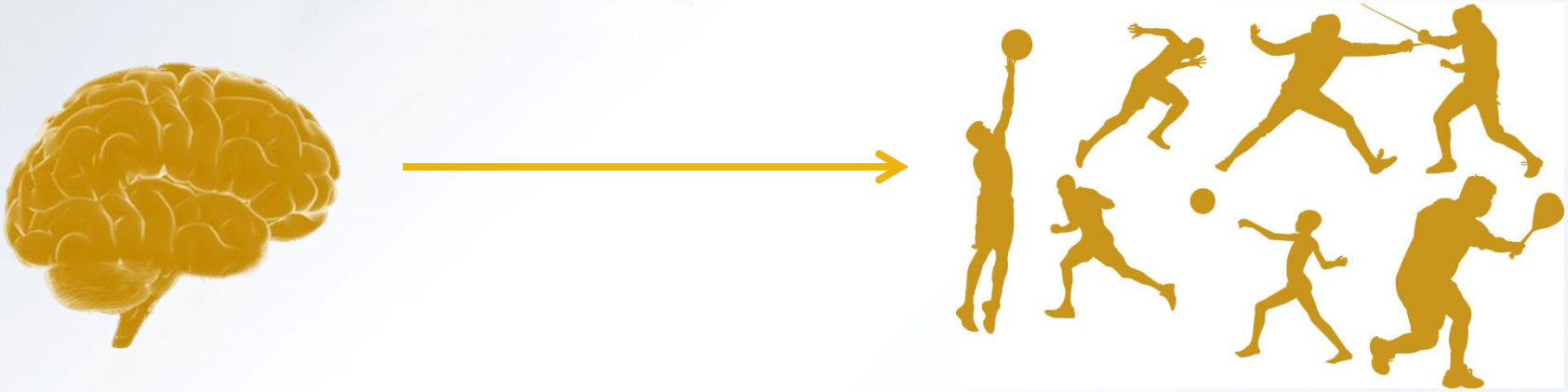
Incorporating human complexities in predictive sports analytics



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Overview

- Why is predictive sports analytics different?
- Examples: what's needed?
  - Solutions: what's being done?
  - Research frontiers: what's needed?

Humans have little/no effect

Weather forecasting

Crop yield

Manufacturing productivity

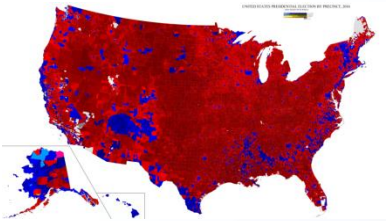
Human effects are collective

(Large *n* → law of large numbers)

Insurance

Marketing

Demand Forecasting



Election Forecasting

Loans

Social Media

Sports analytics: individuals matter!

- Game strategy
  - How will Player/Team X perform (against Player/Team Y) *today*?

- Player selection (Draft, free agency, contracts)
  - How well will Player X perform next year?
  - Over the next k years?

- Training/preparation
  - How will Player X respond to training regimen R?

