1 General knowledge

Give the definitions and a few properties of the perpendicular bisectors and altitudes in a triangle.

2 Document

Pepys’ problem

The binomial distribution

\[ P(X_n) = \binom{n}{k} p^k (1 - p)^{n-k} \text{ for } k = 0, 1, \ldots, n. \]

The distribution with this density function is known as the *binomial distribution* with parameters \( n \) and \( p \). The binomial family of distributions is one of the most important in probability.

Famous problems : Pepys’ problem

In 1693, Samuel Pepys asked Isaac Newton whether it is more likely to get at least one ace in 6 rolls of a die or at least two aces in 12 rolls of a die. This problem is known as Pepys’ problem; naturally, Pepys had fair dice in mind.

Guess the answer to Pepys’ problem based on empirical data. With fair dice and \( n = 6 \), run the simulation of the dice experiment 500 times and compute the relative frequency of at least one ace. Now with \( n = 12 \), run the simulation 500 times and compute the relative frequency of at least two aces. Compare the results.

From the *Virtual Laboratories in Probability and Statistics*.

3 Questions

1. Explain why the binomial distribution is indeed a probability distribution.
2. Explain the sentence “Pepys had fair dice in mind”.
3. How would you carry out the simulation proposed in this text?
4. What do you think the result might be?
5. Solve Pepys’ problem using the binomial distribution.