Problem Set 6 (Optional?)
Group Assignment
Due Monday November 21, 2005 at start of class (10% per day late penalty)

Question 1 (20 pts): Few Americans used trains (i.e., Amtrak) until recent events made people less comfortable flying. Amtrak introduced a new high-speed train called 'Acela Express' that uses fast trains and business-class type cabins between Washington, D.C., New York, and Boston, Mass.

In this problem you will make a model to compare the improved Acela service, the regular Amtrak train service, driving by car, and also airplane trips between downtown Washington and downtown New York. The following table shows details of the three options:

	Washington to New York	
Service Option	**Time required**	**Price**
Current Amtrak	3:30	$84
Acela Express	2:40	$152
Airplane (USAirways)	1:05	$203 last-minute $64 in advance
Personal Car	3:50	$10 toll

Notes:

- Time in (hours:minutes), e.g. 2:40 is 160 minutes and is 'point to point' scheduled times
- Ticket prices for airlines are given for both 'walk-up/last minute' fares and 'advance purchase' travel. Assume all costs above are one-way.
- Assume that 50% of passengers are business travelers earning $60,000 per year and 50% are leisure travelers earning $30,000 per year. Also assume that all business passengers buy last-minute tickets and all leisure travelers buy tickets in advance.
- Assume the Amtrak and Acela stations are downtown, while the USAirways shuttle flights are at airports, which are 30 minute cab rides from downtown.
- Assume driving speed averages 60 miles per hour for your own car or taxis.
- Assume that a cab ride would be needed between the airport and downtown, and that the fare is 50 cents per minute to travel between airport and downtown.
- Driving your own car costs $10 in tolls along the way. Also don't forget the per-mile cost for driving (a total of 40.5 cents a mile – which includes gas, depreciation, insurance, etc.). If you are unfamiliar with this, see http://www.irs.gov/newsroom/article/0,,id=131232,00.html).

A – 7 pts) Consider three classes of passengers: (1) only business travelers, (2) only leisure travelers, and (3) all passengers (i.e., the average passenger). Find the total cost (using only the information above) for each class of passengers using the transit options for passengers looking to travel from downtown Washington to downtown New York. Rank the alternatives in order of cheapest to highest cost for each passenger type. Which option is recommended for each passenger class?

[Hint: You should compare 'equivalent' trips where passengers go from downtown Washington to downtown New York City. Cab rides might be necessary. Assume that the downtown train stations are your final destinations. Drawing a picture may help (but you do not need to submit it).]

B – 4 pts.) Perform sensitivity analysis on all parameters (including those for which I have assumed values for you) to determine the assumptions required for each passenger class to choose Acela. Given your overall findings, what would you tell the head of Amtrak are the primary reasons that more people are not choosing Acela? What kind of marketing might change this?

C – 4 pts) An item ignored above is that the travel times assumed scheduled times. But in reality the times vary a lot and induce delays. I posted "actual flight time" data for USAirways flights Washington - NYC (http://www.ce.cmu.edu/~hsm/bca2005/hw/USAirways_May_05.xls.zip). Using this data, find a distribution function that fits the data well (you should use BestFit, XLSTAT, etc.). Once you make this distribution for flights, use the same "distribution family", e.g. Exponential, as a basis for time distributions for 2 types of trains and cars (state your assumptions and note different parameters). (Note that the curve-fitting programs have more distribution function types than most Monte Carlo tools. Feel free to choose a second or third best distribution such that you can model it in your tool.)

D- 5 pts) Above we also ignored "time waiting", for example being at the airport or train station ahead of schedule. Use the range of waiting times given below with triangular distributions.

	Waiting Time (mins)		
Mode	Min	Mean	Max
Train (business)	15	30	45
Train (leisure)	15	45	90
Airplane (business)	30	45	60
Airplane (leisure)	60	90	120
Car	0	0	0

Now, using all of the new functions from parts C and D, find the distribution of Acela's cost compared to the cheapest option over at least 1000 trials (this may be a negative value). **NOTE YOU ONLY NEED TO SUBMIT YOUR RISKSIM RESULTS (mean, stdev, histogram, cdf), NOT the results of your trials.**

Question 2 (5 pts):

In the "500 Life Saving Interventions" handout, there are a fairly large number of interventions with cost per life-years saved values of "less than or equal to zero".

A – 3 pts) Describe what this "less than or equal to zero" value means, and its implication for public policy and decision making. Do we expect many currently proposed safety interventions with "less than or equal to zero" values?

B – 2 pts) Why are many of the environmental interventions orders of magnitude more expensive than safety regulations?

Question 3 (15 pts.): In the 1990's, the sale of "light trucks" exploded in the United States, mostly because of record-low gasoline prices and higher incomes. This truck category includes mini-vans, pickup trucks, and the popular sport utility vehicles (SUVs). Sales figures show that 51% of new vehicle sales were in the light truck category- more than half- for the first time in history.

Historically light trucks had been exempt from the tight restrictions states have imposed on passenger vehicle emissions. The California Air Resources Board (CARB) wants to include light trucks in its stricter emissions legislation. Beginning in 2005, cars and light trucks had to meet tougher standards. The new regulation requires all vehicles that weigh less than 8,500 pounds--the weight of the largest sport utility vehicles--to meet the new standards of 0.04 grams of hydrocarbons (HC) per mile and 0.05 grams of nitrogen oxides (NOx). This means that all vehicles will have to be re-designed to meet the new standard. The largest trucks will have the highest price increases. They will require the most complex changes to meet the new standard since they are the furthest away from the proposed standards.

Following is a range of 1998 emissions for several models of the 2 million vehicles sold in California that would be subject to the new standard. Assume that the table represents the only vehicles sold with the appropriate sales percentages. Finally, the control costs needed to meet the higher standard are in 2005 dollars. The average California vehicle is driven for 120,000 miles over its life. Also assume that any cars that currently meet the standard will continue to do so.

Car Make / Model	Hydro-carbons*	Nitrogen Oxides*	Percent Sold	Control Cost	Category
Ford Expedition	0.080	0.1	10	300	SUV
GM Suburban	0.084	0.4	6	500	SUV
Lexus LX470	0.088	0.3	2	500	SUV
Plymouth Voyager	0.078	0.2	15	200	Minivan
Toyota 4-Runner	0.116	0.2	5	800	SUV
Mercury Villager	0.160	0.3	7	700	Minivan
Isuzu Rodeo	0.081	0.4	6	400	SUV
Chevy Malibu	0.048	0.1	25	40	Car
Honda Accord	0.025	0.1	24	20	Car
New 2004 standard	0.040	0.05	100		

[Source: CARB, * units in grams per mile]

a – 4 pts) What is the 2004 cost for each of the vehicle categories: cars, minivans, and SUVs? What is the overall cost? [I encourage you to use Excel to do this problem].

B – 4 pts) What are the potential hydrocarbon and NOx emissions reductions of this program for vehicles purchased in 2004 over their expected lifetime? Assume that all vehicles would meet the new standard. [Find results and for each vehicle category and overall]

C – 4 pts) Which of the categories is most economically efficient at reducing pollution of hydrocarbons and NOx?

D – 3 pts) Based on your answers in (a)-(c), analyze the CARB policy across the vehicle categories. Can you suggest any ways of improving CARB's policy?