

An Analysis of Passenger Movement

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Introduction

California's airports are operating at capacity. Overcrowding and passenger delays have become the norm. In this study, we look at reducing the volume of air traffic at certain airports by using a high speed rail to move passengers from one airport to another in California. The study focuses on reducing the number of flights to airports that serve major metropolitan areas in California, such as Los Angeles, San Diego, San Francisco, though the use of a high speed rail system. The nodes are the airports in the domestic United States, and the edges will be the amount of aircraft that move from airport to airport. Each airport will have an initial demand amount, consisting of arrivals. Then, a model that uses the current system of moving passengers by commuter aircraft between the domestic airports will be compared with a model that uses a light rail system instead. The goal to see if this is possible, and how many flights would be eliminated, thereby making the Los Angeles Airspace less crowded.

In the model, High Speed Train systems are used to reduce load on west coast airports. We do this by reducing the percentages of flights into an airport on the west coast, assuming that the new High Speed Train System will pick up the slack.

Experiments and Methodology

A multi-commodity flow model is used to determine the amount of aircraft each airport can take. The model has the major airports of the Western United States as the nodes as well as three nodes representing the North Eastern, Mid-Western, and South Eastern airports. The routes connecting all of these airports are the arcs. Capacities of the airports are represented in the number of aircraft. This number is based on the average of the peak five days of operation of each airport over one year. The arcs connecting the airport have no capacity; they are set to a very large number so they do not limit the amount of flights that are allowed to pass through them. Supply and demand are set for each start and end at the airport using a formula that uses the populations of the cities that the airports reside in, and the distance between the airports. The perceived need to fly from one airport to another is figured in this way, assuming that the more people in a city, the more will have to fly. Since we are modeling a regional air system, the need to fly is inversely proportional to the distance between the two airports, forcing more people to use shorter flights if they are available.

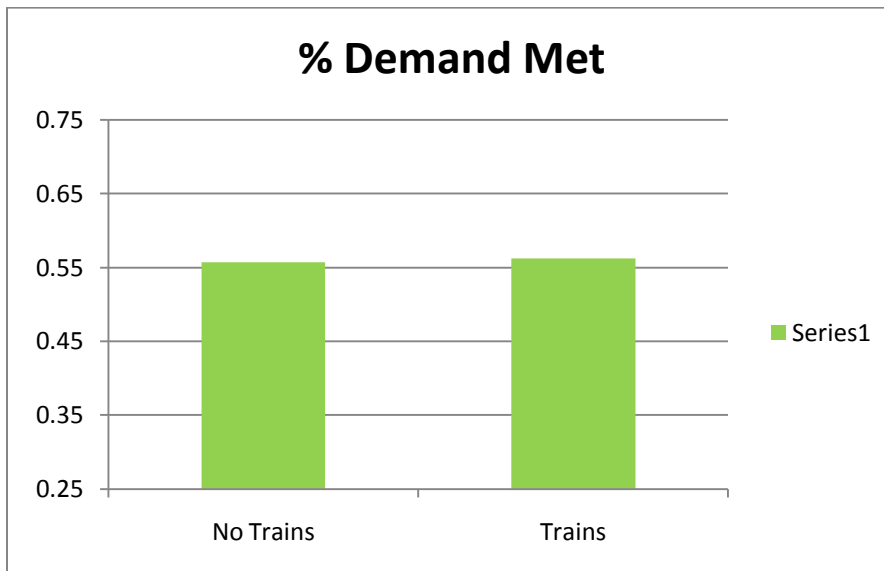
Once the regional air system is set up, we run it at peak capacity to find out exactly how many planes the system can handle. The model shows what airports do not have all demand satisfied due to the capacity constraints. To remedy this, train nodes are introduced, with a capacity equal to 450 (the Van Allen Institute) aircraft. The train nodes represent the extra capacity in a city that has a high speed rail system. These nodes are added to the problem, thus giving us the demand that is satisfied by

