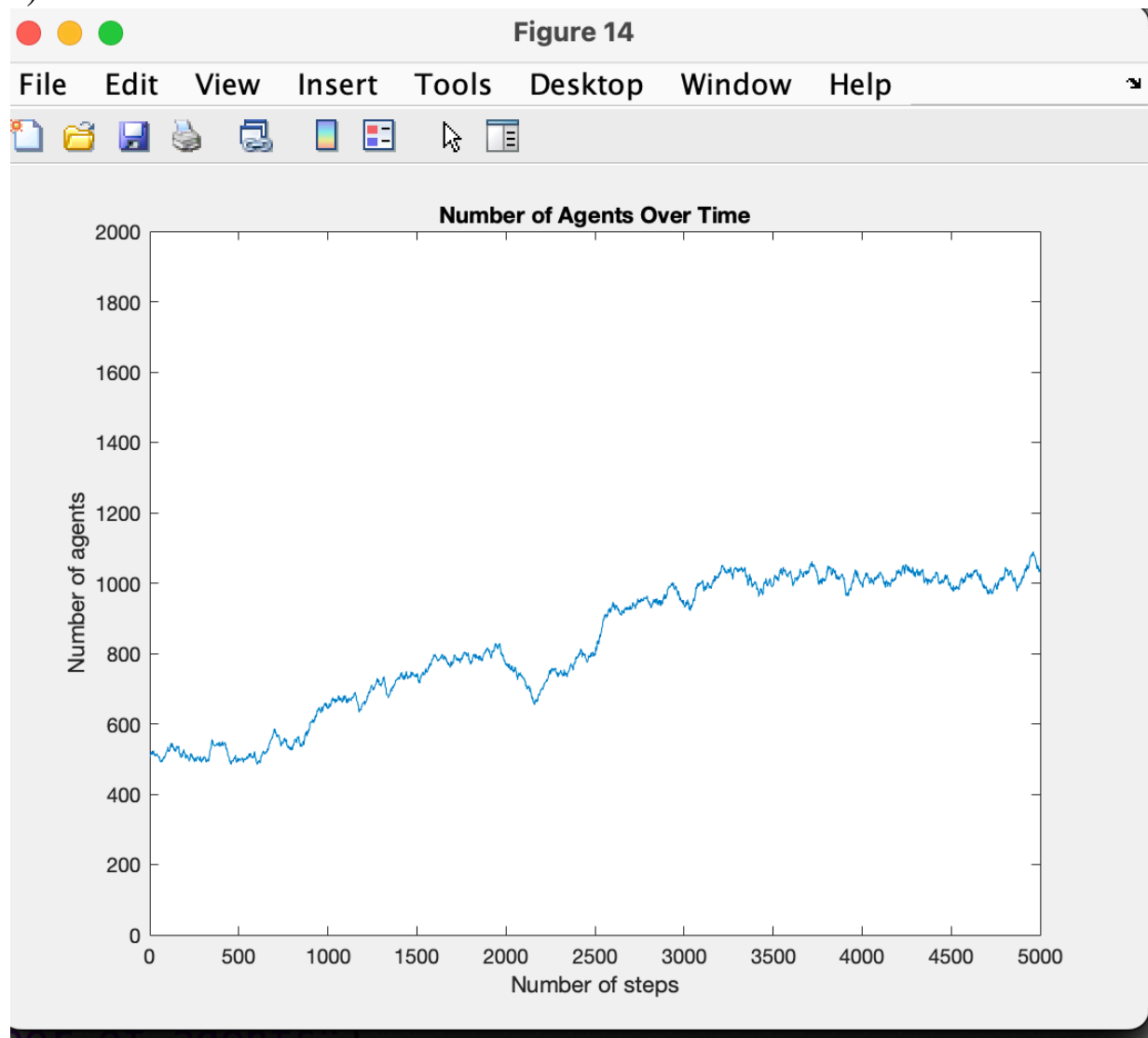