Activity One: Establish the Design Criteria

Before the West Corridor transit system was constructed, it typically took people 30 minutes to drive the 20 miles from the Jeffco Government Center to downtown (Union Station area). The fuel economy of the average vehicle is 20 miles/gallon. In addition, the average commuter would pay $90/month for downtown parking.

1. Estimate the total transportation cost per month for a commuter from Jeffco Government Center to Union Station. Assume the following conditions:

1. One person per car
2. They drive 20 days/month
3. They would own their car irrespective of whether they commuted

Assuming $2.10 per gallon for gas, gas cost = 40 miles/day * 20 days/month * 1 gallon/20 miles * $2.10/gallon = $80.40

Parking cost = $90/month

Vehicle wear and tear = $100 to $300/month (estimate)

Total cost = Gas Cost + Parking Cost + Vehicle Wear

2. If you own the train system, how much would you charge passengers riding from Jeffco Government Center to Union station and back? Justify your answer.

Cost to drive car: $170 / 20 = $8.50 per round trip

Target = 50% of car travel cost = .5 * 8.5 = $4.25 for round trip ticket

3. What should the design travel time from Jeffco to Union Station be? Justify your answer.

Travel time should be ≤ travel time by car. The faster the train is in comparison to the car the more attractive the train will be to riders. The travel time by train should also include the wait time when comparing it to the travel time by car.

4. What should the maximum "wait time" at Jeffco be? Justify your answer.

The wait time should be ≤ about 5 minutes. People do not like to stand or sit at a station doing nothing for too long, particularly when they are rushing to or from work. The wait time will be included in the travel time by train, so an long wait time would have to be made up by a short in-transit time. However there are limits to how fast a lightrail train can travel safely.

5. What should the percent occupancy of the trains be from the perspective of a rider? Be sure to justify your answer.

Riders would like to have plenty of room to choose a seat and not feel crowded by other passengers. About 50% occupancy or less would be ideal for passenger comfort.

6. Given the criteria you have established for passengers in terms of travel time, wait time, and cost per trip, define what the criteria for operation should be from the owner's perspective. Be sure to explain your answers, not simply give a number.

Travel time:

The operators would like the travel time to be low, so that the system is attractive to riders. A 15 minute in-transit time would be considered reasonable.

Wait time at JeffCo or Union Station:

The wait time should be as close to 5 minutes as possible without going over. This way, fewer trains need to be run along the line, which costs the operators less.

Operational cost per trip:

Note: operational cost include debt repayment, maintenance, electricity, etc.

The operational cost per trip must be lower than the sum of the fares collected per trip.

Percent occupancy of trains:

