, the Percentage of Shown Seats should be set to 65 or around two-third.

5. CONCLUSIONS AND FUTURE WORKS

This paper introduces a concept of seat assignment which withholds some seats in order to reserve them next passengers. This prevents fragmentation at some levels. We plan to develop the system for other aircraft types and other applications as well as testing the system in the real situation.

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