

1 Lesson 15 Additional Exercise 1

A medical researcher is recruiting 20 subjects for a study on an experimental drug for COVID-19. Each person that she interviews has a 60% chance of being eligible to participate in the study. What is the probability that she will have to interview more than 40 people?

2 Answer

This problem can be modeled using the negative binomial distribution. The number of interviews required to recruit a fixed number of subjects follows a negative binomial distribution, where:

- $r = 20$ is the number of eligible subjects (successes),
- $p = 0.6$ is the probability that any given person is eligible (success),
- We want to find the probability that the researcher will have to interview more than 40 people.

To compute this, we can use the complement rule:

$$P(X > 40) = 1 - P(X \leq 40)$$

Where $P(X \leq 40)$ is the cumulative distribution function (CDF) of the negative binomial distribution. Since $P(X \leq 40)$ includes $P(X = 20)$ to $P(X = 40)$, we can compute the sum of the probabilities for X in the range 20 to 40 and subtract this from 1.

The Symulate code to solve this is:

```
from symbluate import *

# Negative binomial distribution parameters
r = 20 # Number of eligible subjects
p = 0.6 # Probability of each interviewee being eligible

# Calculate the probability that more than 40 people are interviewed
probs = NegativeBinomial(r=20, p=0.60).pmf(range(20, 41))
1 - sum(probs)
```

Conclusion

Using this code, we calculate that the probability that the researcher will have to interview more than 40 people is approximately 0.0744, or 7.44%.