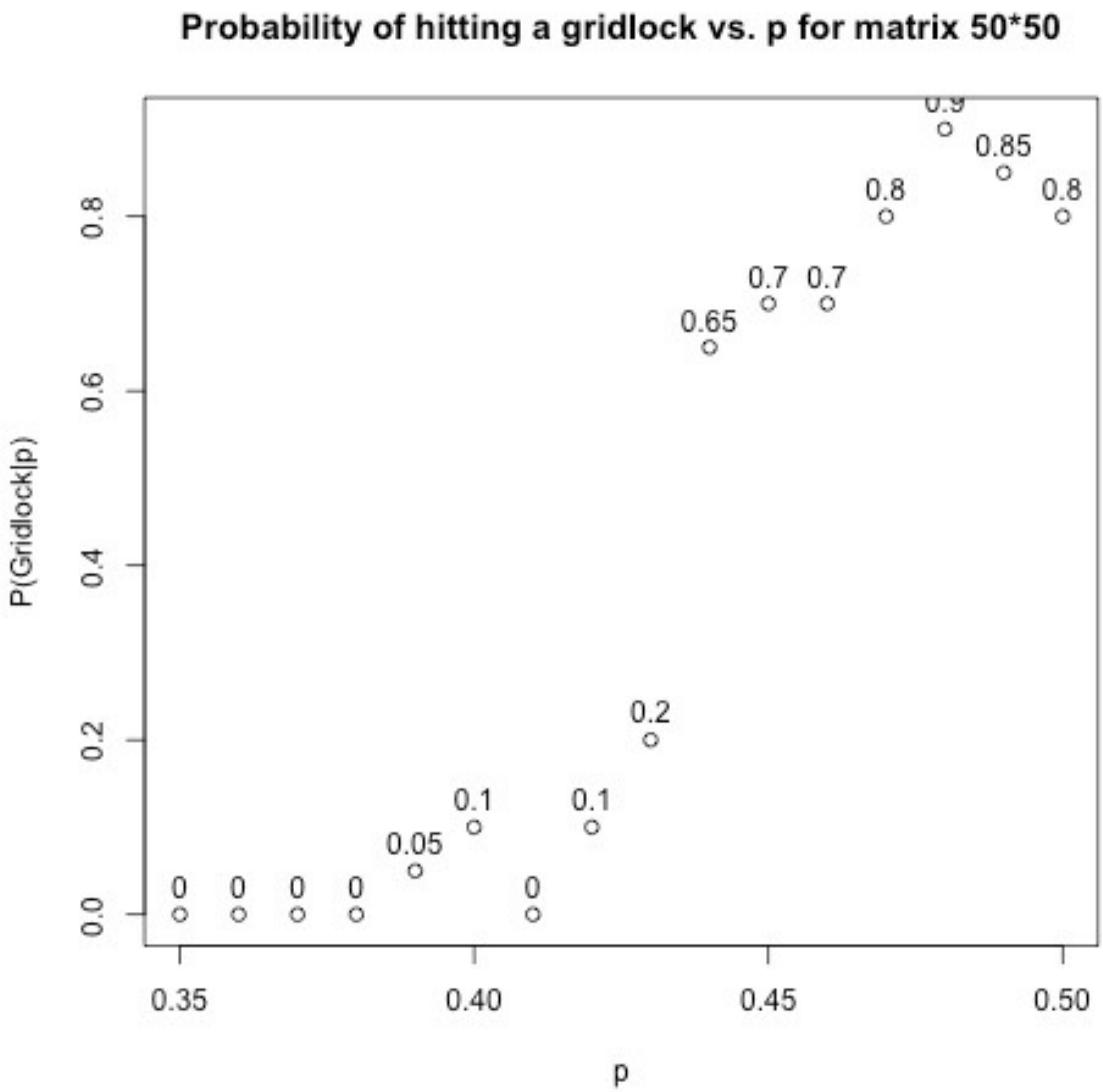
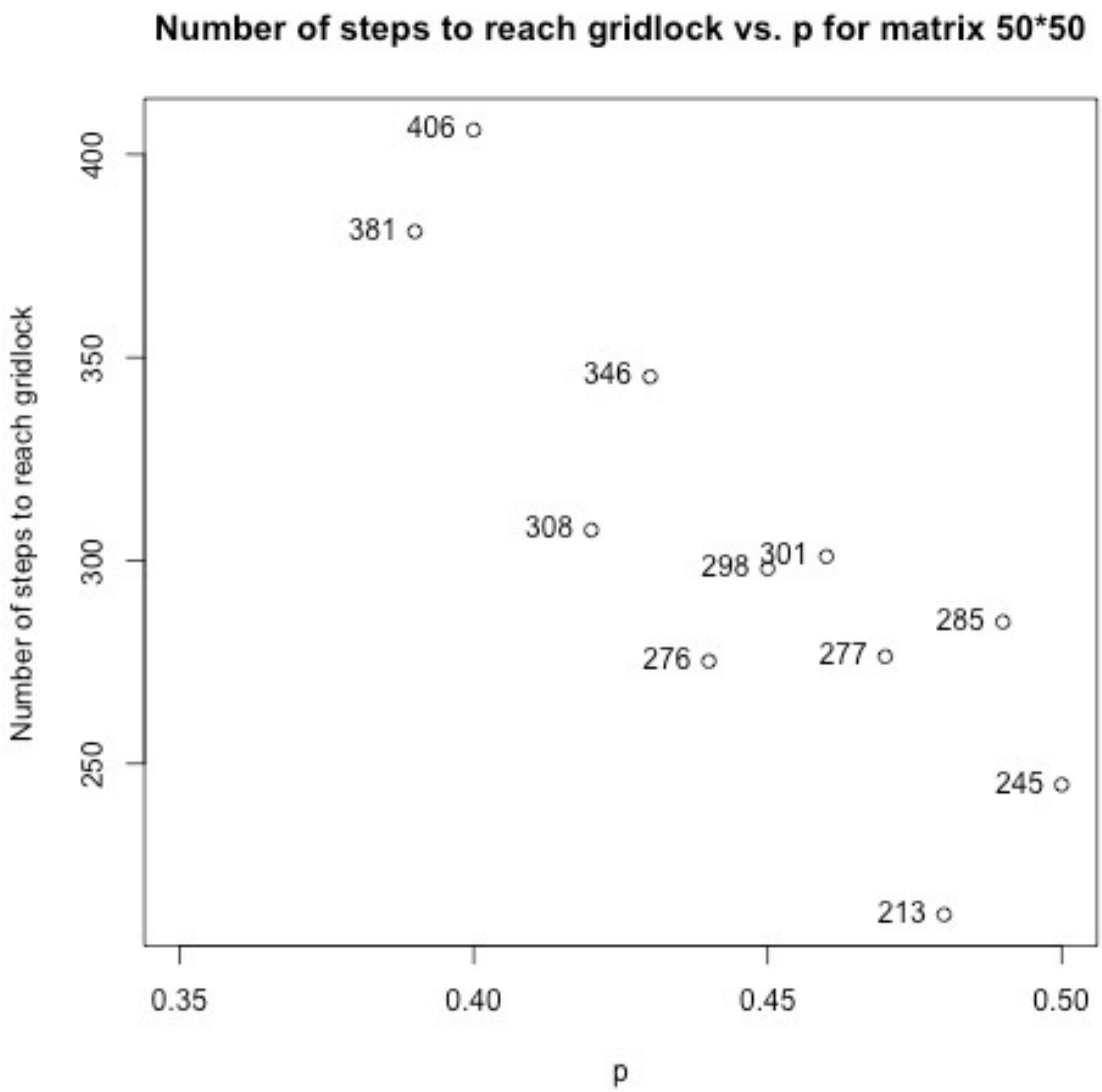
1. I found free flow traffic for simulations for p <= 0.38 , and traffic jams for p > 0.39. The simulation was run on matrix of dimension 50 * 50. I also observed that as p increases, the probability of entering gridlock also increases.
2. For matrices of all dimensions I ran 500 steps on 100 different experiments, and blm.sim would return the number of experiments that eventually hit gridlock from the 100 experiments that were conducted, as well as the average number of steps that it took to hit gridlock for the experiments that did hit gridlock. For matrices of dimension 50*50, I plotted the probability of the simulation reaching a state of gridlock, as well as the number of steps that it took to hit gridlock (if at all), against the probability value (from 0.35 to 0.5, inclusive):

