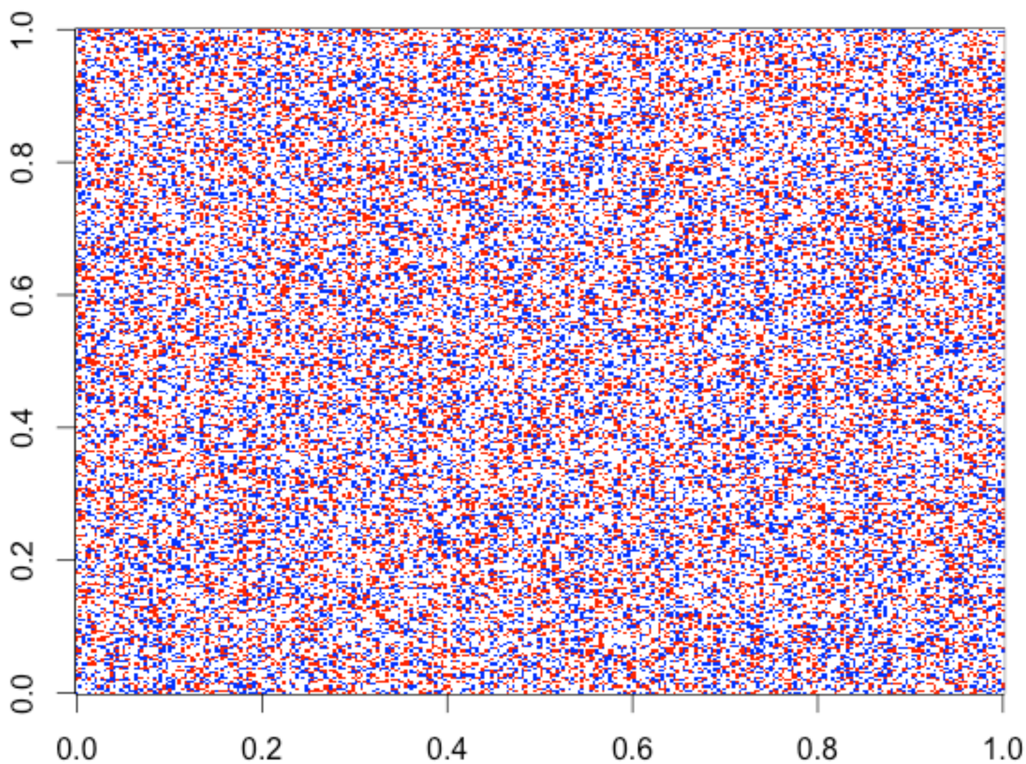
BML Simulations

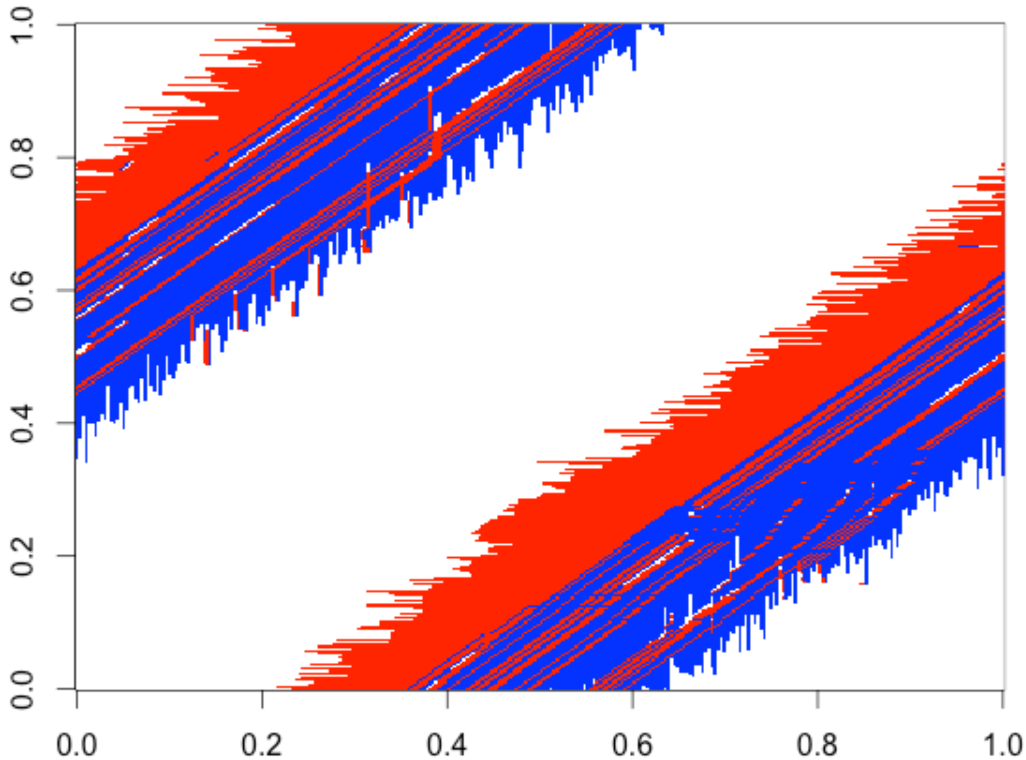
For higher value of *p* it is more likely to find traffic jams than lower value of *p*. At p = 0.5 and greater for grid sizes 500x500, 256x256, 128x128 and 64x64, there will always be gridlock. And for p = 0.3 and below, there will always be free-flowing traffic.

