

College Bound Math Problems #20
week of March 30, 2015

1. The pyramid shown here is a regular tetrahedron (tetra=4, in Greek) which means that it has 4 identical faces. Each face is an equilateral triangle. Suppose we label these 4 faces A, B, C and D, toss this object into the air and look to see which letter land on the bottom. On a single toss, each of the 4 letters has the same probability to be the outcome as each of the others.

- (a) On one toss, what is the probability of getting an A?
- (b) On one toss, what is the probability of *not* getting an A?
- (c) On two tosses, what is the probability of getting an A and then something else?

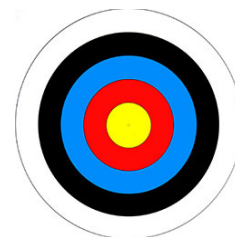


2. Background: Applications of probabilities occur in games and sports, in business and science, and in matters of life and death. Weather probabilities are crucial to farmers and building construction is tied to the probability of earthquakes. In 2011, a gigantic undersea earthquake occurred near Japan causing meltdowns at three reactors in a nuclear power plant. It was the fourth most powerful earthquake in the world since modern record-keeping began in 1900 and the costliest natural disaster in world history. As often happens, this quake was followed by smaller ones. Soon a major research institute, using mathematical analysis of quake data, put out a probability estimate for the timing of a major quake in Tokyo, Japan's largest city.

Now here is the problem: Suppose the probability is 0.4 that a major earthquake will occur in city X within a decade (10 years), and that the probability will remain at that level until a major earthquake does occur.

- (a) What is the probability that the next major earthquake will not occur in the first decade (the one starting now)?
- (b) What is the probability that the next major earthquake not occur until the second decade from now and will occur in the second decade.
- (c) What is the probability that the next major earthquake will occur in the third decade from now?

3. In the archery target shown, the radius of the outer boundary of the red ring is twice the radius of the yellow bull's-eye. The radius of the outer boundary of the blue ring is three times the radius of the yellow bull's-eye. Arrows are fired down a long tube so that they strike points scattered at random within the inner boundary of the black ring.



- (a) An arrow is shot. What is the probability that it hits the blue ring?
- (b) Three arrows are shot. What is the probability of the sequence [miss, miss, hit], in which the first and second miss the yellow bull's-eye but the third one hits it?