Customized Pricing

Outline

- **Examples**
- **Customized Price Optimization**
- **Bid Response Function**
- **Extensions**

Based on Phillips (2005) Chapter 11

Customized Pricing Examples

- B2B: Selling telecommunication (phone) service to companies
  - Global customers, annual spend more than $10M
  - Growth customers, annual spend between $10K and $10M
  - Metro customers, annual spend less than $10K
- B2C: Loans to individuals
  - With no collateral: Selling consumer loans
  - With collateral: Selling mortgage (home) loans
  - Modifying mortgage according to Peter Muriungi GMAC VP of Loan Servicing on Oct 8, 2009.
    - Consumers who fall behind monthly mortgage payments renegotiate payment terms with GMAC
    - GMAC reduces the principal, APR and/or extends payment period to give some relief to the consumers
    - Mortgage modifications depend on consumer characteristics
      - Jumbo loans vs. others; Loan/House value; Underwater borrowers; Disposable income; Fixed expenses; Family size
    - GMAC wants to estimate who will fall behind before they do to be proactive in negotiations; consumers should ask for modification before they fall behind
- C2C: Selling a house without a realtor to an individual.

Customized Price Optimization

- We are selling goods and receive a request for proposal (RFP) or a request for quote (RFQ) to sell *d* items, how should we price each item? How to bid?
- Recall total (deal) contribution to margin at price *p*: $m(p)=(p-c)d(p)$.
- Bid response function: Probability of winning the bid at price *p*: $\rho(p)$.
- Maximize the expected contribution to find the optimal customized price *p*:

Customized Pricing: $\max_p \{(p-c)\, d\ \rho(p)\}$

- Recall the optimization problem of basic pricing with market size *D* and the proportion 1-$W(p)$ of the consumer who are willing to pay more than price *p*.

Basic Pricing: $\max_p \{(p-c)\, D\,(1-W(p))\}$

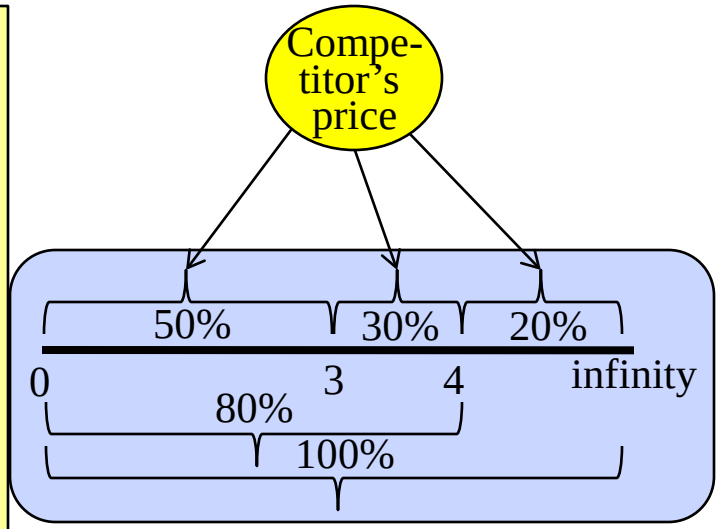
- No new optimization methodology is needed. The customized pricing is structurally the same as the basic pricing problem.
- Analogy: Probability versus Proportion.
  - Bid response function $\rho(p)$ at price *p*.
  - Price response function 1-$W(p)$ at price *p*.
- Despite different interpretations, mathematically they are the same.

