

The Hypergeometric Probability Distribution

- (1) A hung jury is one that is unable to reach a unanimous decision. Suppose that a pool of twenty-five potential jurors is assigned to a murder case where the evidence is so overwhelming against the defendant that twenty-three of the twenty-five would return a guilty verdict. The other two potential jurors would vote to acquit regardless of the facts. What is the probability that a twelve-member panel chosen at random from the pool of twenty-five will be unable to reach a unanimous decision?
- (2) A tax collector, finding himself short of funds, delayed depositing a large property tax payment ten different times. The money was subsequently repaid, and the whole amount deposited in the proper account. The tip-off to this behavior was the delay of the deposit. During the period of these irregularities, there was a total of 470 tax collections.

An auditing firm was preparing to do a routine annual audit of these transactions. They decided to randomly sample nineteen of the collections (approximately 4%) of the payments. The auditors would assume a pattern of malfeasance only if they saw three or more irregularities. What is the probability that three or more of the delayed deposits would be chosen in this sample?

Discrete Probability Function

- (1) Ace-six flats are a type of crooked dice where the cube is foreshortened in the one-six direction, the effect being that 1's and 6's are more likely to occur than any of the other four faces. Let $p(s)$ denote the probability that the face showing is s . For many ace-six flats, the "cube" is asymmetric to the extent that $p(1) = p(6) = 14$, while $p(2) = p(3) = p(4) = p(5) = 18$. Notice that $p(s)$ here qualifies as a discrete probability function because each $p(s)$ is greater than or equal to 0 and the sum of $p(s)$, over all s , is 1. Suppose A is the event that an even number occurs. Then

$$P(A) = P(2) + P(4) + P(6) = \frac{1}{8} + \frac{1}{8} + \frac{1}{4} = \frac{1}{2}.$$

- (2) Suppose a fair coin is tossed until a head comes up for the first time. What are the chances of that happening on an odd-numbered toss?

The Probability Density Function

- (1) As part of her warm-up drill, each player on State's basketball team is required to shoot free throws until two baskets are made. If Rhonda has a 65% success rate at the foul line, what is the pdf of the random variable X that describes the number of throws it takes her to complete the drill? Assume that individual throws constitute independent events.

The Negative Binomial Distribution

- (1) An underground military installation is fortified to the extent that it can withstand up to three direct hits from air-to-surface missiles and still function. Suppose an enemy aircraft is armed with missiles, each having a 30% chance of scoring a direct hit. What is the probability that the installation will be destroyed with the seventh missile fired?
- (2) When a machine is improperly adjusted, it has probability 0.15 of producing a defective item. Each day, the machine is run until three defective items are produced. When this occurs, it is stopped and checked for adjustment. What is the probability that an improperly adjusted machine will produce five or more items before being stopped?