

1.221J/11.527J/ESD.201J Transportation Systems

FALL 2001

FINAL EXAMINATION

(30 points)

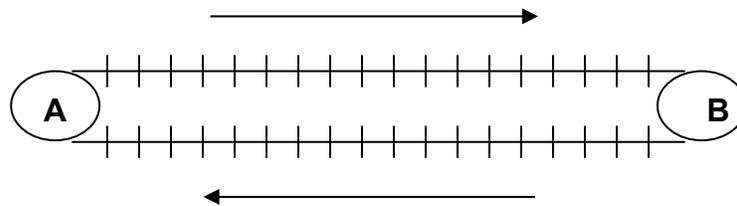
Thursday, October 25, 2001

3-5 p.m.

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QUESTION 1 (21 points)

Consider the following railroad network.



100 carloads of components are produced at A and consumed at B. Both production and consumption proceeds uniformly throughout the day. The producer and consumer are both the same company.

Rail service is available between A and B at a price of  $\$P$ /carload.

It takes 0.01 days to load and to unload a freight car. Work crews to perform these functions are always available.

The railroad is considering 3 options to serve this demand:

- 1 train/day carrying all 100 carloads
- 2 trains/day, scheduled 12 hours apart, each carrying 50 carloads
- 4 trains/day, scheduled 6 hours apart, each carrying 25 carloads

The distance between A and B is 960 miles and train speed is 40 mph = 960 miles/day

When cars are emptied at B, they are returned empty to A on the next train.

Everything in this system can be assumed to be deterministic.

Assume initially that there is no competitive service.

A. Identify the key LOS variables for interest to our shipper/receiver (limited to 4).  
(2 points)

B. Base Case -- No competition

Calculate the car-cycle (CC) and the number of cars (NC) needed to provide service for each of the three service options noted above. (2 points)

Which of these service options would the shipper/receiver (S/R) prefer and why?  
(2 points)

How would the railroad (RR) decide which service to operate? (2 points)

C. Competitive Case: Now, a trucking company enters the A-B market, providing some competition. In response, the railroad purchases new locomotives which will double the train speed to 80 mph.

Calculate CC and NC for the three service options. (1 point)

The RR is thinking about raising its rate per carload to help offset the costs of the new locomotives. Explain how the RR could estimate how much this new service would be worth to the S/R compared to the initial service. (2 points)

Explain how the S/R could estimate the difference in costs for the RR using these new locomotives, compared with the base case. (2 points)

The S/R recognizes this new service is an advantage but wants to continue paying \$P/carload. What might the S/R do to maintain the lower price? (2 points)

The S/R is thinking of doubling the size of its operation to 200 carloads/day. Discuss the possible negotiations between the S/R and the RR in this situation.  
(2 points)

D. Modified Base Case -- with competition

Now, we return to the original 40 mph/100 carloads/day situation, but with the trucking company now in competition.

Until now, all the cars have been returned empty to A from B. Suppose the RR has identified another customer with 50 carloads going daily from B to A. Load and unload rates are the same for this traffic.

Calculate CC and NC needed for this service for each of the three service options.  
(1 point)

How would the RR decide whether to accept this new business? (2 points)

You are the original S/R. What would you do when you learned of this potential new business for the RR? (1 point)

**QUESTION 2** (9 points)

Please read the following article and respond to the questions below.

The Metropolitan Transportation Authority Administration in New York City is facing a budget deficit and is looking for ways to eliminate that deficit. These include raising fares, reducing services or obtaining funds from elsewhere -- likely the U.S. Federal Government.

1. (3 points)

List the people, organizations and stakeholders concerned with the MTA's problem (no more than 5). In one or two sentences, suggest what their concerns are and how they might view the three options noted above.

2. (3 points)

Discuss this situation from the viewpoint of Key Point 22.

Key Point 22: Equilibration of transportation supply and demand for transportation service to predict volume is a fundamental network analysis methodology.

3. (3 points)

You are the chief advisor to the Chair of the MTA. She is about to go to Washington to ask for federal funds to help close the deficit without reducing service or raising fares. Write a one-page opening statement for the Chair to use in her testimony.

(modified from "Budget Woes of the M.T.A. Grow Worse", *The New York Times*, October 13, 2001)

**Budget Woes of the Metropolitan Transit Authority (MTA)**  
**in New York Grow Worse**

The terrorists' attack on September 11 caused immense physical damage to the New York City MTA's subway system. It will cost a huge amount of money to repair the damage.

As transit budget analysts in New York City and Albany (the capital of New York State) examine their balance sheets, it is becoming clear that the subway and bus system -- already in troubled financial territory before the attacks because of the weakening U.S. economy -- is facing the kind of money problems it has not seen in years.

And, short of extraordinary help from the federal government, the state or the city, transit officials might have to consider two options they have not considered in years to fix those problems: *service cuts or fare increase*.

Nobody is talking about implementing either option right now. Both seem unthinkable after so many years in which subway and bus service improved markedly, ridership rose to historic highs and the economy pumped more than anyone expected into the system's coffers. But warning signs were already beginning to appear long before September 11, as the Metropolitan Transportation Authority project operating deficits that would grow to \$406 million by 2004.

The most recent deficit projections, however, were more serious because portions of corporate taxes and other taxes that go to support the transit system's operations were expected to fall as the economy worsened. And income from fares, which also pays for operations and had risen rapidly for years, was beginning to level off.

Now, the events of September 11 have made those concerns seem small.

In the week after the World Trade Center collapse, transit officials estimated that the system -- which has a total annual budget of about \$4.6 billion -- would lose as much as \$326 million by the end of next year as a result of the attack. These losses result partly from lower revenues from fares, as fewer people ride subways and buses. It is also because of further drops in the tax subsidies after the attack. And finally, spending to manage the emergency (like overtime and repairs) will run into the tens of millions of dollars.

None of these costs include the hundreds of millions of dollars to rebuild the 1 and 9 line in Lower Manhattan -- additional money that transit officials hope to receive from the federal government.

Marc V. Shaw, executive director of the authority, said that negotiations will soon begin with the subway's insurers and with federal and state officials. The M.T.A. will discuss how much assistance can be expected not just to rebuild the system but also to help it recover from the direct and indirect economic impact of the attacks.

"It's going to be hard to tell how much of it is going to be attributable to the economy and how much is attributable to September 11," he said. "We will be discussing how to reduce the deficit."

The last time the fare was raised was in 1995, to \$1.50 from \$1.25, though discounts and free transfers built into the MetroCard system have actually reduced the average fare to around \$1.07.

But raising fares would be seen essentially as a tax increase at a time when the economy was weak. And it could further discourage ridership at a time when the city is urging people to rely on mass transit as never before -- and when the system needs high ridership for financial reasons.

Service cuts, the other choice, have also not been made since 1995, when the agency closed one subway station in Brooklyn, eliminated three local bus routes, and provided less frequent service on 11 subway lines and 60 bus lines to bridge a nearly \$400 million budget deficit for the 1996 fiscal year.

But at a time when service has already not kept pace with the increases in ridership over the last few years, leaving many trains and buses overpacked, service cuts are a topic that has become as difficult to discuss as higher fares. Transit officials say they think they can make service cuts that would not be noticed by much of the riding public. But other analysts say that is probably unlikely because so many savings have already been squeezed out of the system.

The only way to avoid the hard choices, officials say, would be significant amounts of money from the federal government to help the system operate. "Like the M.T.A. and the governor, I look to Washington," said Gene Russianoff, staff lawyer for the Straphangers Campaign, a riders advocacy group.