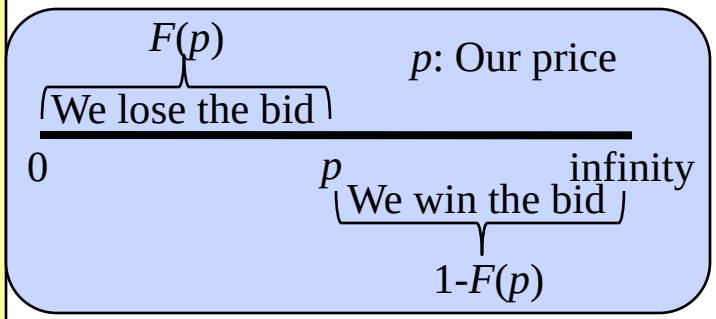
Uncertainty of Bid Response Function

- Uncertainty in bid response
  - Generally buyers pick
    - Objective: Lowest cost (optimization)
    - Constraints: Among qualified offers (satisfaction).
  - Preference uncertainty: Uncertainty of criteria (objective) used by the buyer.
    - Preference can be based on cost, quality, delivery time, or a combination thereof.
      - Cowboy's stadium constructor needs two steel arcs. High strength low-alloy steel (A913 steel) arcs for retractable roof, the longest single-span roof in the world.
      - Dimensions: Each arch spans about 300 meters, reaches 90 meter maximum height and weighs about 3255 tons.
      - Quality: The steel must be strong to carry the roof, indoor TV; It must be flexible enough so that it can be bent to make an arch; Its chemical composition should allow for welding.
      - Delivery time: They should be delivered in 6 months to avoid construction delays.
  - Competitive uncertainty: Uncertainty of constraints and other qualified offers.
    - Constraints can also be based on cost, quality, delivery time, or a combination thereof.
      - Softer constraints: Each arc spans about 300 meters and reaches about 90 meters.
    - Competitors: ArcelorMittal headquartered in Luxembourg; Henan Shinxiang Industry from AliBaba.com.
      - Qualification and number of competitors are not known.
- A buyer has less uncertainty than bidders. A buyer can benefit from the bidder's uncertainty.

Bid Response Function with a Single Competitor

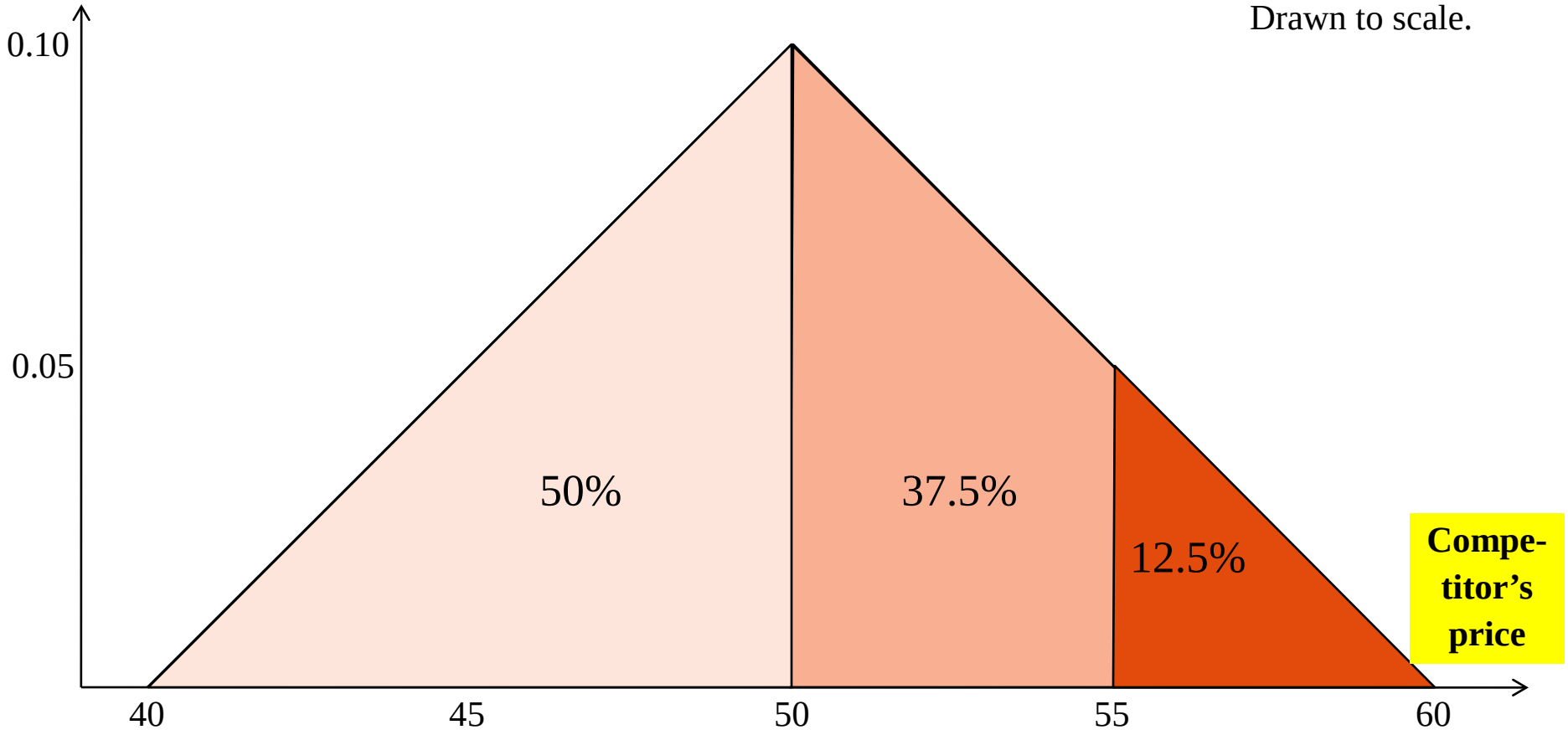
- Write the bid response $\rho(.)$ as a function of the single competitor's price. This price of our competitor is not known to us but we know its cumulative distribution F.
- $F(p)$: the chances that the single competitor will bid p or less.
  - 50% chance for a bid of at most \$3 (from 0 to 3).
  - 80% chance for a bid of at most \$4 (from 0 to 4).
  - 99% chance for a bid of at most \$8.
  - 100% chance for a bid of infinite dollars, so $1=F(\text{infinity})$.
- Then $1-F(p)$ is the chance that the competitor will bid at least p and perhaps more.
  - 50% chance for a bid of at least \$3.
  - 20% chance for a bid of at least \$4.
  - 1% chance for a bid of at least \$8.
- Example: If we charge \$4, what is the chance of winning the bid?
  - 20% as the competitor bids more than \$4.