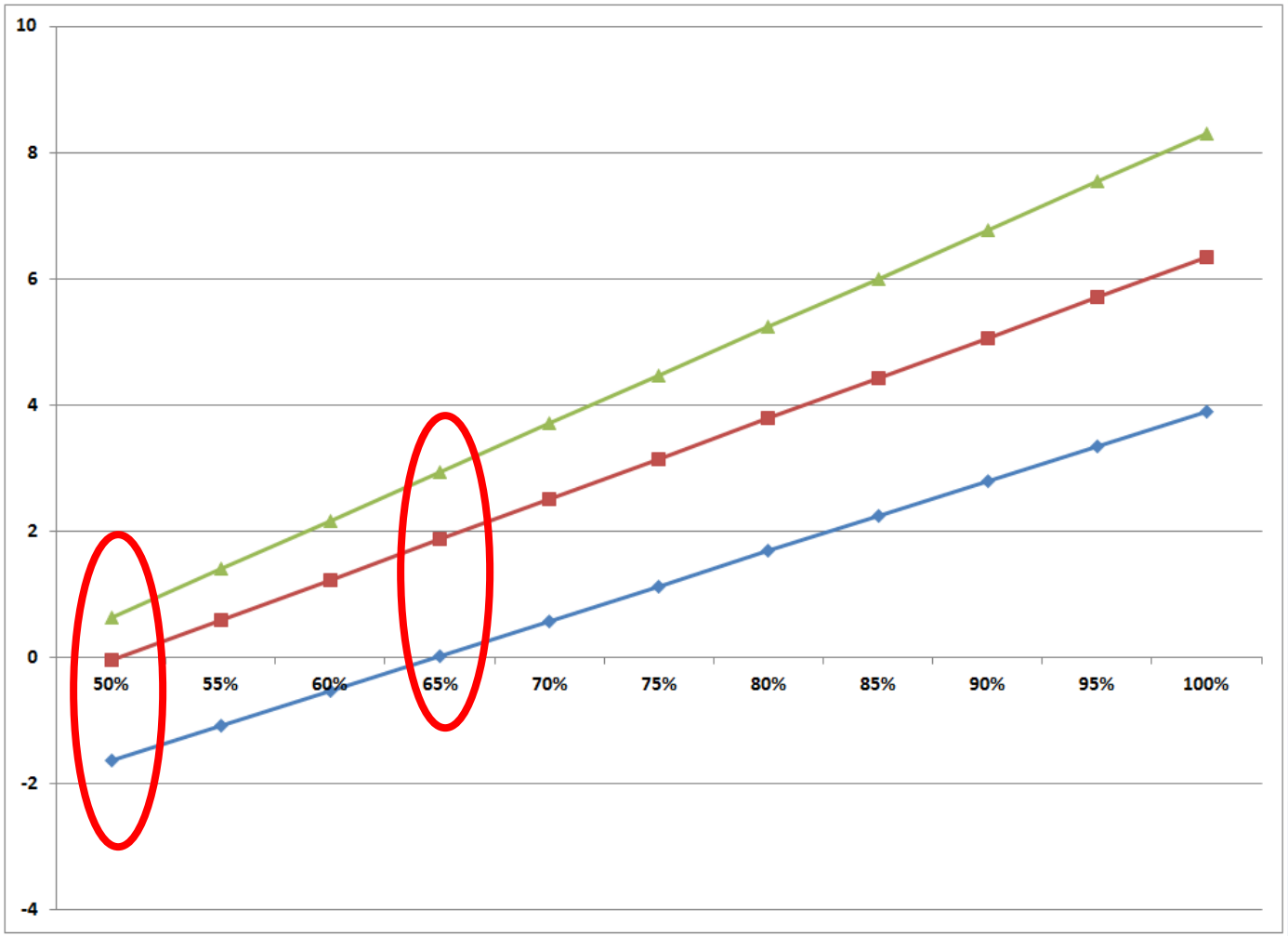
Game strategy example

"Batters behave like a tabletop baseball game…"

- Pick two very similar batters
  - Same team
  - Same hand, other characteristics
  - Played almost every day

- If we knew with probability *p* which has better outcome each day…

Paired batter studies



- Millions of dollars in impact
  - even from 50% to 65%
- Need new types of data
  - Biometric
  - Physiological
  - Psychological
  - Side question: measuring without disturbing