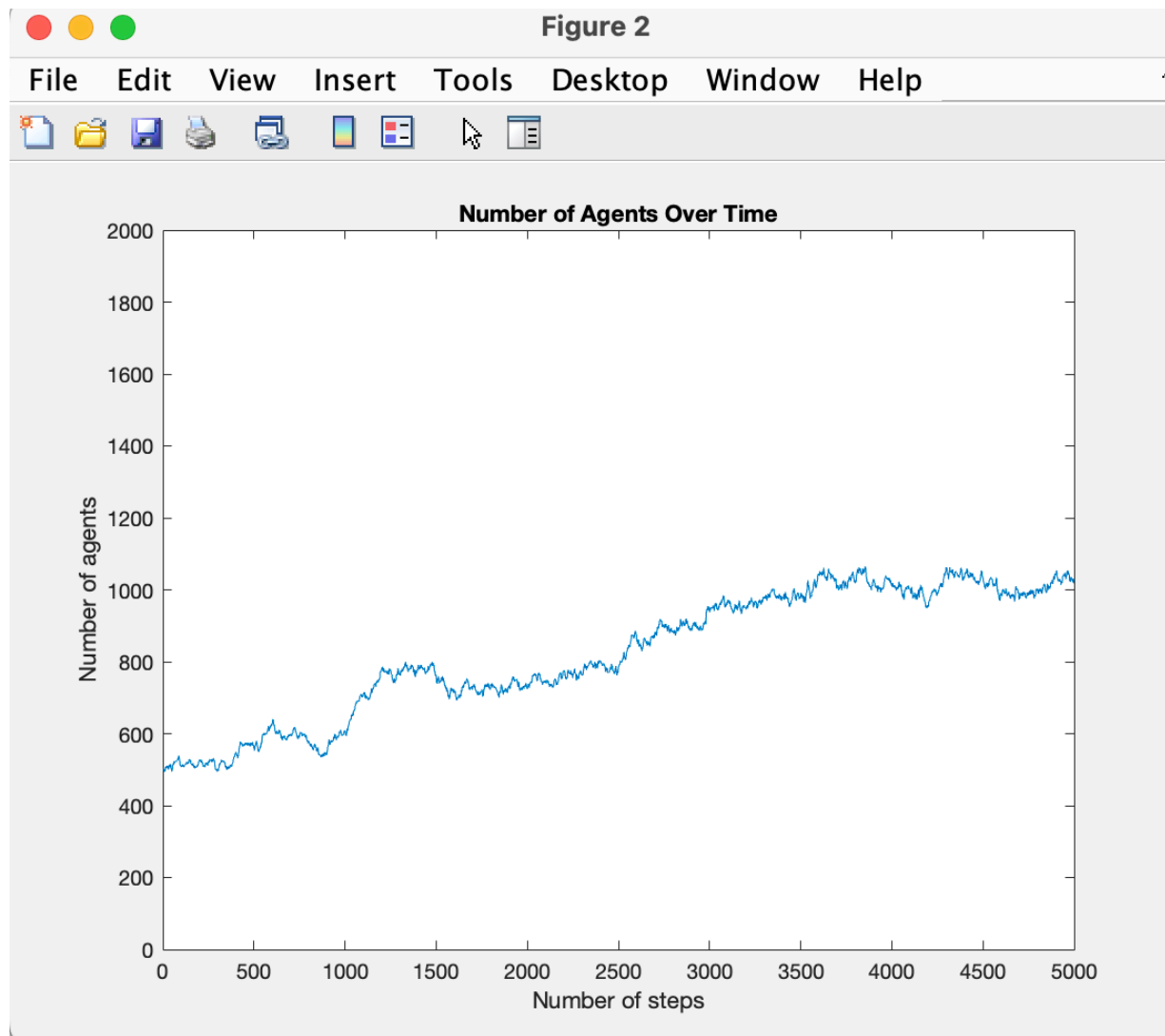a)

