10. Economics of Information

Key Concepts

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Measuring Uncertain Outcomes

Mean

$$E[x] = q_1x_1 + q_2x_2 + \ldots + q_nx_n$$

Where:

- $E[x]$ is the expected value of the uncertain outcome
- x_i is the possible outcomes of a random variable
- q_i the corresponding probabilities of each outcome, where $\sum_{i=1}^{n} q_i = 1$

The mean **does not** provide information about the **risk** associated with the uncertain outcome.

Variance

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

- The variance is a **common measure of risk**.
- The **standard deviation** is the square root of the variance: $\sigma = \sqrt{\sigma^2}$

Risk Aversion

- A **risk-averse** consumer prefers a **sure amount of** $\$M$ to a risky prospect with an expected value of $\$M$
- A **risk-loving** consumer prefers a risky prospect with an expected value of $\$M$ to a sure amount of $\$M$
- A **risk-neutral** consumer is indifferent between a risky prospect with an expected value of $\$M$ and a sure amount of $\$M$

Consumer search

After observing each price quote, a consumer makes a purchase decision by weighing

- The **expected benefit** $EB[P]$ from acquiring an additional price quote
- **Cost of search** c

A consumer should search for a lower price as long as the **expected benefits** for an additional search are greater than the **costs** of an additional search.

The **reservation price** is the price at which a consumer is indifferent between purchasing at that price and searching for a lower price $EB[R] = c$.

Optimal search rule

- A consumer **rejects** prices **above** R (because $EB[P] > c$)
- A consumer **accepts** prices **below** the reservation price R (because $EB[P] < c$)

Diversification

By investing in muliple projects, the manager may be able to **reduce risk** - this is called **diversification**.

Producer Search (!= Consumer Search)

When **producers** are uncertain about the prices of **inputs**, an optimizing firm will use **optimal search strategies**, like consumers.

Optimal search rule for producers

The basic principles of **profit maximization** (i.e. marginal cost = marginal revenue) can be modified to deal with uncertainty about input prices:

If **demand** (hence, revenue) is **uncertain** and the manager is **risk neutral**, he will want to maximize expected profits by producing output where **expected marginal cost = marginal revenue**.

$$\boxed{E[MR] = MC}$$

Assymetric Information

When some people have better information than others in the market, the information people have is called **assymetric information**.

There are two specific manifestations related to assymetric information in markets:

- Adverse Selection
- Moral Hazard

Adverse Selection

Adverse Selection

Adverse selection arises when individuals have **hidden characteristics** and a selection process results in a pool of individuals with **undesirable characteristics**.

A **hidden characteristic** is something that one party to a transaction knows about itself, but the other party does not know.

Examples:

- **Health insurance:** insurance companies don't know the information on people's health, so they charge an average premium. This is too expensive for the healthier people so they choose not to get insured, **leaving people in worse health condition on the market**.
- **Used bikes:** the seller knows more about the bike's condition than the buyer does. As a result, buyers are only willing to pay a price that reflects the average quality of bikes on the market, which drives sellers of high-quality bikes out of the market. Buyers do not have the information and offer an average price (expected value). This is too low for the owners of a good used bike and drives them out of the market.

Moral Hazard

Moral Hazard

Moral hazard arises when one party to a contract takes a **hidden action** that benefits their interests at the expense of the other party.

Mitigate with

- Incentive contract
- Signaling
- Screening (e.g. self-selection device)

A **hidden action** is an action taken by one party in a relationship that cannot be observed by the other party.

Examples:

- **Applying for insurance:** once the driver obtains an insurance, they will drive more recklessly since they are insured. The insurance company cannot observe the driver's behavior, so they cannot charge a higher premium to reckless drivers.
- **Bank lending:** with an obtained loan, firms might engage in risky investments. The bank cannot observe the firm's investment decisions, so it cannot charge a higher interest rate to firms that take on riskier projects. This is a moral hazard problem, because the firm has an incentive to take on riskier projects at the expense of the bank. Government bailouts can create moral hazard for banks, as they may take on excessive risks knowing that they will be bailed out if things go wrong. "Too big to fail" banks may engage in riskier behavior.

