Ex1b1)
By setting the number of X2 to 2, we reduce the initial number of infected individuals in our simulations.
The three most probable reactions, in order of likelihood, are:

1. r3, through which new individuals become infected.
2. r4 and r5, both with equal probability, where the infected either die or recover and gain immunity to the disease, respectively.

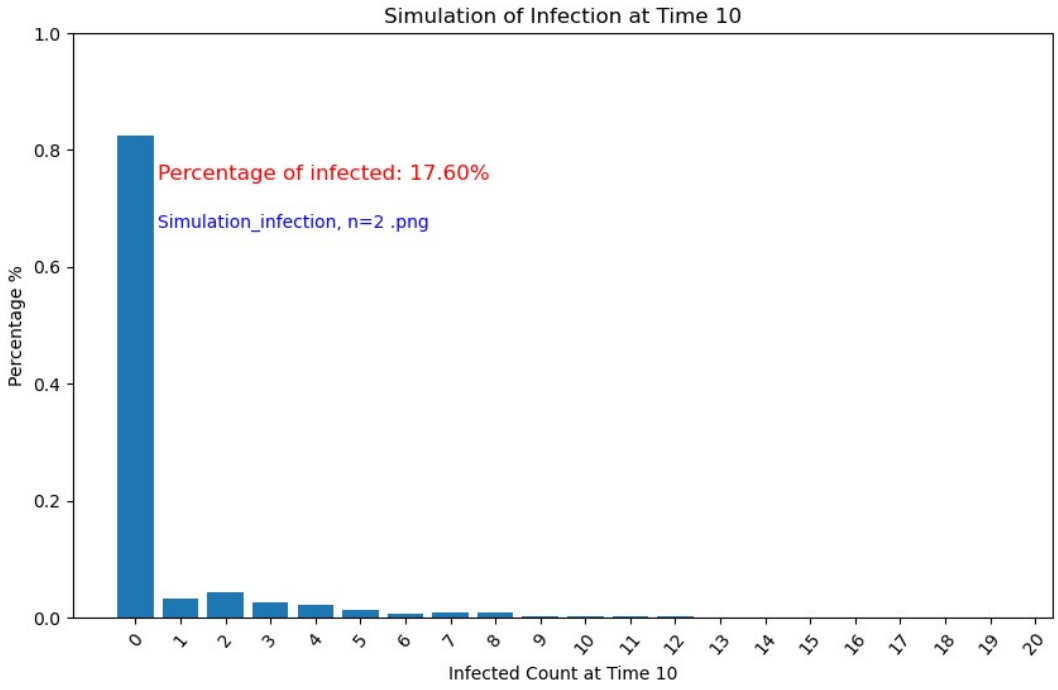
Since the dominant event involves the loss of infected individuals, it is natural to expect that, by time t=10, the total number of infected individuals would reach zero.

The following reactions are described:

r3:X1*X2*10−5

r4:X2*0.3

r5:X2*0.3

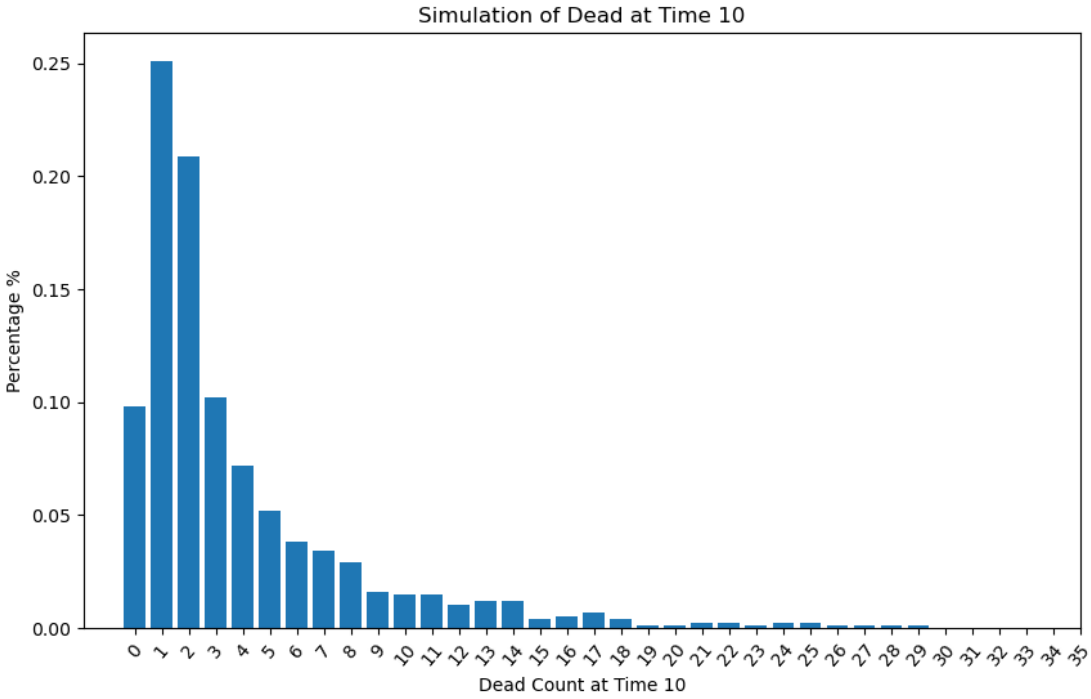


The proportion of individuals still infected in our simulation is 17.60%.

Ex1b2) The plot shows the results of 1,000 simulations, representing the distribution of the total number of dead individuals at time t=10. While the overall trend remains consistent, we observe some differences in the distribution compared to earlier runs.

1. The most frequent outcomes are concentrated around 0 to 5 dead individuals, having a mean of 3.6 dead individuals and a standard deviation of 4.1 .
2. The distribution exhibits a right-skewed shape.
3. Rare events where more than 20 individuals die occur with very low probability.

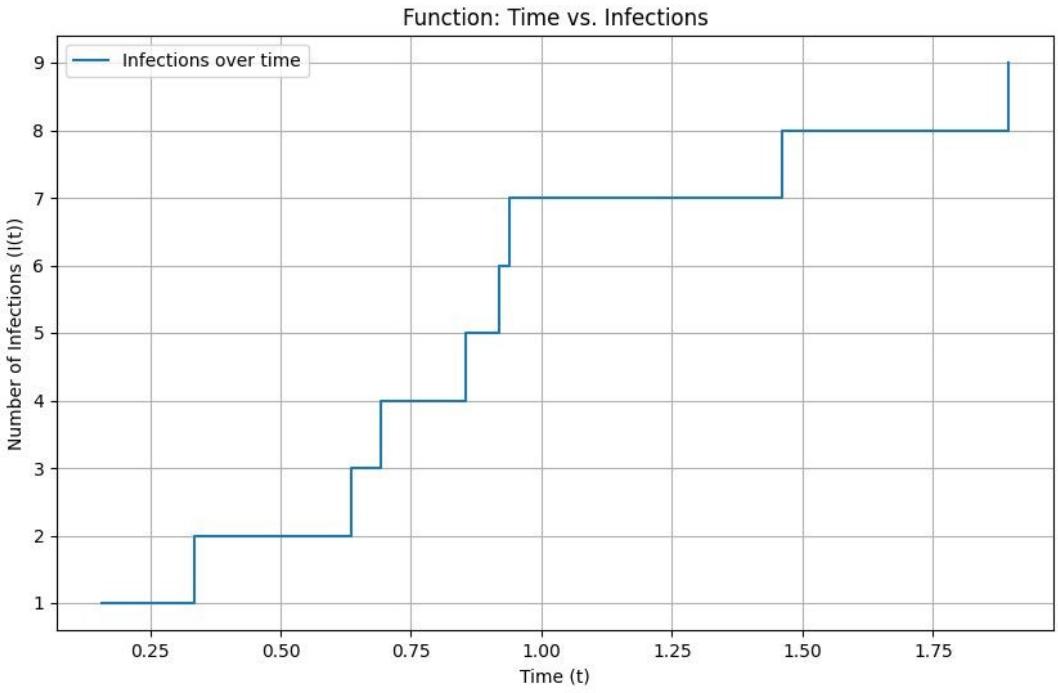
This visualization reflects the stochastic nature of the simulation, and it is different from the infected distribution plot.

