Monte Carlo Simulation of the Daily Revenue of Champaign-Urbana Amtrak

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Scenario & Purpose

This project is aimed to simulate the daily revenue of Champaign-Urbana Amtrak for trains departing from Champaign-Urbana.

The revenue comes from selling train tickets and is determined by the number of passengers and their fares. Generally, Amtrak provides two categories of fares. One is business and another is sleeper. The sleeper provides sleeping accommodation and is usually chosen by passengers on a long journey. Fares are also affected by the travel distance. Moreover, Amtrak allows add-ons such as pets, bicycles and Golf Clubs for a fee.

Hypothesis

According to Transportation Research Board Report 95, the railroad fare elasticity (the percentage change in quantity demanded in response to a one percent change in price) is about -0.2. The elasticity indicates the rate of decrease in passenger number with increasing fare.

In order for Amtrak to increase its revenue, should it increase the fare rate to have more gain of a single ticket sold or decrease fare rate to attract more passengers?

Hypotheses 1

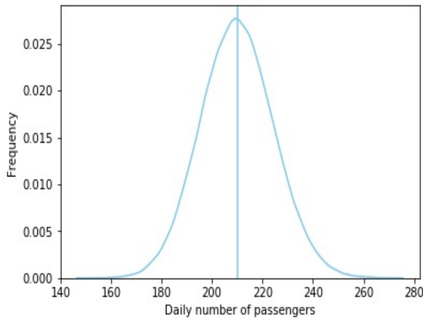
If the fare is increased by 10%, although the number of passengers will shrink proportionally, the total revenue will increase.

Hypotheses 2

Total revenue of increasing fare by 10% is larger than that of decreasing fare by 10%.

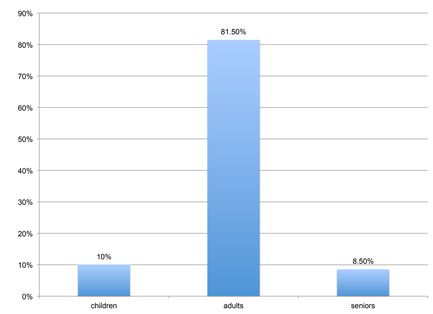
Simulation's Variables of Uncertainty

Number of passengers:



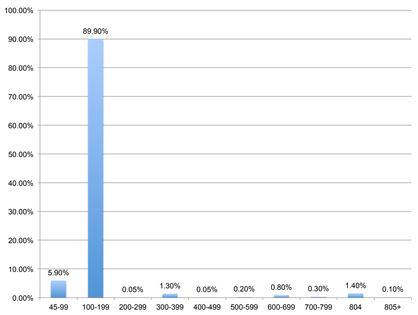
- *Daily passenger number is around 210*
- *Assume following Poisson distribution*

Age structure of passengers:



- *Randomly picked with probability of 10%, 81.5% and 8.5%, respectively*

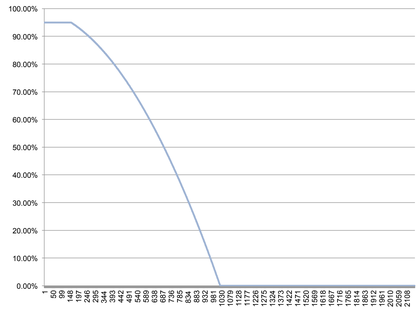
Travel distance:



- *Probabilities of each travel distance range randomly picked*
- *Uniform distribution within each distance range*

Simulation's Variables of Uncertainty

Probability of choosing business fare type:



- *Probability of choosing business fare type is decreasing with increasing travel distance*

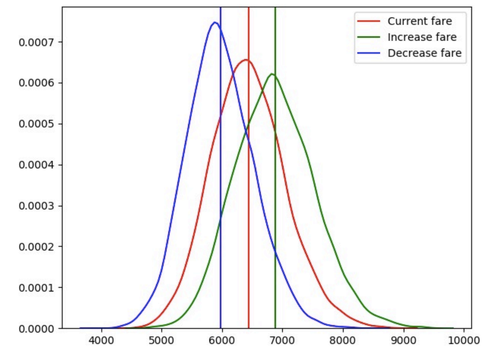
Add-ons:

- *Probability of each add-on randomly picked*
- *Add-ons are independent of each other*

Assumption

- The train will never be full.
- Only two types of fare available: business and sleeper.

Results



- Increase fare generates the highest revenue;
- Decrease fare generates the lowest revenue;
- The revenue from the current fare is somewhere in the middle.

Limitations and Future Work

- Travel distance should estimated by the distance among train stations.
- There are other types of fare, like saver fare.
- Refunds are not considered.
- Some of the train routine do not provide service for all of the three add-ons.
- The elasticity used may be out of date.

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