

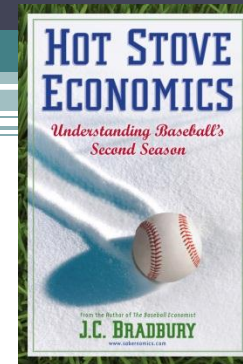
# Resting the Pitcher: How Useful Are Pitch Counts and Days of Rest?

J.C. Bradbury

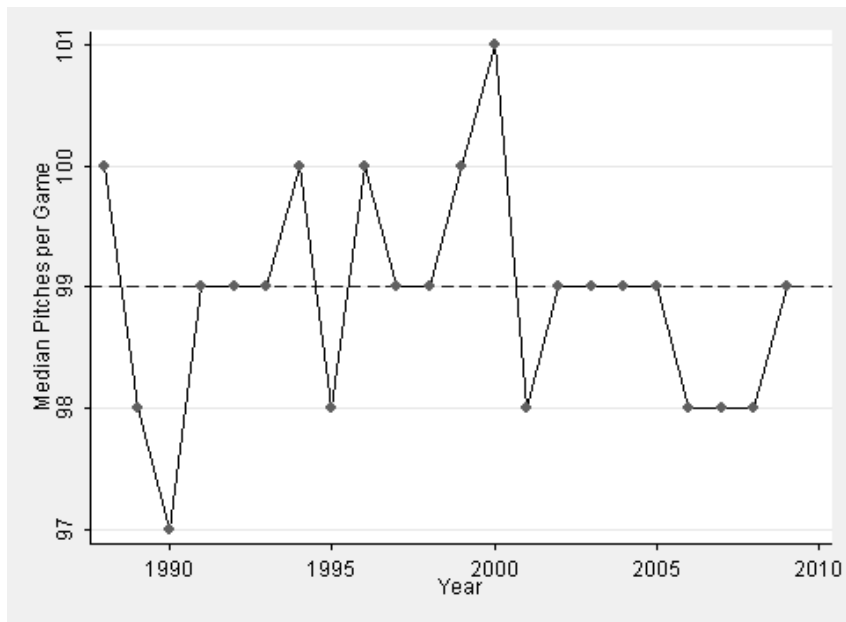
Kennesaw State University  
Sabernomics.com

