

Modeling and Simulation of Human Choices: from Utility Theory to Applications

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Introduction : Science Fiction



- **Psychohistory**: Branch of mathematics which deals with the reactions of human conglomerates to fixed social and economic stimuli. Encyclopedia Galactica, 116th Edition (1020 F.E.)

Introduction: Prof. McFadden

- Laureate of The Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel 2000
- Owns a farm and vineyard in Napa Valley
- *“Farm work clears the mind, and the vineyard is a great place to prove theorems”*



Introduction : marketing



- Prediction of market shares
- Choice of brand
- Choice of product features
- Choice of retail store
- Etc.

Introduction : transportation demand analysis

- Choice of mode
- Choice of path
- Choice of destination
- Choice of parking
- Choice of departure time

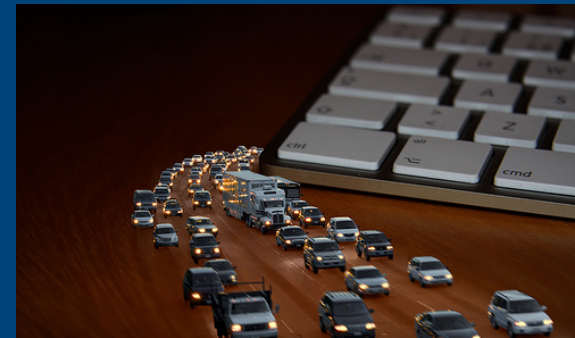
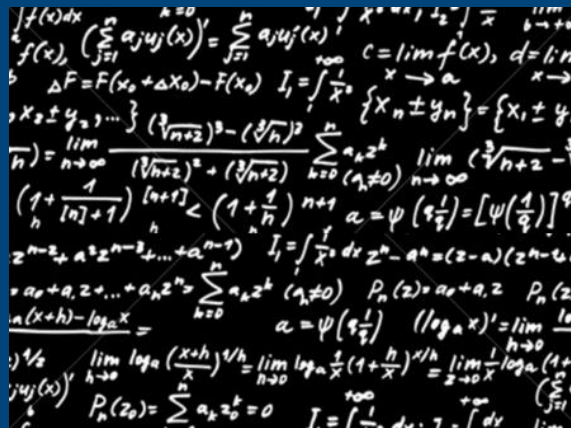
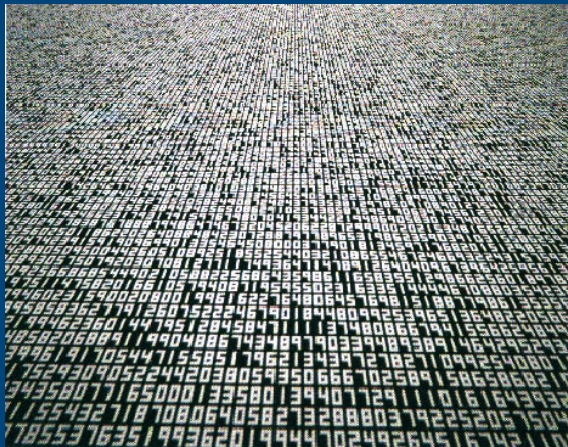


Framework

Data

Model

Simulation



Data: questionnaires

- Data about the respondent
- Choice data
- Revealed preferences
- Stated preferences



Data: smartphones

- GSM, GPS
- Accelerometer
- WiFi
- Bluetooth
- Ambient sound
- And more...

