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Dynamic Seat Allocation in Trains

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ABSTRACT—

The comfort of passengers can be improved, and operator expenses can be decreased, with dynamic seat allocation in trains. While travelling in a train, it's possible to notice some seats are empty for an extended amount of time or, a certain seat can be vacant between few stations. The reason behind this is travelers have various points of boarding and deboarding destinations. The efficiency of transportation as well as the travel experience for passengers will rise if we are able to utilize these partially unoccupied seats. In order to optimize seat arrangements on trains, it looks into the possibility of adopting a dynamic seat allocation method. The method is based on choosing the best or optimal path of dynamic seats for a passenger using his boarding and deboarding stations as input, simultaneously minimizing the number of operator charges and the number of passengers who will stand. This project primarily focuses on the revenue of the railways while also aiming to improve coach maintenance efficiency and avoid rush hours during emergencies and incidents.

Keywords—Dynamic, operator costs, comfort, seats.

Literature survey

Mhamane, et al. [1] Digitalization is necessary in this day because practically all manual systems have been replaced by automated and electronic ones. Hence, a quick and accurate mechanism for checking railroad tickets must be developed. In this article, the QR code is crucial since it serves as a personal identification number for each traveler. Each QR code has a unique value and piece of data that is utilized to properly validate the user. Adaptive Seating Allocation If no passengers are present, the seats are empty and are used by the railway. These technical methods—database update and notification trigger algorithm—are used in this strategy. This method has various benefits, including proper sequential seat distribution to waiting list participants. This method is open and transparent. 100% seat allotment, no need to verify reserved seats separately. Singh et al. [2] While using the ticket to board the train, the QR reader encodes the traveller's unique URL, and the passenger checks in as a result. The SQL database server is redirected to during the check-in procedure, where it verifies the passenger data stored there and updates the data for those who have boarded the train. It is employed in the distribution of seats. First-come, first-served seating will be given to the passengers on the waitlist. The first five database users will be taken into account while allocating seats, and the user with the longest journey will be given preference for their convenience.

Ying-jing et al. [3] The goal of the article is to suggest an ideal seat distribution model for airline alliances through ongoing airline expansion and close airline cooperation. To simulate the dynamic pricing process, centralization and decentralisation in dynamic allocation methods are constructed. This study presents the dynamic capacity allocation model of the airline alliance and theoretically establishes how the airline controls the income after joining the alliance. Over the past two years, both domestic and international airlines have started to pay attention to how airlines manage their revenue in an alliance setting given the growing revenue of the aviation alliance and sophisticated income management techniques. Yan et al. [4] Controlling seat inventory is a key strategy for managing railway income. The majority of seat allocation models now in use, like traditional revenue management, assume a fixed capacity. This paper relaxes the assumption of fixed capacity by discussing the impact of flexible train composition and extending the literature. In this study, judgements about train composition and seat inventory control are made while concurrently taking into account stochastic demand and passenger preference. This study suggests a probabilistic nonlinear programming model to synchronize maximize seat distribution and train composition, which is then converted into equivalent linear programming and promptly resolved using ILOG CPLEX. Refund impact is not taken into account in this study.

Price and seat distribution are complimentary revenue management (RM) techniques for the railroad sector, but in the majority of previous studies, these two tactics were often viewed as separate issues. Hu et al. [5] A nonlinear programming approach is suggested to further the literature for the joint optimization of price and seat distribution in high-speed rail (HSR) networks. With consideration for multistage and discriminatory pricing schemes, this research introduces the MSPSA model for the combined pricing and seat allocation problem in HSR networks. The joint price and seat allocation problem with considering various classes of seat can be a direction for future work since only single-class seats are taken into consideration in this study. Sumalee et al. [6] This study developed a dynamic transit assignment model for a broad network that distinguishes between standing and sitting passengers' levels of discomfort. The research created a model for stochastic seat allocation that reflects the randomness of the likelihood of acquiring a seat. It is assumed that the passengers decide on their departure timings and routes based on how useful they perceive the anticipated travel inconveniences to be. The perception inaccuracy of the travel dis-utility, which is supposed to follow a normal distribution, can affect how useful each transit route is overall.

The Probit Stochastic User Equilibrium (SUE) assignment issue is then used to describe the transit departure time and route selection model. The suggested approach is also used to assess the outcomes of a sophisticated public transportation information system. Wu et al. [7] According to the author, a cooperative model that incorporates seat allocation choices into the HSR dynamic pricing problem is proposed. This model is based on revenue management theory, and it has the goal of maximizing the enterprise's overall ticket revenue while keeping price ceilings in mind. To address practical issues, a two-stage method is created. Obtaining the best seat allocation decisions comes after the optimal price problem is solved in the first stage. Using a dynamic pricing technique, the revenue increase ranges from 4.47% to 4.95%. The pricing and seat allocation issue for high-speed rail should be further researched in the future, taking into account various passenger kinds, seat classes, and even thorough network optimization for high-speed rail using several lines.

S. Mhamane et al. [8] The paper examines one of the main issues with the current ticketing system, which is the line for purchasing and verifying train tickets. People in today fast-paced society want all work to be completed in a matter of minutes, which is now achievable thanks to digitization and smartphone use. The secure hash algorithm was employed by the author of an intelligent ticket checker programme for trains that uses QR codes to complete the task. The paper primarily focuses on the creation of QR Codes. Because a QR code may give you all the information you need about a passenger, using paper less often will help the environment. Because of the large number of people who utilize platforms, it is planned to build a separate system for platform tickets in the future. P.Shriram et al. [9] Checking tickets is performed automatically. The author will employ the AADHAR number and fingerprint recognition method for the same. Additionally, it allocates seats for waitlisted guests dynamically in order to cut management's expenditure and free up TC staff for other tasks.

