Chance Behavior in the Real World

● Example 1: In football, the decision of which team receives possession first is based on a coin toss.

● We say the probability of a coin toss coming up “heads” is 0.5.

● This means if we toss the coin many times, the proportion of times it comes up heads becomes close to 0.5.

● This probability is 0.5 not simply because the coin has two sides and one of the two must turn up (boy-girl baby example).

● It’s based on a long-term data pattern (Examples: Buffon, Pearson, Kerrich).
Randomness and Probability

• A phenomenon is *random* if individual outcomes cannot be predicted with certainly, but there is a predictable *distribution of outcomes* in the long term.

• The *probability* of an outcome describes the proportion of times that outcome occurs in a long series of repetitions.

• A probability is a number between 0 and 1.

• Mathematicians in the 1600s (Fermat, Pascal) studied probability formally to understand problems suggested by gamblers in dice and card games.
Myths about Chance Behavior

- *Myth 1*: Short-term vs. Long-term regularity

- Random phenomena behave regularly in the long term, but not in the short term.

- *Example*: In basketball, having “runs” of made field goals and runs of missed field goals happens fairly often just by chance (no “hot-hand” phenomenon)
Myths about Chance Behavior (Continued)

- **Myth 2: The Surprising Coincidence**

- What we think are highly unlikely coincidences may actually be not as unlikely as we think.

- **Example:** Evelyn Adams winning the NJ lottery twice.

- Is this event unlikely? It depends how you define the event!

- Sometimes we want to ascribe a meaningful cause to an unusual event when it’s actually simply chance behavior (Example: Cancer clusters)
Myths about Chance Behavior (Continued Again)

- **Myth 3: The Law of Averages**
- **Example:** If a roulette wheel has come up “red” 5 straight times, should you bet on black the next time it is spun?

- Random outcomes don’t “even out” in this way.

- Each spin has the same probability of coming up “red” as before, regardless of the previous results (“independent trials”)

- The only “law of averages” is that the ratio of “red” results to “black” results should get close to 1 as the number of spins gets very large.

- This refers to a long-run pattern, not the result of the next spin, or the next few spins.
Personal Probabilities

- What’s the probability that the Gamecocks will win next year’s SEC football championship?
- Note that we can’t base this answer on the long-term pattern in many repetitions.
- Instead, we base the answer on our personal judgment.
- A personal probability is a number between 0 and 1 that expresses someone’s personal judgment about how likely an outcome is.
Personal Probabilities (Continued)

- Often important decisions are based on a *personal probability* as opposed to a long-term proportion.

- *Example 1:* Should I bet on South Carolina to beat Clemson in the upcoming game?

- *Example 2:* Should my company set up offices in Innovista?

- *Example 3:* Should I take the bus downtown instead of trying to drive and find a parking space?

- All these are situations where the outcome of interest comes from a one-time event, not from repeatable trials.
Clicker Quiz 1

Which probability is based on a one-time event rather than repeatable trials?

A. The probability of rolling a “6” with a fair die.
B. The probability of tossing a dime and a penny and getting two “heads”.
C. The probability of rain next Wednesday.
D. The probability of making a 3-point shot in basketball.
Clicker Quiz 2

What is the probability that my one-year-old son will travel to a foreign country in his lifetime?

A. 0, because in none of the days of his life up to this point has he ever been in a foreign country.

B. 1/2 = 0.5, because there are only two possibilities: Either he will travel to a foreign country, or he won’t do so.

C. Neither of the above is definitely true.
Dealing with Very Small Probabilities

- It’s hard for us to comprehend the magnitude of very small probabilities.
- This makes it difficult for us to assess the risks of rare events.

- *Example 1:* What is the probability of a terrorist hijacking a commercial airplane?

- *Example 2:* What is the probability of our house being destroyed by a tornado?

- *Example 3:* What is the probability of dying in a car crash on the way home from work?
Dealing with Very Small Probabilities (continued)

- Important decisions must be made based on the risks of these rare events.

- *Example 1:* Should airports spend the money & manpower to search passengers for weapons & bomb materials?

- *Example 2:* Should we purchase tornado insurance (fire, hurricane, etc.?)

- *Example 3:* Should we spend extra for a car with advanced safety features?

- Probabilities associated with rare events cannot be easily assessed.

- Experts use complicated probability models to try to estimate these probabilities.
Dealing with Very Small Probabilities (continued more)

- Psychologically, we tend to worry less about events we encounter often and which we feel we have control over. (example: driving in a car)

- We tend to worry more about events we encounter rarely and of which we lack knowledge or control. (examples: air travel, natural disasters, asbestos)

- *Example:* Which is riskier, a cross-country airline flight, or driving to the airport to catch the flight?

- *Interesting Example:* If a baby is sleeping at home, would a parent leave the baby alone to drive off on a 15-minute errand?

- Which option poses a greater risk to the baby’s well-being?