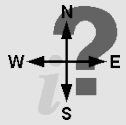
Managerial Economics & Business Strategy

Chapter 12

The Economics of Information

Modified by DF 3/12



Overview

I. Mean, Variance, etc.

II. Uncertainty and Consumer Behavior
- Utility function
- Consumer search

III. Uncertainty and the Firm

IV. Uncertainty and the Market
- Adverse selection, moral hazard
- Possible solutions

V. Auctions

The Mean

- The expected value or average of a random variable
- Computed as the sum of the probabilities that different outcomes will occur multiplied by the resulting payoffs:

$$\mu = E[x] = q_1 x_1 + q_2 x_2 + \ldots + q_n x_n,$$

where x_i is payoff i, q_i is the probability that payoff i occurs, and $q_1 + q_2 + \ldots + q_n = 1$.
- Note that the probabilities (weights) on the possible outcomes need not be identical. For example, if outcome i has very high q_i, then $E[x]$ is close to x_i.
- The mean provides information about the average value of a random variable but yields ***no*** information about the degree of risk associated with the random variable.

Variance & Standard Deviation

Variance is:
- A measure of *risk*.
- The sum of the probabilities that different outcomes will occur multiplied by the squared deviations from the mean of the random variable. Var[x]=

$$\sigma^2 = q_1 (x_1 - E[x])^2 + q_2 (x_2 - E[x])^2 + \ldots + q_n (x_n - E[x])^2$$

- Again, weights may not be equal…

Standard Deviation is:
- The square root of the variance.
- Interpreted as average (Euclidean) distance from the mean.

Uncertainty and Risk Aversion

- Handy utility function representation:

$$U_i = CE_i = E[x] - \tfrac{1}{2} r_i \mathrm{Var}[x]$$

- CE is the **certainty equivalent**, the person's WTP for the bet.
- $\frac{1}{2} r_i \mathrm{Var}[x]$ is the **risk premium**, E[x] – CE.
- For a bet E[x]=$5 and Var[x]=25, most students in class indicated a CE between $4 and $5, or a RP between 1 and 0.
- This implies that most students have **risk aversion** parameter r_i between 0.08 and 0.00.
- **Risk averse**: $CE_i < E[x]$ or (equivalently) $r_i > 0$. The majority.
- **Risk neutral**: $CE_i = E[x]$ or $r_i = 0$. This is fairly common too.
- **Risk seeking**: $CE_i > E[x]$ or $r_i < 0$. Las Vegas needs you!

Diversification

- **Diversification** can actually reduce risk.
- Suppose that 100 people face independent risks:
  - $x_i = 0$ or 10, $p_i = 0.5$, so E[x]=5 and Var[x] = 25 each.
- Pooling, the total is E[T]=500 and Var[T] = 2500.
  - (Var[T] would be higher if the risks were positively correlated.)
- For an equal share s = T/100 in the pool:
  - E[s] = E[T]/100 = $5…no magic there, but
  - Var[s]=Var[T/100]=Var[T]/100^2 = 25/100 !
  - and σ_s is 0.5 instead of 5.0!
- Intuition: T is usually near 500, since independent risks often offset. So a share of the pool is much less risky.
- The magic works better the wider the pool and the lower the correlation.
  - cor mismeasured in subprime loans…

Risk Sharing

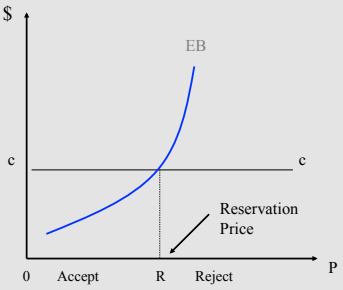
- The other way to reduce the cost of risk is for more risk averse people to sell the risk to less risk averse people.
- E.g., in the bet discussed in class, those whose CE was $4.00 could sell the gamble to classmates whose CE was $5.00. At a price of $4.50, both would be better off. The sum of risk premiums would decrease, and consumer surplus would increase.
- The insurance industry diversifies away a lot of risk, and shares the rest (with re-insurers and shareholders).
  - Fire insurance and national tornado insurance diversify well.
  - Earthquake insurance less well due to high correlation among losses. But risk sharing still helps.