Sean Forman

Sports Reference, Inc.  
Baseball-Reference.com

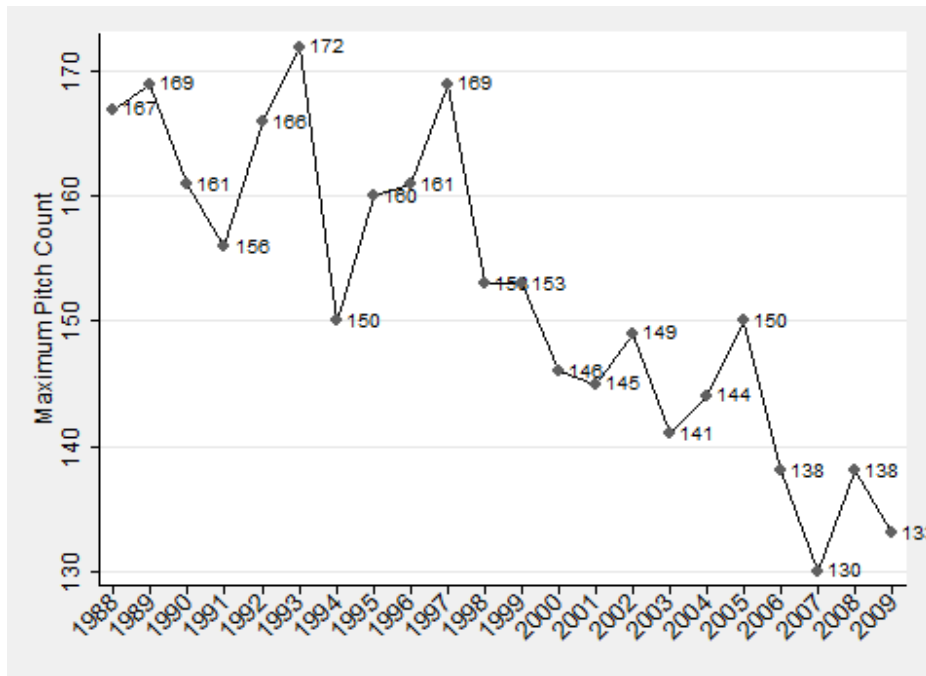


# How Have Pitch Counts Changed Over Time?



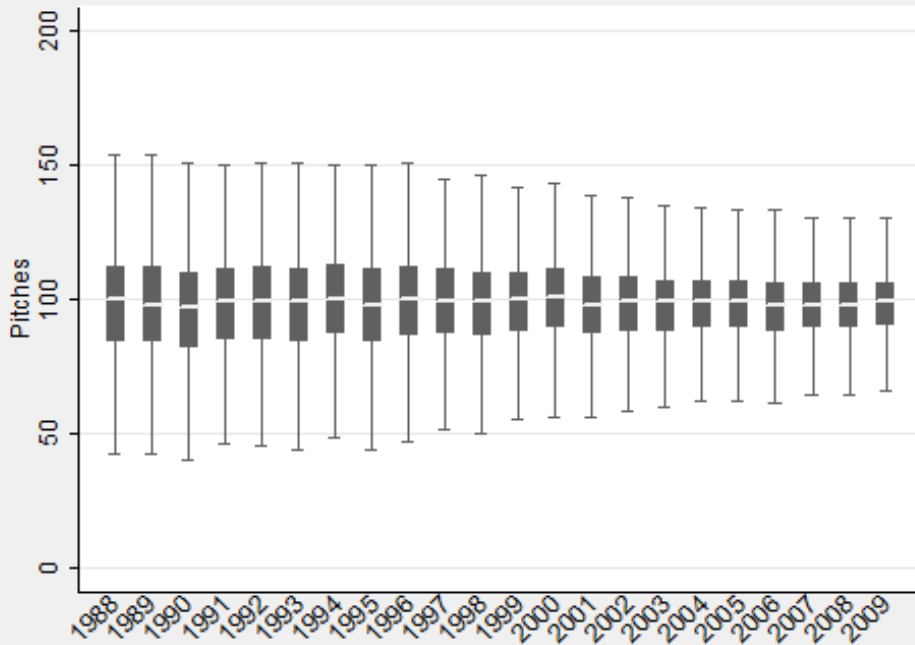
- Median pitches thrown by starting pitchers remained constant for two decades at around 99.
- No declining trend
- What's with all the complaining about declining pitch counts?

# Maximum Pitch Loads by Year



- The maximum pitches in a game has declined by 15% since the late-1980s.
- Why the decline in extreme pitch counts?
  - Injury concerns
  - Performance concerns
  - Wuss factor
- Exacerbated by financial stakes

# Shrinking Variance of Pitch Counts



- The frequency of high *and* low pitch counts has declined.
- Patience early, but a quick hook late.

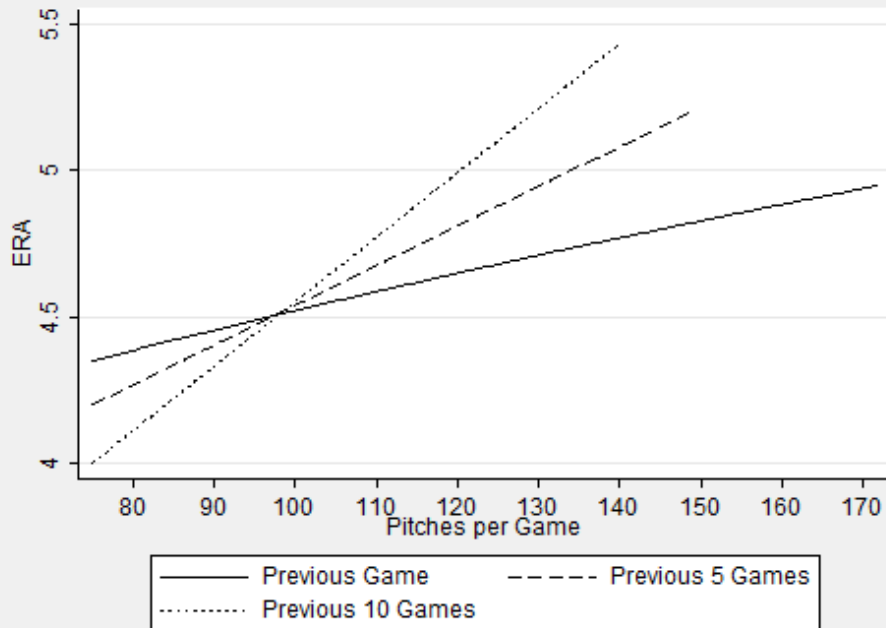
# Effects of Pitch Counts on Performance

- Immediate Effect
  - Impact of previous game's pitch count
- Cumulative Effect
  - Impact of average pitch counts from many preceding games
    - Previous 5- and 10-game average
- Data
  - Game data 1988 – 2009
  - Major-league starting pitchers
    - <15 Days of rest

# Measuring Impact of Pitch Counts

- Performance =  $f$ (several explanatory factors)
- Performance measures
  - Overall: ERA
  - Components: Strikeouts, Home Runs, Walks
- Explanatory Factors
  - Pitches thrown (immediate and cumulative)
  - Days of rest
  - Ability (season ERA)
  - Age
  - Year effects
- Fractional polynomial regression estimation
  - Estimates hypothesized non-linear effects
    - PAP system assumes increasing impact (cubic)

