Analysis:

Nasch model with alpha and beta =0 : When both alpha and beta are zero, it implies that we are neither adding any new car, nor probabilistically removing any car from the last position. It is like an open road where, initially there are a certain number of cars/vehicles, and as time passes, these vehicles move, and depending on their velocity, they can exit the road. Hence, after a long enough time, the road becomes empty. (Refer to the plot)

Alpha<beta: This is the case where the probability of adding a new car is less than the probability of removing a car if it occupies the last position. This means that there is a higher chance that the car at the end of the road will be removed, and a new car will be added in front. As we can see in the plot, alpha is 0.3 and beta is 0.8. It is evident is the plot that the cars reaching the end of the road are removed more often than a new car is added. If alpha is much less than beta, as in the plot, alpha =0.01 and beta = 0.8. We see that there are almost no new cars added and cars at the end are removed.

Alpha=Beta: This is the case where the probability of adding new cars is same as the probability of removing a car from the last cell. Here, we do not see any interesting dynamics dependent on alpha or beta. There is normal traffic jam occurring.

Alpha>beta: This is the case where the probability of adding a new car is greater than the probability of removing a car if it occupies the last position. It implies that new cars will be added more often than they will be removed. The total number of cars on the road to increases after a certain time, and more of a traffic jam occurs in this case. This is evident in the plot.

For p = 0: This case means that the probability of a moving vehicle slowing down randomly is zero. Hence, the velocity can only decrease based on the second condition. This is evident in the plot.

For p = 1: This case means that the probability of a moving vehicle slowing down is 100%. The maximum increment in any vehicle is 1. So, if a car has zero speed at a previous step, it will increase to 1 due to the first condition, and then, if the velocity doesn't decrease by the second condition, it will certainly decrease to zero in the randomization step. Hence, a car with zero speed, will remain at zero. This is shown in the plot.

VDR: Velocity dependent randomization

In this case, the probability of a moving vehicle randomly sowing down depends on the speed of the car in the previous time step. The VDR implemented in this code is as follows:

$$probability = p_o \; if \; v = 0 \; and = \; p \; \; if \; v > 0$$

If we say that p_o>p, then this would mean that cars with zero speed in the previous time step have a higher chances of braking than those of moving cars.

In the code, we have used $p_o = 0.8$, and $p = 0.1$ and it can be seen that there is jam formation due to the cars with zero speed. There are higher chances that the car at rest will remain at rest even in the next time step. However, there is of course a non-zero probability that they can move. This can also be seen in the continued plot of VDR. The chances that the car already in motion can change its speed due to the other conditions in the Nasch model, but the probability that it will slow down at the randomization step are just 10%.