From 200 simulations each at different grid sizes but the same *p* (ie. at 512x512, 300x300 and 256x256 at p = 0.5), it can be deduced that in addition to *p,* grid sizes also affects gridlock behavior. Here, the average number of steps till gridlock for each grid size is different with high standard deviation – look at Table 1.

The effects of grid sizes on gridlock can also be observed here where in 300x300 grid at p = 0.4, there is gridlock:

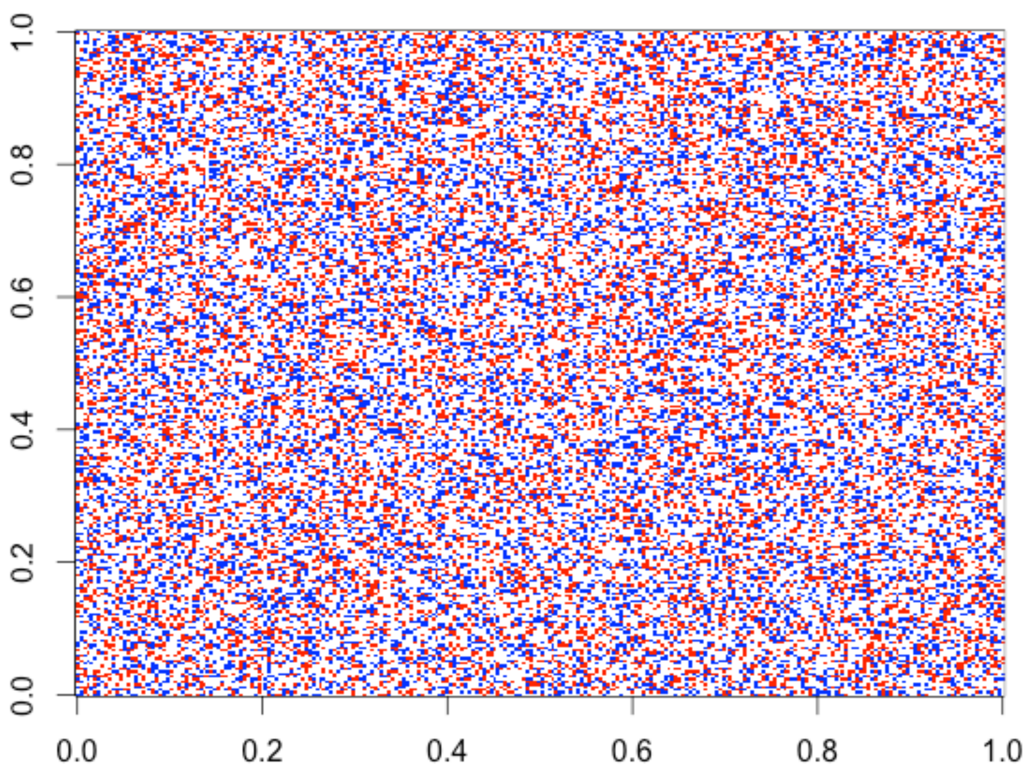


Initial 300x300 grid where p = 0.4

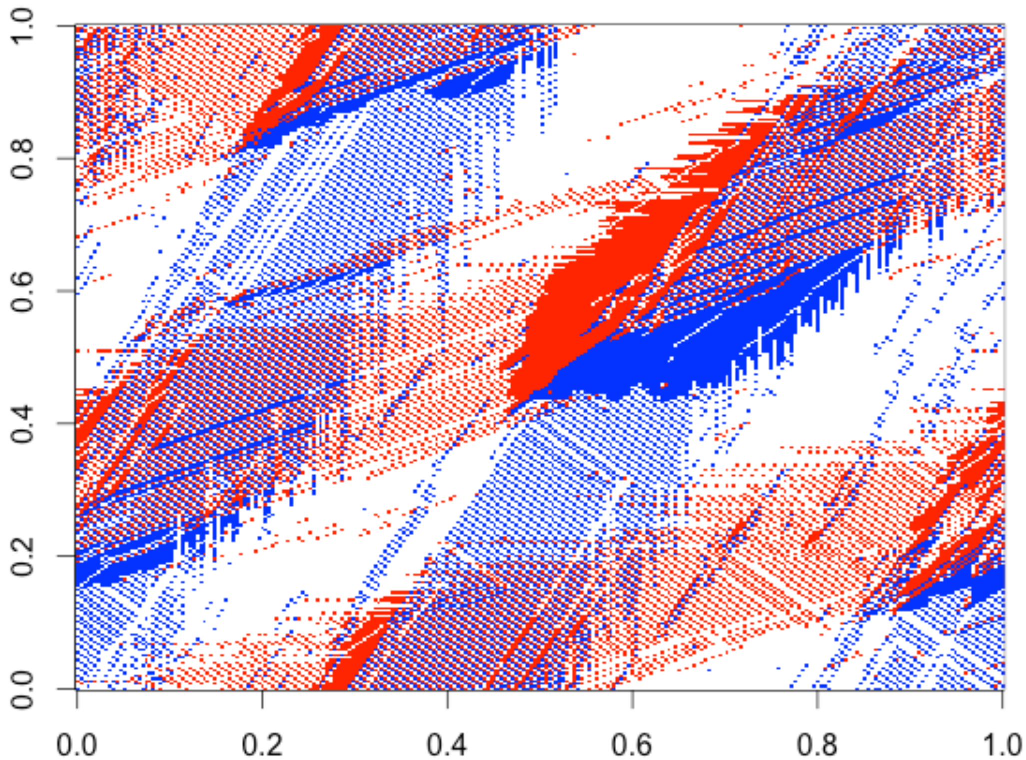


300x300 grid where p = 0.4 after gridlock

However, at the same p = 0.4 in a grid size of 256x256, there is no complete gridlock:

