NEEP 602 -- Engineering Problem Solving II
Example Monte Carlo Problems –
NOT TO BE TURNED IN

1. Use Monte Carlo integration to determine the following integral:

$$\int_{0.105}^{2.4853} e^{\sin x}\, dx$$

2. Solve the problem described below using Monte Carlo techniques

Consider a spaceline operating a new reusable launch vehicle that is expected to capture much of the existing market for launch services as well as generate new demand. The fixed costs for our spaceline are $1 million per year, regardless of the number of flights conducted. The unit cost per flight varies depending on the load factor, or whether or not the cargo bay is full. If the manifest is full, the cost of a flight is $300,000; if it's not full, then the cost is taken to be $150,000 + $150,000*(load factor).The income per flight for a full cargo bay is $3 million, pro rated accordingly if it is not full.

The problem here is that, as the market expands, the traffic level is impossible to predict from year to year. However, as part of our campaign to make spaceflight more accessible, management has determined to fly a regular schedule of flights regardless of load factor, just like the airlines do. The marketing department is confident that for the next year at least, the demand for launch services will equate to somewhere between 25 and 75 full flights. Your task is to come up with a program to determine the optimum number of flights that should be scheduled for the next year so that profit will be maximized.

All random distributions are assumed to be uniform distributions. The process consists of running a (large) number of simulations for each flight level in the range 25 to 75, each time randomly generating a demand level in terms of full flights. The profit for each combination of flight level and random demand level is calculated as the difference between income and costs. The cumulative profit is the sum of profits for all the random simulations for a given flight level. The expected profit for each flight level is then the average of the profit for that set of random simulations. When this has been done for the range of possible flight levels, and we plot expected profit versus number of scheduled flights.