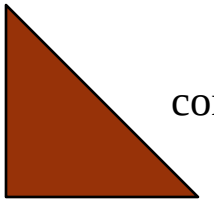




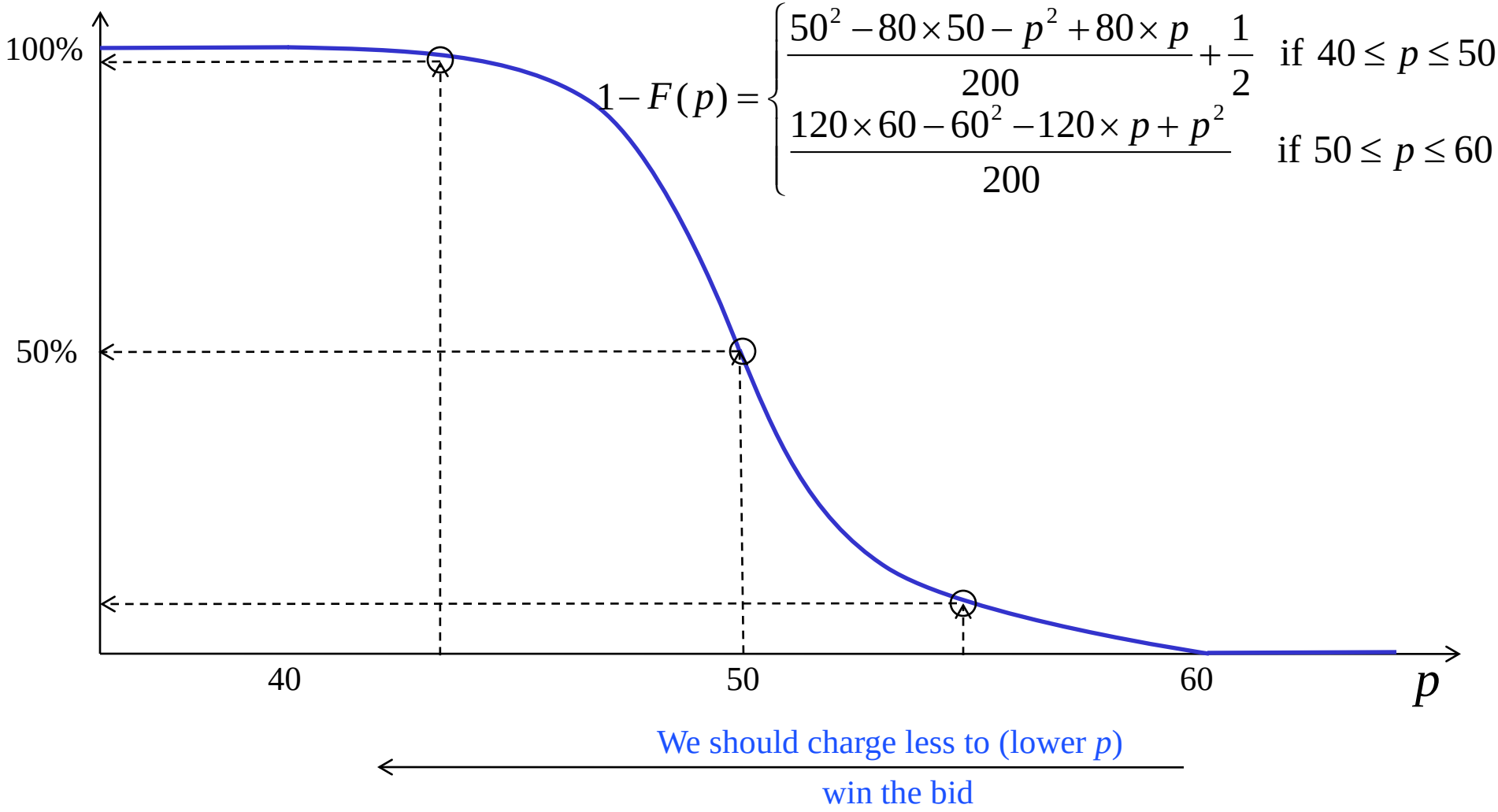
A customer buys from us if [competitor's price $\geq p$]
Or with probability $\rho(p)=1-F(p)$.

