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?**