Airport to Airport Capacity Analysis

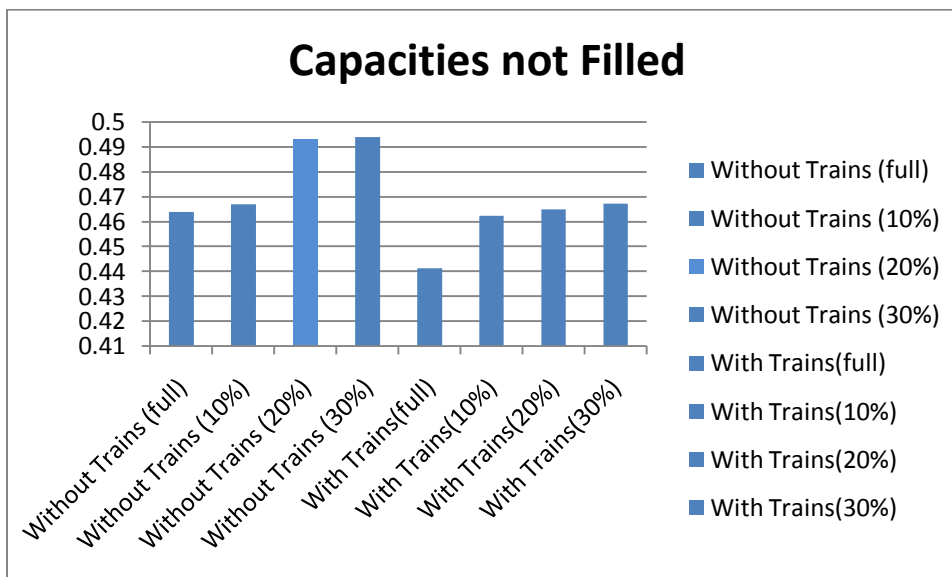
adding trains to the transportation system. Analysis is then done on the number of trains needed compared to the amount of reduced capacity desired at the airports.

Results

The first run of the model shows that the current airline system only handles %55 of the total demand, based on our assumptions. This first run has no trains assisting in the movement of passengers throughout the country. Trains are added in subsequent runs. The train nodes consist of San Diego, Los Angeles and Las Vegas. The train capacities amount to 450 flights per day per each airport. With the trains added, there is only a one percent increase of the demand met compared to when there are no trains in the transportation system:

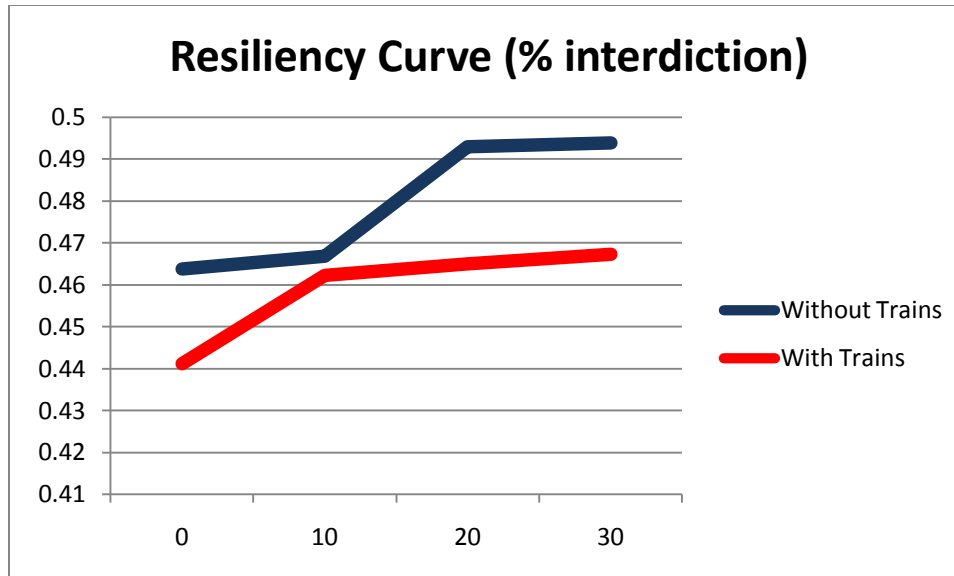


A bar chart showing the demand met by the airline system on its own (left) and the demand met with the combination of the airline and the train system. Not a very notable increase, but the data is based on a very large population.



Although the differences look small, remember that the effects are across the whole population of the United States. We are assuming they are all traveling for the sake of the model, which would not be the case.

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Resiliency curve showing the percent of the demand not met. On the bottom axis are the percentages of interdiction for all routes leading in or out of LAX. There is an improvement with the addition of the trains.

Discussion and Recommendations

According to the model, the billions required to build a high speed rail system might not be worth gaining a one percent increase in capacity. This might be a harsh statement, since the data is based on a large population factor. One percent of the entire population is a significant increase.

There are a few issues with this model, and a few things that could be attempted with more time and further research. A way to account for the affect car commuters turned train commuters would have on the capacities of the trains would be necessary. That is, space will be taken up on the trains by commuters who would not normally fly, and those individuals would take up some of the capacities on the trains. The flow calculated for the model is based on trade flow model that uses total populations of the cities and the distances between them, with a constant:

$$F_{ij} = G (M_i M_j / D_{ij})$$

While this is adequate to determine a ratio for supplies and demands, there are few problems with it. It assumes that all of the populations in the cities would want to travel, and that is not the case. Even though this number has been validated against the FAA website for relative values, it is not an entirely accurate representation.

The effect of a Nationwide High Speed Rail Network could be the next step in this research. Also, instead of expressing cost in time, the actual cost in dollars, either saved by the passengers, airlines, or made by other entities, could be computed. The data could be modified to support this effort.

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