

Maximising Revenues in the “Tatkal” Category of Indian Railways

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Abstract— The “Tatkal” category of tickets in India generally helps last minute travelers to book railway tickets by paying a premium price. The Indian Railways recently made changes to the Tatkal Category of Tickets.

A system of dynamic pricing was introduced wherein in some specific trains, 50% of existing Tatkal Quota of tickets shall be earmarked for a new category called “Premium Tatkal”. Premium Tatkal works on a dynamic model, where the prices of the tickets increase as the demand for them increases (Similar to Flight ticket pricing).

Two criticisms exist about the current pricing scheme of premium Tatkal tickets. Firstly, there is a view that many trains do not run to full occupancy due to the exorbitant prices charged. Secondly, even in the revenue front, due to poor occupancy levels, there is a big scope for improvement.

Our paper focuses on designing a new pricing scheme for this dynamic category of tickets so that Revenues can be maximized (which in our case also means a significant improvement in occupancy levels).

The demand data is estimated for one particular train, after which an optimal pricing scheme is determined for the same using Linear Programming. We found a potential revenue increase of about 30%.

This methodology can be easily generalized for each and every other train operated.

Keywords— Indian Railways, Optimization, Linear Programming, Dynamic Pricing

I. INTRODUCTION

One is allowed to reserve his/her tickets in the Indian Railways around 4 months before the actual departure of his/her train. To help last minute travellers, the Indian Railways has a scheme called the “Tatkal” scheme. Through this scheme, a portion of the total number of seats is opened for booking only one day before the departure of the train. The fare for the Tatkal ticket is much higher than that for a normal ticket.

Recently the Indian Railways introduced the concept of premium ticket pricing, which is the model used by airlines in their pricing methodology. By this concept, the ticket prices increase as the number of tickets sold increases. The Indian Railways earmarked half of the total tickets in the Tatkal scheme for a new quota which they termed “Premium Tatkal”. This new quota is available in specific trains.

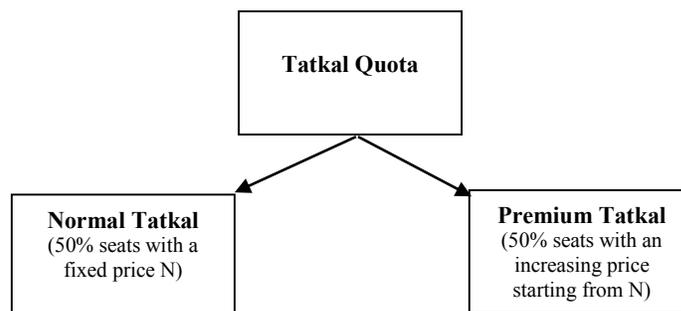


Fig. 1. Some Trains have a premium Tatkal quota carved out of the existing Tatkal quota

In addition to these, the Indian Railways has started to run special trains whose ticket prices fully follow the variable pricing model based on demand. It is thus imperative that the Indian Railways adopt the most optimal pricing scheme so as to obtain the highest revenues as well as improved occupancy rates.

In this paper, we get to the core of the pricing problem and provide ideas towards obtaining specific optimal pricing schemes for various trains.

II. THE PRESENT PRICING SCHEME

Presently for premium Tatkal tickets, after every 10% tickets are sold, the base ticket rates increase by 20% subject to maximum price cap. Typically there exists 10 different price slabs with ticket prices increasing by 20% between each slab. The initial 10% of the tickets are at the same price as the normal Tatkal quota tickets. As we reach the next slab, ticket prices increase by 20%.

Two problems exist for this scheme. Firstly, we find that the ticket prices in the last few price slabs are exorbitantly high. In our researches, we found that these highly priced tickets are rarely purchased by travellers. It is only in times of festivals and holidays that people find it reasonable to shell out the high prices. As a result, the revenues take a hit as these vacant seats will either remain vacant or are provided for waitlisted passengers of the General quota, who pay much less for a ticket. The second problem is an interconnected one. Occupancy levels drop leading to overcrowding in other trains (without premium Tatkal option).

