

Project 4: Phantom Tollbooth

The Maine State Thruway Authority is planning a new entrance/exit and is thinking about the number of tollbooths to construct. Extensive thruway data shows that the average time needed to handle a toll transaction is **15 seconds**. Let us suppose that the number of vehicles needing to pass through the tollgate (during peak traffic) follows the probability distribution:

# Cars Arriving each Minute					
# Arrivals	10-20	21-25	26-29	30-33	34-45
Probability	12%	37%	31%	14%	6%

Create a spreadsheet which randomly assigns the # cars arriving per minute using the probabilities above, allows you to input a number of tollbooths, and which tracks the back-up of cars over a 1 hour period.

- 1. Fill in the following table** (by hand no Excel) assuming there are 6 toll booths constructed. This is VERY IMPORTANT, you must do this paper and pencil exercise first and understand what you are being asked to do before you can hope to create a spreadsheet!

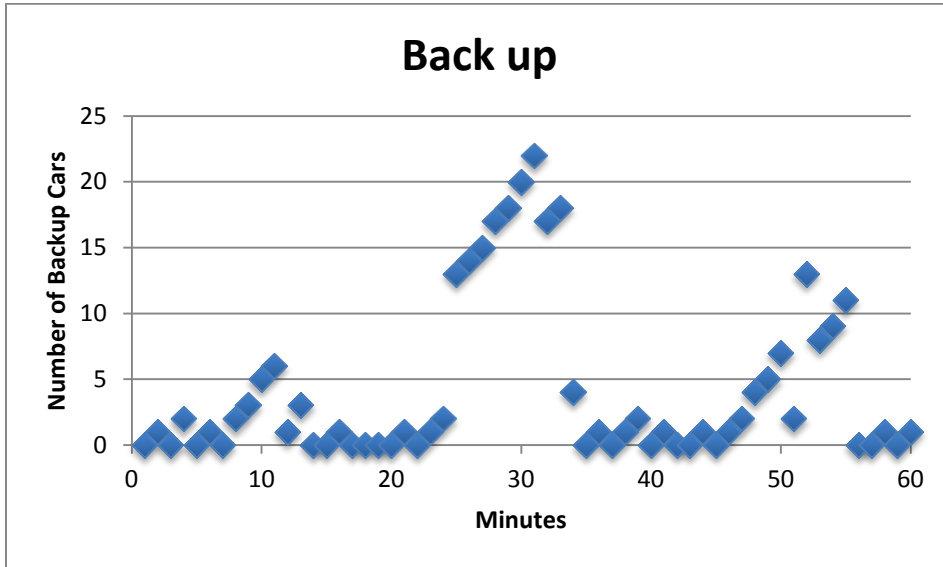
Minutes	New Arrivals	Total Cars	Departures	Back-up
1	21	21		
2	32			
3	15			
4	28			

Your spreadsheet should include:

- Well-labeled cells giving
 - the **number of toll booths** constructed
 - and the **number of cars** your booths can “process” in 1 minute.
 - Name** both these cells.
- A **table** turning the probabilities above into **cutoffs** for use with a **VLOOKUP** function. This function will look up a random number in the table and return the number of cars for that minute. Remember how **VLOOKUP** works, the cutoffs are the left hand endpoints for intervals, your first interval is from 0 to 0.12 (which represents the 12%).
- Columns for Minutes, New Arrivals, Total Cars, Departures, Back-up. Your formulas should link to the named cells from **#2** whenever possible.
 - Minutes:** number of minutes from 1 to 60
 - New Arrivals:** using probability distribution above and **VLOOKUP**
 - Total Cars:** new arrivals + any back-up from previous minute

- d. **Departures:** the number of cars departing each minute based on # of tollbooths you construct
- e. **Back-up:** cars that did not depart that minute

5. A scatter-plot showing the back-up for 1 hour.



- 6. Assume each tollbooth will cost \$1 million to construct. Each day there are 5 peak hours of traffic, with an average fare of \$2.20 per car, and a cost of \$45 per booth per hour for the operator.
 - a. Compute the amount of money you can expect **to make** (fares – operator cost) during **1 peak hour** of traffic for the given number of booths.
 - b. Compute how **many days** it will take to pay off the construction of your tollbooths. Assume during non-peak hours the costs and fares cancel.
- 7. A textbox with **your recommendation** for the number of tollbooths to construct with explanation. Whatever number you recommend, you must explain why you did not choose the **number above and below**.

