# BML analysis

**Stats 133 Assignment #5**

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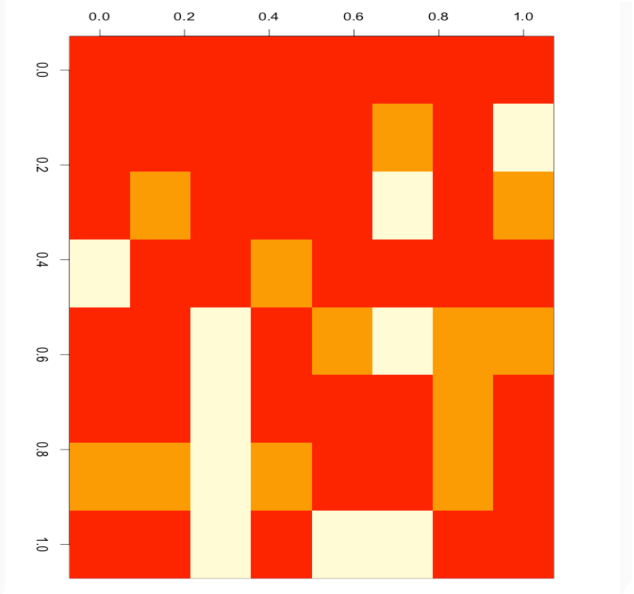
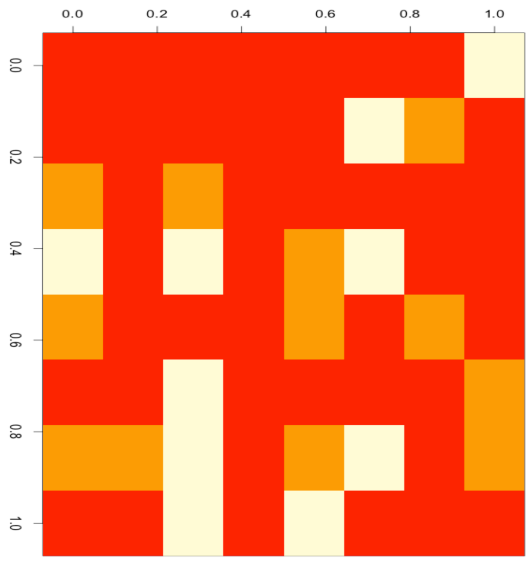
Below are the illustrations of how the car moves and blocks each other. Orange car move first, they move one unit to the right if the space is empty; light yellow car move upwards one unit if the space is empty.

Step 1;