The trip information of the passenger is updated whenever there is a match between the fingerprints collected from the input and the UIDAI database, and the passenger is informed of this by receiving a message stating that the verification was successful. The passenger does not need to enter his information when purchasing tickets because our system will automatically pull up all of that passenger's information. By eliminating or minimising the shortcomings, the proposed solution will enhance our railway system. Kamandanipour K. et al. [10] The authors of this study proposed a stochastic nonlinear integer programming (SINLP) model to maximize overall profit for a service over a predetermined buying horizon (departure date of a specific route). They use a simulation-based method to avoid the nature of the demand uncertainty. We consider options for capacity allocation as well as dynamic pricing simultaneously in a multi-fare, multi-class passenger railroad transportation problem. The problem, which is unique in terms of options for capacity allocation, is given as a stochastic optimization problem. This algorithm employs the simulation-aided annealing (SA) method. Our methodology also has the advantage of increasing the profit of the service provider by considering different service classes over the course of a planning horizon. Zhang C., et al. [11] This essay focuses mostly on the issues of how to bill passengers and how to create workable timetables for the driver in such an online setting. Two allocation algorithms, a timetable algorithm, and a billing technique have all been developed using this concept. This illustrates that this strategy has a competitive ratio of 1/3 in a certain situation. The schedule algorithm offers a Nearby Neighbor Scheduling solution, where the driver always goes to the locations that are nearest to the active requests. They start by providing clients with a fair price structure that is simple to understand and accept. They next develop the UtiMax algorithm and the greedy LiqMax Gre algorithm to optimise liquidity.Wang W et al. [12] Due to the fierce competition in the market, many airlines have recently battled to reduce channel distribution costs. Thus, the author suggests that airlines with multi-channel distribution use dynamic capacity allocation. In this study, they look at customer shift behaviours in a scenario that combines the aforementioned two problems and provide a dynamic programming approach to decide the best course of action. First off, our strategy can maintain more stable revenues even when channel commission rates increase. This suggests that the risk of losing money is decreased by entering into a contract with the channel and keeping a dominant position in the airline market. Finally, all of the presented applications outperform the conventional independent when it comes to handling the multifare and multi-channel capacity issue.

Pratikto et al. [13**]** The author suggested a workable method for including demand function in pricing optimization and solving the ensuing capacity allocation issue. In order to execute revenue management for passenger train services, this study suggests employing a willingness-to-pay technique to predict demand, price differentiation, and capacity allocation. The procedure generally consists of three stages: estimating the demand function, deciding on the best rates, and deciding on the best capacity allocation for each fare class. Han et al. [14] The author proposed a stop plan and tickets allocation collaborative optimization model, which is established to maximise the passenger satisfaction degree and the average seated occupancy rate, with the goal of providing a general modelling framework for finding stop plan and tickets allocation of high-speed railway. Also, the number of people boarding or disembarking from various seat classes at each stop along the route is distributed according to the tickets available.

A few parameters, such as Stop number, Stop station, and Stop time, have an impact on the high-speed railway's stop plan. Wen et al. [15] This study establishes a seat assignment model that takes into account passengers' demand transfers when high-speed train fares are differential. A formula was created to determine the number of seats that each train should assign to each OD on each day of the pre-sale period with the aim of increasing the overall income of all trains throughout the day. This article integrates the actual differential pricing strategy with the fluctuating passenger demand scenario to produce the most profitable seat allocation plan.

METHODOLOGY

STATIONS /SEATS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1																	
2																	
3																	
4																	
5																	
6																	

Let us consider there are stations from A TO Q and the seats are from 1 to 6. Voids are the unreserved/vacant seats in the train. Reserved seats cannot be used by us, represented as shaded parts. Path of Dynamic seating is highlighted. The project mainly focuses on 2 metrics:

I) Distance: The difference between the current seat and next seat where he has to placed.

Distance= mod (current seat -next seat)

Example: 2(A-D) 4(D-F), distance= 2

4(A-E) 1(E-G), distance =3

II) Length: It takes maximum measure of voids (count of continues vacancies of a particular seat).

Example: 4(A-F) means, length= 6

2(A-D) means, length = 4

We also have to ensure that the distance should be less as it is difficult for a passenger to move to a seat which is far from him.The length has to be maximum so that the passenger will sit in one seat for long period of time if it is vacant continuously.

By following these two measures one can find the optimal path to ensure safe and a comfortable journey. The project mainly focuses to develop an application that could select best or optimal path of dynamic seats for passenger taking his boarding and deboarding stations as input.

Example: input=A-K

output= 4(A-E) 6(E-G) 3(G-K)

Filling of boxes: It was taken care by the reservation chart (by authority). The user selects boarding and destinating station of his journey.

INPUT: A-K

OUTPUT:

All possible combinations of dynamic seating.

Example: 2(A-C),4(C-E),6(E-G),3(G-J),4(J-K)

4(A-E) 6(E-G) 3(G-K)

Best seats by less movement or changing of seats

4(A-E) 6(E-G) 3(G-K)

CONCLUSION

A key development in the transportation sector is the dynamic seat allocation in trains. It enables the optimization of train capacity while guaranteeing a pleasant and comfortable journey for passengers. Train operators can make well-informed decisions that are advantageous to both passengers and the railroad corporation by using cutting-edge algorithms and real-time data. Dynamic seat reservation offers a solution to the issue of overcrowding and improves the entire travel experience in light of the rising demand for railway transportation. We may assume more developments in this area as technology evolves further, making train travel even more effective, practical, and pleasurable for all.

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