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

Economics of Privacy
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 (PD) (charge Alice what she’s willing to pay, which can be a different price than for Bob)
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 a lot about Alice
  – 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 patient, and the others
• 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 info, 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