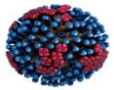
Provided Information



G3M2 Virus

developing two different single-vial vaccines

Manufacturer 1

vaccines need to stored in a temperature-controlled case

Manufacturer 2

Agency

got permission to store 4 vaccines at a time

if no vaccine in the stock at the end of the day, will be delivered the following morning before the agency opens.

very few takers worrying about the side-effects

no of vials administered during a day

0 (50 %) *1(25 %)* *2(25 %)*

Problem Statement

Estimation of the probability of losing an order(we are sending candidates back) on any given day

- Point estimation
- Interval estimation

P(losing an order on any given day) = P(no of candidates come > no of vaccines at time of opening on that day)

Possible cases are

No of vaccines at the time of opening	No of candidates come on that day
1	>1
2	>2
3	>3
4	>4

Note : Since no of vials potentially administered in a day will not be exceeding 2 , we will be left with only the first case. Hence,

The required probability = P(no of vaccines at the time of opening = 1 , no of candidates came = 2)

= P(no of vaccines at the time of opening = 1) * 0.25 [as these events will not depend on each other]

Markov Chain and Transition Probability Matrix

Define X(n) = no of vaccines available at the time of opening on nth day

{ X(n) , n>=1} will be an Markov Chain and X(n) = 1,2,3,4 and tpm,

P =

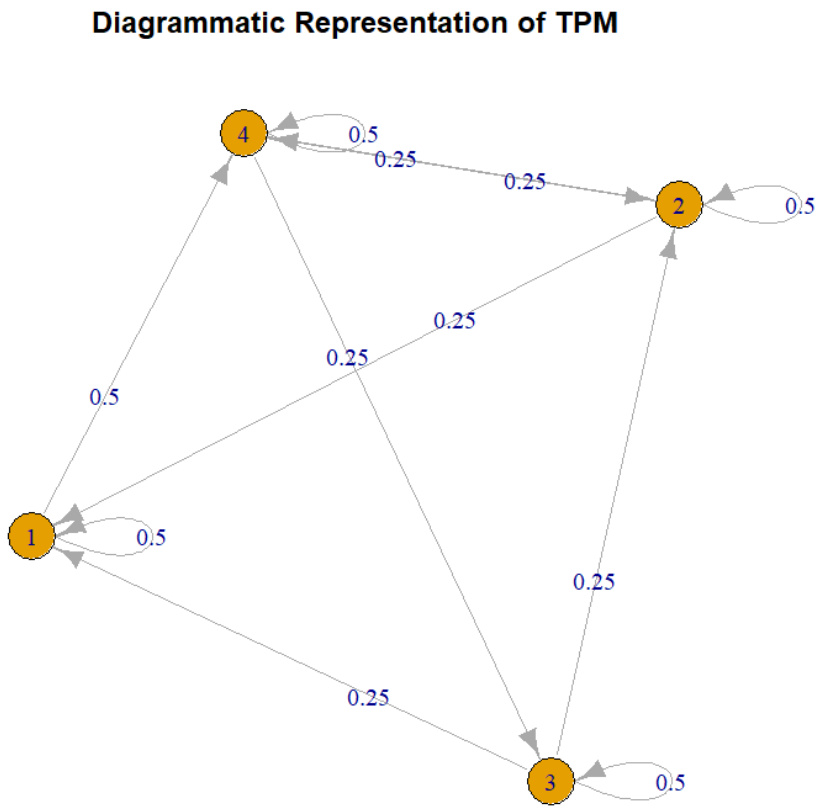
X (n) \ X (n+1)	1	2	3	4
1	0.5	0	0	0.5
2	0.25	0.5	0	0.25
3	0.25	0.25	0.5	0
4	0	0.25	0.25	0.5

Here we will take X(0) = 4 as on the initial day we must have 4 vials and then by generating 1000 samples of the Markov Chain { X(1), X(2)….X(100) } , we will get P(no of vaccines at the time of opening = 1) for each sample and hence will get the estimations.