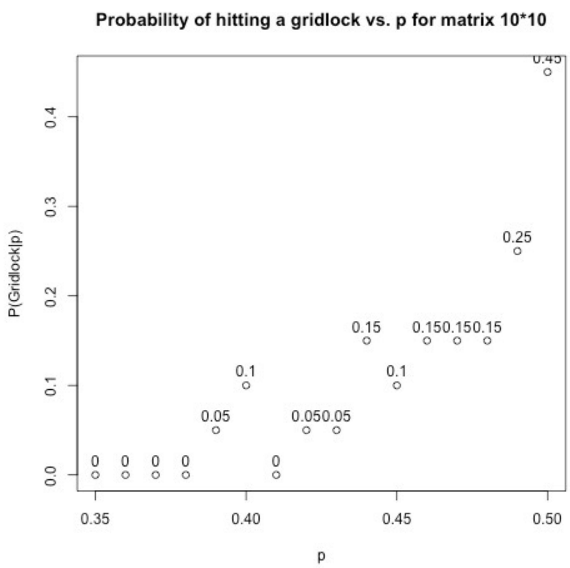


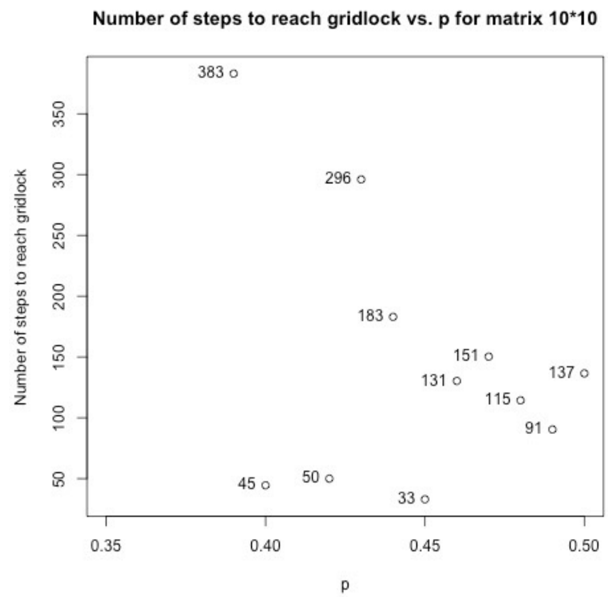

Number of steps to reach gridlock vs. p for matrix 50*50
Number of steps to reach gridlock
p
0.35
0.40
0.45
0.50
250
300
350
400
406
381
346
308
298
301
285
276
277
245
213

We can see that as value of p increases, it is more likely to reach a state of gridlock, also it takes less steps on average to reach that state (despite one outlier).

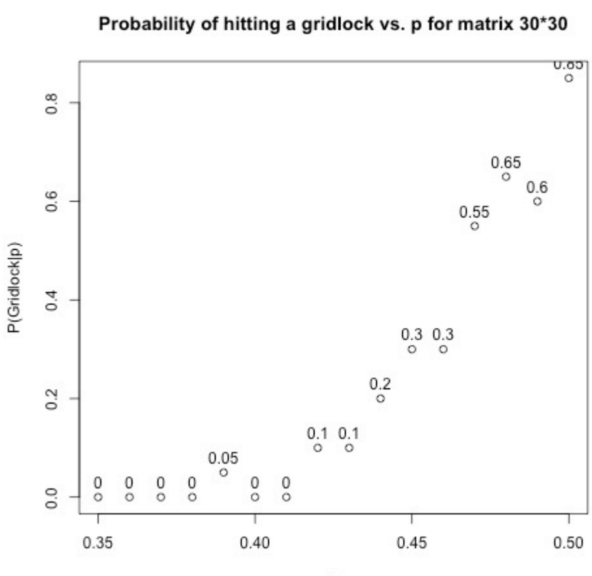
3. For various sizes of matrices:

