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Study on Dynamic Pricing in Indian Railways

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Abstract:-The administration's choice to present a dynamic valuing approach on trains is a positive development. The railways have undergone many years of low investment. Price hikes have not been considered for the advantage of the general population however, this has brought about the strain on the funds and wrecked the development process. In the budget speech by Railway Minister in February 2014, it was specified that a free Rail Tariff Authority is being set up to defend passages and there was a proposition to grow dynamic valuing of tickets in accordance with the aircraft business. Indian Railways presented a few premium trains with dynamic ticket valuing on IRCTC that can only be booked online. The dynamic charge design is like the one utilized by aviation industry running up with demand. The fare applicable to each day/transaction is showed at the time of booking on the IRCTC's e-ticketing website.

In 2006, Indian Railways chose to present a Dynamic Pricing Policy for freight and in addition for traveller, for peak and nonpeak seasons, premium and non-premium services, and for occupied and unoccupied routes. According to this strategy the rates for non-peak season, non-premium administration would be not as much as the general rates and the rates for peak season and premium administrations could be higher than ordinary.

Keywords:-Pricing, Dynamic, Time, price, Constraints, Demand, Strategy.

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Objective:-To Find How Dynamic Pricing can Help Indian Railways to Cut down Losses.

I. INTRODUCTION

For years, Indian Railways was dealing with losses from its passenger division and 75% of the revenue coming from freight division. As there was no profit in this division there was no investment coming in resulting in long stagnation and no new technological advancement. This also pressurised the fiscal deficit of the current year and the resources which could have been invested in other areas were being consumed in those losses. Looking at the growth of other service sectors Indian Railways decided to discontinue its static pricing policy. Learning from hotel industry and airline agencies Indian Railways decided to adopt dynamic pricing. This was done to increase the revenue base from both the passenger division and the freight division.

II. WHAT IS DYNAMIC PRICING POLICY?

Dynamic Pricing is a system adopted by organizations to set flexible costs for their item or administration relying upon the present market requests. The costs depend on few variables like pricing of competitors, time-based pricing and so on. This causes the business to diminish loses by offering a low cost in a circumstance of low demand. The little misfortunes would then be able to be made up by charging a premium during times of appeal.

Objective: This valuing strategy is embraced by organizations with the sole target of increasing occupancy factors alongside maximizing incomes. It is known as a flexi fare rate system and is based on the system common in the aviation sector. As much as 10 percent of the total seats in these trains will be sold at the ordinary charge in the beginning. After that, point the fare will increment by 10 percent with each 10 percent of the seats sold. In any case, there is a ceiling of 50 percent for charge increment.

III. HOW DOES DYNAMIC PRICING WORK?

Dynamic pricing approach is accomplished by dividing the available resources into three divisions or buckets: low fare (discounted price), regular fare and premium fare. The point to be noted is that the three levels of estimating apply to a similar class of travel and similar services are being provided.

The main bucket is aimed at achieving high occupancy by charging just 40-50% of the original fares of the tickets. In any case, a base occupancy (minimum) factor is kept to make the services feasible (it is settled at 10% of seats). One of the issues with this class is that the ticket once bought is non-refundable. As the point is to boost occupancy, railways won't bear the loss of offering the tickets at a low cost. After this, the standard fares comes into play (it is come to gradually and relentlessly by expanding 10 % fares after every 10 % seats sold). The third class is utilized when the standard charge is additionally depleted. An issue with this category is that costs are never stable at this stage and the organization is allowed to charge any cost. It is possible that a man purchasing the ticket one day later will need to pay a higher passage than one who got it a day back. It can likewise occur on an hourly premise (time-based pricing). However, this procedure is adopted only when the demand is very high.

Research in the field of dynamic pricing contains two distinct strands

- Dynamic pricing strategy under social learning and
- Pricing with strategic consumers

Social learning is the customers observing the trend or other customer's behaviour. This has a direct bearing on pricing and

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perceived utility of the product. Different strategies have to be adopted for both kinds of situations. McAfee and Te Velde (2006) have defined dynamic pricing, which is also known as yield management or revenue management, as a set of pricing strategies aimed at increasing profits. The techniques are most useful when two

product characteristics co-exist. First, the product expires at a point in time, like hotel rooms, airline flights, generated electricity, or time-dated ("sell before") products. Second, capacity is fixed well in advance and can be augmented only at a relatively high marginal cost. It will be worthwhile to analyse the strategies adopted by airlines industry and hotel/hospitality industry. Companies to determine best price for product are using predictive analytics. Perhaps it can be applied to the ticketing scenario also to determine base price and price cap for passenger services.

A. *Different Types of Dynamic Pricing*

Segmented Pricing: Segmented pricing features a pricing strategy that offers different pricing for different customers. For example, high-value customers might be offered prices that are higher because they are willing to pay more money for a quicker or higher quality service.

Peak Pricing: Peak pricing is used by different industries to charge extra money for the use of services that take place during peak hours. For example, a train ticket may cost twice the price between 8AM and 10AM but the price will drop after the peak commuting hours.