How Risk Aversion Influences Consumer Decisions

- Customers perceive new products as risky--unknown quality.
- Devices to overcome the problem either raise the expected value or decrease perceived variance.
  - Informative advertising
  - Free samples
  - Guarantees
- Brand names exist mainly to ease the problem.

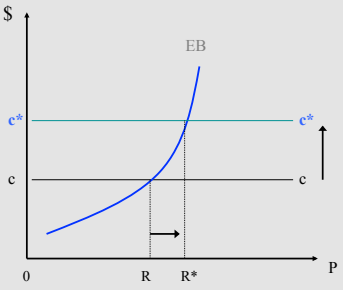
Searching for a good price

The Optimal Search Strategy.



Consumer Search

An increase in search costs raises the reservation price.



Uncertainty and the Firm

- Risk Aversion
  - Are managers risk averse or risk neutral or …?
  - What *should* they be for the sake of:
    - Shareholders
    - Managers
    - Taxpayers
    - ?

Profit Maximization in an uncertain world

- When demand is uncertain, expected profits are maximized at the point where expected marginal revenue equals marginal cost: E[MR] = MC
- Practice problem: suppose demand
  - high with probability 1/3 and low with probability 2/3.
  - Pick high and low demand functions…
  - Compute MR in each case
  - Compute E[MR] and solve E[MR] = MC
  - The biotech industry
- What if costs are uncertain?

Asymmetric Information

- Situation that exists when some people have better information than others.
- First example: Insider trading, the accusation against Martha Stewart

Two Types of Asymmetric Information

- **Hidden characteristics→Adverse selection**
  - Things one party to a transaction knows about itself, but which are unknown by the other party.
- **Hidden actions → Moral hazard**
  - Actions taken by one party in a relationship that cannot be observed by the other party.

Adverse Selection

- Situation where individuals have hidden characteristics, and they self-select to the detriment of the less informed party.
- Examples
  - Choice of medical plans
  - High-interest loans
  - Auto insurance for drivers with bad records

Moral Hazard

- Situation where one party to a contract takes a hidden action that benefits him or her at the expense of another party.
- Examples
  - The principal-agent problem
  - Care taken with rental cars

Possible Solutions

1. Signaling
   - Attempt by an informed party to send an observable indicator of his or her hidden characteristics to an uninformed party.
   - To work, the signal must not be easily mimicked by other types.
   - Example: Education

Possible Solutions

2. Screening
   - Attempt by an uninformed party to sort individuals according to their characteristics.
   - Often accomplished through a *self-selection device*
     - A mechanism in which informed parties are presented with a set of options, and the options they choose reveals their hidden characteristics to an uninformed party.
   - Examples include price discrimination via
     - quantity discounts and
     - quality increments in a product line, eg. bicycles

Auctions

- Seller has item, solicits bids from buyers
- The bids determine the price and new owner
- The word goes back to Rome
- Idea probably goes back at least to Sumeria
- Seemingly are becoming more important in recent years
  - eBay
  - Spectrum auctions
  - Real estate …

Auctions better than posted price when:

- The good does not have a known, stable price that equates supply and demand
  - For example, fresh fish--the price depends sensitively on the quantity and quality of the day's catch and on demand conditions.
- Buyers' participation costs and waiting costs are low relative to the value of items at auction.
  - Otherwise intermediaries can profitably offer immediacy, and buy from the sellers and sell to the buyers on demand.
- Inventories are expensive to carry.
  - Otherwise the retailers can profitably create a convenient shop, post a relatively high fixed price and periodically offer clearance sales.
- Buyers do not highly value customization
  - so sellers can sell "as is" to a wide range of potential buyers.
  - Otherwise again there is a role for intermediaries in catering to buyers' diverse preferences

Classic types of Auction

- English
- First-price, sealed-bid
- Second-price, sealed-bid
- Dutch

May also consider non-classic All-pay auction

English Auction

- An ascending sequential bid auction.
- Bidders observe the bids of others and decide whether or not to increase the bid.
- The item is sold to the highest bidder.