Output 1
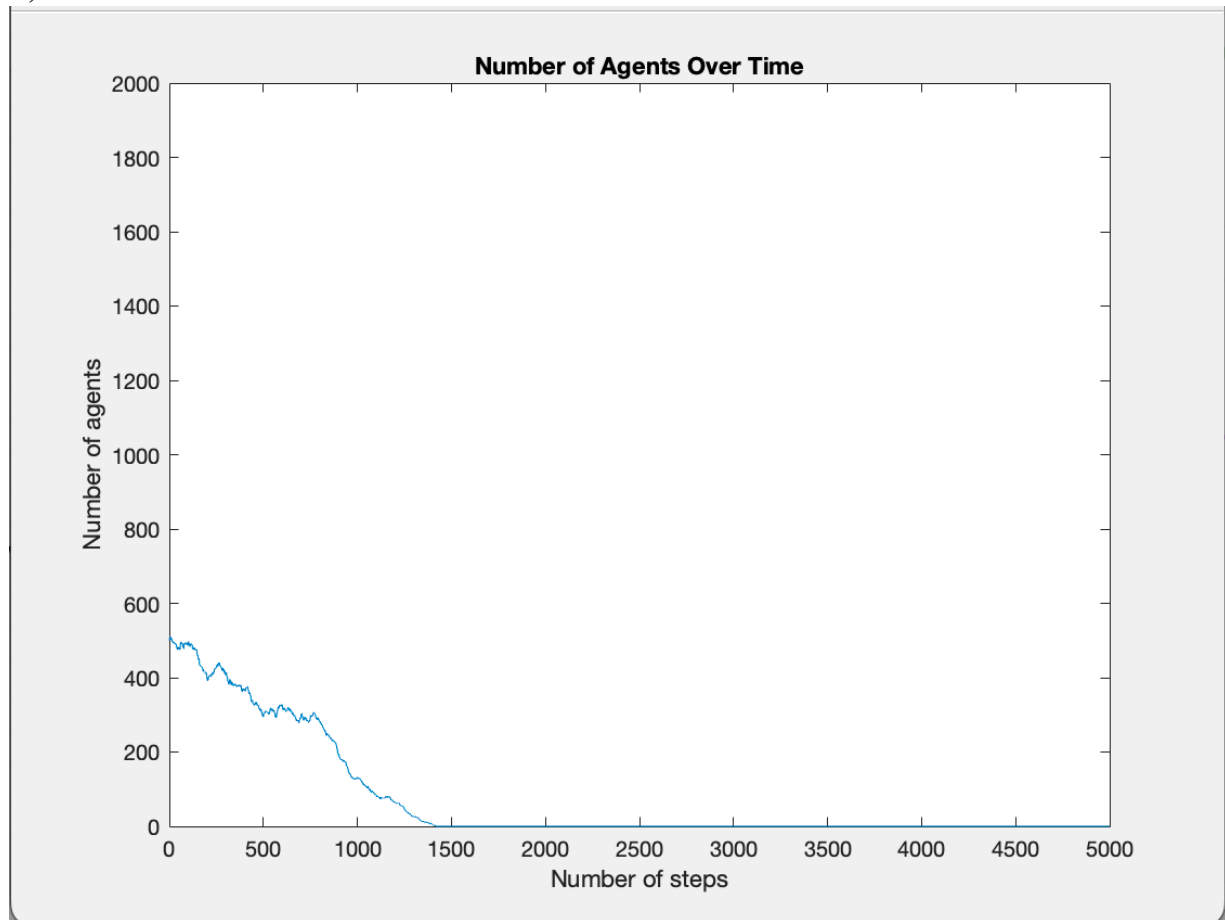
Output 2

The code sets the probability of offspring reproduction as 1/4. Also, it defines the condition that offspring reproduction occurs when there are 7, 8, 9, or 10 agents in the same cell.

During the simulation, it's observed that the number of agents generally increases, but there are significant decreases at certain points. For example, in Output 1, there is a notable decrease between 2000 and 2500 steps, while in Output 2, a similar decrease occurs between 500 and 1000 steps.