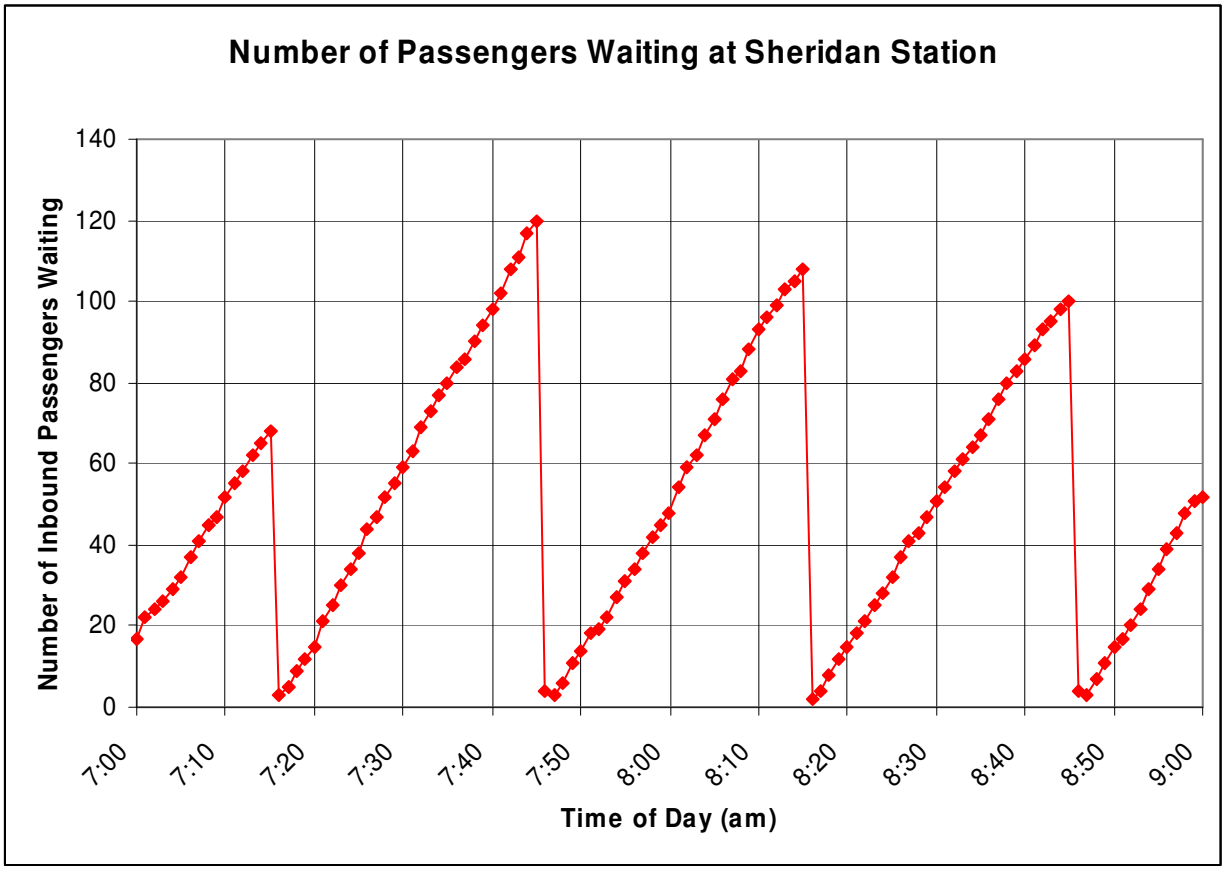
To maximize revenue per trip, the owners would like to have the trains as full as possible, but not so full that passengers are uncomfortable and cannot find a seat. A good target value would be around 90% occupancy.

Activity Two: Graphing the West Corridor Data

To identify problems that might exist with the current design of the system, it is helpful to plot important operational parameters in the form of graphs. These graphs will help you analyze the effectiveness of the west corridor system in meeting design criteria both from a passenger's perspective and an owners.

1. Using the grid below or your own graph paper, choose a station on the west corridor and plot the total number of inbound passengers waiting at that station versus the time of day over the 7:00am to 9:00am rush hour period.

Station Name: Sheridan



2. Answer the following questions. Please show your work.

What is the maximum waiting time at the station?

30 minutes (7:46 - 7:16)