First-Price, Sealed-bid

- An auction whereby bidders simultaneously submit bids on pieces of paper.
- The item goes to the highest bidder.
- Bidders *do not* know the bids of other players.

Second Price, Sealed-bid

- The same bidding process as a first price auction.
- However, the high bidder pays the amount bid by the 2nd highest bidder.

Dutch Auction

- A descending price auction.
- The auctioneer begins with a high asking price.
- The bid decreases until one bidder is willing to pay the quoted price.
- Strategically equivalent to a first-price auction

Information Structures

- Independent private values
  - Bidders know their own valuation of the item, but not other bidders' valuations
  - Bidders' valuations do not depend on those of other bidders
- Affiliated (or correlated) value estimates
  - Bidders do not know their own valuation of the item or the valuations of others
  - Bidders use their own information to form a value estimate
  - Value estimates are affiliated: the higher a bidder's estimate, the more likely it is that other bidders also have high value estimates.
  - *Common values* is the special case in which the true (but unknown) value of the item is the same for all bidders

Optimal Bidding Strategy in an English Auction

- With independent private valuations, the optimal strategy is to remain active until the price exceeds your own valuation of the object.

Optimal Bidding Strategy in a Second-Price Sealed-Bid Auction

- Strategically equivalent to English auction.
- The optimal strategy is to bid your own valuation of the item.
- This is a dominant strategy.
  - You don't pay your own bid, so bidding less than your value only increases the chance that you don't win.
  - If you bid more than your valuation, you risk buying the item for more than it is worth to you.

Optimal Bidding Strategy in a First-Price, Sealed-Bid Auction

- Bidding higher increases probability of winning but reduces surplus for winner.
- Given:
  - n bidders, who all
  - perceive valuations to be evenly (i.e., uniformly) distributed between a lowest possible valuation of L and a highest possible valuation of H
  - are risk neutral and know own valuation v
- Then your (Bayesian Nash) equilibrium bid is

$$b = v - \frac{v - L}{n}.$$

Example

- Two bidders with independent private valuations ($n = 2$)
- Lowest perceived valuation L = 1
- Optimal bid for a player whose valuation is two ($v = 2$) is given by

$$b = v - \frac{v - a}{n} = 2 - \frac{2 - 1}{2} = \$1.50$$

Optimal Bidding Strategies with Affiliated Value Estimates

- Difficult to describe because
  - Bidders do not know their own valuations of the item, let alone the valuations others.
  - The auction process itself may reveal information about how much the other bidders value the object.
- Optimal bidding requires that players use any information gained during the auction to update their own value estimates.

The Winner's Curse

- In a common-values auction, the winner is the bidder who is the most optimistic about the true value of the item.
- To avoid the winner's curse, a bidder should revise downward his or her private estimate of the value to account for this fact.
- The winner's curse is most pronounced in sealed-bid auctions.

E[Revenue] in NE for Auctions with Risk Neutral Bidders

- Independent Private Values
  - English = Second Price = First Price = Dutch
- Affiliated Value Estimates
  - English > Second Price > First Price = Dutch
  - Bids are more closely linked to other players information, which mitigates players' concerns about the winner's curse.

Conclusion

- Information plays an important role in how economic agents make decisions.
  - When information is costly to acquire, consumers will continue to search for price information as long as the observed price is greater than the consumer's reservation price.
  - When there is uncertainty surrounding the price a firm can charge, a firm maximizes profit at the point where the expected marginal revenue equals marginal cost.
- Many items are sold via auctions
  - English auction
  - First-price, sealed bid auction
  - Second-price, sealed bid auction
  - Dutch auction