Approx. $6M

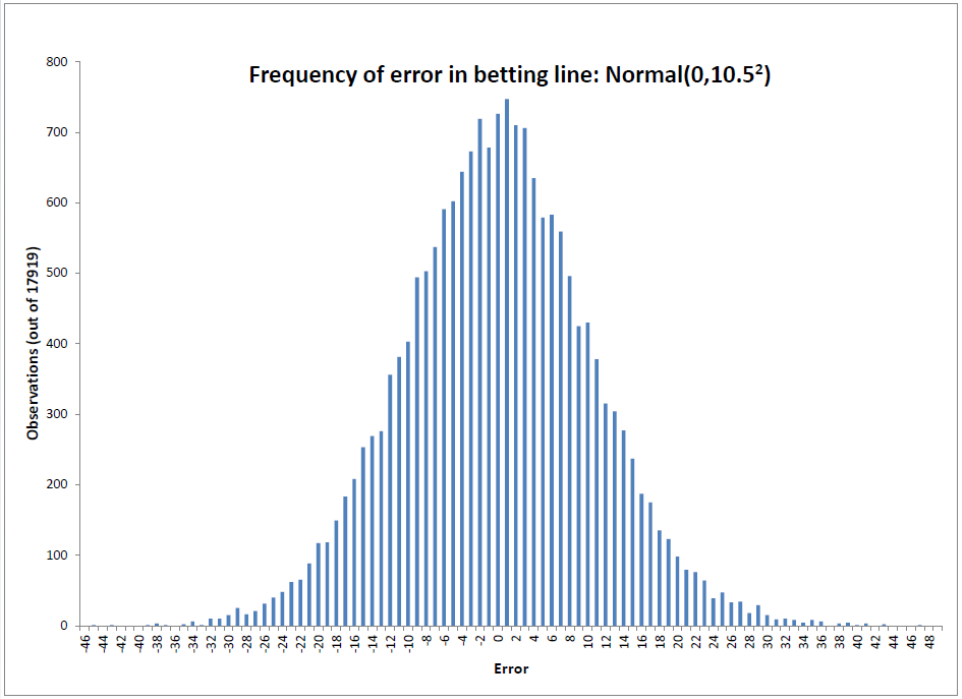
Game prediction

- Who will win the match?

- Who will win the tournament?
  - Complexities
    - Reliance on small number of events
    - Reliance on rare events (e.g., soccer goals)
    - Importance of individual performance
      - Physiology: Time zones, elevation, circadian rhythm
      - Other physiological/psychological factors?
      - Luck

Where does error come from?

"Why haven't you improved LRMC lately?"



- *Randomness*:
  - Does the ball bounce in or out?
  - Does the player trip or not?
  - Etc.
- *Uncertainty*:
  - Errors in estimate of team ability
  - (Also other estimation errors: home court advantage, etc.)
- Frontier of sports analytics:
  - Identify and quantify uncertainties separate from randomness
  - Better insight & better value

Where does error come from?

"Why haven't you improved LRMC lately?"

For significant improvement:
"Randomness" → "Uncertainty"

Usually that means "new data", not "better models or algorithms"

Uncertainty in team strength

Randomness in game events

Curry & Sokol (forthcoming)

Player selection

Player prediction *and* expert behavior

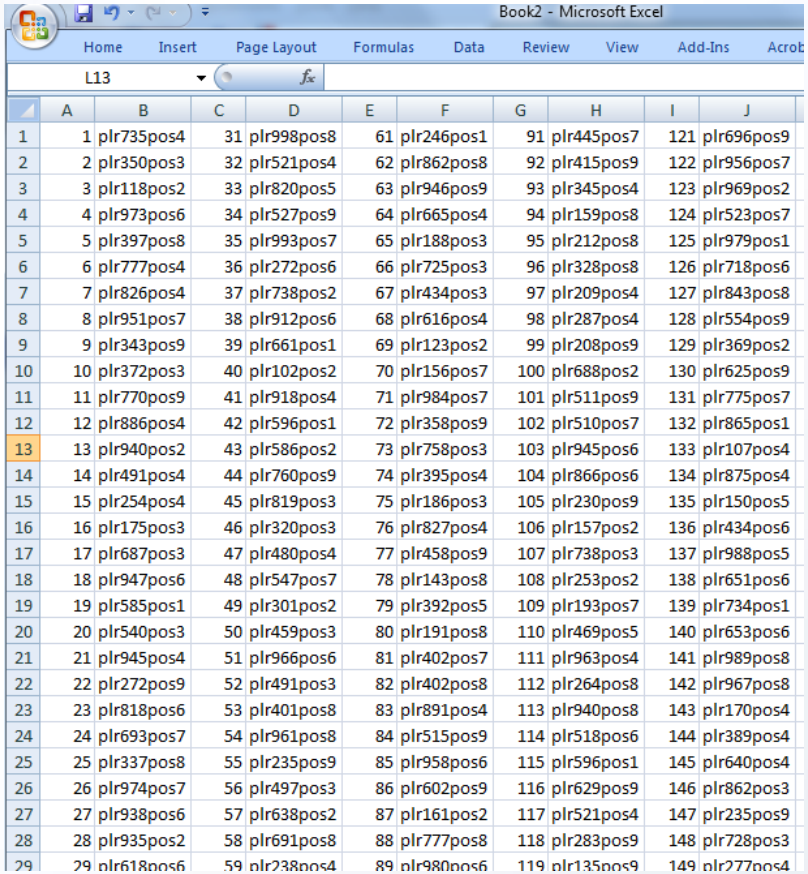
- Example: Major League Baseball draft
  - (Teams take turns selecting a player)