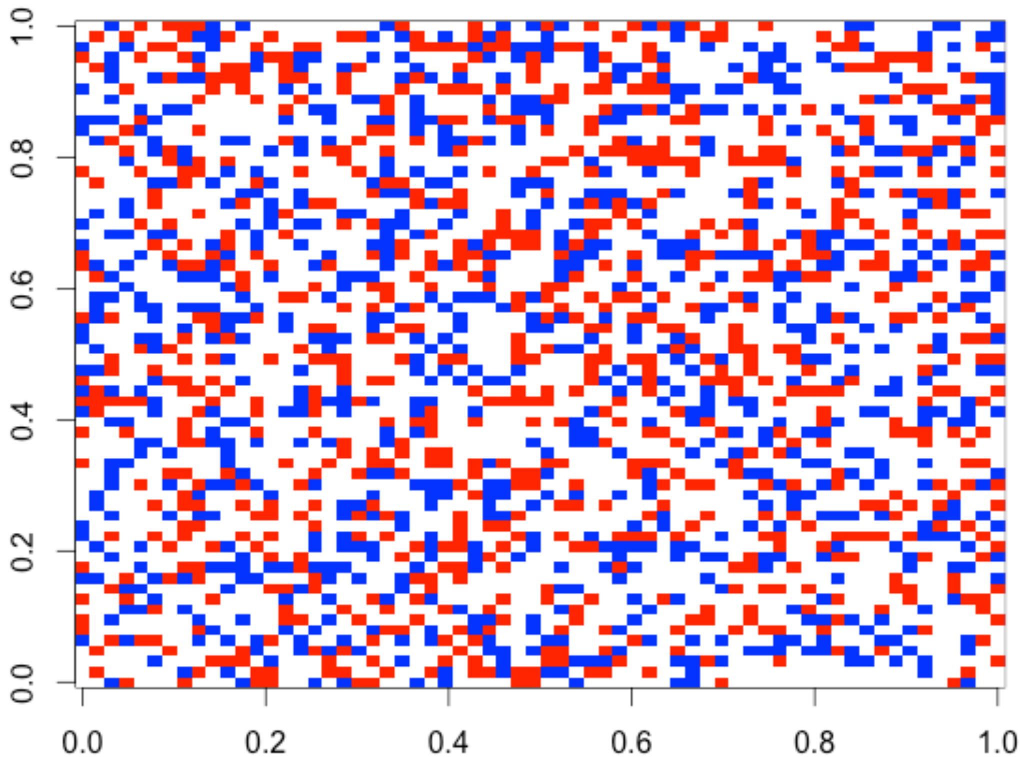


Initial 256x256 grid where p = 0.4

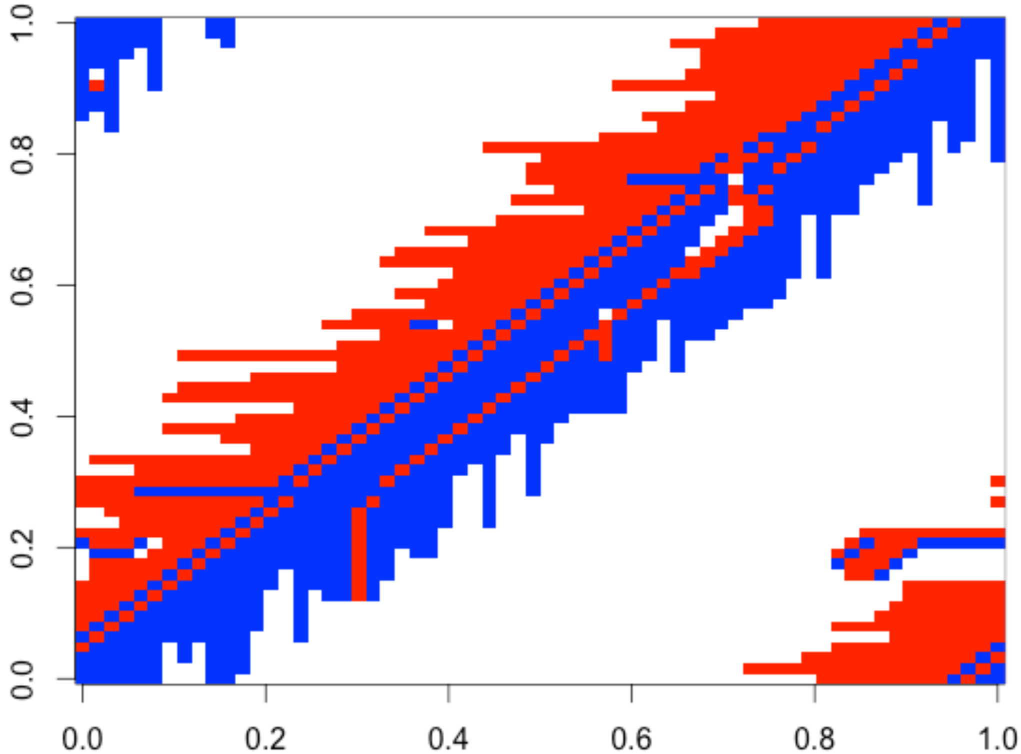


256x256 grid where p = 0.4 after 15,000 steps and still have not yet reached complete gridlock, only partial gridlock

Also from Table 1, it can be seen that at grid size of 300x300, there is a probability of 0.74 of gridlock at p = 0.4. At 256x256 at the same p of 0.4, it is less likely to reach gridlock. But at 64x64 and p = 0.4 there is also a large 0.81 probability to reach gridlock. This suggests that at smaller grid sizes and same p, the probability of reaching gridlock does not necessarily decrease. So grid sizes and p are not the only factors that affect gridlock behaviour.