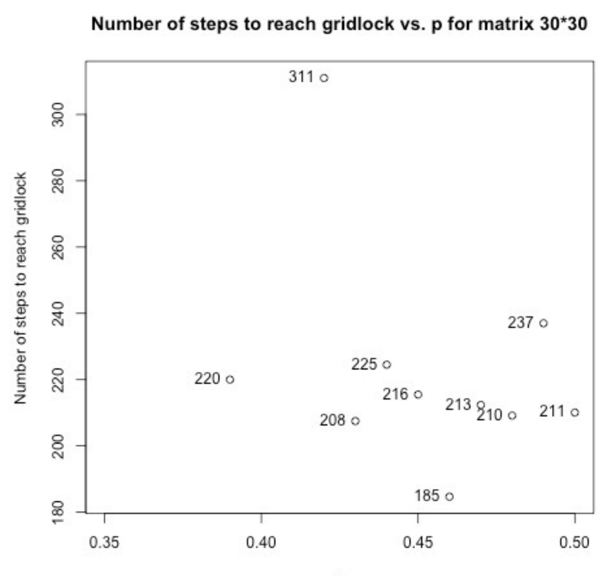
10*10



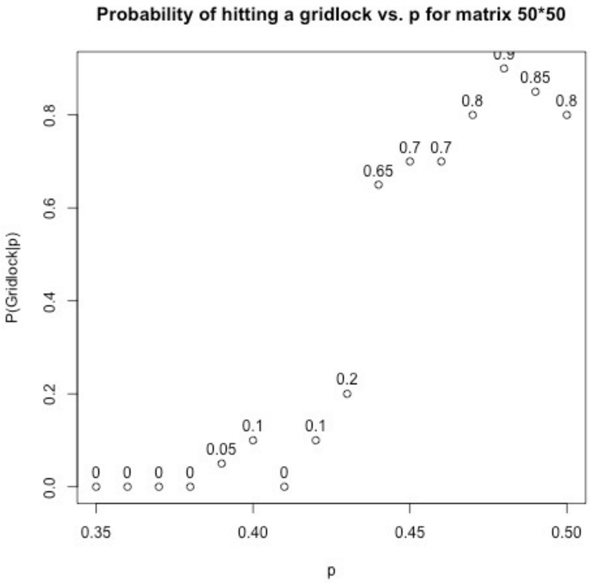


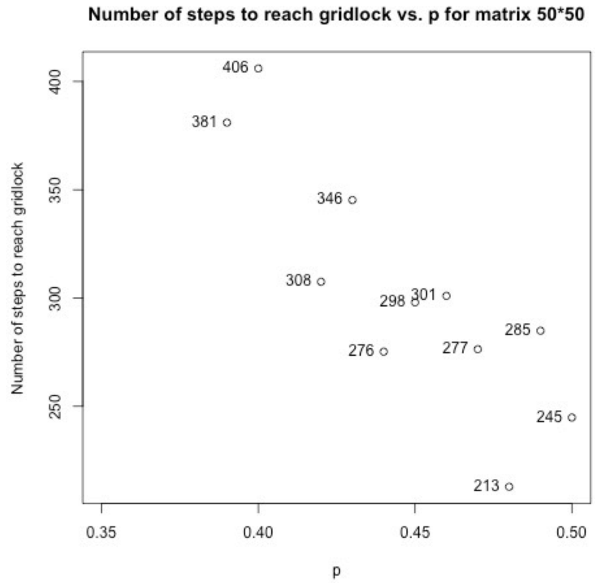
30*30



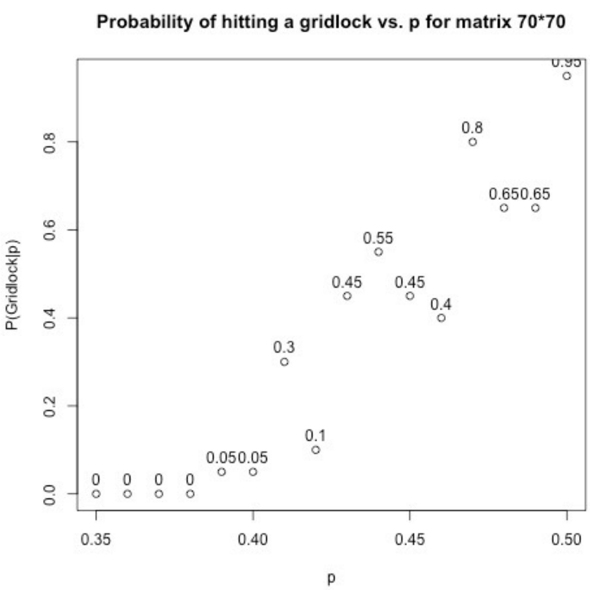


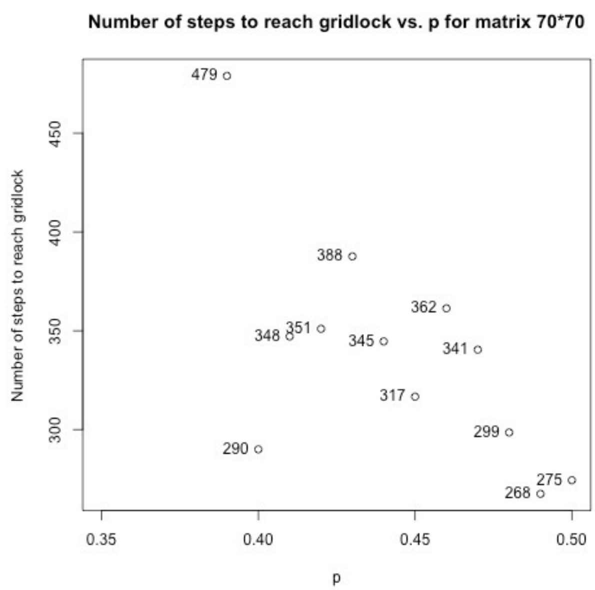
50*50


Probability of hitting a gridlock vs. p for matrix 50*50
P(Gridlock|p)
p
0.0
0.2
0.4
0.6
0.8
0.35
0.40
0.45
0.50

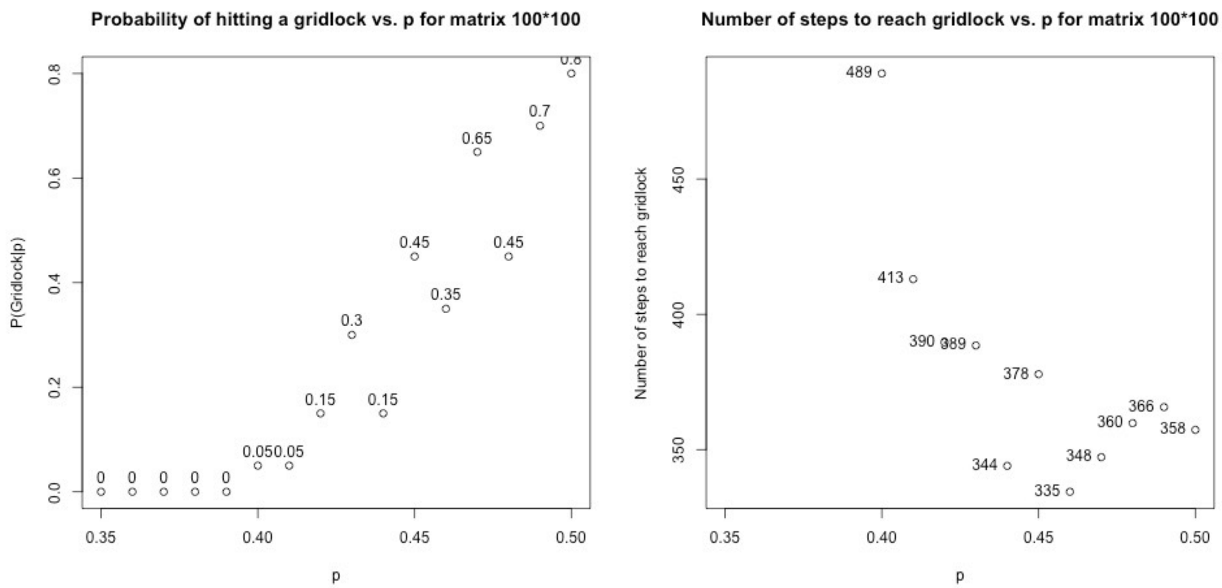

Number of steps to reach gridlock vs. p for matrix 50*50
Number of steps to reach gridlock
p
250
300
350
400
0.35
0.40
0.45
0.50

70*70


Probability of hitting a gridlock vs. p for matrix 70*70
P(Gridlock|p)
p
0.0
0.2
0.4
0.6
0.8
0.35
0.40
0.45
0.50


Number of steps to reach gridlock vs. p for matrix 70*70
Number of steps to reach gridlock
p
300
350
400
450
0.35
0.40
0.45
0.50

