# Modelling sequential ticket booking choices during Chinese New Year

中国春節におけるチケット購買行動の動的モデル構築

高 宇涵*
Yuhan Gao

*交通マネジメント工学講座 交通情報工学分野

## 1. Introduction and objectives

The Spring Festival travel season is a time period of extremely high travel volume around the Chinese New Year. Most of the trips are long distance, between the coastal urban areas to the inland rural areas. The current transportation systems in China cannot fully meet this extremely large demand, thus a series of traffic as well as social problems are emerging. Tickets for popular routes are sold out within seconds at the released time. To reduce the risk of failing to get a ticket, people often take alternative plans after booking failures instead of giving up travelling. Thus the booking behavior can be seen as sequential choices. This study aims at modelling the sequential booking choice behavior during Spring Festival, investigating behavior changes after experiencing booking failure, and providing some suggestions for current ticketing policy.

## 2. Decision making process and resulting survey

A survey is conducted with the purpose to establish a discrete choice model that reflects decision making under extreme capacity shortage. Based on ticketing policy for the Spring Festival travel season the choice process of an individual is depicted in the flow diagram (Figure 1). The figure describes people's decision making process within each day and from day to day when aiming to buy tickets. *t* is 30 days before each travel day when train tickets become available; $U_{kt}$ is the utility of option *k* on day *t*; $W_t$ is the utility of not buying a ticket on day *t* but waiting instead for tickets on day *t*+1; superscript (*n*) denotes the order of each option *k* in the descending order. While planning travel for the Spring Festival, individuals determine the acceptable departure time period, rank the preference to transportation modes, and then attempt their favorite choice. If the tickets of the first choice are sold out, individuals may change to an alternative plan, or decide to stick to their favorite travel mode and wait for another set of tickets becoming available on the next day. Individuals make decisions on each day when tickets of their acceptable time releases.

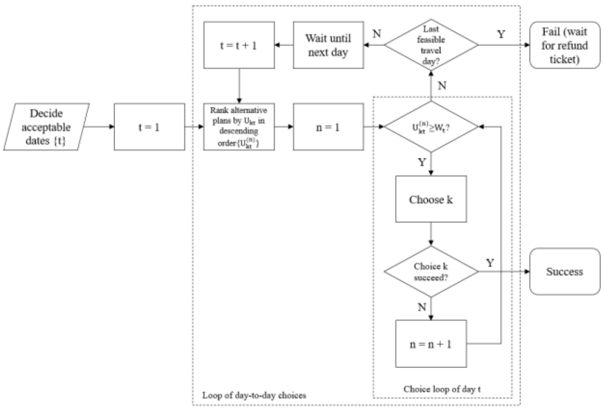


**Figure 1: Proposed choice sequence for buying tickets during spring festival travel season**

An online survey as is created where the respondents are given a scenario as in Figure 2 with presumed origin and destination as well as 4 alternative travel modes which allow the respondents to project themselves into the situation of booking tickets for long-distance travel in the ticketing peak of the Spring Festival. The respondents are asked to answer the questionnaire considering their current living circumstances, including family and financial situation. In addition, loop questions in line with Figure 1 are used in the survey to capture the choice sequence for investigating how people change their behavior after experiencing failure in ticket purchases.


**Figure 2: The Scenario given to respondents**

Based on the survey data, HSR is found as the most preferred choice in the survey scenario. Dominant transitions between the first three levels are concluded in Figure 3.

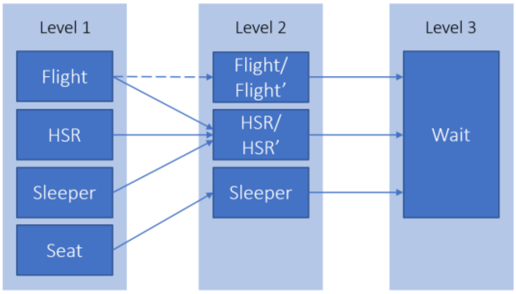


**Figure 3: Dominant transitions**

## 3. Modelling the sequential choice

This study focus on the first two level of people's sequential choice behavior when booking tickets for Spring Festival rush season. The basic idea of sequential choice is that the decision maker does not consider the next choice until he/she knows the result of the current choice. In other words, when determining current choice, the decision maker takes the result of previous choice into consideration. A separated two-level sequential model is introduced. The decision making in each of the level is modeled by multinomial logit (MNL) model.

