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OBJECTIVE:

To develop a hand-on activity/display for the ASA booth at the USA Science & Engineering Festival that demonstrates statistics concepts, generates excitement about statistics, and emphasizes statistics as science.

SUBMITTED BY:

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Video file of the game available at http://www.sendbigfiles.com/abcefc659f583b127ca9ec3fde65abad/.

DESCRIPTION OF ACTIVITY:

This "statistical" game was created by Jim Rubasch for one of the game booths at the annual ʻIolani Fair. It combines both skill and chance.

There are two phases of this game. The first is a Frisbee throw in which students throw a Frisbee from a pre-determined distance in hopes of hitting a target. Hitting the target depends on the skill on the player.

If the target is hit with enough force, a tennis ball is released and falls into a pinball setup of nails. At each nail intersection, the ball will theoretically fall left or right with equal probability. The ball finally lands in one of five slots each assigned with a different point value. In the traditional pinball setup, the pattern of balls will eventually resemble a binomial distribution and given a large enough number of balls, a normal distribution.

In Jim's game, each student was given five tosses and their total point score was recorded. He recorded data for all the students in his classes, each student given one chance at five tosses. In order to look at how "learning" was involved in this game, some students elected to try their hand at a second set of five tosses. The data collected is submitted with this entry.

STATISTICAL CONCEPTS INVOLVED:

Statistical inference is based upon probability models. In statistics, data collection is very important in determining probabilities. This is the relative frequency approach of probability.

In this game, many questions can be generated based on collecting data from a large number of trials.

What is the probability of hitting the target?
Is hitting the target independent of gender?
How does "learning" affect the probability of hitting the target?
Is there a pattern in the distribution of balls in the five slots?
Does the empirical pattern in the distribution of balls match the theoretical distribution?
How many different paths can the ball take through the nails? What are they?
What is the expected point total for a given game?

Suggestions for the display board.

WHAT IS STATISTICS?

Statistics is the art and science of collecting, analyzing, and interpreting data. Statistics often starts with a question about the world around us.

- How many text messages are sent out in a day?
- Is the number of text messages sent dependent on age?
- What are my chances of hitting a fixed target eight feet away with a frisbee?
- Is hitting the target dependent on gender?
- What is the weight distribution of teens in the United States?
- Has the distribution changed from a decade ago?

We collect data in order to help answer our questions. We look for patterns in the data, try to describe what we see, and use the patterns we see to predict future events. Here are some things we look for in the data:

- What is its shape?
- Where is it centered?
- How spread out are the values?
- Are there any unusual values, clusters, or gaps?

In this world where information abounds and can be overwhelming, we need to be able to simplify and summarize in order to help us make sense of the world. When we plot the data according to its value and frequency, we can obtain a picture called a data distribution. And you know the saying … a picture is worth a thousand words!

A GAME OF SKILL AND CHANCE.

Play the game. You will have three chances to toss a frisbee at the target. Hitting the target will release a tennis ball that will then fall through a maze of nails and fall in one of 5 slots. Record your results by placing a "sticky dot" in the dotplot below. Total up your score:

0 points	Try again later. Take home some statistical ideas.
< = 5 points	Good job. Take home a little prize and some statistical ideas.
➢ 5 points	Congratulations. Take home a big prize and some statistical ideas.

(Dotplot. Participants will be able to see the evolving pattern of the distribution of balls in the five slots.)

(Example)

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        X
      X X X
  X   X X X X
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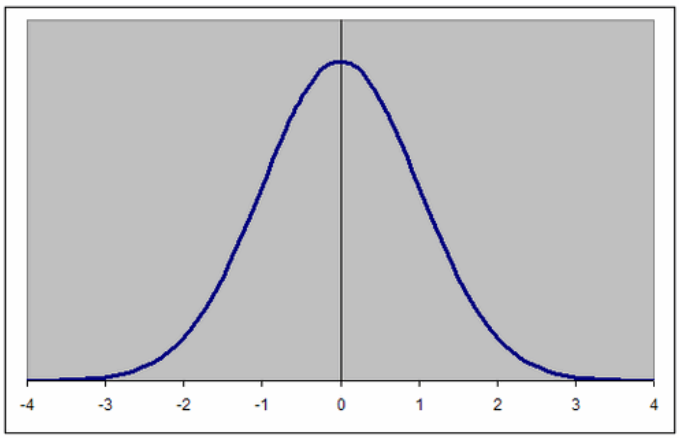
What questions can you generate? Here are a few that have already been asked as well a few others.

- What is my chance of hitting the frisbee target?
- Would that be different for boys than girls?
- What pattern do I see in the outcome of balls?
- What are the chances of winning a big prize?

(Participants will be asked to submit questions that can be written on sticky notes and placed on the display board.)

THE NORMAL DISTRIBUTION.



While all data distributions are interesting and most are useful, one that is found in real life to describe many physical and mental characteristics is the normal distribution. First described by the German mathematician Gauss, the normal distribution has relatively few low and high values, with most of the values centered around the middle. The normal curve is

symmetric and mound shaped, looking like a bell, it is often referred to as the bell curve.

Does are distribution of tennis balls resemble a normal distribution? Would you expect most balls to fall in the center and fewer at the ends?

Where might you also find normal distributions? The distribution of test scores? The weights of football players? Body temperatures? Shown below is the pattern of width of sepals (the green part around the base of a flower) for various iris plants. Note that in nature, the shape of the distribution is really normal-ish rather than perfectly normal!

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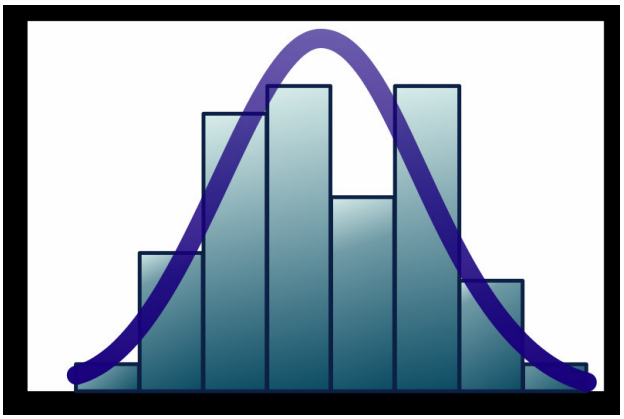

Histogram of sepal widths for Iris versicolor from Fisher's Iris flower data set. Wikimedia Commons. http://commons.wikimedia.org/wiki/File:Fisher_iris_versicolor_sepalwidth.svg. 7/12/2010

Blue flag (iris versicolor). Wikiemedia Commons. http://commons.wikimedia.org/wiki/File:Iris_versicolor_1.jpg 7/12/2010