Step 2

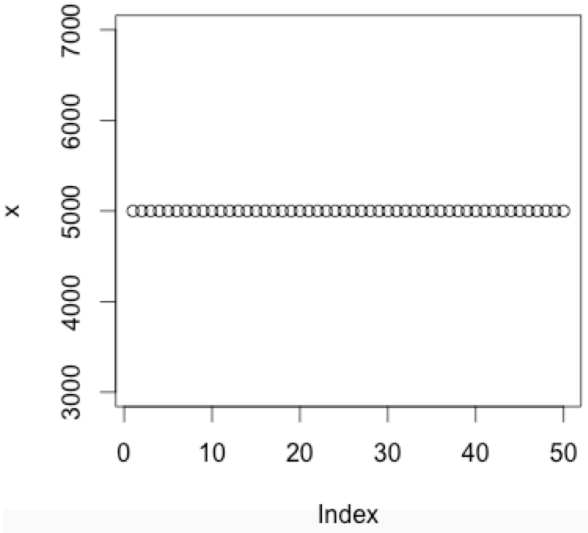



**BML simulation study**

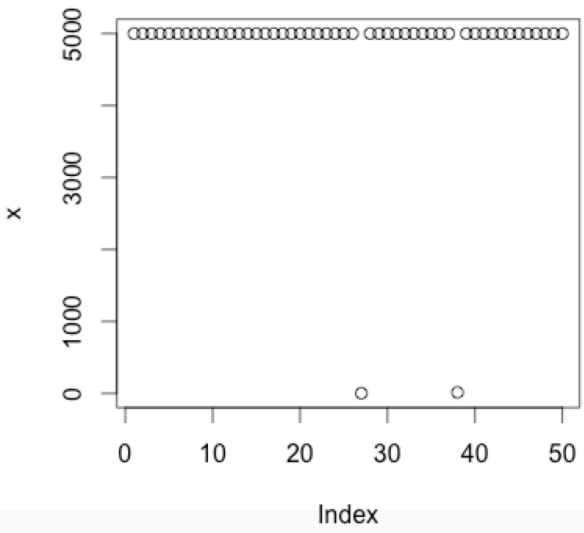
*1. For what values of p, the density of the grid, did you find free flowing traffic and traffic jams? Did you find any cases of a mixture of jams and free flowing traffic?*

With the help of graphs, I repeat the bml simulation process for 50 times and found out that when the density p is smaller than 0.3, there will always be free flowing traffic. When p equals to 0.4, traffic jams start to appear. When p is around 0.6~0.7, there is a mixture of jams and free flowing traffic. When p becomes larger than 0.8, there is a very high chance of traffic jams. Below are the graphs that illustrate the findings. X-axis is the number of trials and the y-axis is the number of steps taken until a traffic jam.

