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

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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 = \( f(\text{several explanatory factors}) \)
- 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 $\uparrow$ ERA by 0.007
  - 5-game average
    - Each Pitch $\uparrow$ ERA by 0.014
  - 10-game average
    - Each Pitch $\uparrow$ ERA by 0.022
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

<table>
<thead>
<tr>
<th></th>
<th>Previous Game</th>
<th>5-Game Mean</th>
<th>10-Game Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal Impact to ERA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>0.0066*</td>
<td>0.0135</td>
<td>0.0220</td>
</tr>
<tr>
<td>Under 25</td>
<td>0.0076</td>
<td>0.0132</td>
<td>0.0212</td>
</tr>
<tr>
<td>25 to 34</td>
<td>0.0076</td>
<td>0.0134</td>
<td>0.0214</td>
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<tr>
<td>Over 34</td>
<td>0.0043</td>
<td>0.0154</td>
<td>0.0225</td>
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</table>

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<th>25 to 34</th>
<th>Over 34</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitches needed to raise ERA by 0.25</td>
<td>38</td>
<td>33</td>
<td>33</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>19</td>
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<td>11</td>
<td>12</td>
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<td>11</td>
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</tbody>
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*Estimated at 101st 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

<table>
<thead>
<tr>
<th>Days of Rest</th>
<th>ERA</th>
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<tbody>
<tr>
<td>3</td>
<td>4.52</td>
</tr>
<tr>
<td>4</td>
<td>4.50</td>
</tr>
<tr>
<td>5</td>
<td>4.49</td>
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<tr>
<td>6</td>
<td>4.47</td>
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<tr>
<td>7</td>
<td>4.46</td>
</tr>
<tr>
<td>8</td>
<td>4.44</td>
</tr>
</tbody>
</table>

(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

- 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

Mean K/9 = 6.10
SD K/9 = 3.35
Impact of Pitches Thrown on HRs

- Previous Game
  - Each Pitch $\uparrow$ HR/9 by 0.0013
  - 10 pitches $\uparrow$ HR/9 by 1%

- 5-game average (101st 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%

Mean HR/9 = 1.22
SD Hr/9 = 2.02
Impact of Pitches Thrown on Walks

- Counterintuitive Result!

- Previous Game (101\textsuperscript{st} pitch)
  - Each Pitch ↓ BB/9 by 0.0024
  - 10 pitches ↓ BB/9 by 0.66%

- 5-game average (101\textsuperscript{st} pitch)
  - Each Pitch ↓ BB/9 by 0.0038
  - 10 pitches ↓ BB/9 by 1%

- 10-game average (101\textsuperscript{st} pitch)
  - Each Pitch ↓ BB/9 by 0.0060
  - Up until 89\textsuperscript{th} pitch, ↑ BB/9
  - 10 pitches ↓ BB/9 by 1.67%

Mean BB/9 = 3.59
SD BB/9 = 3.97