This phenomenon can be attributed to the specified condition that offspring-producing cells must contain $7, 8, 9,$ or 10 agents. As the number of agents in the simulation increases, it becomes more likely that a cell will contain more than 10 agents, which does not satisfy the reproduction condition. Consequently, fewer offspring are produced, leading to a sharp decrease in the overall number of agents.

b)

Output 1
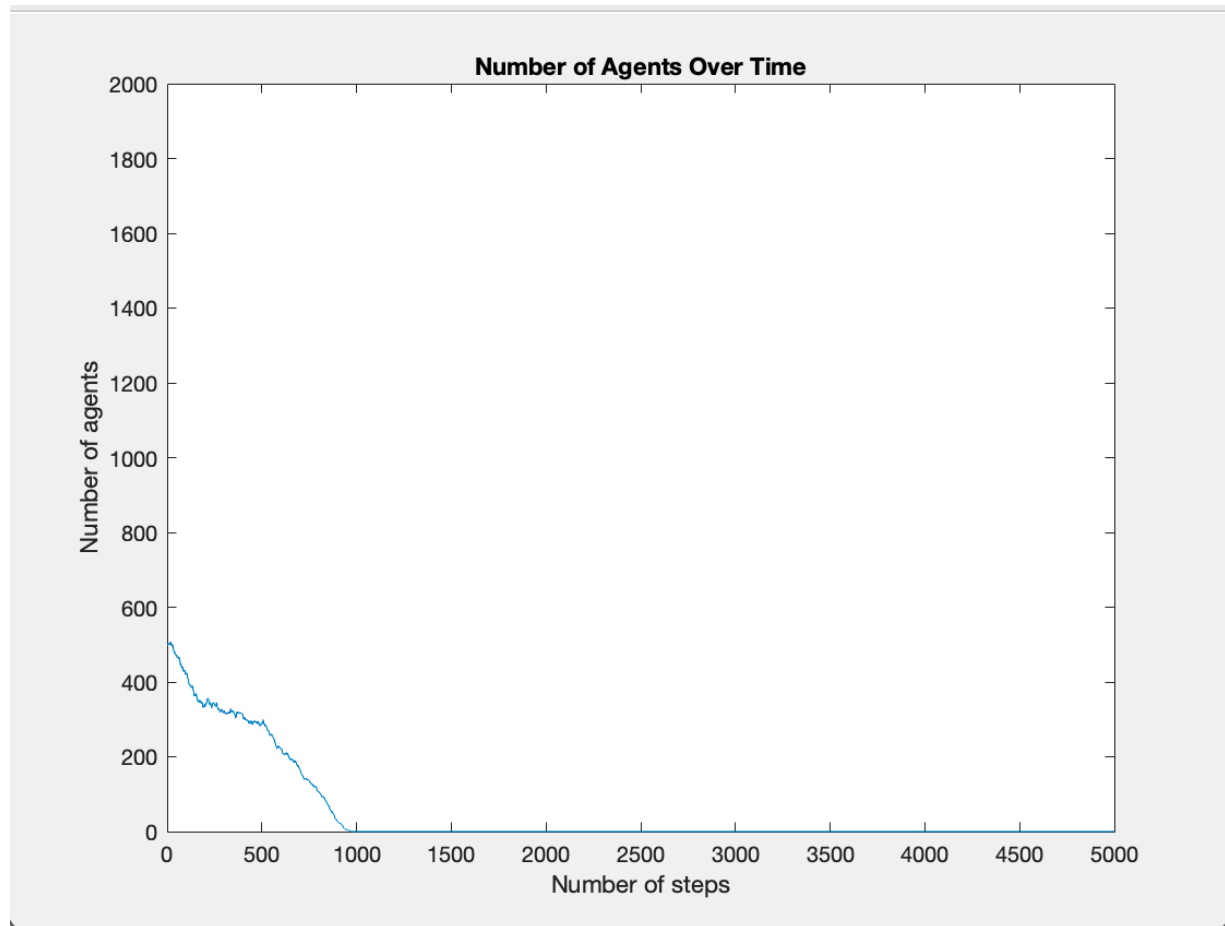
Output 2

Upon reducing the offspring reproduction probability from 0.25 to 0.2, a notable and swift drop in the agent count was noted, with all agents vanishing before the 1500-step threshold. Compared to earlier instances with higher probabilities (1/4 or 0.25), the 0.2 probability of offspring generation in cells with 7-10 agents equates to a very low rate of population expansion. This pace might not be adequate to offset the rate of agent loss due to mortality, thereby leading to an overall population decline.