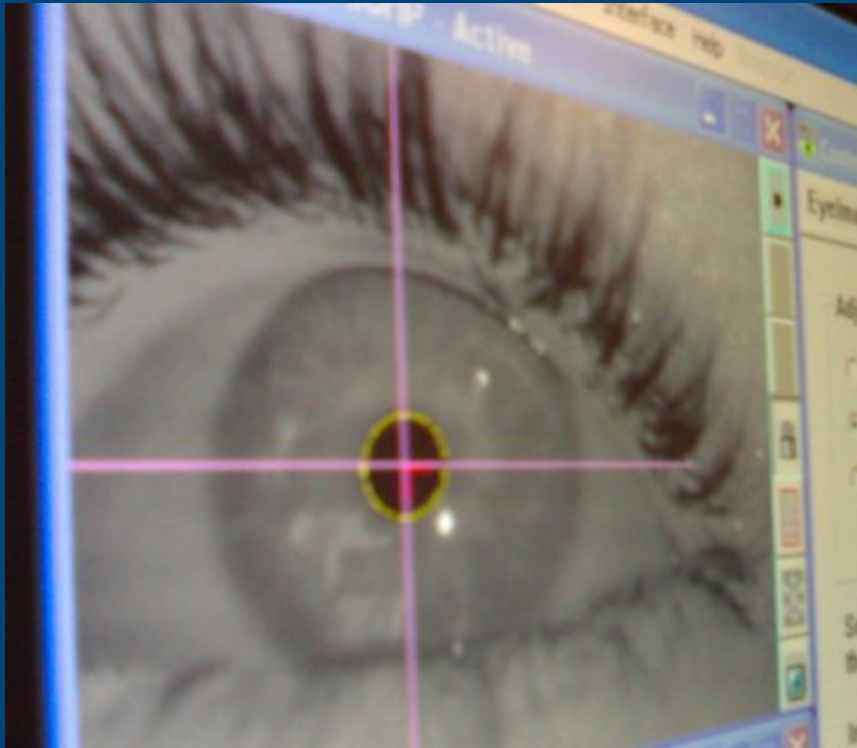


Data: scanner data

- Detailed purchase information
- Personalized



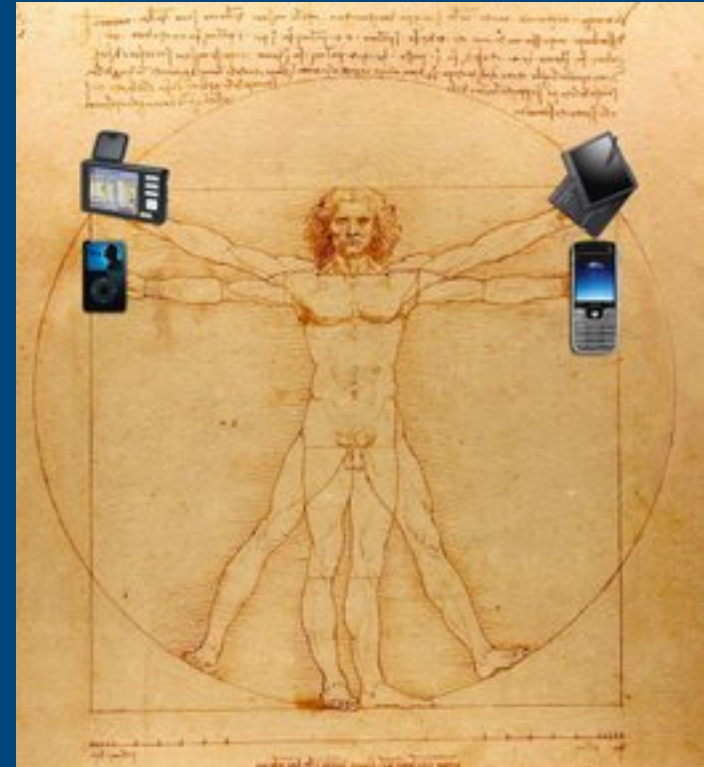
Data: eye tracking



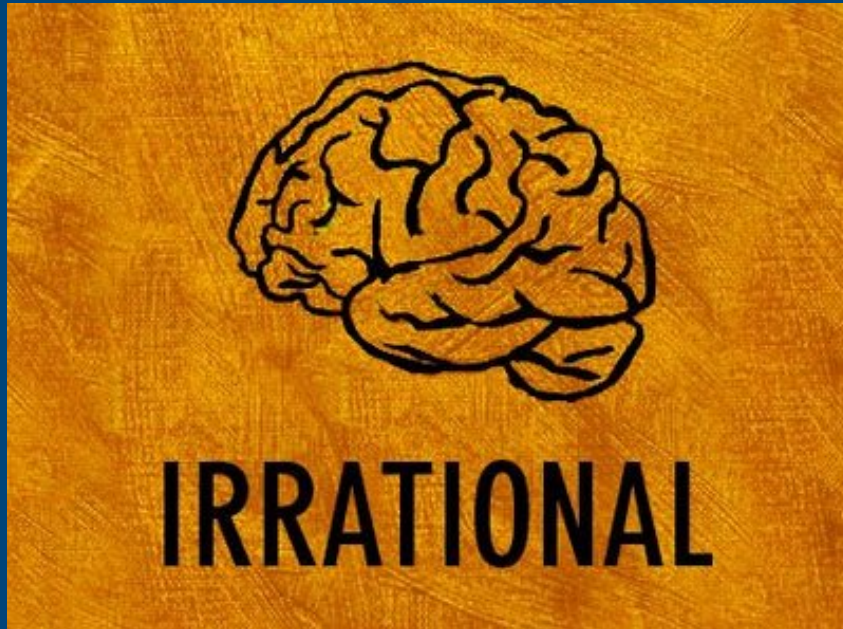
- Where do people look?
- Used in marketing research
- Used in driving safety research
- Relevant for pedestrian models

Model : assumptions

- Homo economicus
- Rationality
- Utility theory
