Geometric Probability Examples

The Parachute Problem

A parachutist jumps from an airplane and lands in a square field that is 2 kilometers on each side. In each corner of the field there is a large tree. The parachutist's ropes will get tangled in the tree if she lands within 1/11 kilometer of its trunk. What is the probability that she will land in the field without getting caught in a tree?

The Fairground Problem

At a state fair a game is played by tossing a coin onto a large table ruled into congruent squares. If the coin lands entirely within some square and doesn't touch any edges, the player wins a prize. If the coin touches or crosses the edge of any square, the player loses. Suppose the squares are *S* units on a side and the coin has a radius of *R* units. What is the probability of winning this game?

The Triangle Problem

The students in a geometry class are considering when three line segments will form a triangle. They know that a triangle will be formed if and only if the sum of the lengths of any two segments is greater than the length of the third segment. The class has two wooden dowels, one of which is twice as long as the other. The students break the longest dowel at a random spot, so that they now have three dowels. What is the probability that the three lengths form a triangle?

The Tape Recorder Problem

A tape recording is made of a meeting between two businessmen. Their conversation starts at the 21st minute on the tape and lasts only 8 minutes. The tape will record for 60 minutes. While playing back the tape one of the businessmen accidentally erases 15 minutes of the tape, but he doesn't know where.

1. Find the probability that the entire conversation was erased.
2. Find the probability that some part of the conversation was erased.
3. Suppose the exact position of the conversation on the tape is not known, except that it began sometime after the 21st minute. Find the probability that the entire conversation was erased.

Above problems from:

Geometric Probability. New topics for secondary school mathematics. NC School of Science and Mathematics. National Council of Teachers of Mathematics, Inc. 1988.

Problems involving Pairs of Random Numbers

1. Suppose two numbers, x and y, are generated at random, where $0 < x < 3$ and $0 < y < 6$. What is the probability that the sum is less than or equal to 2?

2. Suppose two numbers, x and y, are generated at random, where $0 < x < 1$ and $0 < y < 1$. What is the probability that the quotient $\frac{y}{x}$ is between 2 and 3?

3. Suppose two numbers, x and y, are generated at random, where $0 < x < 1$ and $0 < y < 1$. What is the probability that the product of the two numbers is less than $\frac{1}{2}$? (**uses Calculus to get exact value)

4. Suppose two numbers, x and y, are generated at random, where $0 < x < 4$ and $0 < y < 4$. What's the probability that the sum of the numbers exceeds the product? (**uses Calculus to get exact value)

Buffon's Needle Problem

Suppose a flat surface is marked off with parallel lines space D units apart. If a needle of length L is dropped at a random place on the surface, with a random orientation, what is the probability that the needle will lie across one of the lines? (**uses Calculus to get exact value)

***Buffon's Needle was one of the first problems solved using Geometric Probability.*

***By dropping needles and calculating an experimental probability, Buffon was able to approximate π.*