Time Based Pricing: Businesses use a time based pricing strategy when they charge more money for faster services. Different industries will use this pricing structure to charge higher prices for same-day services. Another way to implement this structure includes charging more for orders that are processed close to the end of business hours.

Penetration Pricing: Penetration pricing is a dynamic pricing strategy that involves a business setting the initial price of a product below normal market level in order to drive demand. The low price is designed to reach a large portion of the market but can also be used to increase market share.

Changing Conditions: The changing conditions strategy involves a business using a strategy to boost profits when the conditions of the market are changing. For example, when there is a lot of uncertainty in the market or the market opportunity has only a short window of time. This strategy works by lowering the price as sales begin to fall and then raising the prices back up again.

B. *Decision Variables*

The following set of decision variables are the most significant ones and does not include all decision variables:

1. The Demand: Demand can be modelled in a simple way: assume 10 purchases per hour; or complex: random arrivals with time varying means and deviations. Demand is usually considered as exogenous to the model by most, but that is not the case, and is generally a simplifying assumption. Market always responds to product changes, even under a perfect monopoly.

2. The Inventory: Pricing and indexing of inventory can also be done easily: last 80 seats to be sold at 2.5x the price; or modelled statistically and probabilistically: demand responsive, time dependent and fare class conscious, with demand and purchase probabilities for each bracket of customer and fare class combination statistically estimated.

3. The Purchase Probability: The probability of an arriving customer (modelled in 1) who will buy a product (priced and indexed in 2) for the listed price is computed. For example, 7 in 10 people will buy 3rd AC, 2 will buy 2nd AC and 1 will buy 1st AC. It can also be done by computing the probability of purchase by applying utility theory, logit models, probabilistic regression of past purchases, etc.

4. Nesting: Purchases are not often straightforward. There are subclasses of products than can be nested. When a customer goes to buy a ticket, he usually has a few conditions that must be met (say arrival and departure times), some that should be met within a reasonable range (price, travel time), and some that are perceived as added bonus (on board catering, included in the ticket price or number of stops on the route). Most of these can be nested. Consider departure time is the parent super-nest, journey time will be a sub-nest, pantry service either can be a function of journey time and departure time, or can be nested within journey time, number of revenue stops can again be modelled as a nest within journey time. Thus, Indian Railways can fix price limits based on the amenities provided like, journey time, departure and arrival times, stops and pantry service.

C. *Model Construction*

This is just a general framework. Over the years, researchers have tried different techniques and algorithm designs to solve the problem.

1. The whole algorithm is mainly constructed in terms of revenues and expenses for the company. The revenue obtained from the amount charged for the products sold over the cost of providing the products is generally, what the final objective function is.

2. Nowadays, the objective function is written in such a way that it feeds back into itself (closed form), rather than an open form. This makes the model aware of the state of the system across time, and space (capacity). The past decisions taken by the model have an impact on the current state of the system, along with external changes (the time, capacity, demand, nests, etc.). Therefore, there is a growing trend to write objective functions such that they resemble Markov decision process.

3. There are constraints on the objective function to keep it from going off proportions and charge a large amount for basic service. Maximum and minimum fares are constraints, but there are others as well. For example, the products sold at a given price are (usually always) constrained, the time for which products are on sale are (again usually) constrained.

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4. Depending on the decision variables used in the objective function, the result of maximizing the function will yield the optimal values for either the price to charge the customers or the products to offer them or both.

5. The outcome from the model may either be directly usable or not. It depends on what is returned. If probabilities for the decision variables are returned, then they need to be converted to actual applicable numbers.

6. Frequency of model runs needs to be taken into account. This model needs to be run periodically to be dynamic. Ideally, the model runs every time a new arrival occurs. However, it may not be always possible (especially when people try to book tatkal on a favourite train during holiday season), and that needs to be taken into account when building the model.

IV. HOW DOES INDIAN RAILWAY DO IT DIFFERENTLY

To start with, it does not provide any extra benefit to the customers. Here the low fares are still equal to the regular fares that mean the travellers get no advantage. The argument put here by IR is that the regular fares are already below par. However, these fares are refundable which means this dynamic pricing cannot guarantee hundred percent occupancy.

What's the other side? Defence of interest is particularly expected to take care of the mismatch between supply-demand. Since refunds are almost full and overbooking is wild. Trains with waitlisted tickets some of the time have reservation as low as 60%.

Revoking the Ticket Deposit Receipt, at the time of not being able to undertake the journey is submitted, has been a logical step to obtain a refund.

Secondly, what dynamic pricing model of railways does is directly increase ten percent fares after every ten percent tickets are sold. This ignores the important factor of demand and is strictly against the basic idea of dynamic pricing.

Thirdly, after every ten percent tickets are sold the prices only go up and not down. They assume the fact that every time the demand will more than the supply. This may not hold true in case of Premium fares. This may result in seats remaining vacant and defeating the purpose of dynamic pricing

Here the difference between regular fares and premium fares is not due to demand but is according to the quotas fixed. The reasons behind this can be:

1. Citizens have taken Railways for granted just like any other Government Institution, any changes made to these institutions is like taking away the fundamental rights of the citizens.
2. The other reason can be as Railways being a Government Institution the employees here feel they are not answerable to anyone for the loss of revenue or for any seats that went unsold.