- Each alternative is associated with a utility
- The alternative with the largest utility is chosen



Model : assumptions



- Strong assumptions
- Uncertainty and irrationality must be captured
- Random utility models
- Latent variables

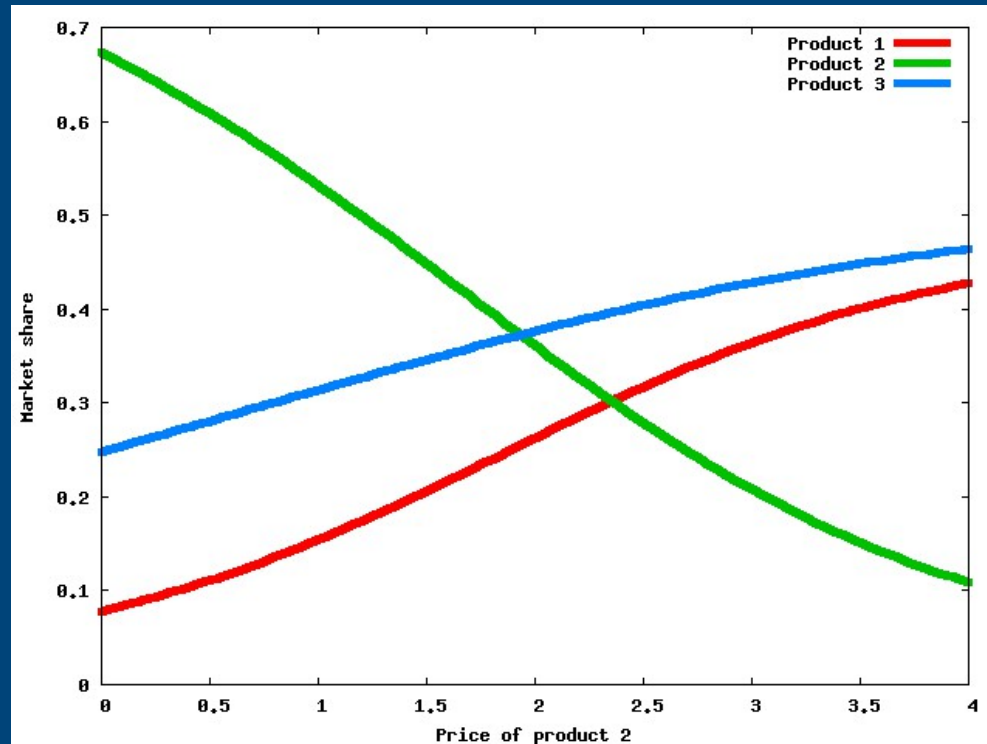
Model : features

- Disaggregate – market segments
- Quantitative and qualitative variables
- Can handle subjectivity - attitudes- perceptions



