

Introduction:

This lesson is a collection of four individual activities that will take you through the process of engineering improvements to a light rail transportation system. As you work through each activity you will develop the skills that real engineers use every day in their professional lives. In the first activity, you will examine a light rail system that is already in place and determine the criteria that will indicate whether the system is operating as it should or not. Then, in the second activity, you will graph the numerical data from the system visualize the condition of the corridor. After creating these graphs you will analyze the data to determine whether the system is meeting its design criteria. Finally, you will have the chance to suggest changes to the system and speculate on how they would improve the operation of the West Corridor, just like a real engineer. You will need access to a computer which has an internet connection to begin. Have fun!



NAME _____

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

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.

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



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

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

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:

Wait time at JeffCo or Union Station:

Operational cost per trip:

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

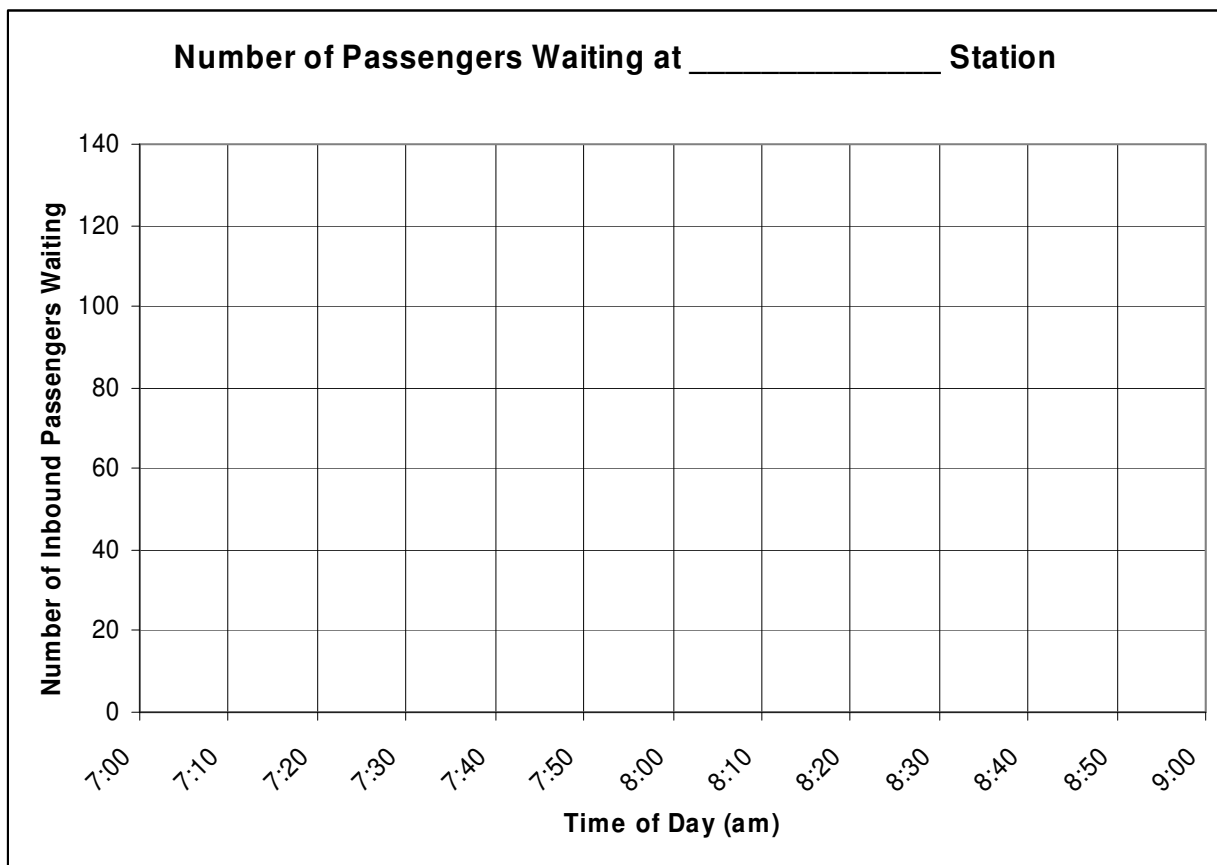
Percent occupancy of trains:

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 owner's.

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: _____





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

What is the maximum waiting time at the station?

What is the average wait time?