c)

Output1

Number of Agents Over Time
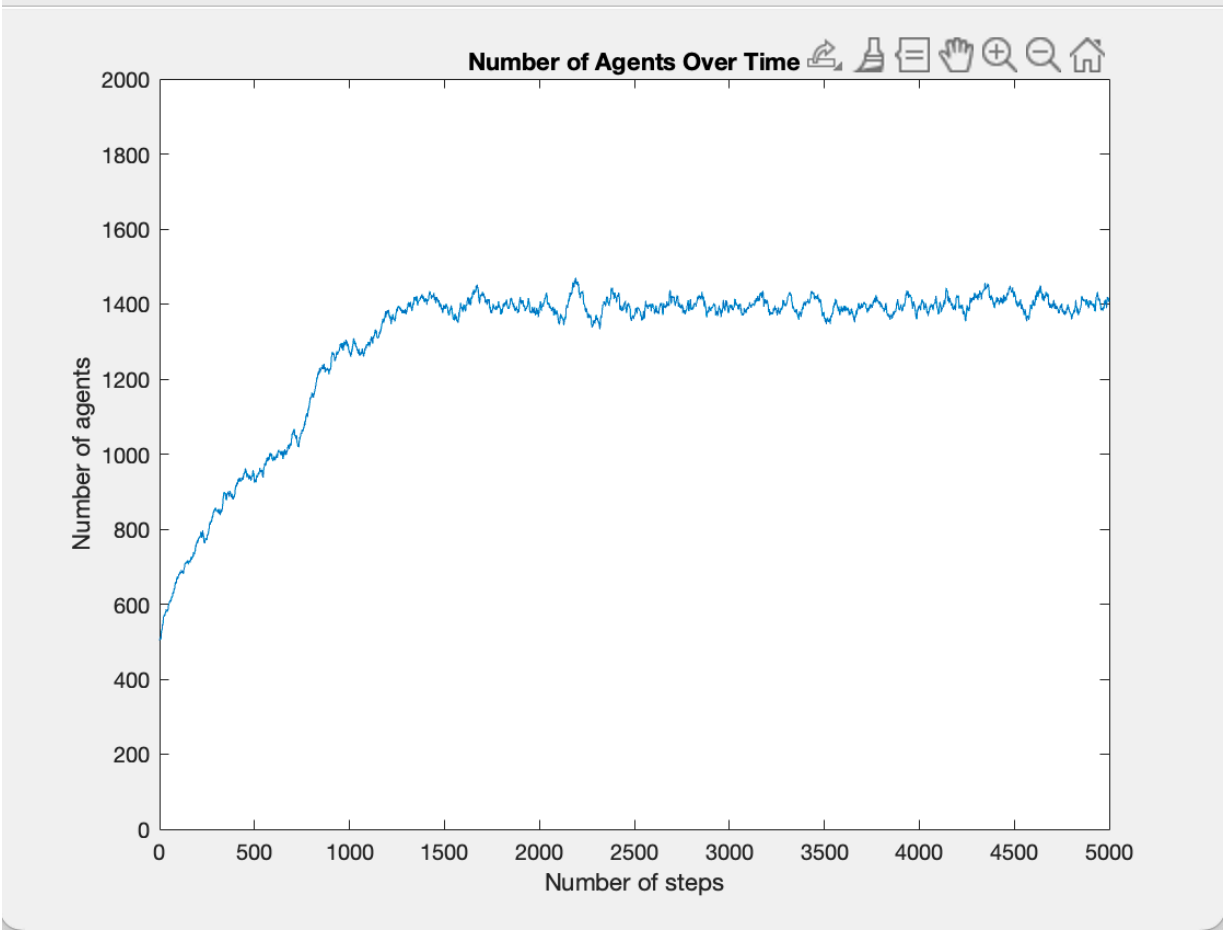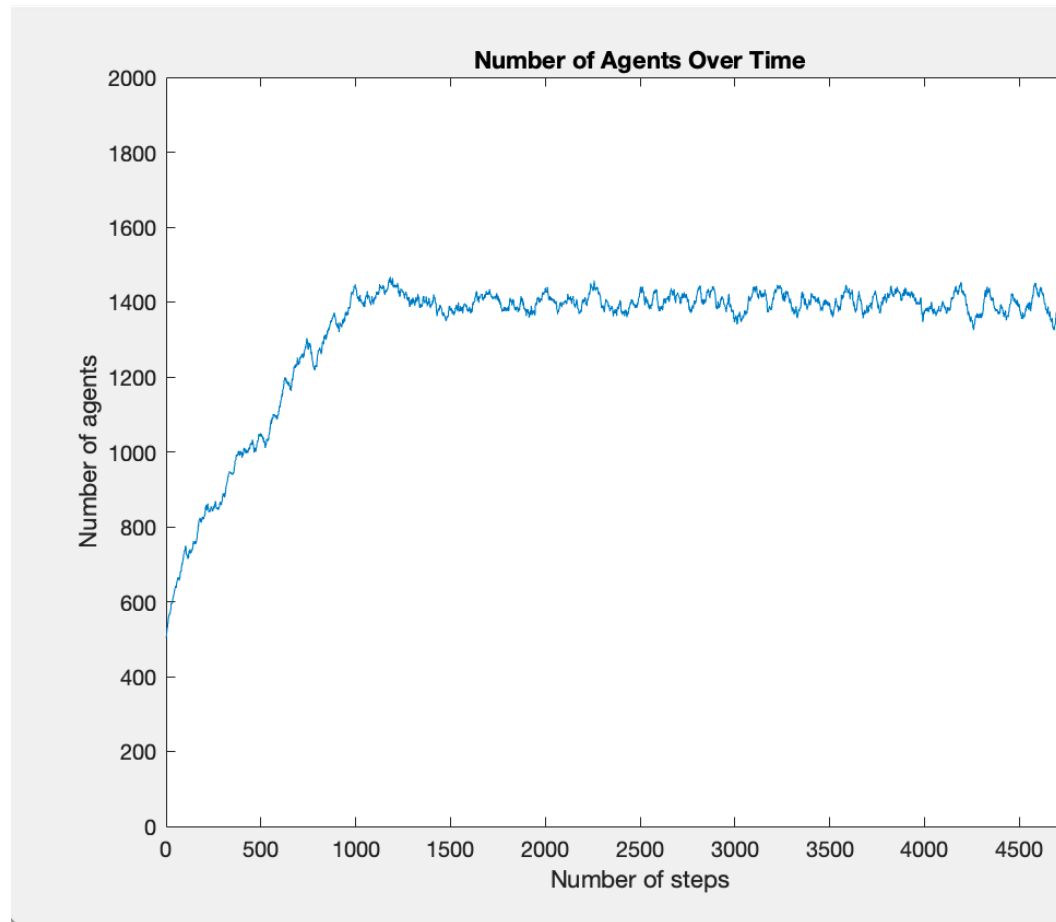
Output 2

When the offspring reproduction probability remains at 0.2 but the range of qualifying cell sizes increases from 7-10 to 7-15 agents, an intriguing pattern emerges in the graph. Following an initial ascent, the number of agents does not exhibit significant fluctuations around the 1000-step mark, indicating a relatively stable population. 1) Initial Rise: The population initially grows due to the broader range of cell sizes (7-15 agents) eligible for reproduction, which increases the average reproduction rate compared to the earlier range of 7-10 agents. 2) Minor Fluctuations: The slight oscillations observed within the stable population are attributable to the inherent randomness in the probability of offspring creation (1/5).