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LECTURE 11: EXPECTED VALUE

I. Expected value

a. Suppose I roll a four sided die and pay you a dollar if the result is even and nothing if the result is odd. How much are you willing to pay to play this game?

   i. What if you only get paid if the result is a one?

   ii. Or suppose I pay you, in dollars, the result of the die? (Rolling a "2" gets you $2; a "4" gets you $4.)

b. What game would you rather play?

   i. If the die is even, you lose $1 and if odd, you get $1.

   ii. If the die is even, you lose $10 and if odd, you get $10.

c. Both questions can be aided by *expected value*, or the value of a random payoff. (Expected value is also called the mean, or average).

   i. To determine expected value, multiply the payoff of each scenario by the probability of that scenario happening. Then add these values together.

   ii. So for the game in I.a.ii., the expected value is:

$$\frac{1}{4}\$1 + \frac{1}{4}\$2 + \frac{1}{4}\$3 + \frac{1}{4}\$4 = \$2.50$$

II. Attitudes towards risk

a. We have not yet answered the question from the beginning: how much are you willing to play these games?

b. Just because 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.

c. It's useful to compare expected value, E(x), with a certain amount of A, where A = E(x).

   i. *Risk loving* individuals prefer E(x) to A.

   ii. *Risk neutral* individuals are indifferent to E(x) and A.

   iii. *Risk averse* individuals prefer A to E(x).

d. 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.

e. 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).
    i. 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.
    ii. 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.

f. 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).
    i. 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.
    ii. 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.

g. 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.

h. Note that a person's attitude towards risk is ***not*** the same as her attitude towards uncertainty.
    i. People tend to be either risk loving, risk neutral, or risk averse. We compare a riskless payoff to a probabilistic one to see.
    ii. But people tend to be averse to ambiguity. They prefer the probabilistic payoff to an unquantifiable payoff.

III. Prediction markets

a. Talk is cheap. Saying something will happen without any punishment if you're wrong means little. Betting on something says a lot more.
    i. Mere talk means it is cheap to indulge sloppy thinking like bias and poor logic. If you're wrong, nothing happens.

b. If we allow people to "bet" on future events, we get a more balanced assessment. People put their money where their mouth is.
c. If we allow many people to bet, we can create a market. With the market, we'll have prices which we can use to inform us about the future.
d. *Prediction market*—speculative market designed so that prices can be interpreted as probabilities about future events.
    i. Suppose you buy "tickets" with some event on them (e.g. Hilary Clinton is elected). If the event happens by a indicated date (2016), the ticket is worth $1.00 (or $10, or $100). If not, it is worth zero.
    ii. This is expected value in action. But here, the expected value, the market price, is given to us. We know the payoff if the event happens (what the ticket is worth). We solve for the probability.
e. Predictiuos.com values its tickets at m฿10[1] each. As of September 19, 2014, you could buy a ticket that Clinton wins at m฿4.25.[2] That means she has a 42.5% chance of winning.

IV. Negligence
a. When a firm causes harm to its employees or customers due to negligence, should the firm be punished?
    i. All the time?
b. Crafted by Judge Learned Hand in 1947, the Hand formula describes someone should be held responsible due to negligence if:

$$B < pL$$

    i. Where **B** is the burden of avoiding the accident,
    ii. **p** is the probability the accident will occur, and
    iii. **L** is the cost of the accident.
c. So if there are no handrails (which are cheap to install) to prevent people from falling off a balcony (which is common and dangerous), the owner will be held liable.
d. But if an owner didn't clear the sidewalk of ice shortly after it formed (which is expensive to do) to prevent people from slipping (uncommon given the time constraint and not very harmful if it happens), the owner won't be held liable.

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[1] "m฿" is the symbol thousandths of a Bitcoin.
[2] https://www.predictious.com/politics/us-presidential-election-2016/hillary-clinton