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Econ 301—Bethany College

**Lecture 12: Risk, Uncertainty, and Types of Error**

1. Expected value
   1. Suppose I roll a four sided die and pay you a dollar if the result is even and nothing if the result is zero. How much are you willing to pay to play this game?
      1. What if you only get paid if the result is a one?
      2. Or suppose I pay you, in dollars, the result of the die? (Rolling a “2” gets you $2; a “4” gets you $4.)
   2. What game would you rather play?
      1. If the die is even, you lose $1 and if odd, you get $1.
      2. If the die is even, you lose $10 and if odd, you get $10.
   3. Both questions can be aided by *expected value*, or the value of a random payoff. (Expected value is also called the mean, or average).
      1. To determine expected value, multiply the payoff of each scenario by the probability the scenario will happen. Then add these values together.
      2. So for the game in I.a.ii., the expected value is:
   4. It’s useful to clarify how probabilities work when doing expected value.
      1. If multiple random events *both* have to happen, multiply the probabilities together. Ex.: finding a deer *and* shooting it successfully (probability of finding a deer times probability of shooting it equals probably of successfully hunting a deer).
      2. If *either* one of several random events have to happen, add the probabilities together. Ex.: killing a deer either in the first hour of hunting or the second hour of hunting (probability of killing a deer in the first hour plus the probability of killing a deer in the second hour equals the probability of killing a deer after two hours of hunting).
      3. Since all probabilities are fractions, more necessary conditions decrease final probability and more sufficient conditions increase it.
2. Attitudes towards risk
   1. We have not yet answered the question from the beginning: how much are you willing to play these games?
   2. Just we know the expected value, doesn’t mean we know how much people are willing to pay. The very idea of a risky payoff can be exciting for some and nerve wrecking for others.
   3. It’s useful to compare expected value, E(x), with a certain amount of A, where A = E(x).
      1. *Risk loving* individuals prefer E(x) to A.
      2. *Risk neutral* individuals are indifferent to E(x) and A.
      3. *Risk averse* individuals prefer A to E(x).
   4. Different people have different risk preferences and these preferences can vary for the same person from time to time. Some industries are built on how people approach risk.
   5. The insurance industry is built around people being risk averse. People find more pain in facing –E(x) compared to –A, where –A is the insurance price and –E(x) is the expected cost of an accident. They would rather lose A than lose E(x).
      1. Suppose each person has a 1% chance of having an auto accident which causes $1,000 in damages, or an expected cost of $10. Suppose each person is willing to pay $15 to get insurance.
      2. With, say, 50,000 customers, the insurance company receives $750,000 in revenue and pays out only $500,000 in damages, leaving room left over to pay for the costs of business and secure a healthy profit.
   6. The gambling industry is built around people being risk loving. People prefer E(x) to A, where A is the cost to play a game and E(x) is the expected payoff from that game. They will give up A to get E(x).
      1. Roulette is a game where you spin a disc with 38 spaces and a spinning ball that eventually lands on one of those spaces. If it lands on a space of yours, you get 35 times what you paid in (one dollar becomes $35), and lose the dollar otherwise.
      2. Since the probability of success is 1/38, the expected value is $35/38, or $0.92, which is less than the dollar payment. If 10,000 made this bet, the casino would get $10,000 in revenue at a cost of $9,200 with the money left over for expenses and profit.
   7. When it comes to income, most people are risk averse. They prefer a steady income than a fluctuating one. Remembering compensating differentials, jobs with a fluctuating income should pay higher, on average, than those with a steady income.
3. Types of Error
   1. Suppose you are hiring someone for a new job. There are two types of errors you can make.
      1. The first error is hiring someone who turns out to be a dud.
      2. The second error is not hiring someone who is really capable.
   2. These errors are better known as Type I and Type II error, respectively.
      1. *Null Hypothesis*—assertion corresponding to the default position
      2. *Type I error*—false positive; a non-match is declared a match—or when you reject the null hypothesis and you should fail to reject it
      3. *Type II error*—false negative; a good match is not detected—or when you fail to reject the null hypothesis and you should reject it

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| **Examples** | |
| *Type I* | *Type II* |
| Convicting an innocent person | Letting the guilty go free |
| Approving a damaging drug | Rejecting a beneficial drug |
| Befriending a jerk | Ignoring a nice person |
| Funding a poor investment | Passing on a good investment |

* 1. Type I and Type II errors are equally undesirable, but Type II errors are insidious because they are harder to notice when they happen.
     1. *In general*, Type I errors are self correcting; Type II errors are not. But precisely because Type I errors are self correcting, the fact that one made an error at all is evident thus there is a tendency for people to favor Type II errors.
  2. The Tragic Tale of the Sensor Pad