

The Negative Binomial Distribution

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Practice problems

1. A basketball player has a success rate of 0.3 for three-point shots. What is the probability that their 4th successful shot occurs on their 7th attempt?
2. A software tester finds a critical bug in a module with probability 0.2 per test case. How many test cases should the tester expect to run to find 6 critical bugs?
3. A fair coin is flipped until 3 tails appear. What is the probability that this happens on the 6th flip?

Solutions

1. A basketball player has a success rate of 0.3 for three-point shots. What is the probability that their 4th successful shot occurs on their 7th attempt?

- Identify parameters: $r = 4$, $k = 7$, and $p = 0.3$.
- Use the negative binomial formula: $P(X = 7) = \binom{7-1}{4-1}(0.3)^4(1 - 0.3)^{7-4}$.
- Calculate the combination: $\binom{6}{3} = 20$.
- Calculate the powers: $(0.3)^4 = 0.0081$ and $(0.7)^3 = 0.343$.
- Multiply together: $20 \cdot 0.0081 \cdot 0.343 = 0.055566$.

Answer: 0.0556

2. A software tester finds a critical bug in a module with probability 0.2 per test case. How many test cases should the tester expect to run to find 6 critical bugs?

- Identify parameters: $r = 6$ and $p = 0.2$.
- Use the expected value formula for the negative binomial distribution: $E[X] = \frac{r}{p}$.
- Substitute the values: $E[X] = \frac{6}{0.2}$.
- Calculate the result: $6 \div 0.2 = 30$.

Answer: 30

3. A fair coin is flipped until 3 tails appear. What is the probability that this happens on the 6th flip?

- Identify parameters: $r = 3$, $k = 6$, and $p = 0.5$.
- Use the formula: $P(X = 6) = \binom{6-1}{3-1}(0.5)^3(0.5)^{6-3}$.
- Calculate the combination: $\binom{5}{2} = 10$.
- Calculate the powers: $(0.5)^3 \cdot (0.5)^3 = (0.5)^6 = 0.015625$.
- Multiply together: $10 \cdot 0.015625 = 0.15625$.

Answer: 0.1563