Example

We have taken an example to run the model

Indian Railways has decided that they will increase 10 percent fare over sales of 10 percent of seats. Price ceiling to be 150% of the basic fare value.

Therefore, we have come up with a formula to calculate how much surge price one will have to pay. The formula is

$(1.1)^{x}$ *base fare

Where x is the greatest integer function of the percentage of tickets sold divided by 10.

For example, let us take base fare as Rs. 100 for a particular class of ticket on a normal working day.

Here is a table that shows how much it will cost

Percent of Ticket Sold	**Total Price To Be Paid**
<10%	100
10<x<20	110
20<x<30	121
30<x<40	133.1
40<x<50	146.41
50<x<60	150
60<x<70	150
70<x<80	150
80<x<90	150
90<x	150

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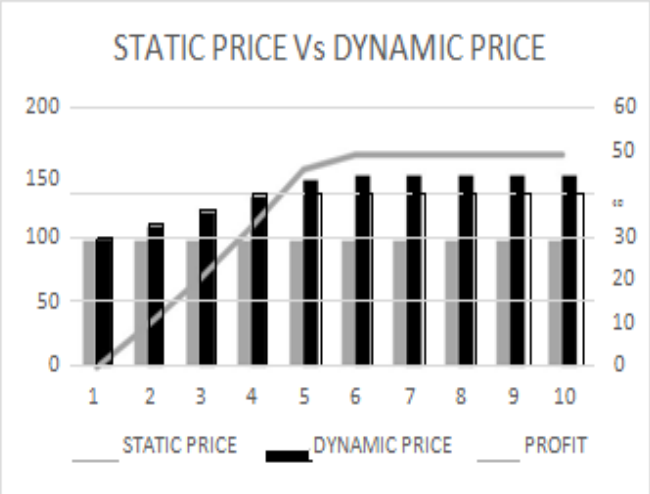
Here is the graph that compares both static and dynamic price



V. WHAT INDIAN RAILWAYS SHOULD LEARN FROM OTHER SECTORS?

The initial step is to present non-refundable discounted prices. Report this move, yet don't reveal the quantity of seats in this bucket. Aircrafts don't uncover their estimating price structure. Indeed, even Air India doesn't.

Individuals from the lower-middle class who travel long distances for holidays (rare travel) will be immensely profited. This is because their trip designs are for the most part certain and they can exploit the profound markdown tolls. Including the no discount statement likewise lessens fake booking by touts.

It is important to present in part refundable discount fares. Discount rules must be stringent than normal charge class, however tolerant when contrasted with profound rebate tolls.

IR needs to present dynamic bucket assignment. They need to embrace the dynamic estimating model completely and not piecemeal. It should be presented over every single express prepare, in all classes, not for a couple of months, but rather for an entire year.

Removing of quotas should be the first step. If necessary, coupons or vouchers must be presented. Each quantity is a spillage that should be stopped.

The initial two stages help in concealing occupancy issues and appeasing the majority. The following two stages help in gathering the income required for future investments.

Obviously, we should request that Indian Railways cut expenses and oversee itself even more proficiently. Nevertheless, that is an alternate subject, requiring an alternate article.

VI. HOW DOES DYNAMIC PRICING BENEFIT INDIAN RAILWAYS

Despite the fact that the advantages for this estimating for travellers are very little at show, it might be a need considering the horrifying states of the railways. Portions of the circumstances, which require this progression, include:

The Railways have experienced low venture for right around 10 years now. The funds in this part have been lastingly low because of all cargo profit being redirected to giving endowments to travellers. The evaluated misfortunes per annum have been Rs 30,000 crores.

The move wouldn't influence the travellers, as it were, as these are expected just for the few trains conveying travellers of higher financial status. In any case, not doing as such can influence the railways truly.

In the past few years, one has caught wind of a few grumblings with respect to the states of railways nourishment, sanitation, cleanliness and so on. On the off chance that these are to be kept up, the railways spending plan must be expanded to some degree.

VII. CONCLUSION

Running the model is like a nightmare as it takes into consideration lot of variables and railways is the one of the most important factor in running an economy. The basic idea of the algorithm is to find the sweet spot. If they charge too much, they will lose potential customers. If they charge too little, they may be able to fill up the seats, but the profit margin will be thin (worse case, they end up making a loss). Indian Railways model may never hit the upper limit because it is for the people and it is a government owned entity. Even though there are shortcomings and inefficiencies, in the model, it is a great step for the betterment of the Indian Railways and it is high time people stop taking it for granted. With more revenue coming in it will offer better facilities and service to the passengers.

VIII. SCOPE OF FURTHER RESEARCH

Base fare algorithm can be developed which can help to calculate the price one has to pay with just the distance between two junctions and number of tickets sold.

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