

1.201J / 11.545J / ESD.210J Transportation Systems

FALL 2006

ASSIGNMENT 3: Transportation Demand and Costs

Date assigned: October 3, 2006

Date due: October 17, 2006

Value: 10 points

To be done in teams of 2. Both members on the team should work collaboratively on all parts of the assignment. Dividing the work and working separately on different questions or different parts of questions is not appropriate. Both team members will be responsible for the final answers.

Question 3A (60%)

Consider the following urban travel choice situation: MIT students are attending a subject taught at the Kennedy School of Government in the spring semester which meets Tuesday and Thursday mornings from 10:30 to noon. These students do not have access to automobiles and in any case would be unable to park close to the Kennedy School in mid-morning so their choices for getting to and from the Harvard class are:

1. Access MBTA bus route #1, alight at Harvard Square, and walk from there to the Kennedy School.
2. Walk to Kendall Square, take the MBTA Red Line to Harvard and walk from there.
3. Walk from MIT to the Kennedy School.

A recent study has estimated the following utility function for mode choice which could be applied to this choice scenario:

$$V_i = -0.17 * IVTT - 0.42 * TA - 0.29 * WT - 2.00 * COST$$

IVTT: In-vehicle travel time (minutes)

TA: Access or walk time (minutes)

WT: Wait time (minutes)

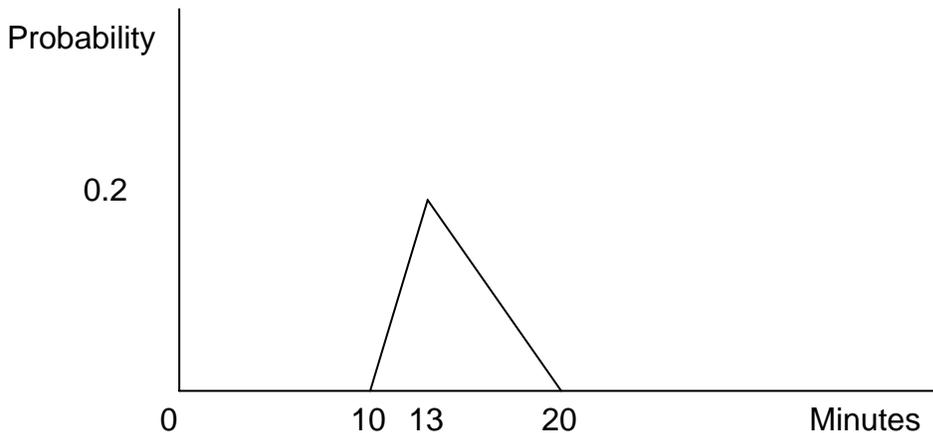
COST: Fare (dollars)

Note:

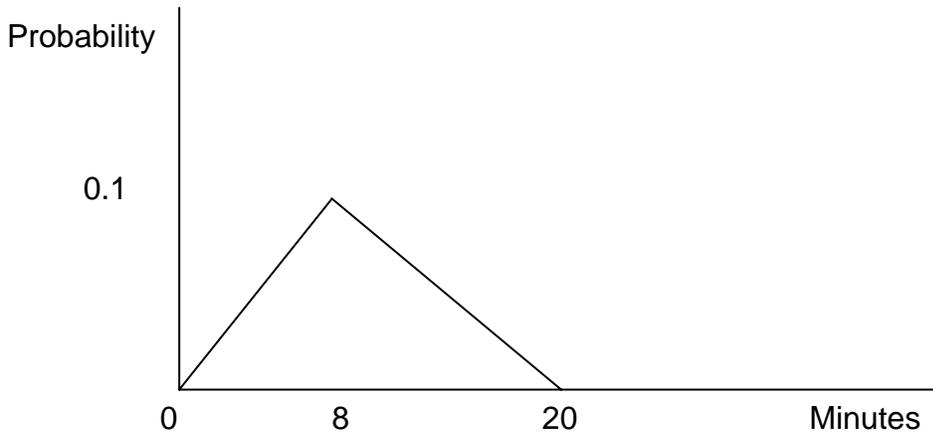
- 1) Mean in-vehicle travel times (IVTT) and wait times (WT) were used to estimate this utility function.
- 2) The shape parameter in the logit function μ , is 1.0