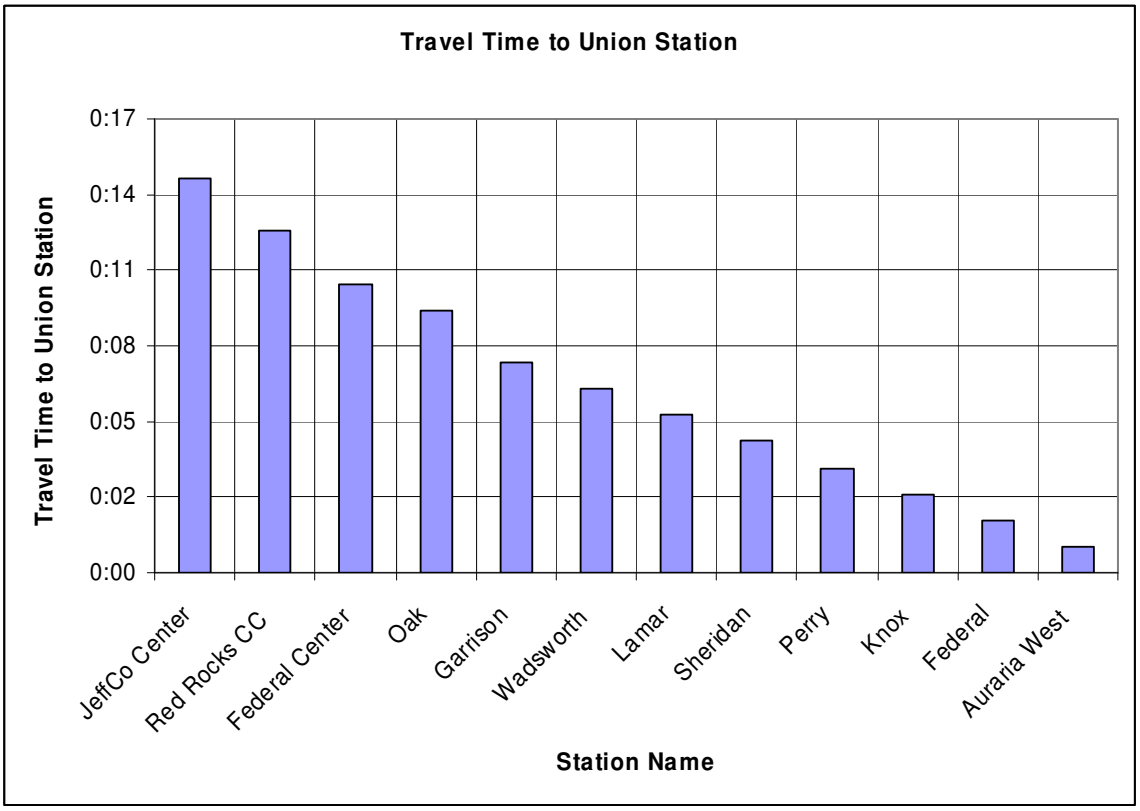
What is the average wait time?

Nearly the same

What percentage of passengers have a wait time greater than 5 minutes?

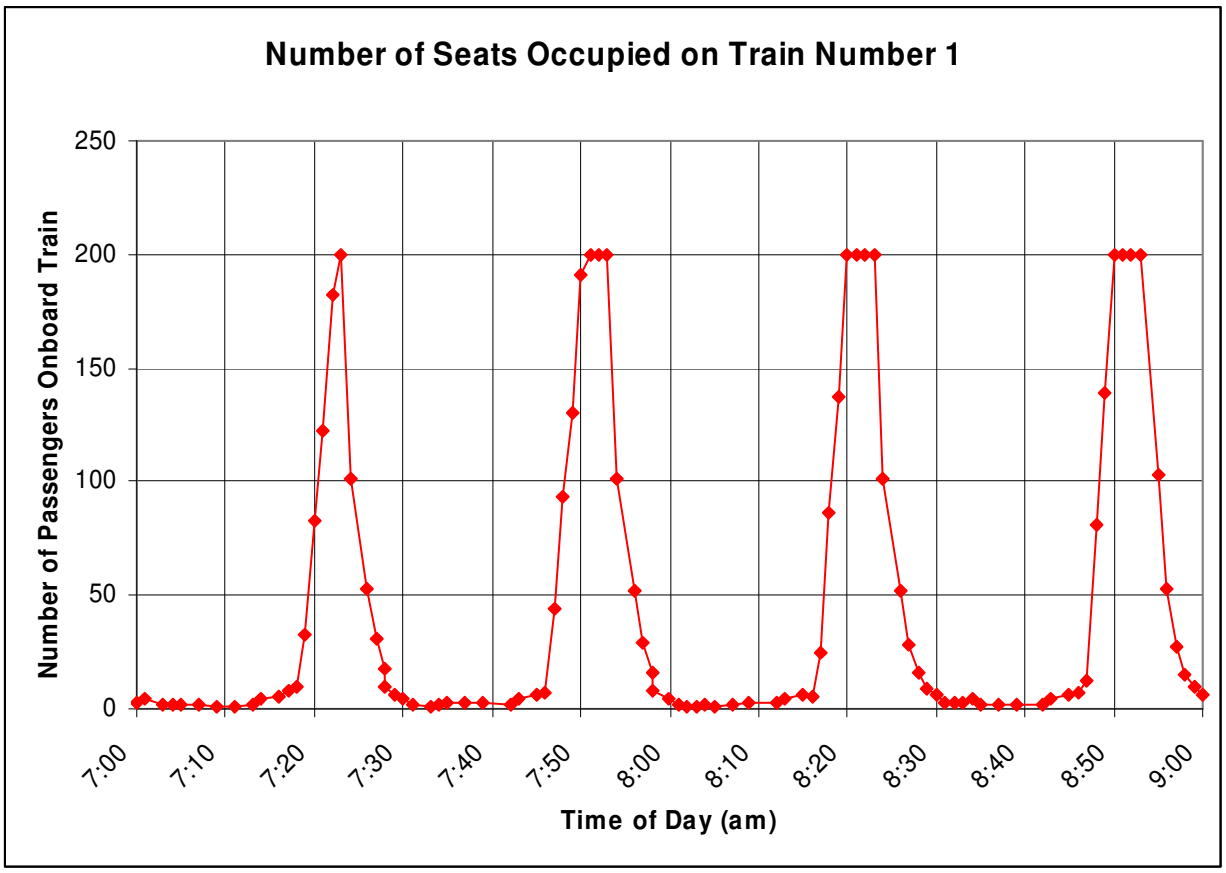
342 passengers wait for more than 5 minutes / 396 passengers move through the system during this time = 86.36%