- Statistical models can predict…
  - Expected player performance (with lots of variance)
  - Probability of getting to Major Leagues
    - Little apparent difference between consecutive players

- ...but teams need to pick a single player
  - Unsuccessful choices cost wins, jobs

Second layer of complexity: uncertainty

- 1000+ players, 25+ scouts
- Each scout ranks a subset of players
  - Better statistical models → emphasis on psychology and motivation
  - Scouts have significant contradiction
  - Uncertainty is inherent in scouts' evaluations



Book2 - Microsoft Excel

Home Insert Page Layout Formulas Data Review View Add-Ins Acrob

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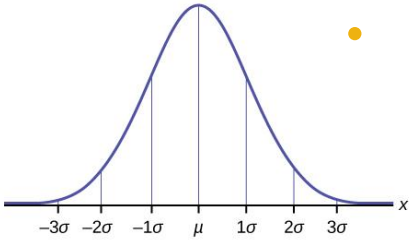
Current approaches

Difficulty in predicting individuals

- Rely on “law of small numbers”
  - Acquire lots of good-probability players
  - Likely that some (enough?) will turn into good players



- Shift in scouting (facilitated by analytics/data science)
  - Statistics to predict range of outcomes (including injuries)
  - Scouts analyze psychology
    - Motivation, drive, self-control
    - “Big-market effect”

Current approaches

Include scout certainty estimates in player rankings

Team confidence in scout *v* ranking of players *i* and *j*

$$\sum_{v \in V} \sum_{(i,j) \in C_V} \left((r_v(i) - r_v(j)) \sqrt[a]{n_v} \sqrt[b]{t_{v,i} t_{v,j}} \sqrt[c]{u_{v,i} u_{v,j}} \right) f(p_i, p_j)$$

Scout *v* confidence in his ranking of players *i* and *j*

- Has been used by >15% of Major League Baseball teams

Streib, Young, & Sokol (2012)

Personalized training regimens

- Get player to maximum readiness at right time
  - Large *n* can take over?
    - Daily performance data (training/practice)
    - Millions of people with wearable devices
      - But only outlier performance matters!
  - Psychology still matters
    - Less data; more research

  - *Many* professional (and college) teams are working on this!

In-game seat upgrades

- Seat upgrades at sporting events
  - …as early as possible (*before* game time?)
  - …low probability of error

- Is individual fan behavior predictable?
  - With the right data…
    - Ticket scan times
  - …and the right probabilistic and statistical models
    - Sorry, NDA

Takeaways

- Predictive sports analytics is different
  - Individual human behavior: small *n* (or even *n*=1)
- Important effects under investigation
  - Daily performance variation
  - Physiological & psychological indicators
  - How to incorporate judgement uncertainty
  - Lots of interesting cross-disciplinary questions
    - “Analytics plus…”