Data has been analyzed to derive the following level of service attributes for the relevant services at the time of day on interest:

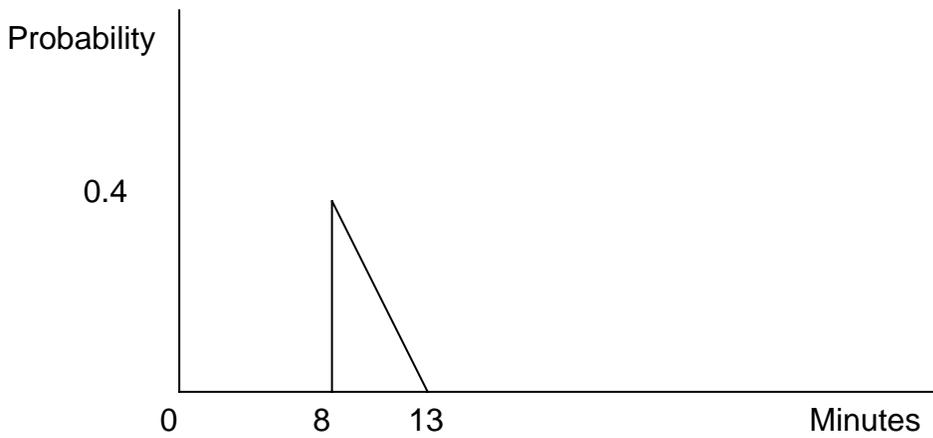
Function A: PDF of in-vehicle travel time (IVTT) for MBTA bus route #1



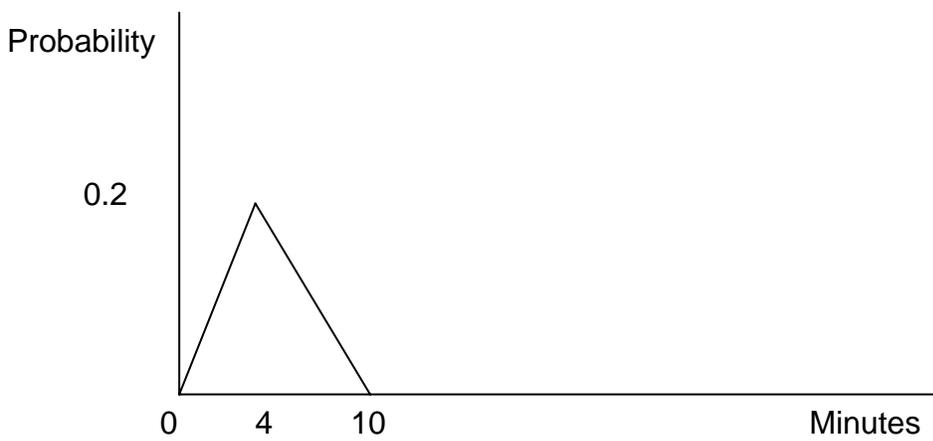
Function B: PDF of wait time for MBTA bus route #1



Function C: PDF of in-vehicle travel time (IVTT) for MBTA Red Line



Function D: PDF of wait time for MBTA Red Line



Answer the following questions: (all questions have equal credit: 7.5%)

1. What are the choice probabilities for each of the three defined alternatives above? Make all necessary assumptions, including walking travel times and state them clearly.
2. How do the choice probabilities change if a student has
 - a. An MBTA Rail monthly pass?
 - b. An MBTA Bus monthly pass?
 - c. An MBTA Bus/Rail Combo monthly pass?(Note: a pass means that you can ride as many times as you want once you have bought the pass)
3. How do the choice probabilities change if the MBTA adopts a new fare structure of \$1.75 for both bus and rail?
4. What are the departure times and route choice probabilities if the student must be on time (i.e. arrive with probability 1 at or before the start of class)?
5. Critically assess the utility function given above.
6. Are there likely to be any equilibrium effects which might affect this particular problem - in other words is the performance of the services likely to be sensitive to the choices?
7. Which of these alternatives would you choose and explain why?
8. What would you expect the overall share of trips for these alternatives for a set of students facing these choices, and explain why?