3. Using the grid below or your own graph paper, plot the travel time to Union Station for each of the stations along the west corridor. (Hint: this information is actually recorded in the trains, not the stations)



4. Using the grid below or your own graph paper, plot the number of seats occupied in a train of your choosing versus the time of day.

Train number: 1



At peak time, what is the percent occupancy?

100%

At low time, what is the percent occupancy?

Around 3%

5. Answer the following questions. Please show your work.

What is the frequency of train arrivals at JeffCo Center? Does this frequency change throughout the day?

A train arrives at JeffCo Center every 29 minutes. (6:38 - 6:09 = 0:29)

No this frequency does not change during the day.

How many stops does a train leaving JeffCo Center make on its way downtown?

12 including Union Station

How many cars does a train going from JeffCo Center to Union Station have?

Does this change throughout the day?

Four trains capable of holding 200 passengers. No, the capacity does not change throughout the day.

Activity Three: Analyze the Data

An important part of a transportation engineer's work is to determine if a system is meeting the passenger's and owner's requirements, that is, the design criteria. The following questions will take you through an analysis of the system's performance.

1. Is the system currently meeting the design criteria for passengers? Why or why not? Specifically address the following:

Travel time:

Travel time is satisfactory. It only takes about 15 minutes to travel the entire length of the west corridor.

Wait time:

A train only arrives about every 29 minutes. This is not an acceptable wait time given the five minute design criteria.

Percent Occupancy:

At times, the trains are critically overloaded and cannot take everyone waiting at the station. This is uncomfortable and inconvenient for passengers.

2. Is the system currently meeting the design criteria for the owners? Why or why not? Specifically address the following:

Travel time:

The travel time is right on target for the owner's expectations.

Wait time:

The wait time is entirely too high according to the operator's design criteria. The operators need to add more trains to the line to get lower wait times.

Percent occupancy of trains:

The occupancy of the trains is very low most of the time. This makes the system very inefficient and costly to operate. To increase efficiency, each train should have more people aboard before it departs.

3. When is the system's ability to meet passenger needs being stressed the most? Why is this occurring?

The system is stressed most when rush hour occurs. Many people are showing up to the station, and the trains do not have enough capacity to handle the sudden influx of people. Some people are not even able to board the train because it is already full when it arrives at the station.

Activity Four: Improve the System

One of the most vital functions a transportation engineer performs is to recommend changes to the system design to improve performance and compliance with the design criteria. You should now be able to combine your knowledge of the design criteria, the systems current performance, and the weak points in the systems design to identify portions of the project that need improvement and suggest ways to solve these problems.

1. Identify the design criteria that are NOT being met by the current west corridor design.

An argument can be made that only the travel time is meeting expectations. All of the other design criteria are not being met.

