

Épreuve de section européenne

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

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

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.