Question 3B (40%)

Regulatory Effects on Carrier Costs & Decisions: in a regulated transportation system, a public agency often determines whether or not to grant operating authority to additional firms to serve a particular market. In such a system operating authorities can have substantial value, because they tend to limit competition and allow carriers to make a reasonable return on their investment. In such a system, a company may decide if it no longer wants to serve a market. It might then be able to sell its operating authority (just the piece of paper – not any equipment or facilities!) for a considerable sum of money, as illustrated in this example. The new operator can then determine how best to serve the market.

(All questions have equal credit: 10%)

1. The year is 1970 and your father would very much like to enter the highly profitable trucking market between Boston and New York. He figures that he could transport apples and fresh fish using refrigerated trucks from Boston to New York, a distance of roughly 200 miles, for a cost of \$1/mile loaded (for either commodity) and \$0.75/mile for the empty return trip. Current transportation rates, which have been approved by a regulatory process, are \$500 per truckload for fresh fish and \$600 per truckload for apples. He would like to start with a small operation involving 5 trucks, which he can buy for \$50,000 each. With an operation of this size, he expects that he would easily be able to obtain enough loads to keep his trucks busy making roughly 125 2-day round-trips per year each. However, he needs regulatory approval to enter this market, and the Interstate Commerce Commission believes that there is no need for additional carriers. Hence, his only option is to buy the operating authority from another carrier. Assuming that all of his assumptions are correct, how much should he be willing to pay for this authority given that he would like to make a good return on his investment of \$250,000 for the five trucks?
2. Now it is 1985 and trucking has been deregulated. Your father eventually did acquire the necessary operating rights (for much less than he was willing to pay), and quickly became rich sending fish and apples to the Big Apple (American slang for New York City). He retired in 1978, leaving the company to your elder brother to manage. Almost immediately, however, deregulation of the transport rates for fresh food drastically changed the trucking business, allowing almost anyone with a truck to enter the business. Your brother, who lacked the benefit of an MIT education (which you are fortunate enough to have), responded too slowly, and barely avoided bankruptcy. He has laid off all of his employees and sold all but one of his trucks. He would like to try to make a living as an owner-operator (driving the truck himself), using the one, nearly brand new truck that he managed to salvage from the financial disaster. He tells you that the cause of his problems was that the market rates for transporting fresh fish and apples dropped to \$400 per truckload, while operating costs of refrigerated trucks rose to \$1.50/mile loaded and \$1.00/mile empty.

The most recent statistics from the company showed that variable costs (fuel, tolls, servicing, meals, lodging, and maintenance) accounted for half of the average costs,

while the remainder was used to cover equipment ownership costs and drivers' wages. Your brother says that since he already owns his truck, he can earn \$0.75/mile on the loaded trip and \$0.50/mile on the empty trip, which would amount to nearly \$40,000 per year, which would be plenty for him to live on, since his wife divorced him and took the kids when the trucking business started to fall apart. How much would your brother really earn in his first year, if he continued operating in the same way that the firm had in the past?

3. After deflating your brother's expectations (and mentioning that he had forgotten about his alimony payments of \$1,000 per month to his ex-wife), you try to give him some advice on how to improve his operation. In particular, you tell him that he needs to utilize his equipment more effectively, either by making more trips/year, by getting backhauls (a loaded revenue-generating return trip) from New York to Boston, or by getting into another market. To get a backhaul will require additional time and expense for loading, unloading, and repositioning equipment. Write equations for i) the total cost of a round-trip from Boston to New York and ii) the time required. Using these equations, calculate for your brother the minimum amount he should accept for bringing a load of pastrami back to Boston if the return trip requires 200 loaded miles, 50 empty miles, and an extra day (3 rather than 2 days for the round-trip)?
4. How would getting into another market (different O-D pairs or commodities) affect your brother's prospects? What do you recommend that he do?