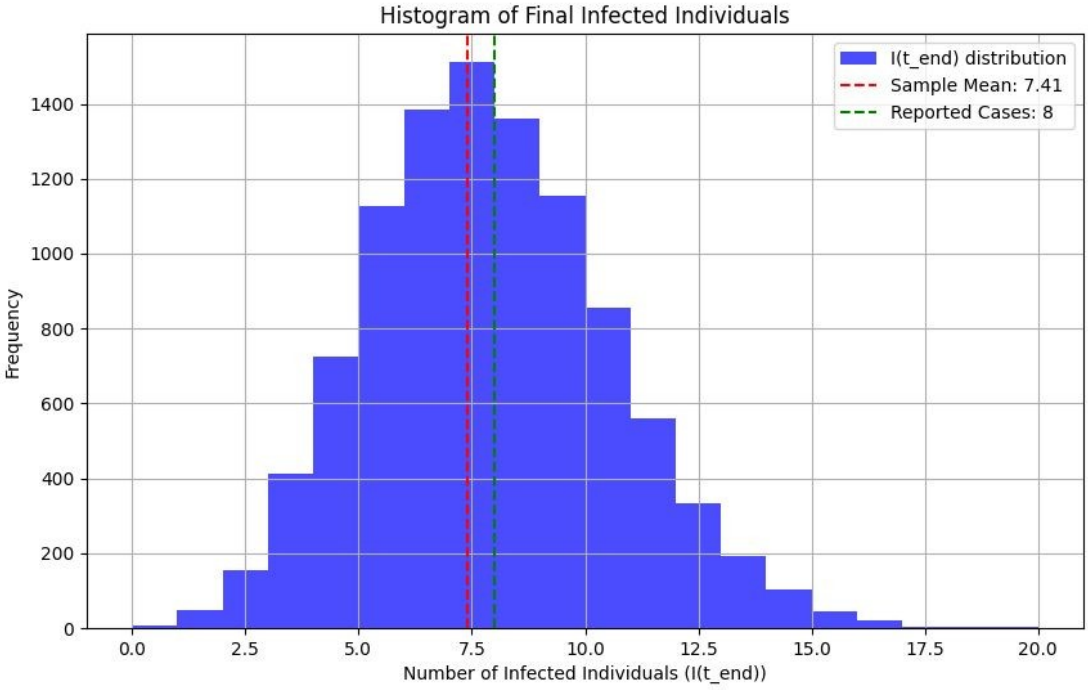


Task 2

a)The difference is due to the stochastic nature of the simulations, where randomness determines which individuals get infected and which drop out.

b)To evaluate the effectiveness of the vaccine, compare the simulation results with real-world outcomes. Repeat the trials, gather results from each trial, and create a range (confidence interval) to ensure that the real-world clinical results fall within this range. This is essential because a single trial cannot represent all possible outcomes. Additionally, identify the importance of each parameter in influencing the results. Running simulations multiple times increases the robustness and reliability of the findings.


Function: Time vs. Infections
Infections over time
Number of Infections (I(t))
Time (t)
1
2
3
4
5
6
7
8
9
0.25
0.50
0.75
1.00
1.25
1.50
1.75


Histogram of Final Infected Individuals
I(t_end) distribution
Sample Mean: 7.41
Reported Cases: 8
Frequency
Number of Infected Individuals (I(t_end))
0
200
400
600
800
1000
1200
1400
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0