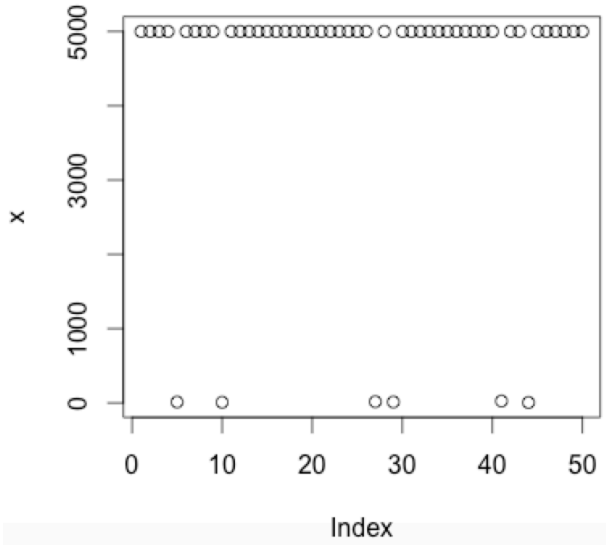
5*5 grids with $0 < p < 0.3$



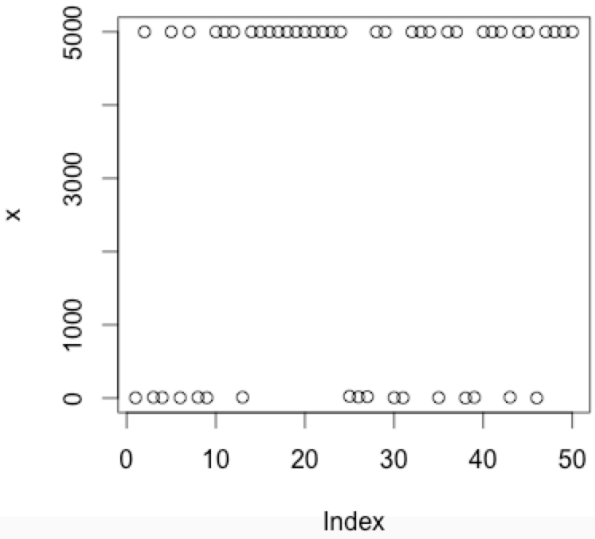

5*5 grids with $p = 0.4$



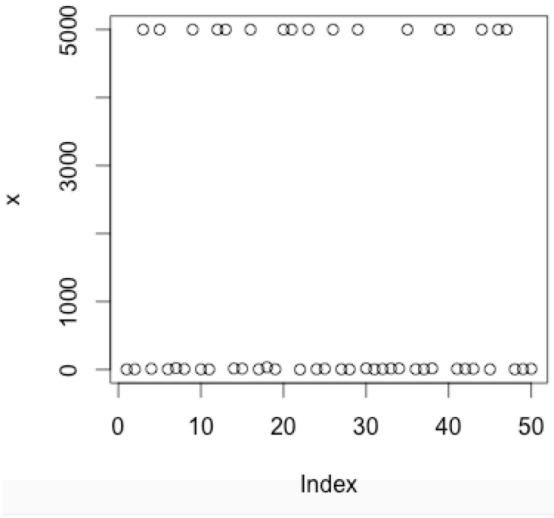

5*5 grids with $p = 0.5$



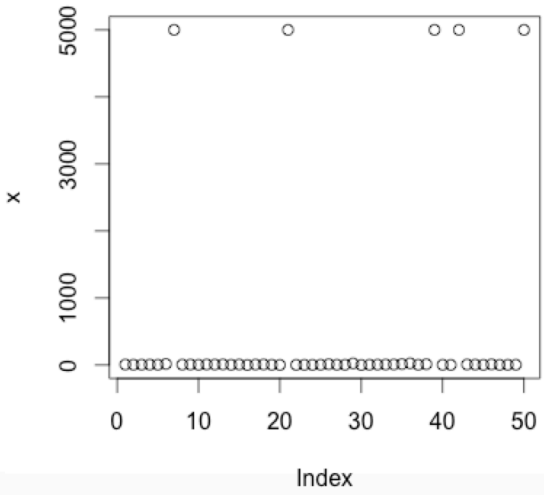

5*5 grids with $p = 0.6$



5*5 grids with $p = 0.7$

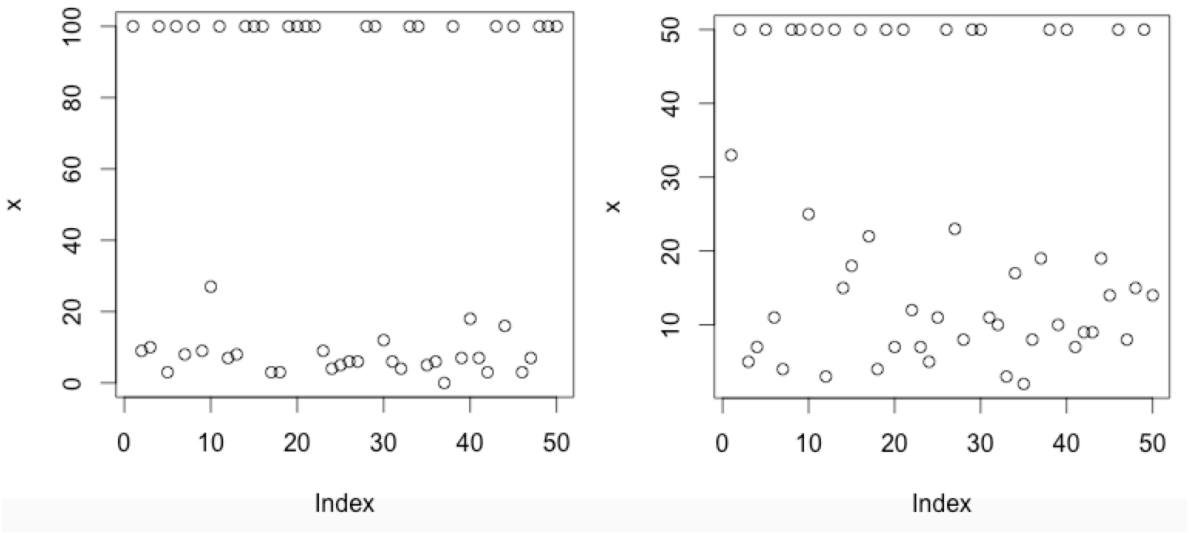



5*5 grids with $p = 0.8$




*2. How many simulation steps did you need to run before observing this behavior?*