Point Estimation

Estd. P(no of vaccines at the time of opening = 1) = 0.212

Estd. P(losing an order on any given day) = 0.053

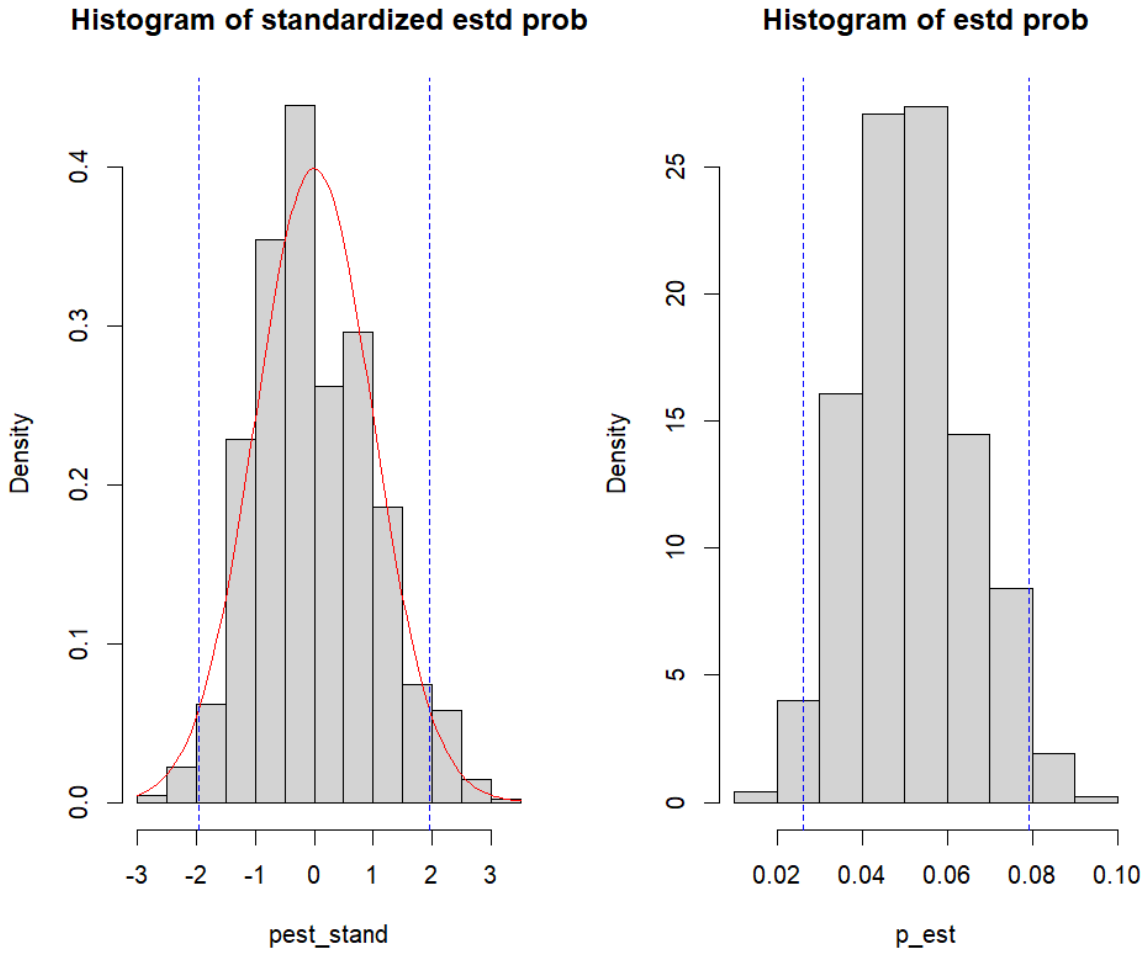


Interval Estimation

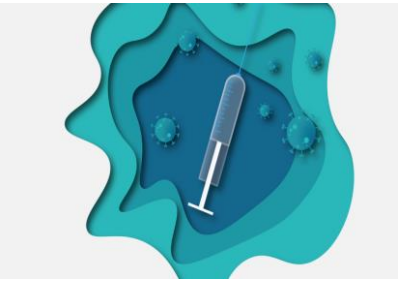
95 % Confidence Interval :

Lower Bound = 0.0261

Upper Bound = 0.0792



Conclusion



Observations :

- In the given problem we encountered that each day no more than 2 vials will be administered which seems to be a bit rare event even though the fact that the vaccines have been developed within a very short time period.
- We needed to do some adjustments in the 4^{th} column of matrix P to make it a tpm.

The estimated probability is around 0.053 which means we are not losing that much order mainly because of very low number of potential candidates interested to take vaccines.