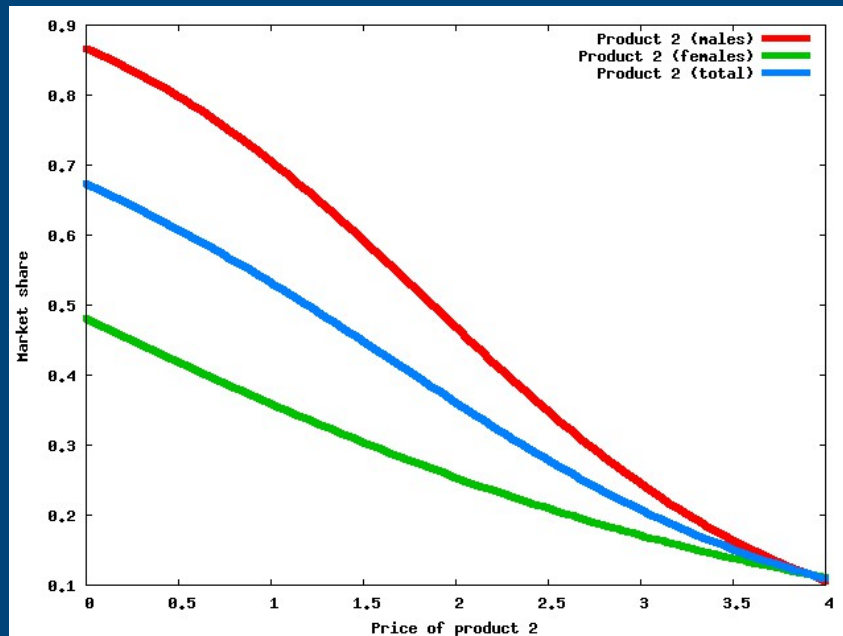
Application : simulation of market shares

