

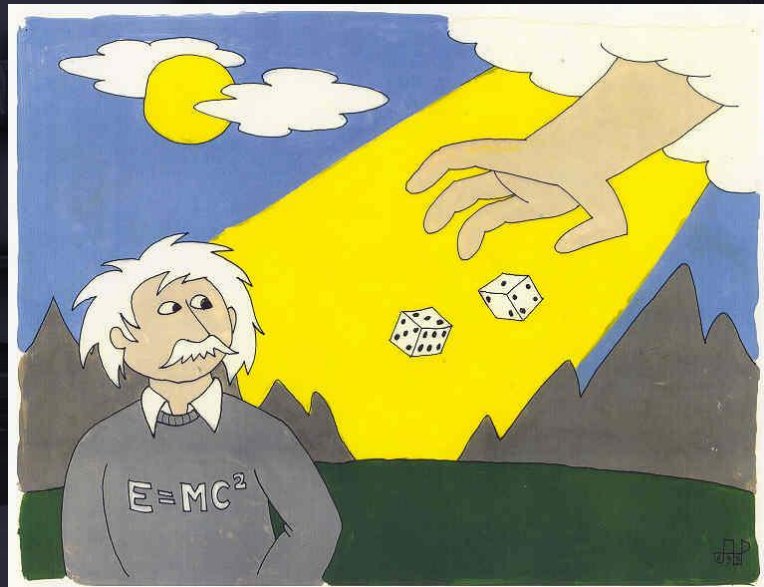
Chance, Luck, Fate, and Probability II

Doğan Kökdemir, PhD

dogan@kokdemir.info
www.kokdemir.info/courses/sb5715

RISK AND CRISIS MANAGEMENT

"God does not play dice."
A. Einstein



Birthday Problem

What is the probability that **2 students have the same birthday** in a given sample of **23 students**?

Bayes' Rule

- It is estimated that 0.6 % of the population have AIDS.

- 99% of the people with AIDS receive a positive diagnostic result (*eliza*) while 1% of people who do not have AIDS receive a positive result.

⊕ Suppose one of your friends took the eliza test and the test results were positive. What is the probability that your friend has AIDS?

Binomial Experiments

1. The same action (trial) is repeated a fixed number of times.
2. Each trial is independent of the others.
3. For each trial, there are just two outcomes of interest. One outcome may be called "success" [**p**] and the other "failure" [**q**].
4. The probability of success remains constant for each trial.

⊕ Example

- ⊕ In your exam, the first page contains 5 multiple-choice questions with 4 choices for each.
- a. What is the probability the you would give correct answers for all questions just by *mere guess*?
 - b. What is the probability that your all answers would be wrong?
 - c. What is the probability that only two of your answers would be correct?

Determining Binomial Probabilities - I

Combinations

- ⊕ A combination is a selection of r items from a set of n distinct objects without regard to the order (i.e.; "AB" = "BA" in which r items are picked. ${}_n C_r$)

$${}_n C_r = \frac{n!}{r!(n-r)!}$$

⊕ How many ways can we choose r items out of n ?

$$\oplus 4! = 4 \times 3 \times 2 \times 1 = 12$$

$$\oplus 3! = 3 \times 2 \times 1 = 6$$

$$\oplus 2! = 2 \times 1 = 2$$

$$\oplus 1! = 1$$

$$\oplus 0! = 1$$

Determining Binomial Probabilities - II

⊕ c. What is the probability that only two of your answers would be correct?

$$P(r) = {}_n C_r p^r q^{n-r}$$

$$P(2) = {}_5 C_2 p^2 q^{5-2}$$

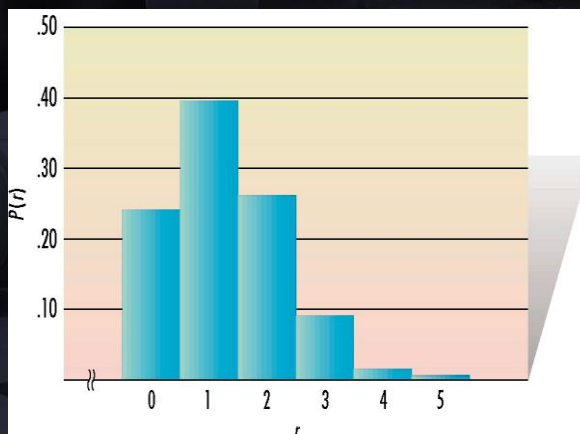
$$P(2) = \frac{5!}{2!(5-2)!} \left(\frac{1}{4}\right)^2 \left(\frac{3}{4}\right)^{5-2}$$

$$P(2) = 10(.0625)(.4219) = .2637$$

Binomial Probability Distribution

r	$P(r)$
0	.2373
1	.3955
2	.2637
3	.0879
4	.0146
5	.0010
$\Sigma P(r)$	1.0000

⊕ Figure 1. Histogram of probability distribution.



The Poisson Distribution

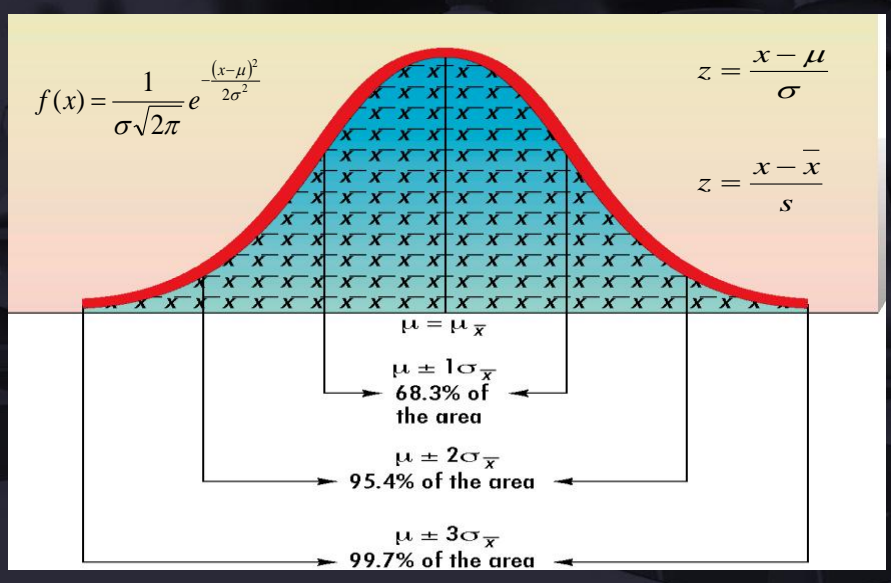
1. An experiment consists of counting the number of times a certain event occurs **during a given unit of time or space**.
2. The probability that an event occurs is **the same** for each unit of time and space.
3. The number of events that occur in one unit of time or space is **independent** of the number that occur in other such units.

$$P(x) = \frac{\mu^x e^{-\mu}}{x!}$$

⊕ Example

- ⊕ An average of 3 cars arrive at a highway tollgate every minute. If this rate is approximated by a Poisson process, what is the probability that exactly 5 cars will arrive at 1-minute period?

Areas under Normal Distribution



Measures of Dispersion I

Lecture I	Lecture 2
29	13
46	91
82	84
86	87
13	18
90	90
63	98
50	10
69	98
72	11

⊕ Q1. Which lecture would you like to enroll? Why?

⊕ Q2. Who is more successful: the 6. student of the lecture 1 or the 6. student of lecture 2? Why?

Measures of Dispersion II

- The range
 - max - min
 - easiest to measure
 - it emphasize only extreme values
- The Mean Absolute Deviation (MAD)
 - gives equal weight to each score
 - easy to measure
 - not influenced by extreme scores
 - limited for further calculations
- The Standard Deviation
 - most frequently used
 - gives equal weight to each score
 - may be distorted by extereme values (because of squaring)
- The Quartile Deviation
 - frequently used in skewed data sets
 - not affected by extreme values

$$MAD = \frac{\sum |x - \bar{x}|}{n}$$

$$MAD = \frac{\sum |x - \mu|}{N}$$

$$\sigma = \sqrt{\frac{\sum (x - \mu)^2}{N}}$$

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$$

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