# Impact of Pitches Thrown on ERA



- Linear Relationship
  - Minor exception
- Cumulative > Immediate
- Previous Game
  - Each Pitch ↑ ERA by .007
- 5-game average
  - Each Pitch ↑ ERA by .014
- 10-game average
  - Each Pitch ↑ ERA by .022

# Impacts: Overall and by Age

- Immediate vs Cumulative
- Older pitchers suffer more from increased cumulative workloads
- Older pitchers suffer less from immediate workload
  - Veteran know-how
  - Sample bias

	Previous Game	5-Game Mean	10-Game Mean
Marginal Impact to ERA			
All	0.0066*	0.0135	0.0220
Under 25	0.0076	0.0132	0.0212
25 to 34	0.0076	0.0134	0.0214
Over 34	0.0043	0.0154	0.0225
Pitches needed to raise ERA by 0.25			
All	38	19	11
Under 25	33	19	12
25 to 34	33	19	12
Over 34	58	16	11

\*Estimated at 101<sup>st</sup> pitch

# Impact of Days of Rest on Performance

- Each day of rest improves performance by 0.015 ERA
- Not statistically significant
- ↓ ERA by 1% for 4.5 pitcher
- Impact on pitching on less rest is likely larger than estimated, but the impact is not picked up
  - <0.5% starters had less than 3 days rest

Days of Rest	ERA
3	4.52
4	4.50
5	4.49
6	4.47
7	4.46
8	4.44

(Hypothetical 4.5 ERA Pitcher)

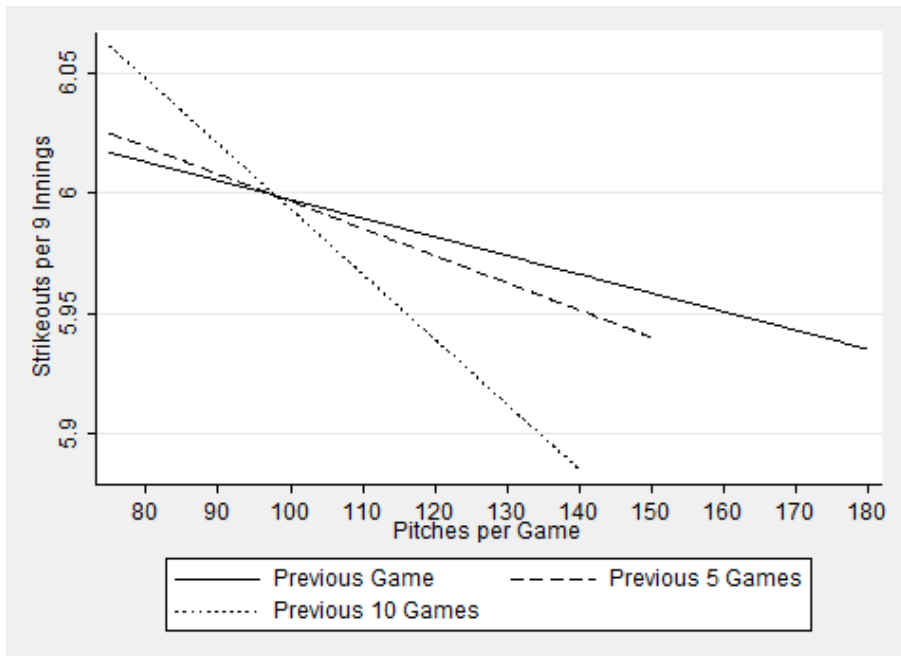
# Summary of Findings

- There is a positive relationship between pitch counts and future performance.
  - Small, but real, effect.
- The cumulative effect > the immediate effect.
  - ↑38 pitches in one game ↑ ERA by 0.25.
  - ↑10-pitch average over 10 games ↑ ERA by 0.25.
- Days of rest have little impact on performance
  - Heavily influenced by small variation.