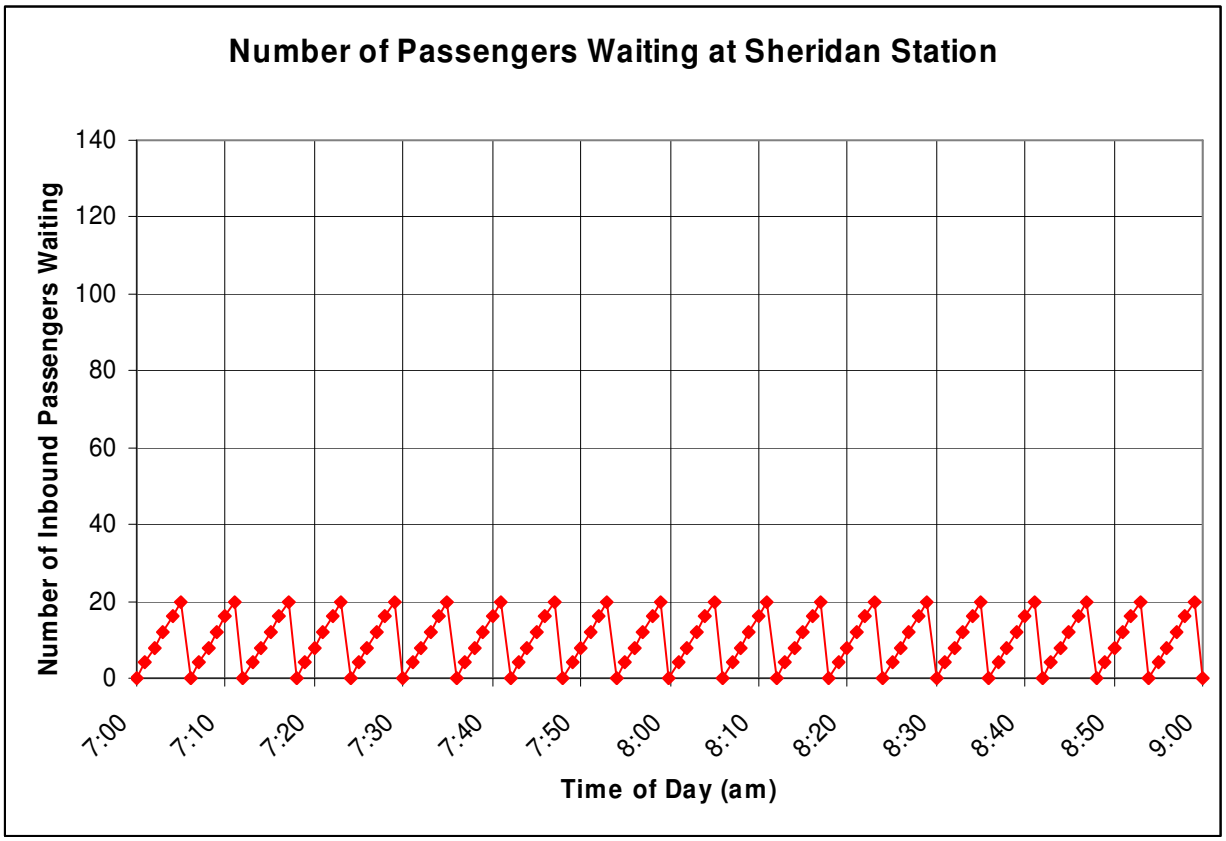
2. Summarize your suggested improvements to the west corridor system.

Increase the number of trains running on the corridor to reduce wait time and alleviate sudden surges in ridership during rush hour periods. These extra trains could be pulled off of the line when the ridership is low during off periods. Also, traffic during rush hour could be alleviated by expanding the capacity of the trains with additional cars. These cars could be dropped off during low ridership periods.

Test Your Solution:

3. Assume that you increased the frequency of trains to decrease the wait time at each station. Replot the data from activity two with the new wait time.

An example (answers could vary greatly on wait time chosen) :



4. Using the data from question three, plot the occupancy of a train (with your prescribed number of cars) traveling inbound during morning rush hour and outbound during afternoon rush hour.

An example: