Ch. 16: The Law of Averages

John Kerrich, a South African mathematician, tossed a coin 10,000 times in a row, and kept track of the results:

Number of Tosses	Number of Heads	Difference from Half (= Chance Error)
10	4	-1
20	10	0
50	25	0
100	44	-6
200	98	-2
500	255	5
1,000	502	2
2,000	1,013	13
5,000	2,533	33
10,000	5,067	67

The Law of Averages

If we toss a coin many times

number of heads =

half the number of tosses + chance error

The _____ says that the chance error (for a large number of tosses) is likely to be

- large in absolute terms
- small compared to the number of tosses

The percentage of heads is likely to get closer to 50%, although it is not likely to be exactly 50%.

Ex: A coin will be tossed and you win $1 if the number of heads is exactly equal to the number of tails. Which is better for you, 10 tosses or 1000?

Ex: A coin will be tossed and you win $1 if the percentage of heads is between 40% and 60%. Which is better for you, 10 tosses or 1000?

Ex: You are betting on tosses of a coin: if the coin lands on H, you win $ 1, if it lands on T, you lose $1. The last 10 tosses have all been H's. What is the chance that the next toss is a H?

Box Models

Chance processes are affected by _____, e.g.,

- number of heads when tossing a coin
- amount won when playing a game of chance
- percentage of unsatisfied customers in a random sample

_____ help us answer the question:

"How big is the chance error likely to be?"

When we make a box model we must answer three questions:

- What numbers go into the box?
- How many of each number?
- How many draws will we make?

We use the term _____ as shorthand for "drawing tickets at random with replacement from a box, and then adding them up".

Ex: You play a game in which you roll a die 10 times and get paid the amount shown on the die (each time). Find a box model:

Ex: You play a game in which you roll a die 10 times. Each time a "6" occurs, you win $ 10, otherwise you lose $ 1. Find a box model:

Ex: A multiple–choice quiz has 20 questions, each with 4 possible choices. Each correct answer is worth 5 points, and for each incorrect answer you lose 2 points. Find a box model for your test score if you guess all the answers:

Summary

Setting up a box model:

- The tickets show the amounts (points, etc.) that can be won or lost on one play (question, etc.).

- The chance of drawing any particular number must be the chance of winning or losing that amount (points, etc.) on one play (question, etc.).

- The number of draws from the box equals the number of plays (questions, etc.).