CS 523: Social, Economic, and Legal Aspects of Security

Privacy & Price Discrimination

Who wants to learn private info

- Governments use coercive power to obtain private info, and use it for many purposes:
  - Prevent tax evasion
  - Determine eligibility for aid
  - Combat crime
  - Detect planned terror acts before they occur
  - Prevent the spread of disease
  - Increase political control over the population

Who wants to learn private info (cont'd)

- Criminals
  - For purposes of fraud, theft, blackmail, ...
- Legitimate businesses, to increase their profits
  - Monitor employees to increase productivity
  - Use the information for targeted advertising (ads are more effective when tailored for the viewer)
  - **Use the private info for price discrimination** (charge Alice what she's willing to pay, which can be a different price than for Bob)

Privacy v. price discrimination

- This set of slides explores the connection between privacy and price discrimination (PD)
- Explains why charging different prices to different buyers can be socially desirable
  - And a win-win for both sellers and buyers
- Covers examples of PD, and the different ways that vendors have used to achieve PD in a manner that is tolerable to their customers

Why doesn't re-selling prevent PD?

- Alice gets lower price than Bob, re-sells to Bob
  - This would result in a "market price" (same for all)
- Re-selling may not be practical, e.g.,
  - Non-transferrable services (airline tickets, cell phone service, cable TV, …)
  - Much lower prices for goods that are "used" the minute Alice buys them (e.g., cars, electronics)
  - Bundled goods that are hard to price individually (Alice knows only the price of the bundle)

Historical examples of PD (1)

- Railroads in 19th century
  - Overt price discrimination (unlike today, industry lacked the means to make it covert)
  - Caused public outrage, political action
  - Resulted in regulation (later extended to trucking)
  - Regulation stopped price wars, stabilized prices (it was good for the railroad industry, and it stopped the public outrage at price discrimination)
  - Regulation had bad consequences for a long time

Historical examples of PD (2)

- Soft drink vending machines experiment
  - Machine increased prices on hotter days
  - OK as long as it was undetected
  - Outrage when it was detected (very negative reaction against the company that did it)
  - It may have been better received if vending machines gave discounts on colder days (mathematically identical to "surcharge on hot days", but psychologically less objectionable)

Historical examples of PD (3)

- Online merchants
  - Charged different prices for different customers
  - If customer did not login, they used IP address, type of computer used, info in cookies, ...
  - When discovered, public reaction was negative
- Businesses learned lesson from history: Overt price discrimination elicits public outrage
  - Businesses try to use covert price discrimination

Government ambiguity

- People want governments to fully protect their privacy, and thereby thwart PD
  - For PD, businesses need to know about buyer
  - PD inherently requires privacy to be violated
- Governments are reluctant to stop all PD
  - PD is not only good for business profits, it can also benefit the public (it has good economic and social consequences)
  - Preventing all PD can decrease total social welfare

Example of PD benefit

- Carol can design a widget at a cost of $1,000
  - Manufacture cost is negligible (the main cost is the time it takes Carol to design the widget)
  - The market for that widget is Alice and Bob
  - Carol knows enough about Alice and Bob to determine that Alice would pay $800, Bob $400
- Without PD, Carol would not make the widget
  - If price ≤ $400 then she gets ≤ $800; if price > $400 she also gets ≤ $800 (as Bob wouldn't buy)

Example of PD benefit (cont'd)

- With PD *and* Carol's knowledge of what Alice and Bob can pay, she could price the widget at $750 for Alice and $350 for Bob
  - Carol would make $1,100, $100 above her cost
  - Alice would pay $50 less than her $800 valuation
  - Bob would pay $50 less than his $400 valuation
  - Everyone is better off with PD than without PD
  - But: Alice would feel bad if she knew that Bob paid so much less than her (the "fairness" issue)

Example of PD benefit (cont'd)

- Imagine that Carol is a private university, Alice is the set of "rich parents", Bob is the set of "non-rich parents", and the price is tuition
  - Not only does the government not prevent Carol from learning private info, it actually helps Carol !
  - As usual, differential pricing is disguised as a "fixed price but with rebates for the talented needy" (a talented Bob gets a break on tuition, an equally talented Alice does not)

Other examples of PD

- Senior citizen discounts
- Student discounts
- Periodic sales in stores
  - Discriminate between the informed and uninformed, the patient and the impatient
- Similarly in price-matching offers
  - "We'll match any of our competitors' prices"
- What gasoline wholesalers charge gas stations

Covert PD

- Bundling (esp. if individualized)
  - Including k items in a bundle offered to Alice
  - Alice knows only the total (bundle) price
- Site licenses (for online journals, software, …)
  - If seller knows their product's value to each employee of X, they add them up and charge that sum for "unlimited access to all employees of X"
  - Mathematically equivalent to individually using PD on all the employees of X (yet apparently not PD)

PD without any prior private info

- Problem: Practicing PD without having any prior knowledge of the item's value to Alice

- Solution: Get Alice herself to self-discriminate

- Offer Alice different versions at different costs

- She reveals through her choice of version

- Different versions of a digital product have nearly same cost of production
  - Higher-priced version is often cheaper to produce

Examples of Versioning

- IBM Laser Printer series E
  - Identical to IBM's standard printer, but printed at half the rate (by deliberately waiting)
- Federal Express
  - The "before 10am" higher-priced option
  - Fed Ex incurs the cost a separate delivery after 10am rather than early-deliver standard package
- Online stock quotes
  - Real-time vs 20-minute delay

Examples of Versioning (cont'd)

- Resolution of images or videos
  - Higher price for the better quality
- Regular vs "Server" version of OS
  - Practically identical, but one is configured to accept far fewer simultaneous connections
- Train travel in 19th century
  - 3 classes (from luxury down to miserable)
- Airline travel today

Shoppers unwittingly enable PD

- Shopping as a registered user tells online stores about your capacity to pay

- Even if you check prices without signing in and with cookies disabled, the type of computer you're using can be revealing
  - If it's a Mac, you can't be too price-conscious

- Shopping anonymously, and without revealing the type of computer, can lower cost