It is worth noting that the pricing scheme appears to be entirely arbitrary without any rationale towards maximising revenues. It does not come out of a simulation run based on demand data (or estimate of demand data).

III. DEVELOPING A NEW PRICING MODEL

We would like to maximize revenues. Therefore our objective function is quite clear. We would have to determine the number of price slabs as well as the different prices at those slabs. Ideally we would like to have as many slabs as there are number of tickets allotted for the premium quota. In other words, after every ticket is booked, the prices should increase. However such a scheme may be practically unviable given that a certain level of transparency and clarity is required for a public organization like the Railways in India. We would need to obtain a balance between the most optimal pricing model and that which is practically viable.

The second concern is that this optimization process needs to be taken at the individual train level. This is because the demand patterns of various trains are different. Therefore different price slabs may be required for different trains. The computational capabilities shall have to be ascertained before proceeding by this route. Similarly, will having different pricing models for different trains be appropriate when a certain level of transparency and clarity is expected in the pricing methodology?

However in this paper, we lay out the procedure for developing the new pricing model assuming a certain number of price slabs. The pricing scheme adopted here is different for different trains.

A. Estimating the Demand function

The demand function represents the demand at various ticket prices. The Indian Railways has details about the demand patterns at various price points through data obtained about number of tickets booked in the premium tatkal quota. However the chief difficulty here is that the demand data is constrained. What does this mean? The ticket prices increase from one price slab to another. Therefore the number of tickets booked in the second slab should also contribute to the demand at the first price slab, since a person booking a ticket at the higher slab would automatically book it at the lower slab. However as there are routinely vacant seats, one is unable to ascertain the exact demand at a particular price slab. Various algorithms can be used to perform the unconstraining process. These are easily cited in literature [1] [2]

We could also make one or two assumptions about the shape of the demand curve, and then using a few data points estimate the demand at various prices. For example, we can easily predict the demand at the base price. For this we can compare our train with another similar train in the same or slightly different route which does not have the premium tatkal quota. For that particular train, we can estimate the demand for normal tatkal tickets (which is the base premium tatkal price too). From this information we can clearly get the demand at one price point. We could also see that the demand would fall to zero at some point as price of the ticket increases. This is true through out the year, except during times when there is a spike in the demand. From these two demand points, we can roughly estimate the demand pattern.

Other means such as data mining, 'willingness to pay' surveys, comparative options available etc. can also be used to estimate the demand. One innovative way to use data mining for this purpose will be by using a neural network which learns on new data (here the new data could involve a new pricing scheme and the revenues obtained therein). By learning on new data, we can effectively tune our pricing scheme based on the new information and move towards achieving the maximum revenue. But it has

to be emphasised that even any basic optimization based on the demand pattern improves revenues significantly on account of the number of empty seats in the present pricing scheme.

B. Optimization and Determination of the new pricing scheme

Once this demand data is determined, it becomes a optimization problem. Our objective function is to maximize revenue. The constraints are that at every price point, our demand should be higher than what we allocate in terms of number of seats for that pricing point. This is to ensure that no seats go vacant. We can work this problem for varying number of price slabs, or even allow the system to determine the number of price slabs as required.

The solution would thus be an optimal one where each price point is determined by the demand at that point. In other words, the willingness to pay (of the consumers) determines the price point.

IV. AN EXAMPLE: IMPROVING REVENUES OF TRAIN NO. 12661/2 POTHIGAI EXPRESS

We adopted the above procedure and determined an optimal pricing scheme for Train No. 12661/2 Pothigai Express running between Chennai and Sengottai in Southern India. This is an overnight train running all days in a week. Premium Quota was introduced in this train some time back. We perform the optimization process for two classes within the train namely Sleeper and Third AC. Ten different pricing slabs exist for the train. We show three of them to emphasise the present methodology where the base prices increase by around 20% for the next slab. It is important to note that by the way the system has been designed, a logical individual would go for premium tatkal quota only after exhausting the normal tatkal quota. Thus in the table below, number of tickets sold include the ones sold by normal quota too.

TABLE 1. EXISTING PRICING MODEL

Class	Number of Tatkal Tickets Sold	Price (Rupees)
Sleeper	130(Min)	490
	195	925
	259 (Max)	1140
Third AC	40 (Min)	1280
	70	2950
	80 (Max)	3425

We compared this train with Train No. 12631/2 Nellai Express running along almost the same route. This train did not have premium tatkal quota and thus provided a suitable comparison to estimate demand data at various price points. We found that for Nellai Express, the tatkal quota in sleeper class routinely got filled up and even entered an average waiting list of 5. If we assume the same works for Pothigai express, one can estimate the demand at the base price point. Similarly it was found that above Rs 940 for Sleeper class, the demand fell to zero on most days. We similarly compare the demand data for Third AC class. The data can be summarized in the table below. The inherent assumption while proceeding by this methodology is that the demand pattern is linear. This assumption is admissible right now as one can always use data mining to alter the pricing scheme based on new data if required.

TABLE 2. ESTIMATING DEMAND

Class	Price (Rupees)	Demand
Sleeper	490	264 (259+5)
	925	0
Third AC	0 (Min)	1280
	30	2950

Once this demand has been estimated, we used linear programming to identify the ideal pricing methodology. We carried out the process by fixing the number of slabs at 5, 10, 20 and then carried out the optimization process. As expected, the pricing scheme with 20 slabs was the most optimal followed by 10 and then 5. This is logical as if we increase the number of slabs, we can discriminate and gain most from the different ‘willingness to pay’ of different customers. We present our findings for the case with 10 slabs as this is what the Railways employ presently. We also recommend that the Indian Railways do away with the Normal tatkal quota and use variable pricing for the entire pool of tatkal quota. Our pricing scheme is as follows.

TABLE 3. NEW PROPOSED PRICING SCHEME

Class	Number of Tatkal Tickets Sold	Price (Rupees)
Sleeper	0	496
	130	667
	259 (Max)	880
Third AC	0	764
	40	1352
	80 (Max)	1852

The pricing scheme can be presented as a chart shown below. To emphasise, it can clearly be seen that the entire tatkal quota is priced variably.

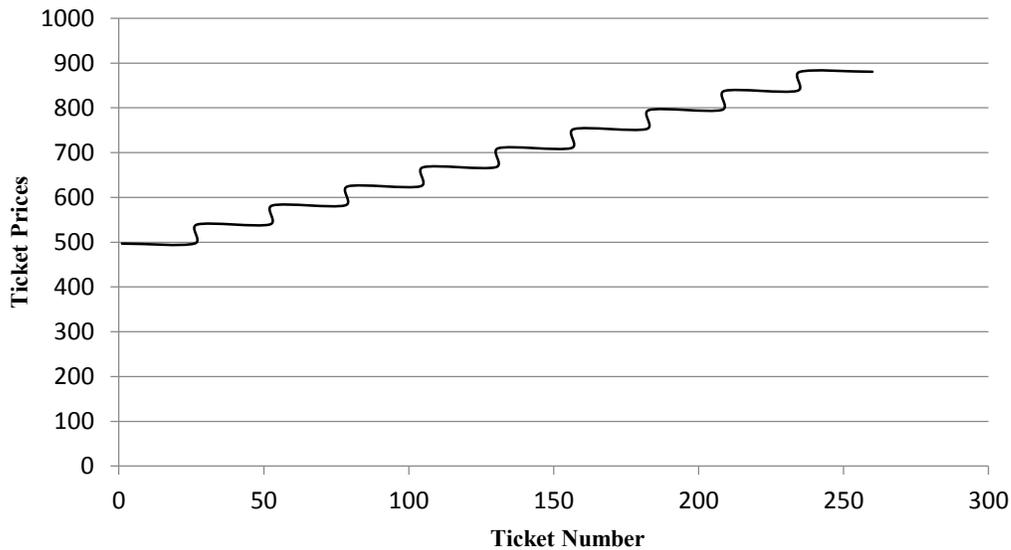


Fig. 1. The New proposed pricing scheme for Sleeper Class

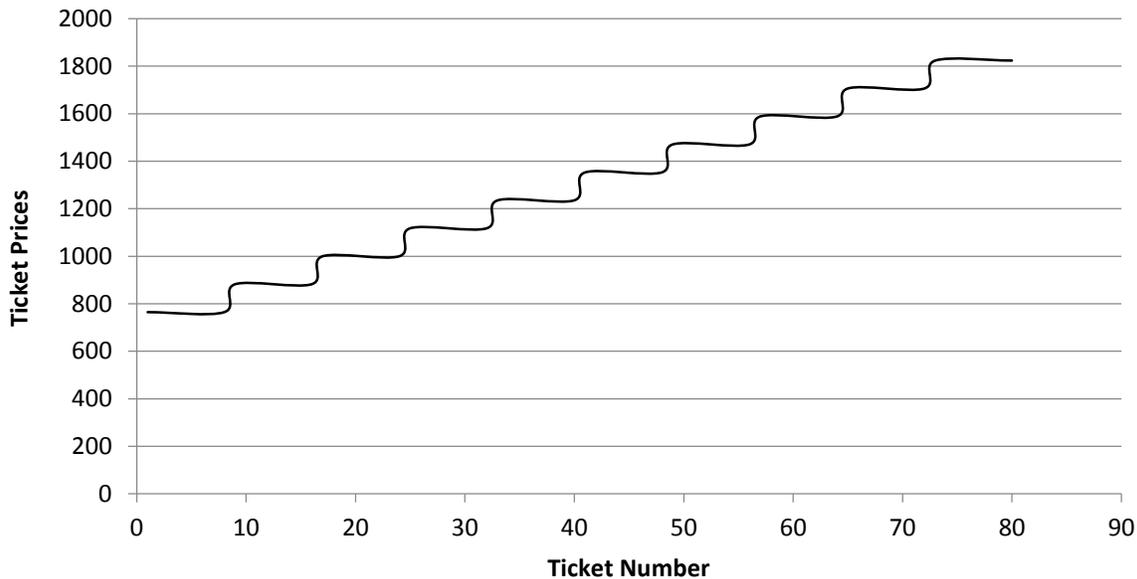


Fig. 2. The New proposed pricing scheme for Third AC Class

By adopting this new model of pricing (with the same 10 slabs) we found that the revenues increased by around 29.5% for Sleeper class and by around 7.4% for the Third AC class.

V. CONCLUSIONS

The new pricing scheme prices erases the distinction between normal and tatkal quota and prices the entire tatkal quota variably. This greatly improves revenues and occupancy rates. It also helps to remove the impression that variable pricing involves charging exorbitant pricing. The new prices are far lower than the old ones and in many ways helps to bridge the deadweight gap where neither is revenue earned nor is there customer satisfaction (due to empty seats). Indeed higher prices also cause discontent among travellers as huge differences existed between the prices of Normal Tatkal and some Premium Tatkal tickets. The new methodology bridges this discrimination in a small way. We can always look at using more sophisticated techniques once we get real-time data on the performance of the above pricing scheme.

This methodology can easily be translated to hundreds of other trains improving the efficiency of the Indian Railways. The beauty of this approach lies in the fact that we can have both improved revenues and satisfied customers and all this by merely altering the pricing scheme within the existing 10 slabs of ticketing.

REFERENCES

- [1] Zeni, Richard H. *Improved forecast accuracy in revenue management by unconstraining demand estimates from censored data*. Diss. Rutgers, The State University of New Jersey, 2001.
- [2] Orkin, Eric B. "Wishful thinking and rocket science: The essential matter of calculating unconstrained demand for revenue management." *The Cornell Hotel and Restaurant Administration Quarterly* 39.4 (1998): 15-19.

BIOGRAPHY

Vivek Sundar Magesh is an MBA from the Indian Institute of Management at Tiruchirappalli, India. He is presently employed at TVS Logistics Services Limited. His interest areas are in developing better public systems and tackling global problems using techniques from Management Science. He also has an Electrical Engineering degree from the prestigious National Institute of Technology at Tiruchirappalli. As an Engineer he has published papers on optimization using heuristics. He looks forward to researching about improving public systems to tackle global challenges by joining a doctoral program in a reputed global business school.