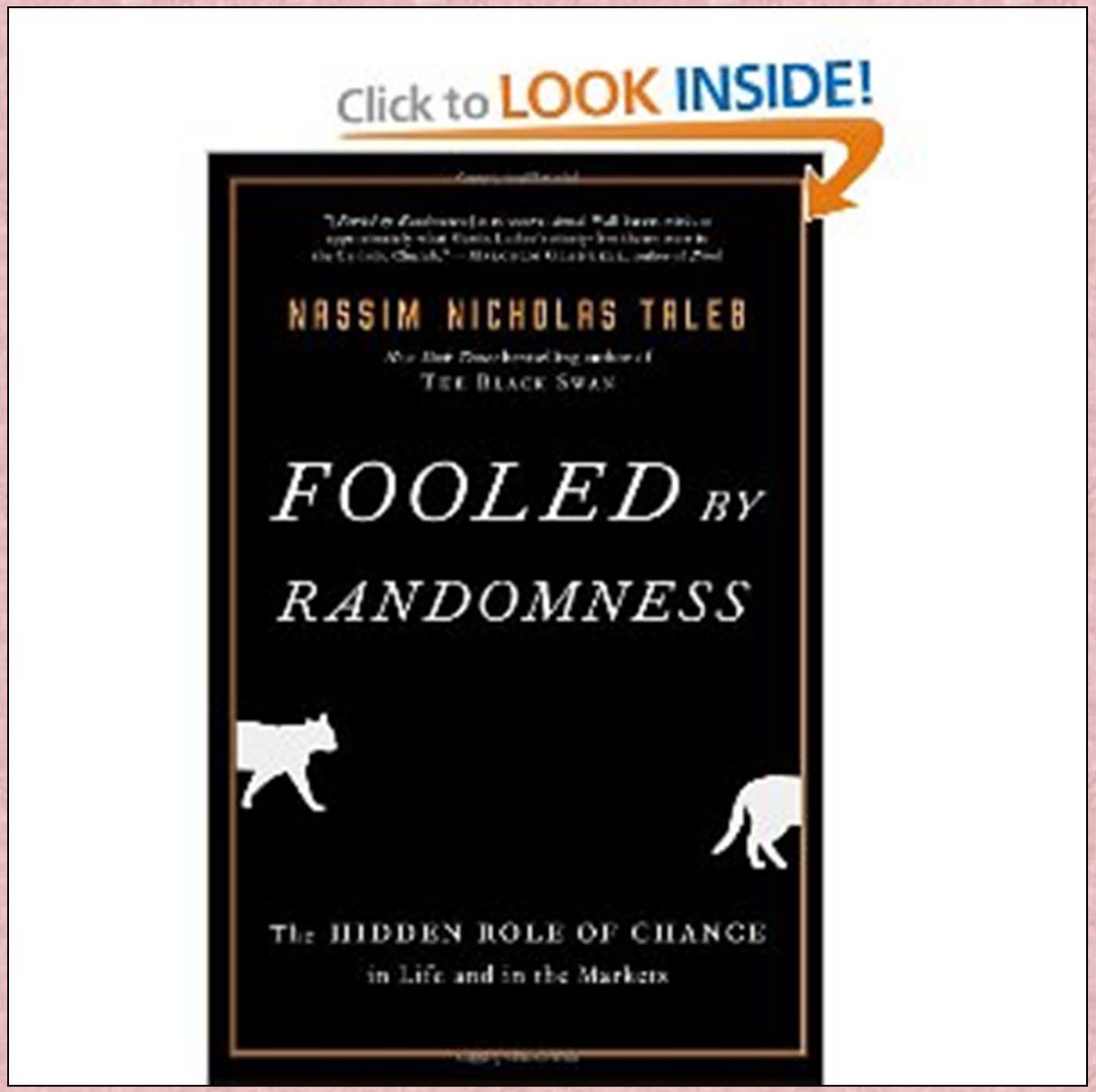
Beyond randomness and pattern: Are Christian and scientific worldviews compatible?

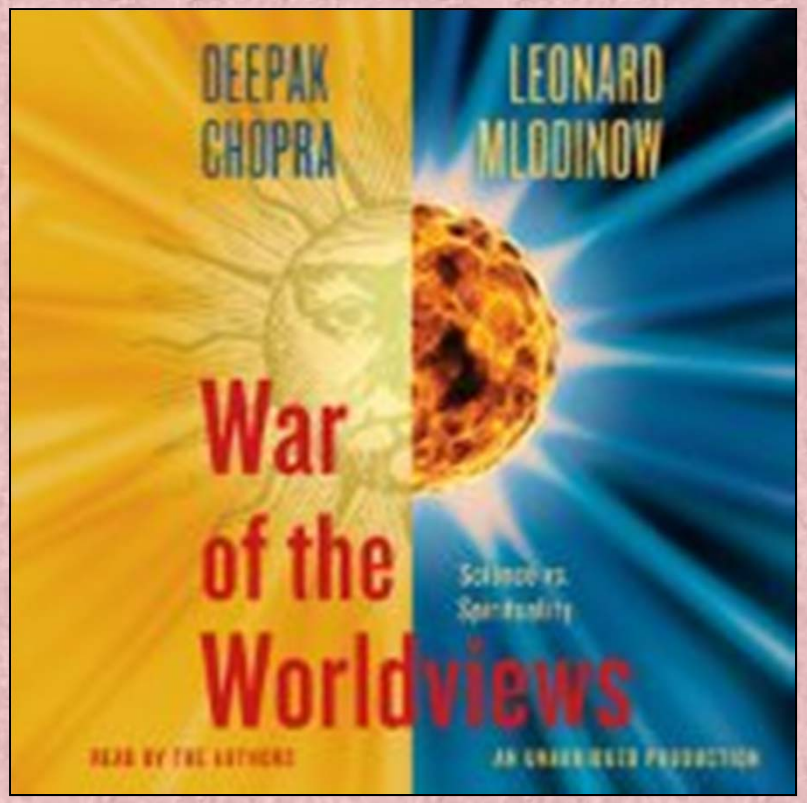
Paper presented at Southern California Christians in Science Conference, Azusa, CA.

Chong Ho Yu, Ph.D., Ph.D.
Associate Professor
University Quantitative Research Consultant


Click to LOOK INSIDE!
NASSIM NICHOLAS TALEB
THE BLACK SWAN
FOOLED BY RANDOMNESS
The HIDDEN ROLE OF CHANCE
in Life and in the Markets

Leonard Mlodinow

- Prominent physicist
- His parents were both Holocaust survivors. His father was a leader in the Jewish resistance under Nazi rule in his hometown of Częstochowa, Poland.
- When Nazi troops took over her mother's home town, they randomly executed Jews. Her mother survived. Did it happen at random or due to a divine purpose? If God saved his mother, what would we say to those who were massacred?



Jesses Bering

- **The Belief Instinct: The Psychology of Souls, Destiny, and the Meaning of Life**
- A thief was eaten by a crocodile when he attempted to escape by jumping into a pool.
- A criminal who was just released from the prison hit the jackpot in a casino.
- Good things happen to both good and bad people
- Bad things happen to both good and bad people
- All things are random, but humans tend to find a pattern or a purpose in random events

Teleological reasoning

- Bering traced our tendency of believing in the supernatural to instinct.
- Even though events in the universe are random, we tend to find a pattern or purpose in these events.
- This tendency was developed among our ancestors throughout the history of evolution.

Teleological reasoning

- Many people are helpless when facing unfortunate events, and use adaptive or coping mechanisms to optimize negative outcomes that are out of their control, such as putting their faith on God.
- This inclination of seeing random events as designed for a purpose by God is known as “teleological reasoning”, an idea that can be traced back to Kelemen and Rosset’s (2009) notion of promiscuous teleology.

Is the sequence random?

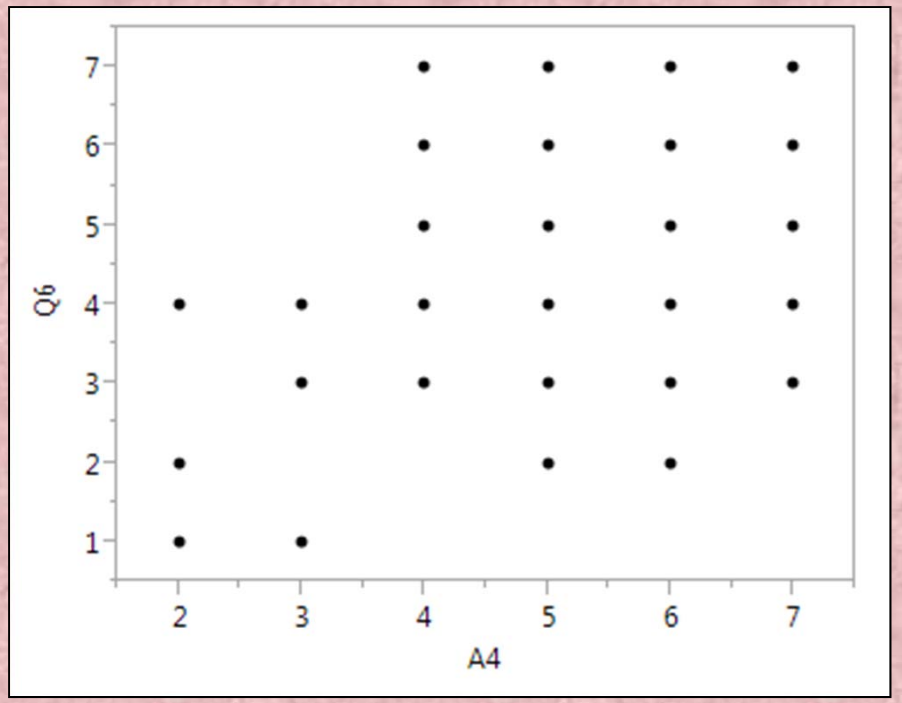
- 100111100110111001101

- 100111100110111001101100111100110111001101100111100110111001101

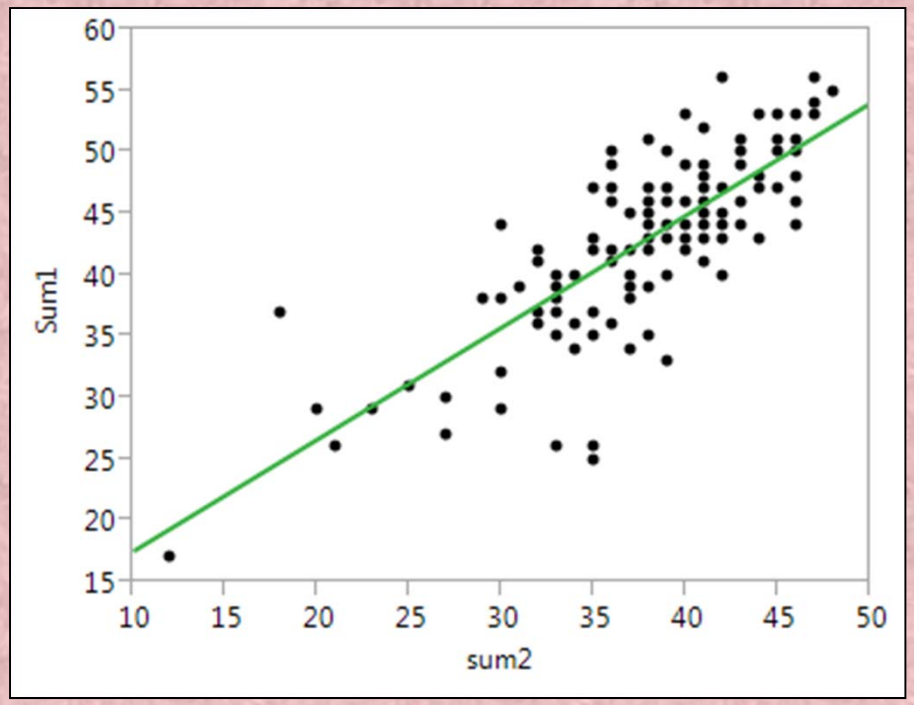
- Argentine-American mathematician and computer scientist Gregory John Chaitin: any attempt to decide the randomness of a sufficiently long binary string is inherently doomed to fail.
- The goal of statistics is to examine whether something happens at random (by chance alone) or has a systematic pattern
- But it is unable to detect randomness or patterns in the short run

Patternless variables

- It is common for researchers to use a 5-point or 7-point Likert scale to collect data.
- Usually when we want to detect a pattern or relationship between two single survey items, the data points appear to be random.



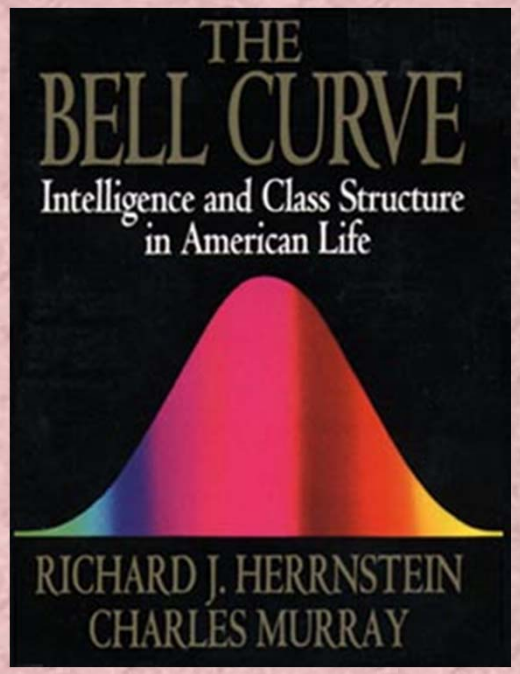
Pattern found in the aggregated level



- When variables are put together to form a composite score, a pattern can emerge!
- Size matters! Amount of data matters!

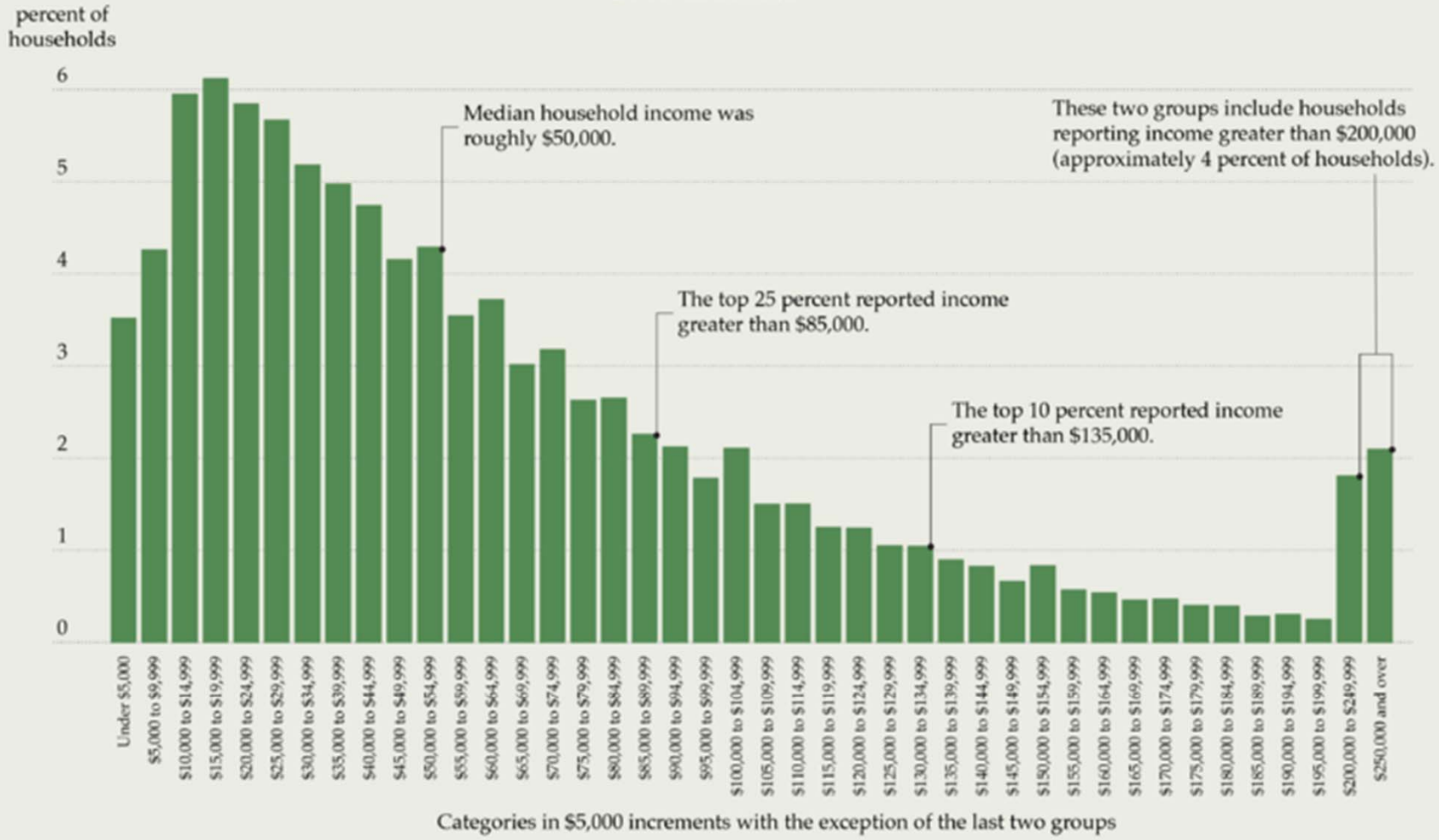
Standard Normal Distribution

- symmetric
- continuous
- unimodal
- bell-shaped
- asymtotic
- the mean, median, and mode are the same.



Distribution of annual household income in the United States

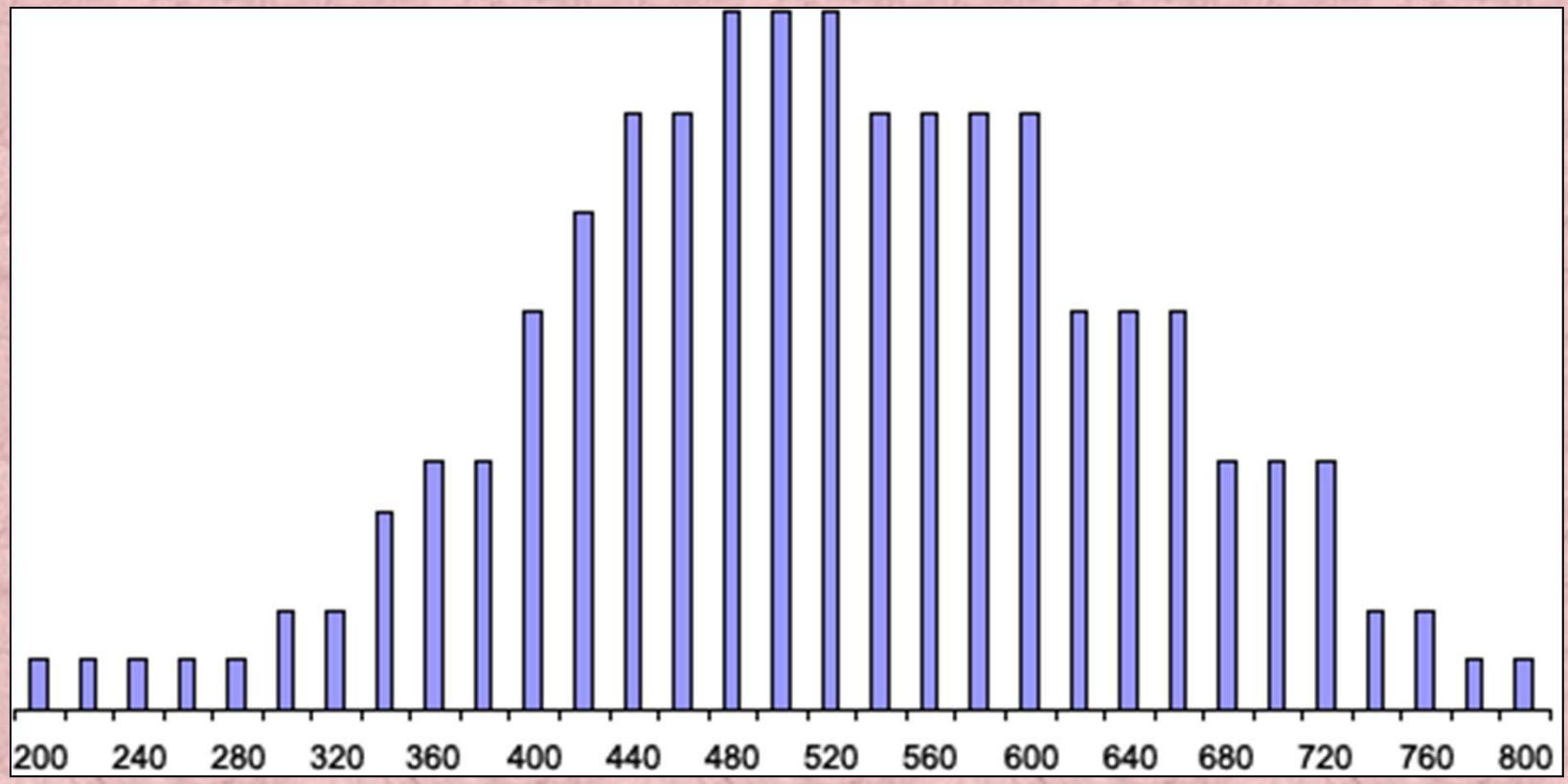
2010 estimate



Categories in $5,000 increments with the exception of the last two groups

Source: U.S. Census Bureau, Current Population Survey, 2011 Annual Social and Economic Supplement

The real SAT distribution



Normal distribution

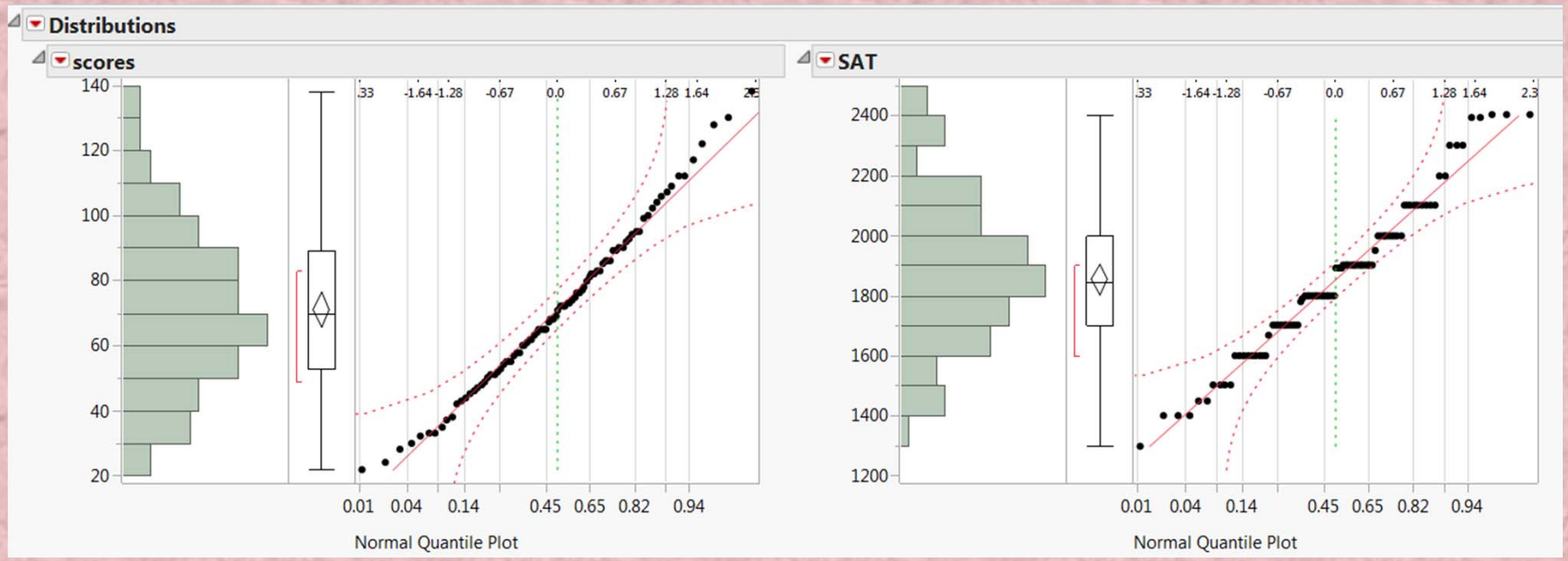
- French physicist Lippmann disliked use of normal curves for the circular logic of proving normality: “Everybody believes in the normal approximation, the experimenters because they think it is a mathematical theorem, the mathematicians because they think it is an experimental fact” (as cited in Thompson, 1959, p. 121).

Normal distribution

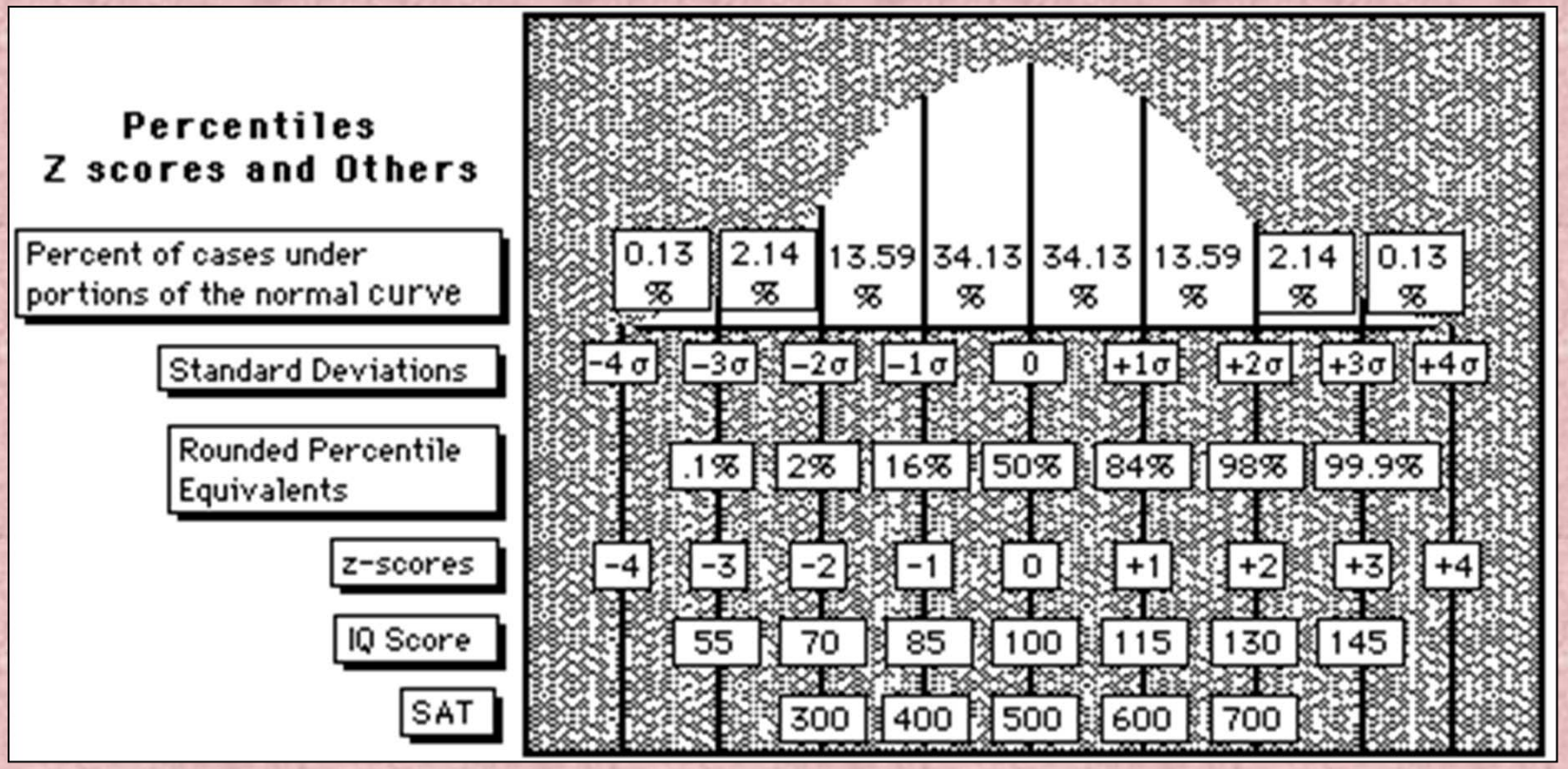
- Geary (1947) stated that normality could be viewed as a special case of many distributions rather than a universal property. Geary suggested that future editions of all existing textbooks and new textbooks should include this warning: “Normality is a myth; there never was, and never will be, a normal distribution” (p. 241).

Normal Quantile Plot

- There is no perfectly normal curve.
- We can use the normal quantile plot to examine whether a distribution is "fairly" normal.

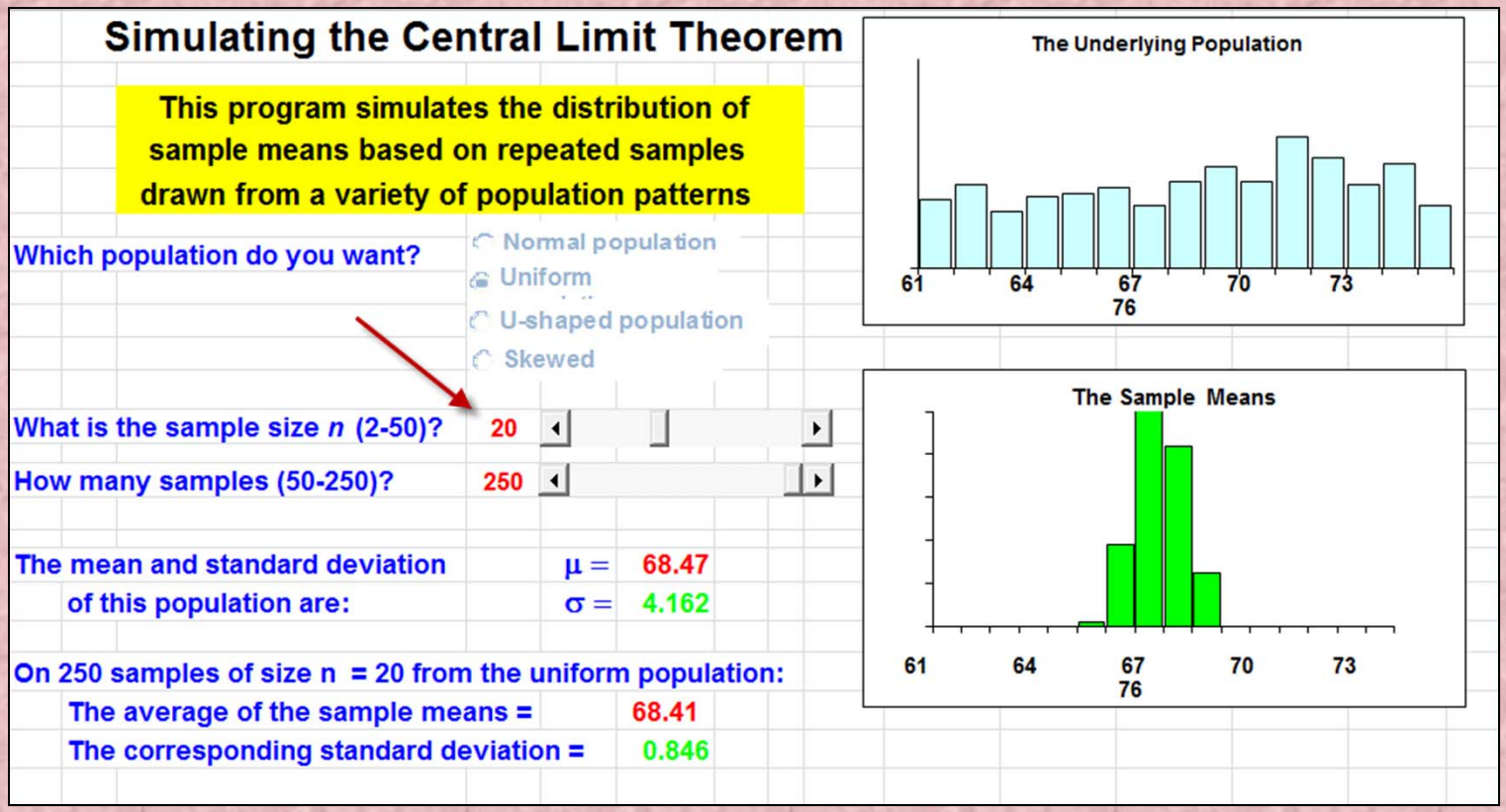


We ASSUME a normal curve



Central Limit Theorem (CLT) and sampling distributions

- No matter how messy or noisy the population is, there is always a **normal sampling distribution**!



Simulating the Central Limit Theorem

This program simulates the distribution of sample means based on repeated samples drawn from a variety of population patterns

Which population do you want?

- ○ Normal population
- ○ Uniform
- ◉ U-shaped population
- ○ Skewed

What is the sample size *n* (2-50)? 20

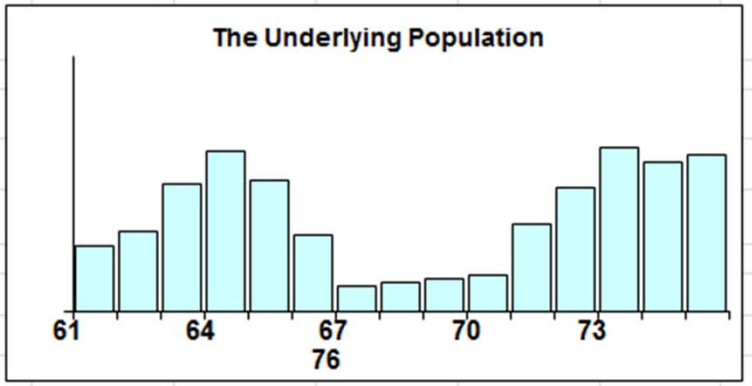
How many samples (50-250)? 250

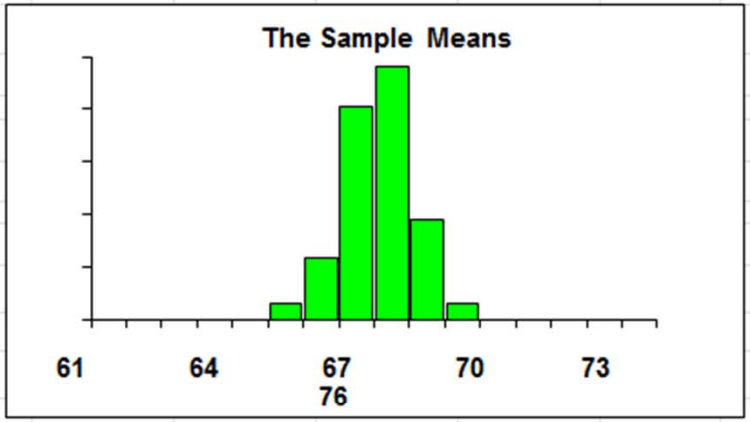
The mean and standard deviation of this population are: $\mu =$ 68.61, $\sigma =$ 4.801

On 250 samples of size n = 20 from the U-shaped population:

The average of the sample means = 68.64

The corresponding standard deviation = 0.953





Simulating the Central Limit Theorem

This program simulates the distribution of sample means based on repeated samples drawn from a variety of population patterns

Which population do you want?

- Normal population
- Uniform
- U-shaped population
- Skewed

What is the sample size *n* (2-50)? 20

How many samples (50-250)? 250

The mean and standard deviation of this population are:

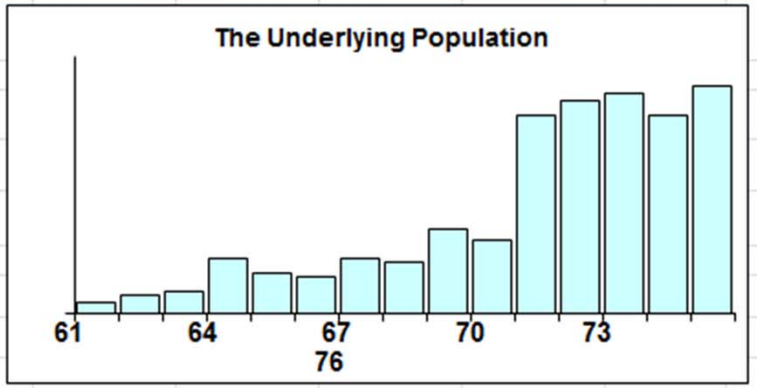
$\mu =$ 71.19

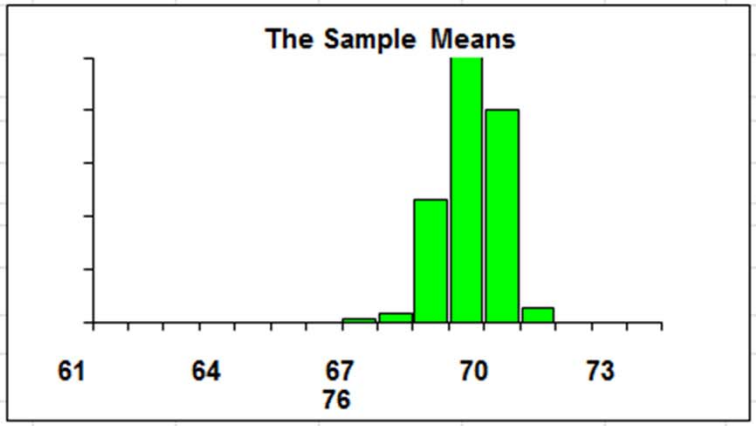
$\sigma =$ 3.291

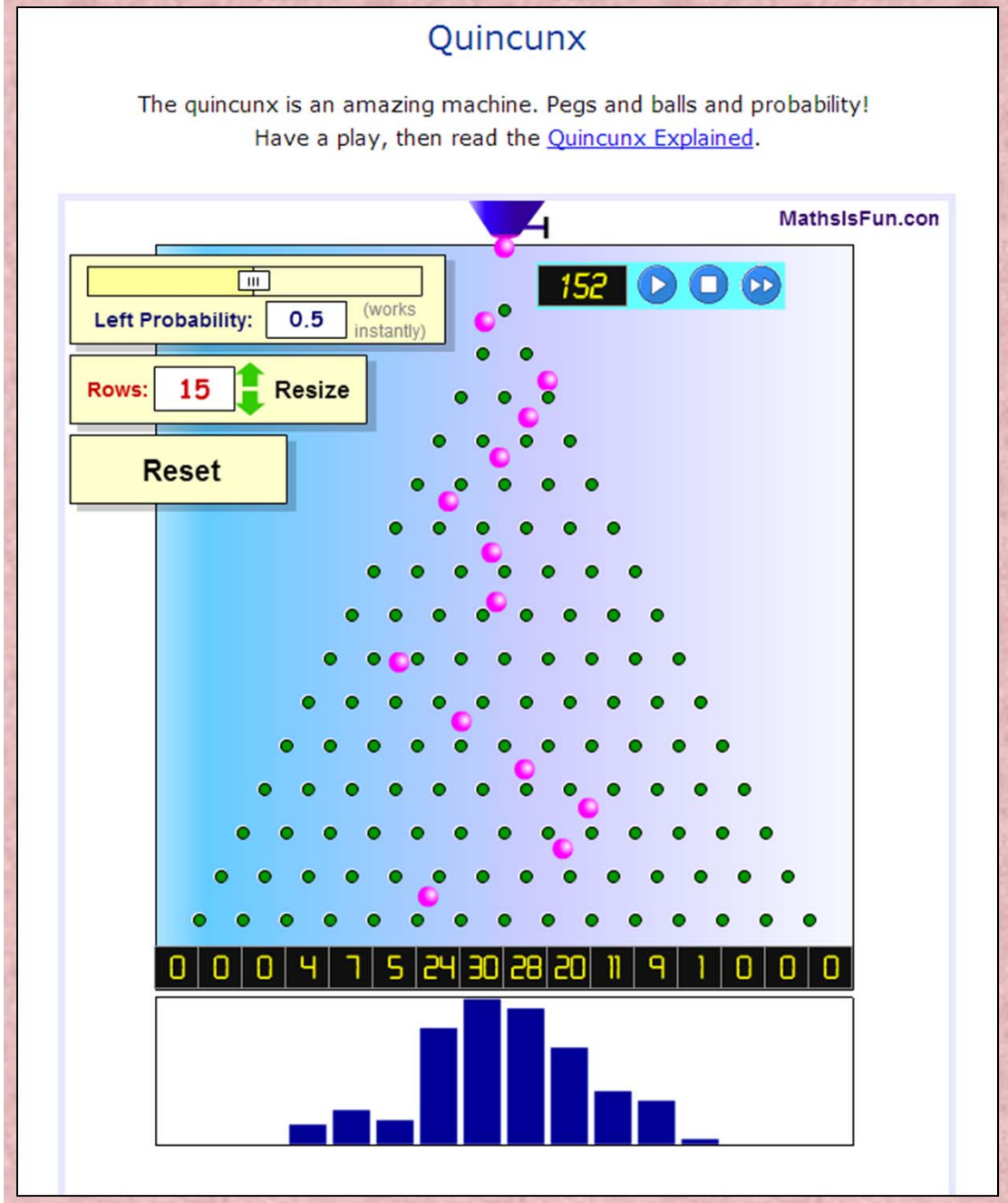
On 250 samples of size n = 20 from the skewed population:

The average of the sample means = 71.17

The corresponding standard deviation = 0.756



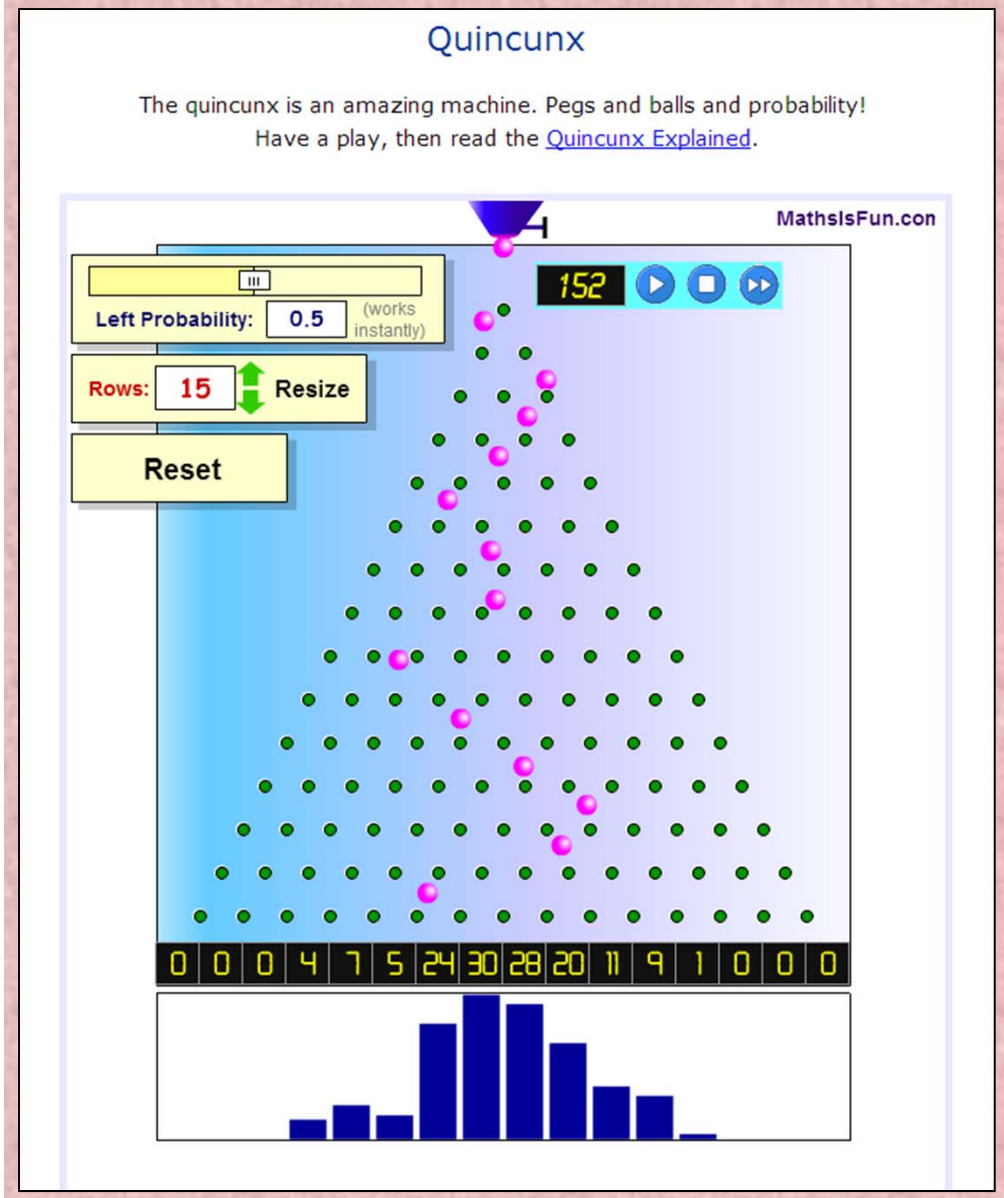




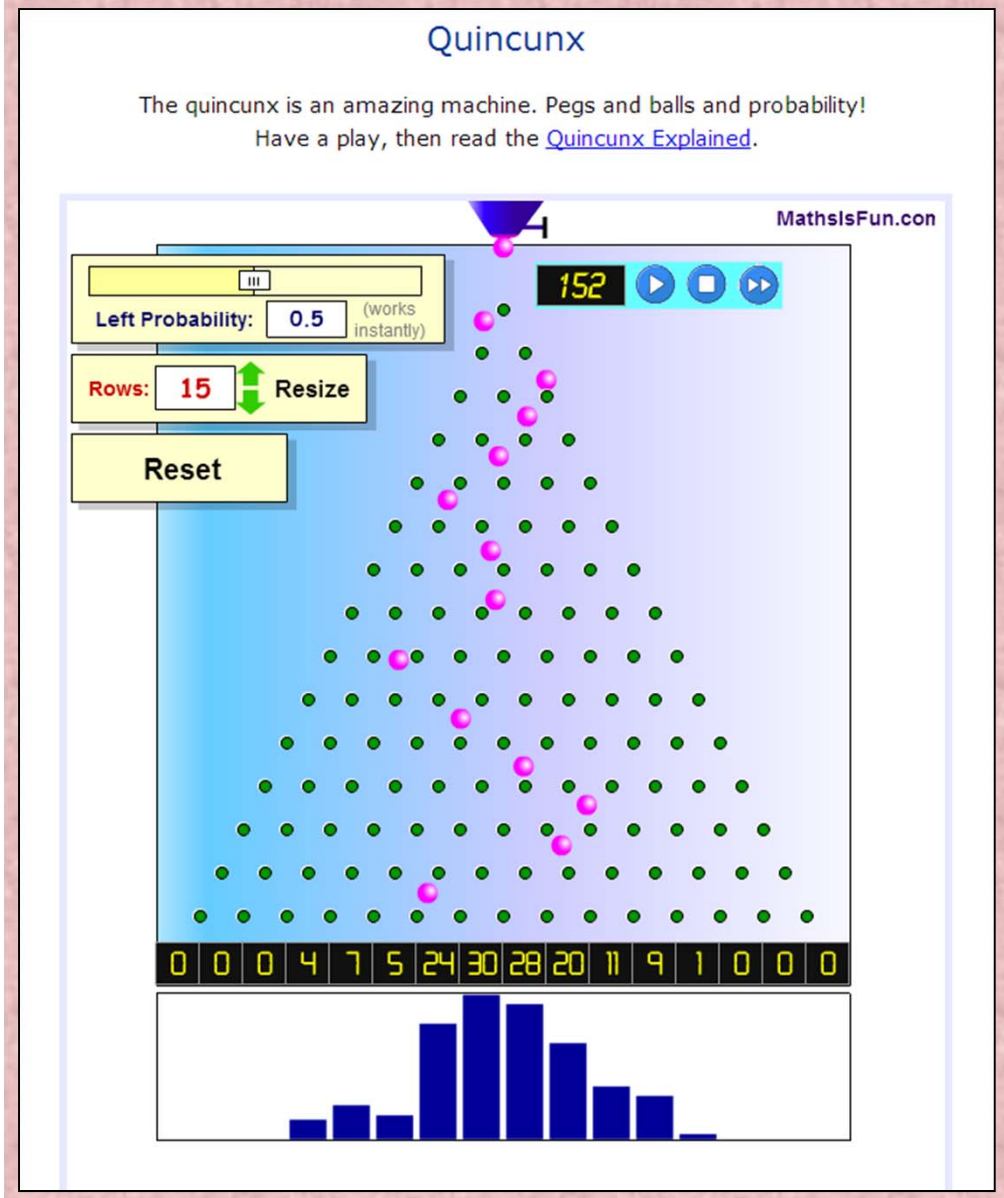
Pascal Triangle (Quincunx)

- In the past this experiment was done in a physical box, but today we can use a computer simulation
- Nails were punched into a box to form a triangular shape.

Pascal Triangle (Quincunx)



- On top there is only one nail. The second row has two nails. Each subsequent row has one additional nail.
- When a ball is poured into the box from top and lands on the first nail, the probability of going to the left is .5 and to the right is also .5.

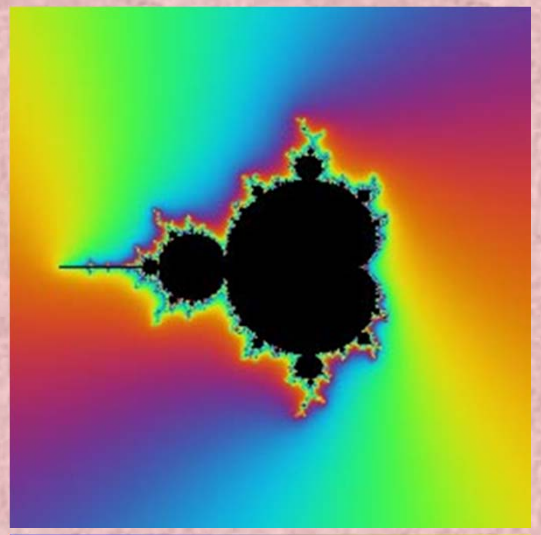


Pascal Triangle

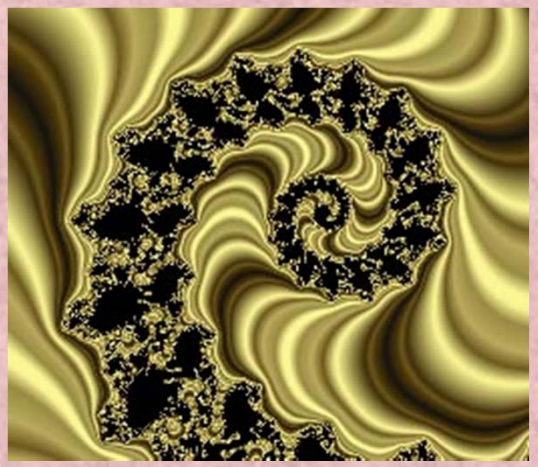
- Subsequently, the probability of going to which direction gets more and more complicated. Nonetheless, the process is random.
- But this random process always produces a normal distribution!
- http://www.mathsisfun.com/data/quincunx.html

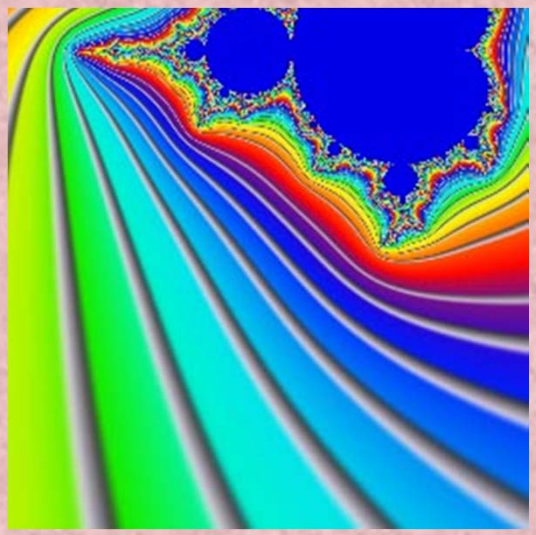
Mandelbrot Fractals

- Mandelbrot found that repeated computations lead to the approximation of the same fundamental mathematical structure. It made no difference which computer was used for performing calculations.
- Fractal sets appear to be random but there are unifying rules to govern the appearance of each beautiful fractal.



Mandelbrot Fractals





- Therefore, he asserted that the Mandelbrot set, as well as other mathematical theorems, are not mere inventions of the human mind, rather they exist independently.
- The Mandelbrot fractal set is used by physicists as an example to support the notion that order is embedded in chaos. This notion is known as the chaos theory.

Mandelbrot Fractals

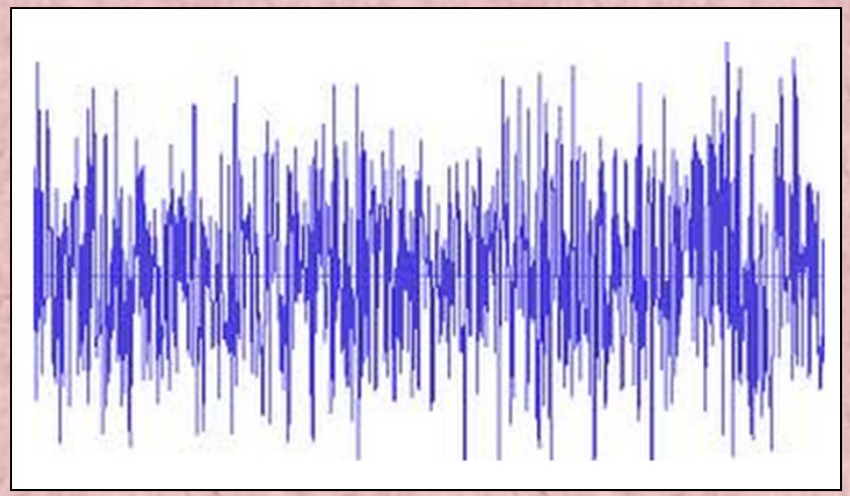
- Fractal sets appear to be random but there are unifying rules to govern the appearance of each beautiful fractal.

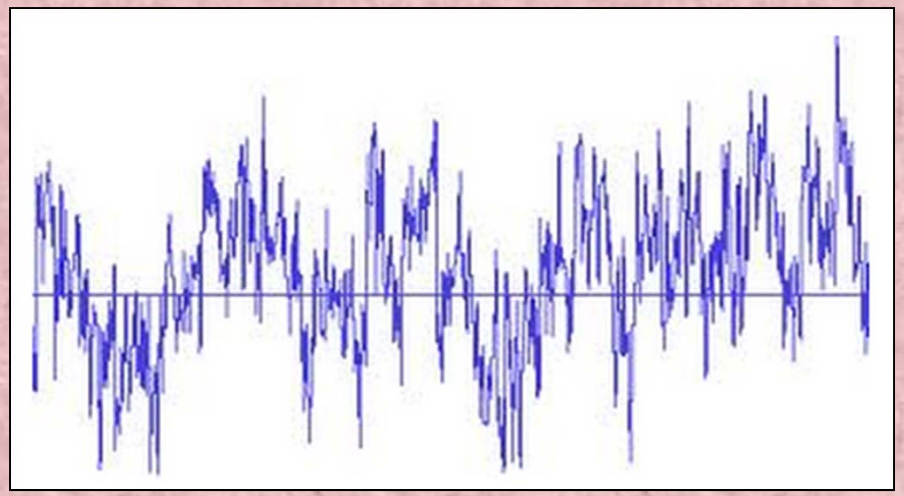
Fractals in nature

Fractal in art

Fractals in the human world

- Heart rate variability, music, and Internet traffic…etc.





Chinese Ink Painting

- Design and randomness together

Randomness in Photography

- Design and randomness together

Why bother?

- World events are neither totally random nor entirely determined.
- Statistical modeler **Nate Silver** bluntly pointed out many predictive models are flatly wrong, but scientists keep making gradual improvements.
- Why bother to study statistics and create predictive modeling if we really believe that world events are just random. This claim is **self-defeating**!
- The very essence of universe is a fusion of noises and signals. We need to filter noise to extract signal; pierce though chaos to see patterns and design.

Contact Info:

901 E. Alosta Ave.
Department of Psychology
Azusa Pacific University
Azusa CA 97102
cyu@apu.edu