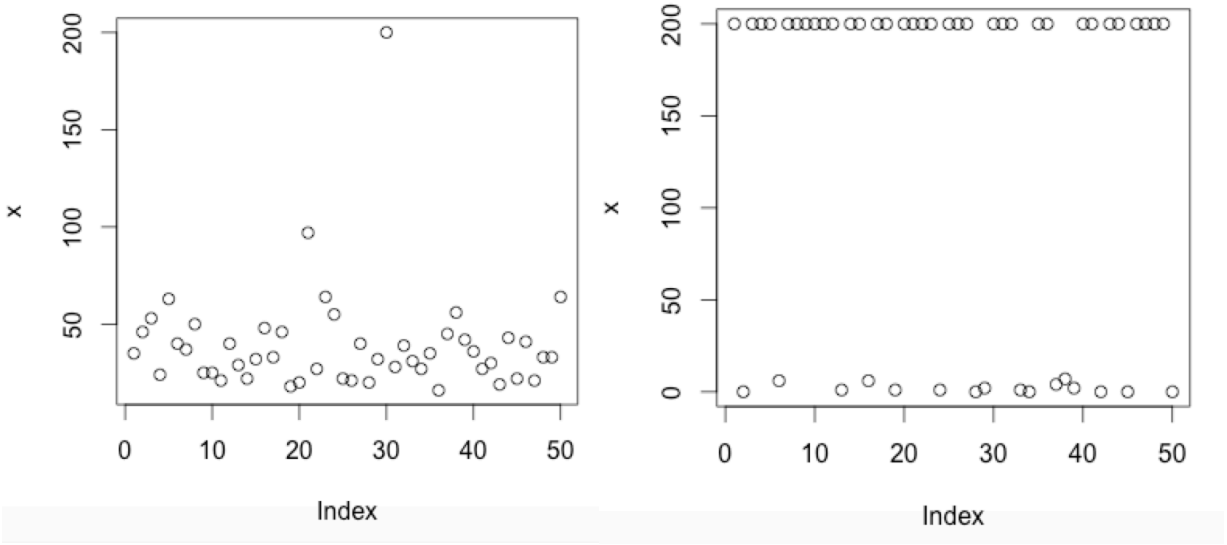
From multiple trial and error, I found that at least 40 simulation steps need to be run before observing this behavior. Most of the traffic jams happen within the first 40 steps, if we commit fewer than 40 steps, the simulation might end before it actually hit a traffic jam. Below are the graphs that illustrate the point that most traffic jams happen within the first 40 steps.




*3. Does the transition depend on the size or shape of the grid?*

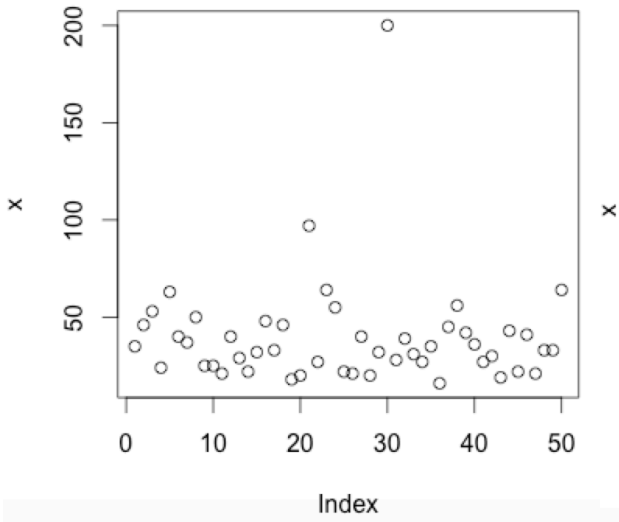
When the grid size increases, it takes more steps to hit traffic jams but meanwhile, the rate of traffic jam for 15*15 grids is much higher than that of the 3*3 grids out of the 50 trials.

15*15 grids with $p = 0.7$ 3*3 grids with $p = 0.7$




Holding the overall size of the grid constant, when the grid becomes more narrow, the rate of traffic jam increases significantly out of the 50 trials.

15*15 grids with $p = 0.7$




45*5 grids with $p = 0.7$