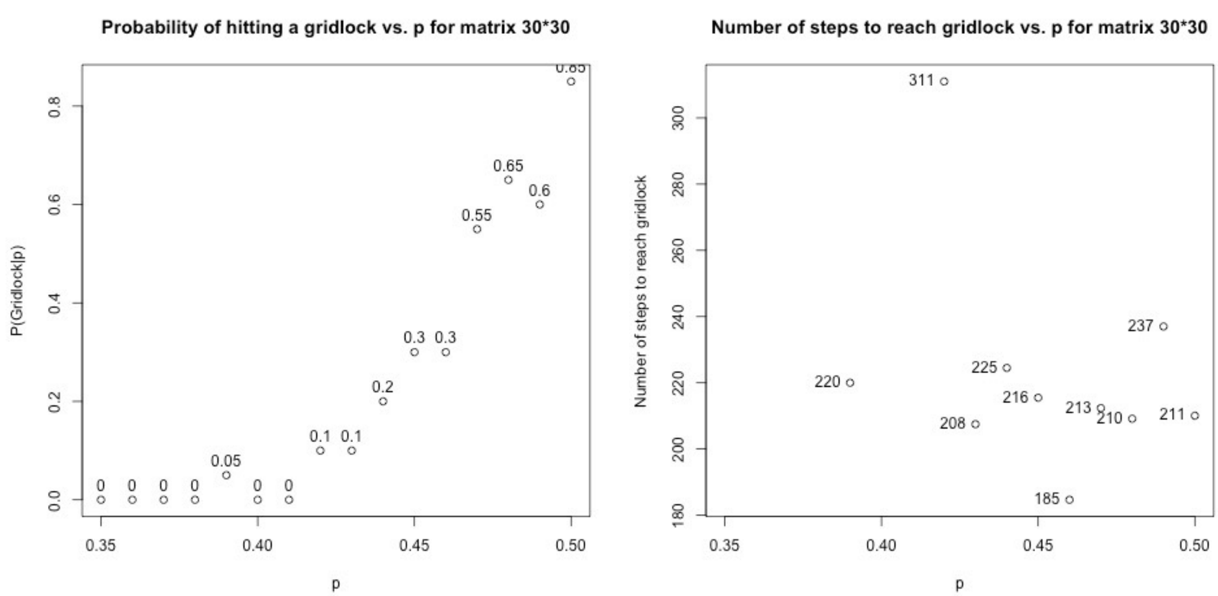
100*100



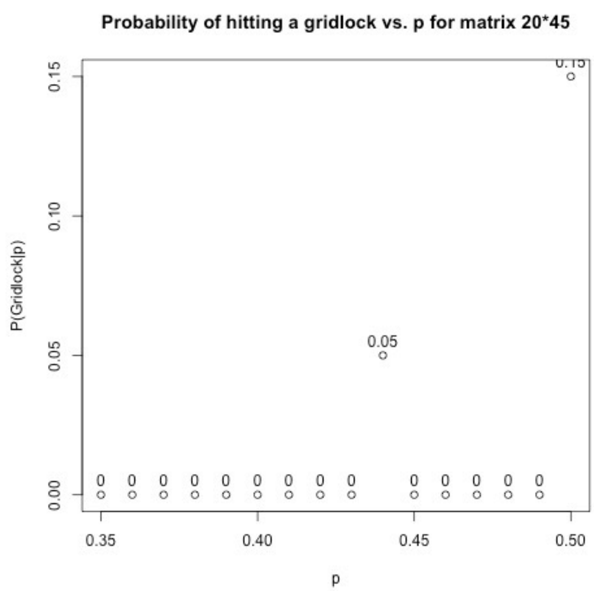
As we can see, there seems to be little to none effect on the p value at which the transition from free flow to traffic jam for various sizes. However, for larger matrices, the number of steps needed to reach gridlock generally increase at equivalent p values.

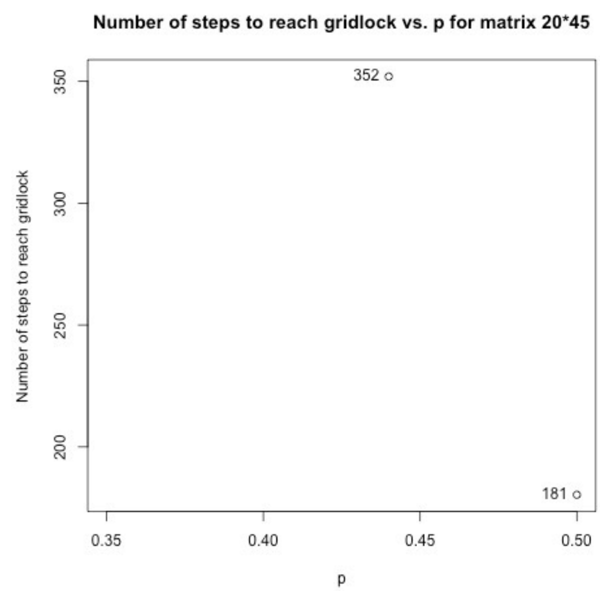
For various shapes while fixing the size:

30*30



20*45





10*90: no gridlock for p = 0.35 to 0.5.

We could see that rectangular matrices are less likely to hit gridlock.