# APPENDIX

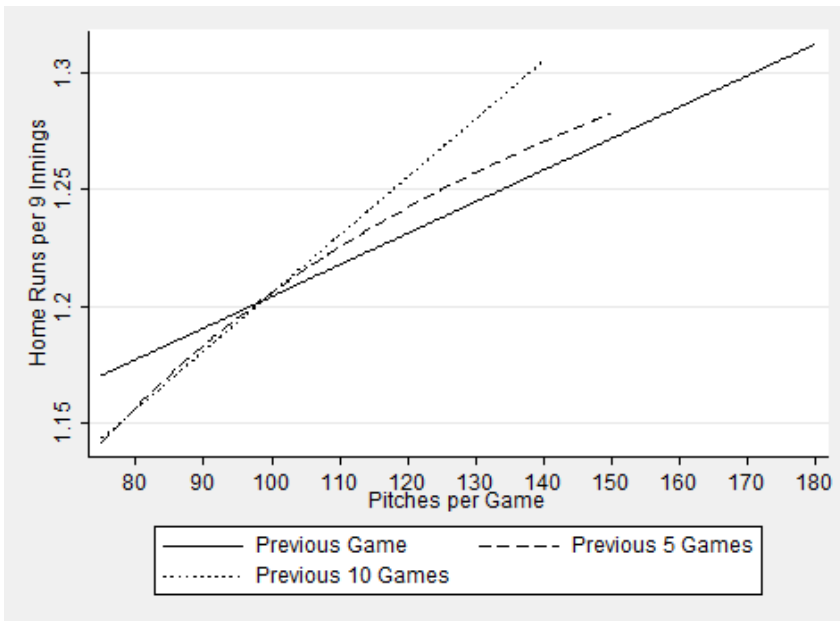
# Impact of Pitches Thrown on Strikeouts



Mean K/9 = 6.10  
SD K/9 = 3.35

- Previous Game
  - Each Pitch ↓ K/9 by 0.0008
  - 10 pitches ↓ K/9 by 0.13%
- 5-game average
  - Each Pitch ↓ K/9 by 0.0011
  - 10 pitches ↓ K/9 by 0.18%
- 10-game average
  - Each Pitch ↓ K/9 by 0.0027
  - 10 pitches ↓ K/9 by 0.44%
- Small effect
  - Not statistically significant

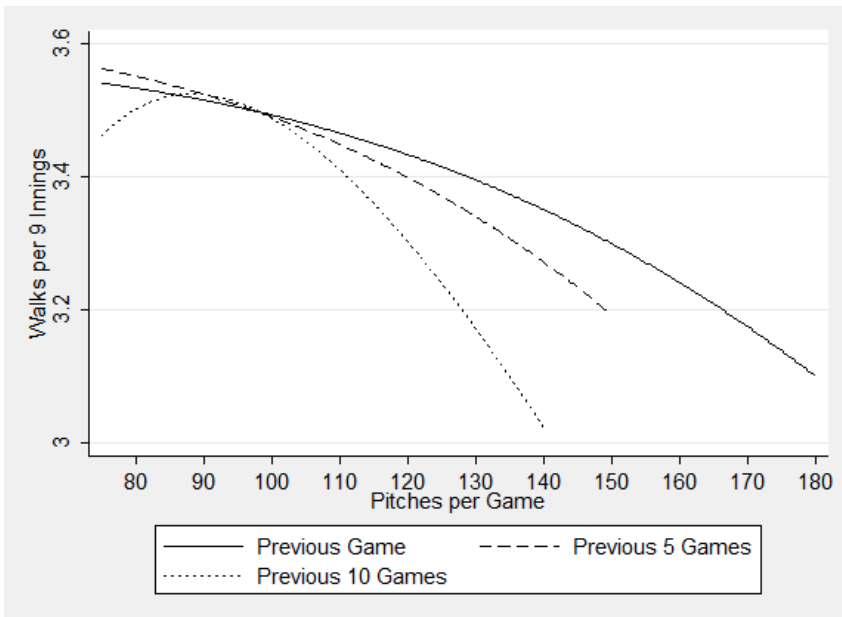
# Impact of Pitches Thrown on HRs



Mean HR/9 = 1.22  
SD Hr/9 = 2.02

- Previous Game
  - Each Pitch  $\uparrow$  HR/9 by 0.0013
  - 10 pitches  $\uparrow$  HR/9 by 1%
- 5-game average (101<sup>st</sup> pitch)
  - Each Pitch  $\uparrow$  HR/9 by 0.002
  - 10 pitches  $\uparrow$  HR/9 by 1.6%
- 10-game average
  - Each Pitch  $\uparrow$  HR/9 by 0.0025
  - 10 pitches  $\uparrow$  HR/9 by 2%

# Impact of Pitches Thrown on Walks



Mean BB/9 = 3.59

SD BB/9 = 3.97

- Counterintuitive Result!
- Previous Game (101<sup>st</sup> pitch)
  - Each Pitch ↓ BB/9 by 0.0024
  - 10 pitches ↓ BB/9 by 0.66%
- 5-game average (101<sup>st</sup> pitch)
  - Each Pitch ↓ BB/9 by 0.0038
  - 10 pitches ↓ BB/9 by 1%
- 10-game average (101<sup>st</sup> pitch)
  - Each Pitch ↓ BB/9 by 0.0060
  - Up until 89<sup>th</sup> pitch, ↑ BB/9
  - 10 pitches ↓ BB/9 by 1.67%