Example: Triangle Distribution for Competitor's Price

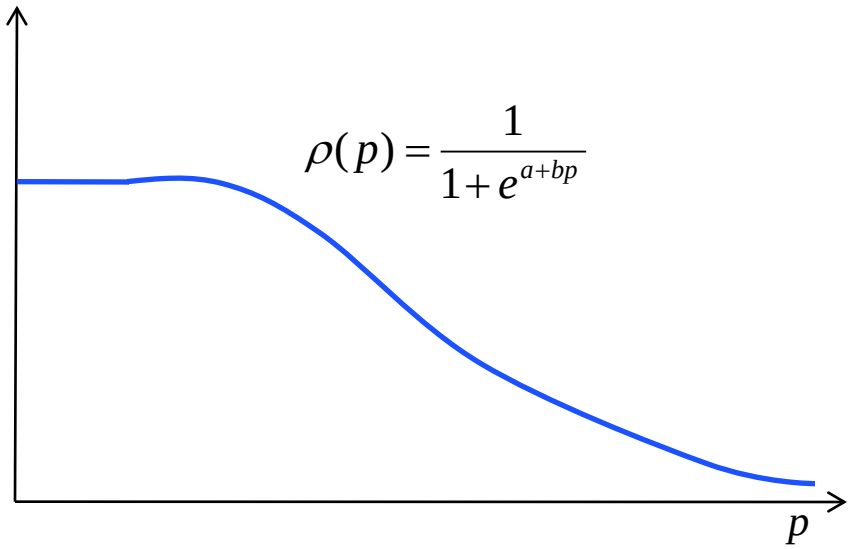


A traingle of this size  corresponds to 3.125%. There are 32 of this size traingles in 100%.

Example: Triangle Distribution for Competitor's Price



Example: Logit Bid Response Function



- Logit bid response function has the same form as the logit price response function.
- Techniques used in estimating the logit price response function apply to the estimation of the logit bid response function.
  - But the parameterization in chapter 3 of the textbook is slightly different, recall

$$1-W(p)=1-\frac{1}{1+e^{-(a+bp)}}$$

where the parameters are multiplied by negatives.

In general, *W* of Chapter 3 can be interpreted as *F* here to replicate the examples therein.

Bid Response Function with Multiple Competitors

- Write the bid response $\rho(.)$ as a function of N competitor's price. These prices of our competitors are not known to us but we know their cumulative distribution F_n for competitor n.
- $F_n(p)$: the chances that competitor n will bid p or less.
- $1-F_n(p)$ is the chance that competitor n will bid at least p and perhaps more.
- We sell if we bid p and less than all of the competitors:
- A customer buys from us if [minimum competitor's price $\geq p$]
- Example: If we charge \$4 while each of the two competitors is independently expected to charge more than \$4 with 20%, what is our chance of wining the bid?
  - 4%=20% x 20%.

A customer buys from us if [price of competitor $n \geq p$] for competitor n, $1 \leq n \leq N$.

Or with probability $\rho(p) = (1-F_1(p))\,(1-F_2(p)) \ldots (1-F_N(p))$.

Extensions

- Pricing to increase market share: $\rho(p) \geq$ threshold.
- Pricing to increase contribution to margin: $p \geq$ threshold.
- Pricing contracts: Contracts are over a duration for the purchase of goods/services. They are often based on aggregate quantities (total dollar spent rather than individual products bought). Uncertainty in level (total demand) and mix (individual demands) play important roles.
- Bundling:
  - Price the bundled product
  - Price the items in the bundle but sell the bundle as a whole; not preferred by sellers
  - Price and sell the items separately
- Fulfillment: Dual sourcing – understand your customer
  - OPRE 6366: Supply Chain Management Sourcing Module
  - OPRE 6371: Purchasing and Sourcing Management

Customized Pricing

- Examples
- Customized Price Optimization
- Bid Response Function
- Extensions