- Policy variables (e.g. price)
- Nonlinear effect



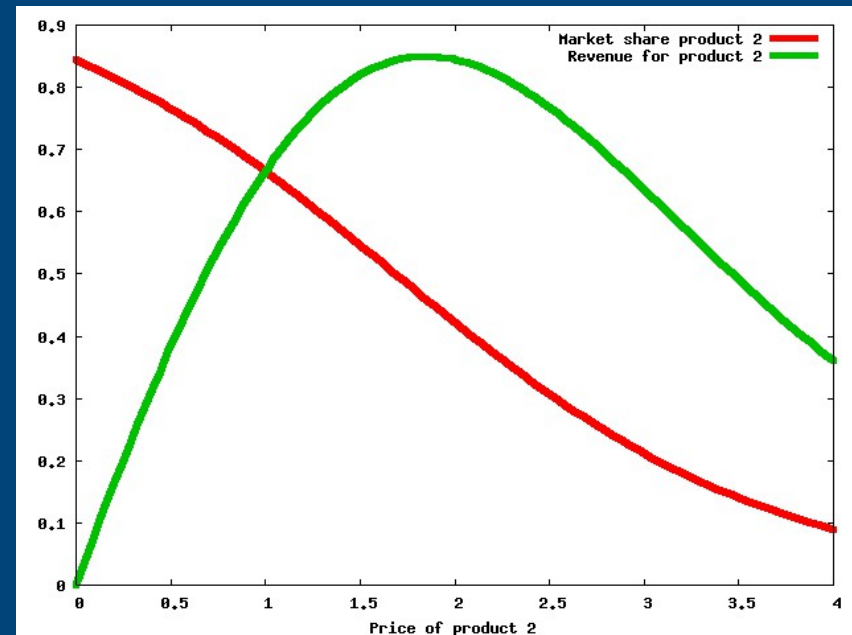
Application : market segmentation

- Market shares per segment
- Granularity depends on the data availability



Application : simulation of revenues

- Concept of optimal price
- Can be segment specific

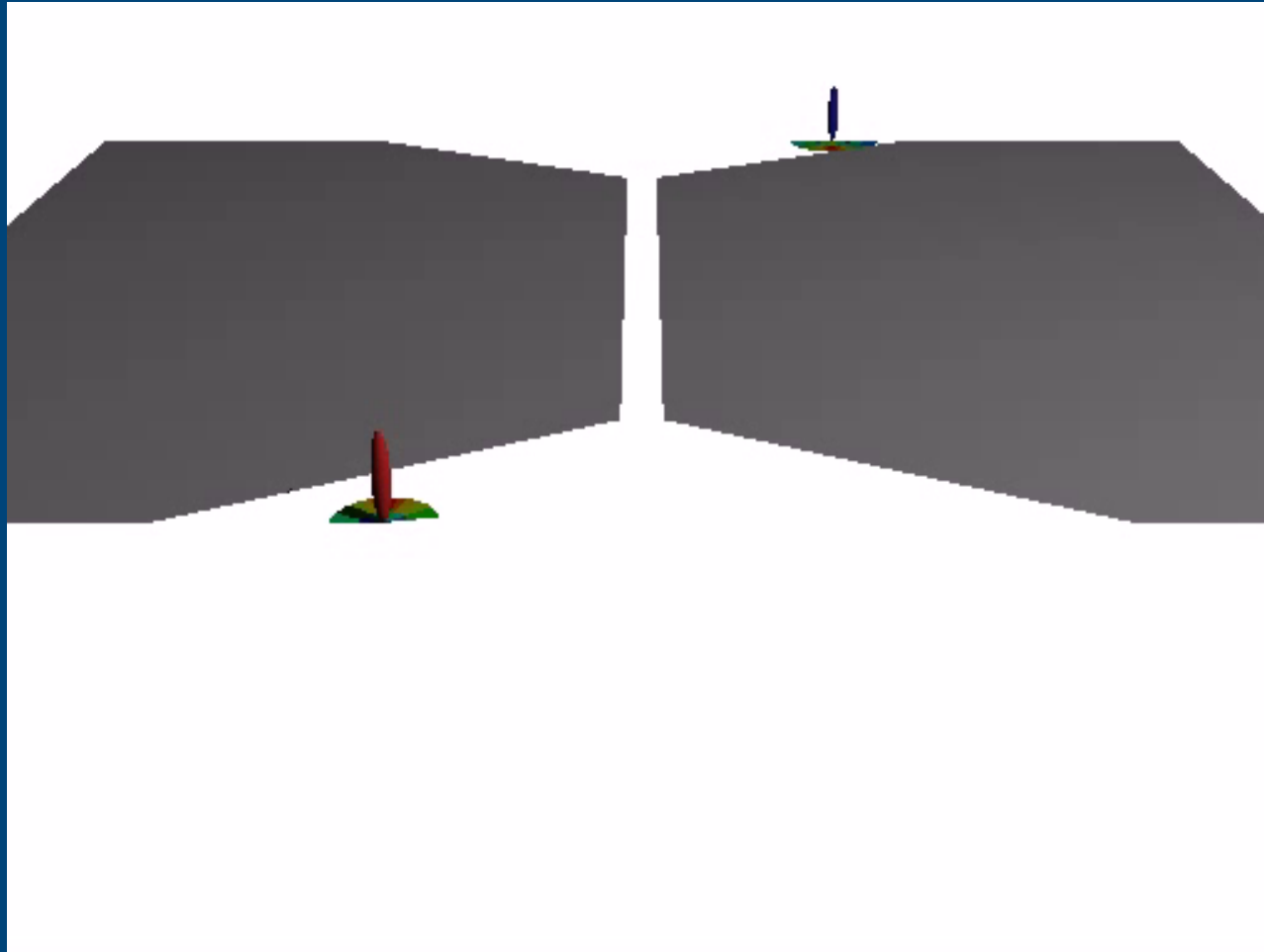


Application : pedestrian walking behavior

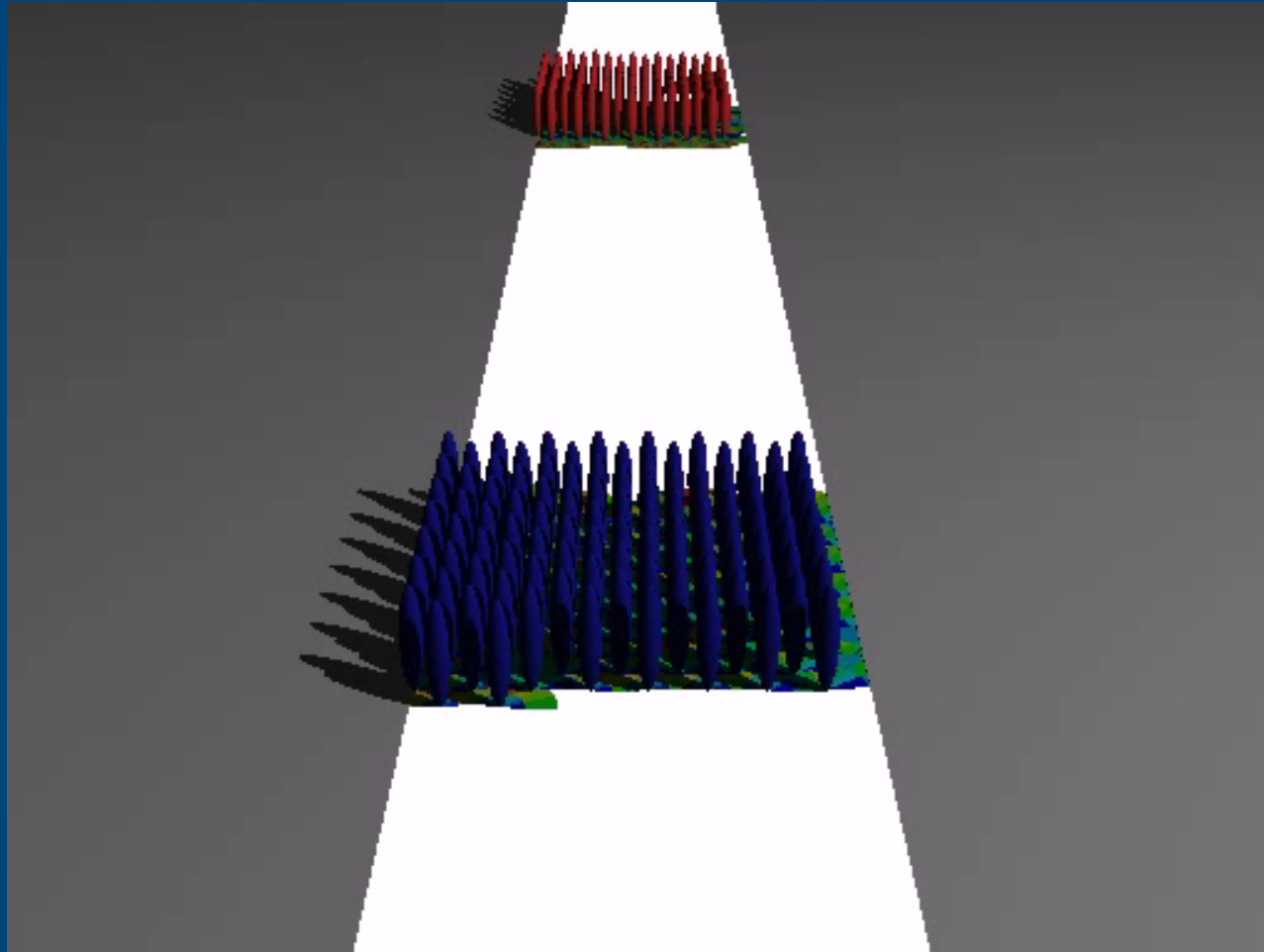


- Choice of the next step
- Collision avoidance
- Leader follower

Application : pedestrian simulation



Application : pedestrian simulation



Applications: route choice

- Complex problem
- Number of paths is huge
- High level of overlapping
- Shortest path not behaviorally meaningful



Application : electric vehicles

- Market shares
- Hypothetical choice
- Importance of attitude toward the environment



Application : facial expression recognition

- Automatic identification of the emotion
- Potentially different across cultures
- Requires advanced image processing algorithms



Application : demand-supply interactions



- Revenue management
- Market equilibrium
- Combination of operations research and demand models

Conclusion

- Discrete choice models
- Advanced and operational
- Accomodate modern data sources
- Wide range of applications
- Complex models requires simulation tools

Short course : Discrete Choice Analysis: Predicting Demand and Market Shares

- January 29- February 2, 2012
- Ecole Polytechnique Fédérale de Lausanne
- Prof. Ben-Akiva (MIT) – Prof. Bierlaire (EPFL)
- transp-or.epfl.ch/dca