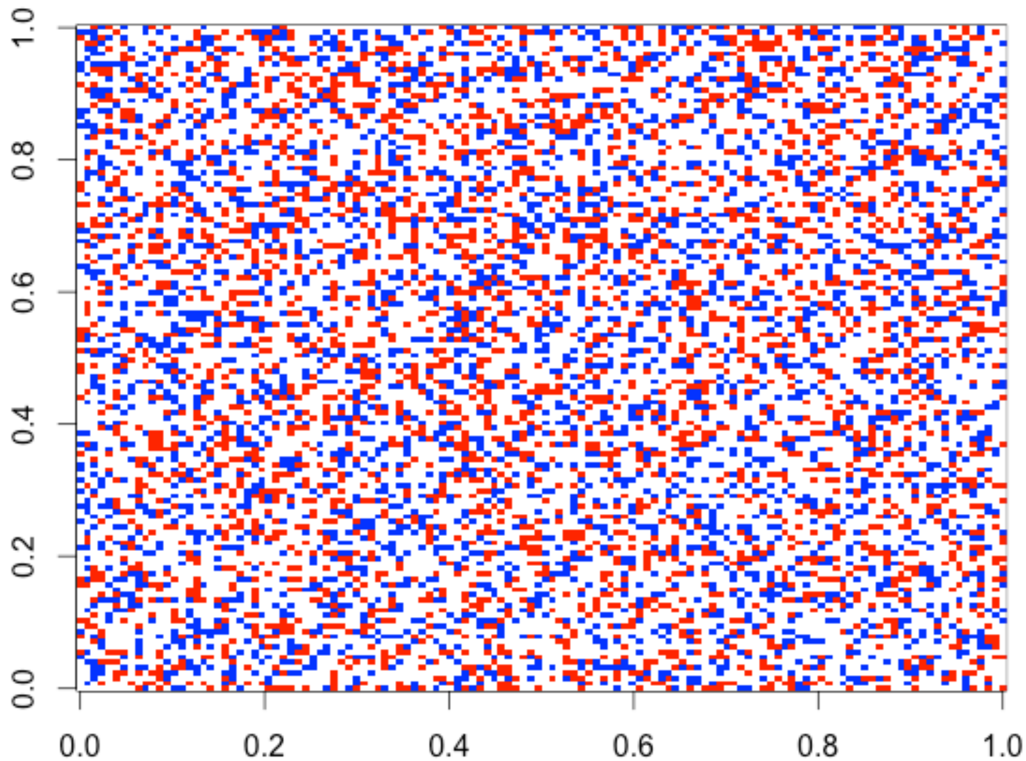


Initial 64x64 grid where p = 0.4

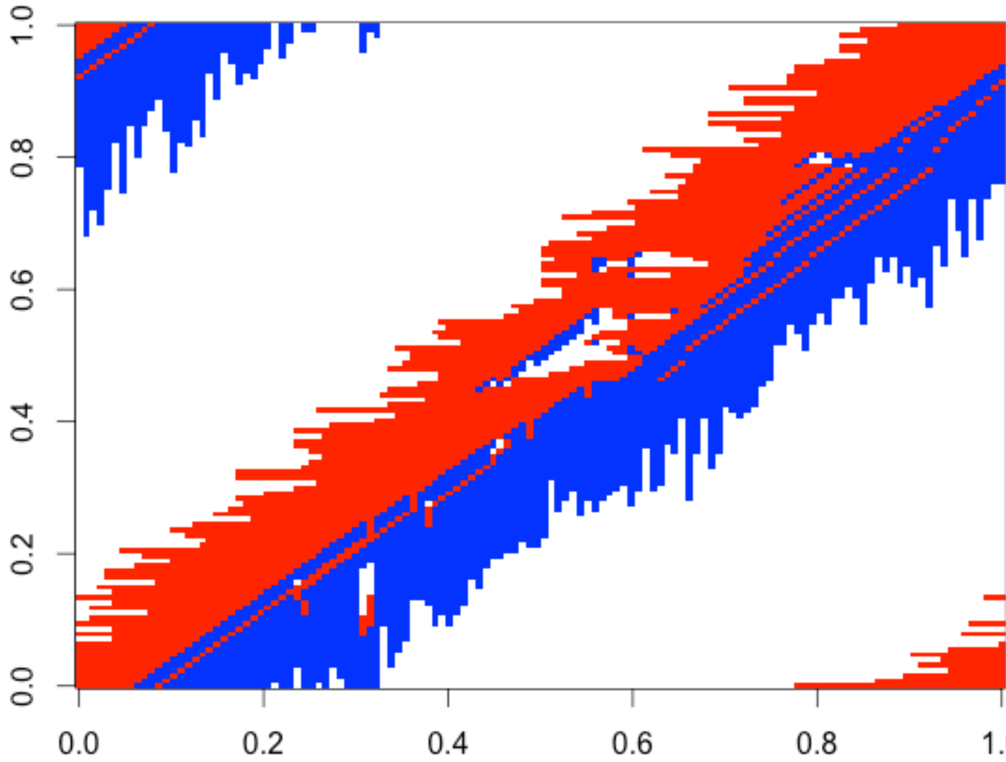


64x64 grid where p = 0.4 after gridlock

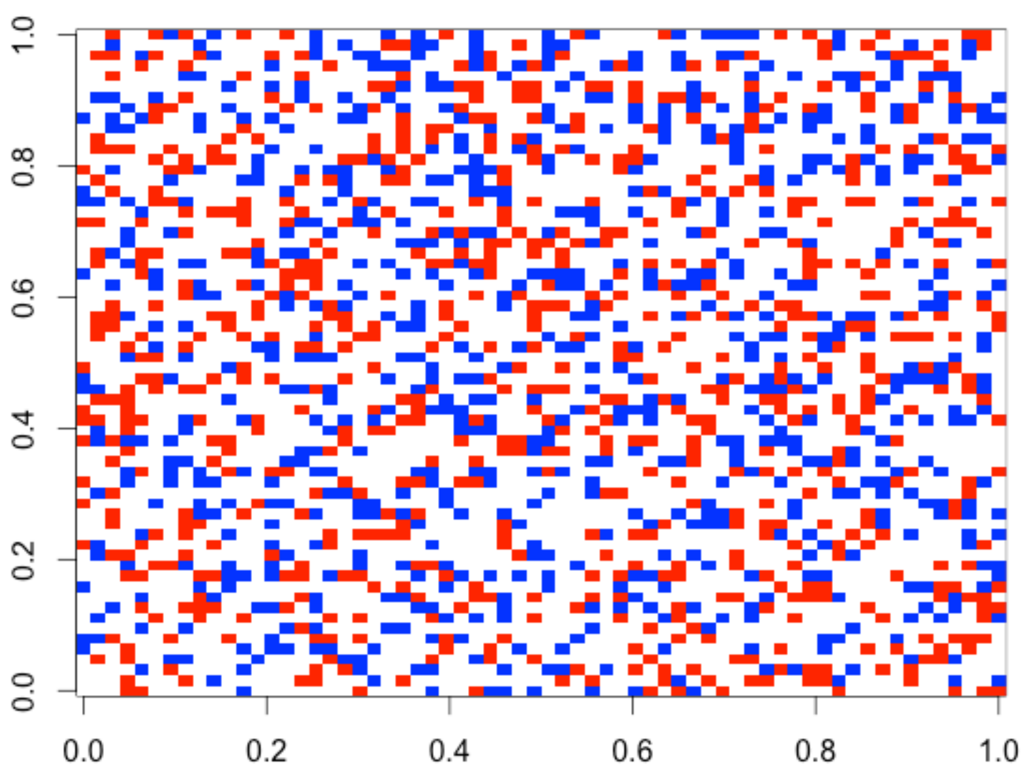
In attempting to find a critical *p* value where the probability of gridlock is greater than the probability of free-flowing traffic. I selected a grid size of 128x128 and 64x64 and used binary search to try to locate the *p* value:



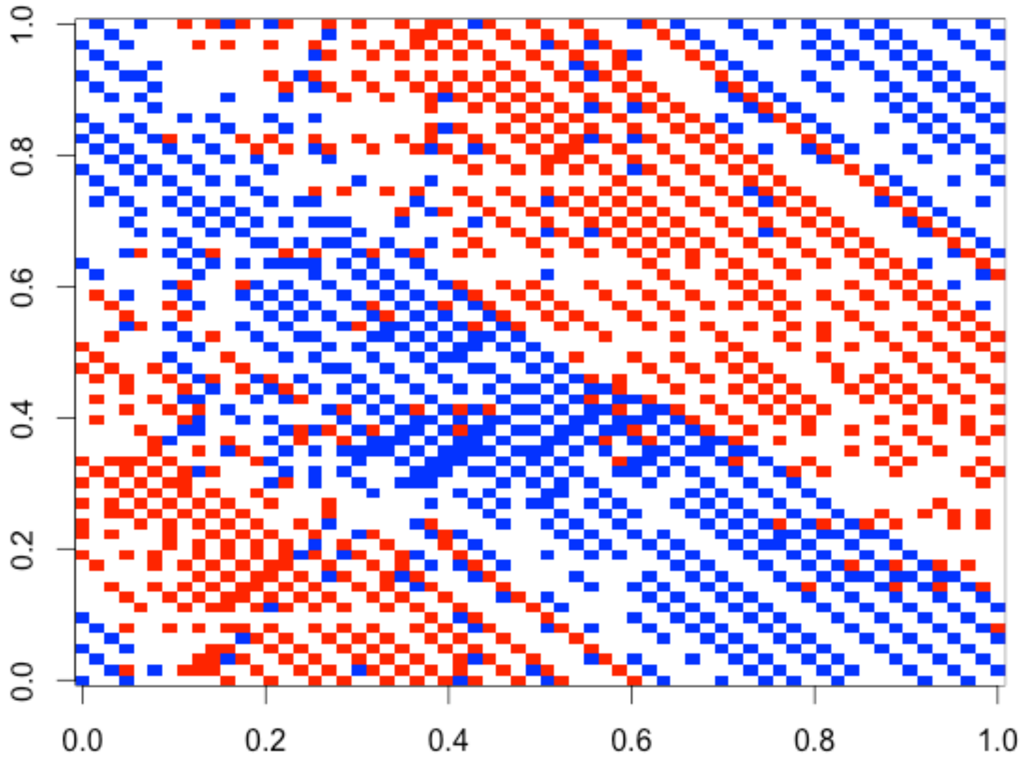
Initial 128x128 grid where p = 0.384



128x128 grid where p = 0.384 after gridlock



Initial 64x64 grid where p = 0.35

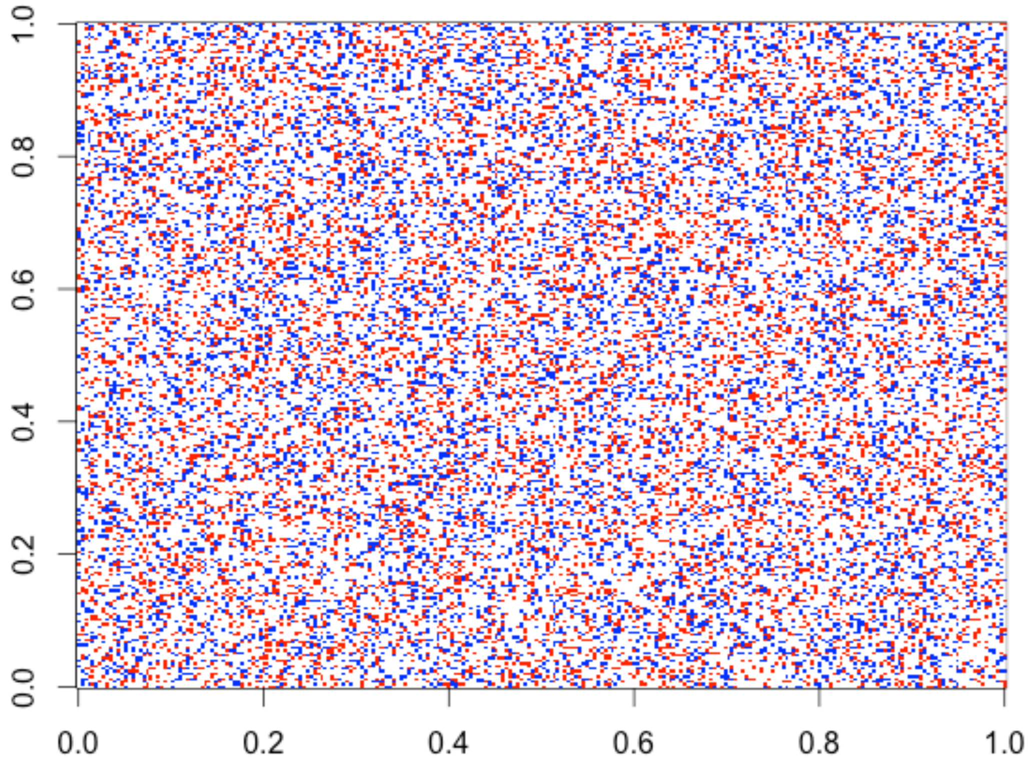


64x64 grid where p = 0.35 and gridlock is not reached after 15,000 steps

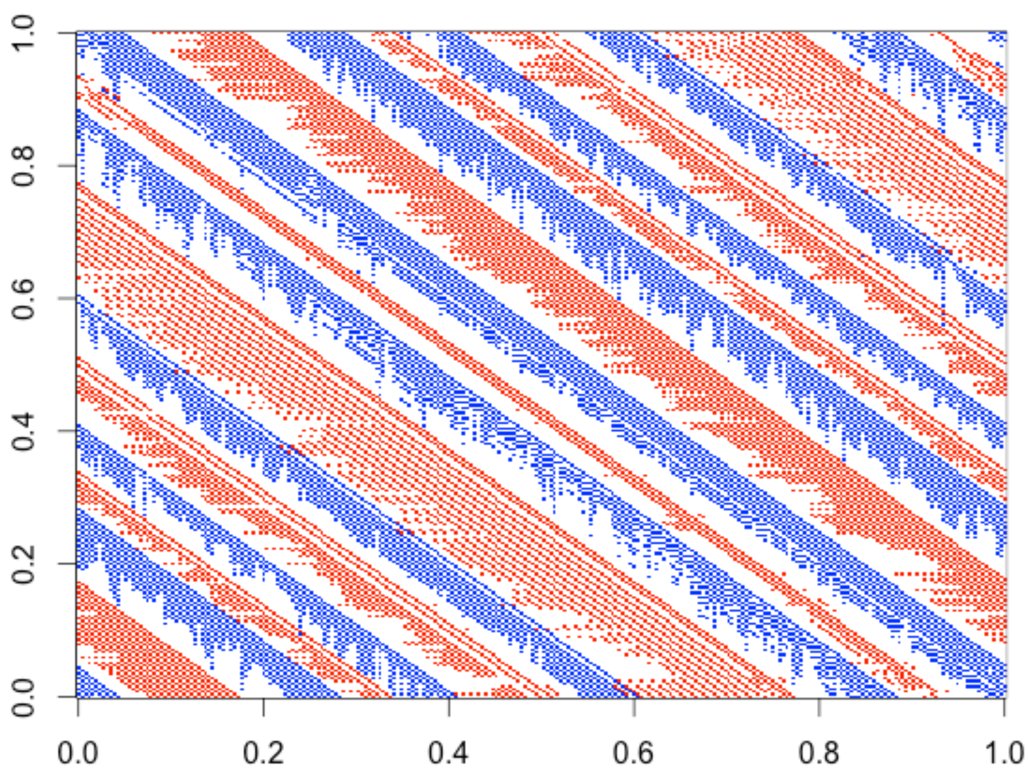
In narrowing down this *p* value, it can be seen from Table 1 that for grid size 128x128, this *p* value lies between **0.384 and 0.3825.**

And for grid size 64x64, this *p* value lies **close to 0.3875.**

I should also note that at grid size 128x128 and $p = 0.3875$, there is a 0.93 probability to reach gridlock. But at 64x64 grid size at same $p = 0.3875$, there is only a probability of 0.48 to reach gridlock. This again, suggests that grid size and *p* are not the only variables that affect gridlock behavior.



Initial 256x256 grid where p = 0.3



256x256 grid where p = 0.3 and traffic is still free-flowing

Table 1:

(Max number of steps is defined at 15,000 steps)

grid size (r=c)	p	average steps to gridlock	sd of steps to gridlock	% reach gridlock	how many reach gridlock	not reach gridlock	sample size
512	0.5	1698.35	493.53	100	200	0	200
300	0.5	1151.11	760.36	100	200	0	200
300	0.4	1932.79	1504.42	74	148	52	200
256	0.5	1061.03	879.39	99.5	199	1	200
128	0.3875	346.48	28.59	93	93	7	100
128	0.384	3520.02	4140.13	51	51	49	100
128	0.3825	2946.34	3521.08	47	47	53	100
128	0.381	2404.23	2712.56	44	44	56	100
128	0.375	2835.62	3075.78	33	66	134	200
128	0.35	4725.83	4446.79	9	18	182	200
64	0.4	4702.62	4024.24	81	81	19	100
64	0.3875	5276.13	4391.92	48	48	52	100
64	0.375	8286.88	4500.78	16	16	84	100
64	0.35	0	0	0	0	100	100