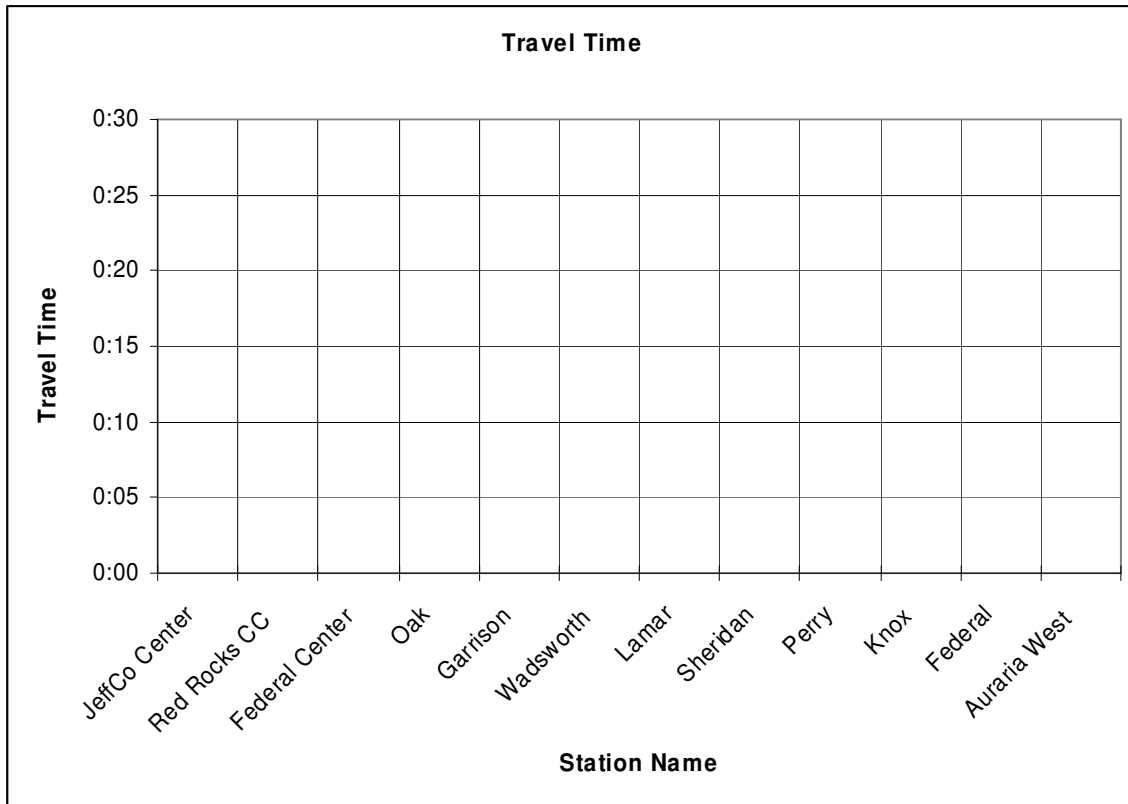
What percentage of passengers have a wait time greater than 5 minutes?

3. What is the standard deviation of the number of passengers waiting? What does this tell you about the variability in the number of people waiting at that station?

Improving West Corridor



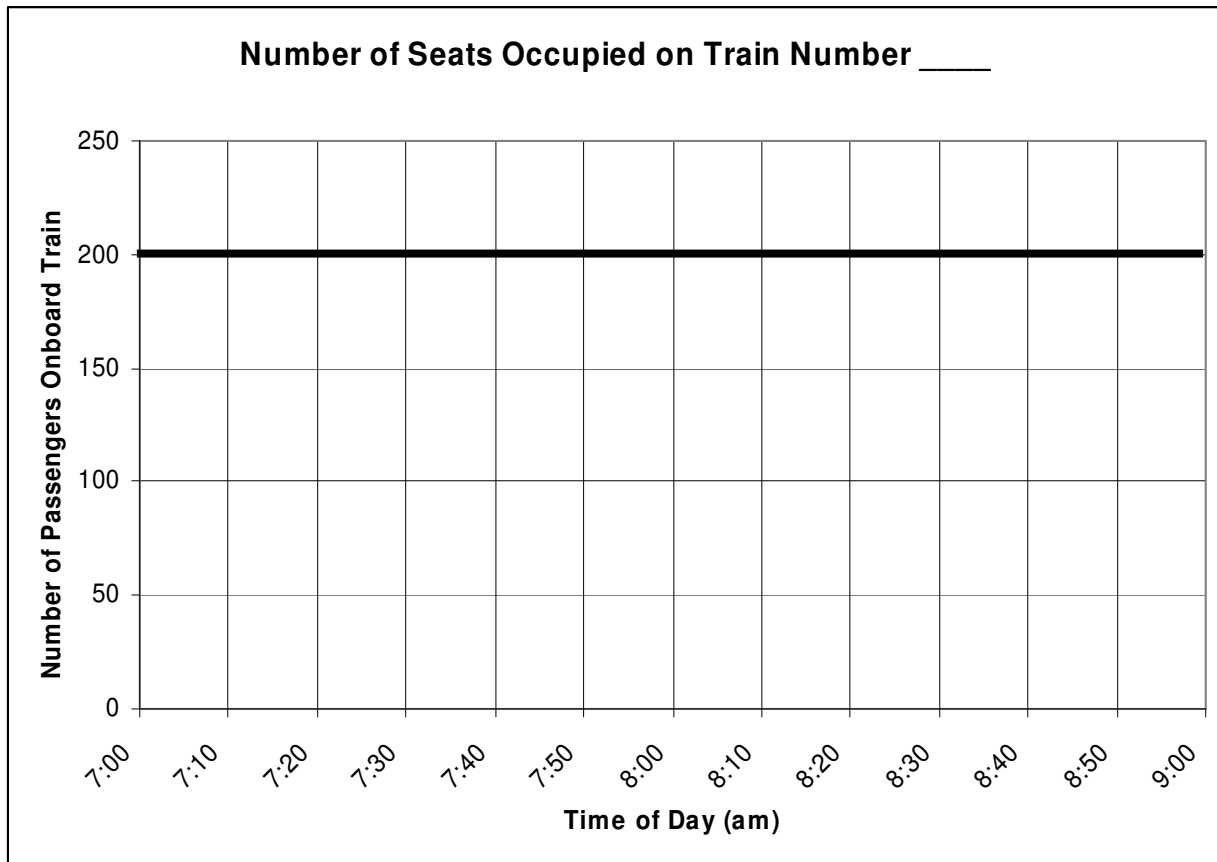
4. Using the grid below or your own graph paper, plot the travel time to Union Station for each of the stations along the west corridor. (Hint: this information is actually recorded in the trains, not the stations)





5. 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: _____



At peak time, what is the percent occupancy?

At low time, what is the percent occupancy?



6. 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?

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

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

Wait time:

Percent Occupancy:

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

Travel time:

Wait time:



Percent occupancy of trains:

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

Why is this occurring?



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.

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

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.
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.