The level 1 of the sequential model is also a MNL model for the first mode choice among Seat, Sleeper, HSR and Flight. The estimation result of the level 1 model is presented in Table 1

**Table 1: Estimation results: level 1 model**

| | HSR | Seat | Sleeper | Flight |
|---|---|---|---|---|
| ASC | ref. | 1.29 | -1.17 | -2.81*** |
| Income | ref. | -0.212 *** | -0.0255 * | 0.00896 |
| Income dummy | ref. | 2.61 ** | 1.17 1.68* | -0.0993 |
| Monetary concern | ref. | 0.114 | 0.544 *** | -0.681 *** |
| Time concern | ref. | -0.602 *** | | 0.532 *** |
| Comfort concern | ref. | -0.831 *** | -0.14 | 0.429 ** |
| Gender (female) | ref. | -0.742 | ref. | ref. |
| Married | ref. | ref. | -0.669 ** | ref. |
| With child | ref. | ref. | ref. | 0.699 ** |
| Perceived risk | 0.369 *** | | | |
| Sample size | | | | 452 |
| Init log likelihood | | | | -626.605 |
| Final log likelihood | | | | -389.136 |
| Rho-square | | | | 0.379 |
| Adjusted rho-square | | | | 0.345 |

The level 2 model is generalized from the original sequential choice structure. The generalization is reasonable for simplifying the excessive choice brunches caused by multi-level choice. Shown in Figure 4, after the simplification, in each level since level 2, the universal choice becomes same, which are Up, Stay, Down and Wait. The estimation result for level 2 model is presented in Table 2.

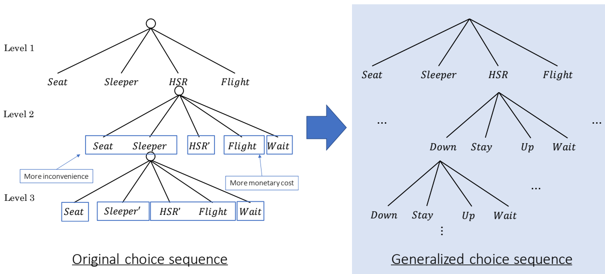


**Figure 4: Sequential choice generalization**

**Table 2: Estimation results: level 2 model**

| | Up | Down | Stay | Wait |
|---|---|---|---|---|
| ASC | ref. | -0.046 | -2.37 | 1.49 |
| Eagerness to go home | ref. | ref. | ref. | -0.394** |
| Perceived risk for first mode | 0.198** | ref. | | |
| Income | ref. | -0.0668*** | -0.0421*** | -0.0657*** |
| Income dummy | ref. | 1.4** | 1.25** | 0.193 |
| Choice consistency | 1.23 *** | | | 0 |
| Familiarity to ticketing policy | ref. | ref. | 0.164** | ref. |
| HSR dummy | ref. | ref. | 2.01*** | ref. |
| Flight dummy | / | 1.01** | 2.75*** | ref. |
| Student dummy | ref. | 1.52** | 1.17** | ref. |
| Sample size | | | | 452 |
| Init log likelihood | | | | -592.659 |
| Final log likelihood | | | | -455.466 |
| Rho-square | | | | 0.231 |
| Adjusted rho-square | | | | 0.201 |

## 4. Simulation

Based on the estimation results from the 2-level model, two simulations are conducted. The first simulation aims at exploring the impact of HSR expansion on China society. The result of this simulation shows that if the railway route is under serious capacity shortage, then it is always good to add more HSR; if the capacity shortage is no that serious, too much HSR replacing normal trains will turn down the social utility since poor people cannot afford high price tickets. The second simulation explores if it is possible to make more ticket capacity for the low-income people. The result shows that by guiding other income group people to buy unwilling tickets, low-income people have higher chance to book cheap tickets instead of giving up. Moreover, both simulations show that people obtain more utility to get a ticket if known the success chance is low.

## 5. Conclusion

The study explores people's decision making behavior when buying tickets for long distance travel during Chinese New Year (Spring Festival) travel season, and how their perceived chance of getting a ticket changes, especially when their preferred traffic mode becomes unavailable. By basic analysis and modelling the sequential choice, how passengers manage the complex ticketing is studied. Their changes of the behavior after experiencing failure in ticket booking is investigated. HSR is the most preferred choice as expected. One of the important findings is that there seems to be a separated market for seat tickets. Most of the customers of seat tickets are in low-income group, whose booking behavior is found dominant by income factor. Also, the low-income group may suffer from HSR expansion since crowded out the capacity of cheap tickets. Furthermore, number of people who gain ticket can be increase at expanse of some social utility. Regarding the reliability of the booking system, the finding of when people already knew the system is unreliable, they will be happier for success can be concluded as perception of ticket availability effects utility.

**修士論文指導教員**

Jan-Dirk Schmoecker 准教授