Mitigating Moral Hazard

1. Incentive Contracts

A way to **mitigate the moral hazard** is an incentive contract (aligning the intereset of the two parties with rewards/penalty).

2. Signaling

Signaling

An attempt by an **informed party** to send an observable indicator of their hidden characterists to an **uninformed party**.

It must be

- observable by the uninformed party
- a reliable indicator of the hidden characteristic
- difficult to mimic for parties with other characteristics

3. Screening

Screening

An attempt by an **uninformed party** to **sort individuals** according to their characteristics.

It may be achieved through a **self-selection device**

Self-Selection Device

A mechanism in which informed parties are presented with a set of options, and the options they choose reveal their hidden characteristics to the uninformed party.

Types of Auctions

Auction

An auction is a mechanism where potential buyers compete for the right to own a good, service, or more generally, anything of value.

- Sellers offer an item for sale and wish to obtain the **highest price**
- Buyer seek to obtain the item at the **lowest price**

Four common types of auctions:

Types of Auctions

- **English Auction**
  - Ascending
  - Sequential
  - Bidders *observe the bids of others*
  - Ends when a single bidder remains
- **First-price, sealed-bid Auction**
  - Simultaneous
  - Auctioneer awards the item to the highest bidder, who pays their bid
- **Second-price, sealed-bid Auction**
  - Simultaneous
  - Auctioneer awards the item to the highest bidder, who **pays the second-highest bid**
- **Dutch Auction**
  - Descending
  - Sequential
  - Bidders obtain **no information** about the bids of others
  - Auctioneer lowers the price until a bidder accepts the price

Strategic Equivalence Dutch/First-price

Strategic Equivalence of Dutch and First-price sealed-bid auctions

The Dutch and first-price sealed-bid auctions are **strategically equivalent**.

- It is the same decision problem: how much should I bid around my true value to avoid overpaying?
- The optimal bids by participants are identical in both auctions.

Information structures

Information Structures

- **Perfect information**:
  - All bidders know the valuations of all other bidders.
- **Independent private values**:
  - each bidder has their own private valuations
  - E.g. art auctions
- **Affiliated/correlated value estimates**
  - Special case: **common-value auctions**, where the item has a single true value, but bidders have different estimates of that value (bids are noisy)

Optimal bidding strategy

Optimal bidding strategy

An optimal bidding strategy for **risk-neutral** bidders is a strategy that **maximizes a bidder's expected profit**.

Strategy for Independent Private Value Auctions

- = bidder's private valuation
- $\{b_i\}$ = bids of other bidders
- $b_{\max}$ = highest bid among other bidders
- L = lowest bid among other bidders
- H = highest bid among other bidders
- n = number of bidders

Strategy:

- **English auction**
  - Remain active until the price exceeds
- **Second-price sealed-bid auction**
  - If $> b_{\max}$, bid , win and pay $b_{\max}$
  - If $< b_{\max}$, bid , lose and pay nothing
- **Dutch auction / First-price sealed-bid auction (strategically equivalent)**
  - Bid **less than your valuation**
  - The valuations of all n bidders are uniformly distributed between L and H.
  - The optimal bid b for a player with valuation is given by:

$$\boxed{b = \ - \frac{- L}{n}}$$

Dutch/First-price auction bidding strategy

In a Dutch or first-price sealed-bid auction (strategically equivalent) with n bidders whose private valuations are uniformly distributed between L and H, the optimal bid b for a player with own valuation is given by:

$$\boxed{b = \ - \frac{- L}{n}}$$

Strategy for Correlated Value Auctions

An example of a correlated value auction is a **common-value auction**, where the item has a single true value, but bidders have different estimates of that value (bids are noisy).

Bidders do **not** know their own valuation, nor the valuations of other bidders. This makes bidders vulnerable to the **winner's curse**, where the winning bidder tends to overpay due to overly optimistic estimates.

Expected Revenues

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