Alleviating Competitive Imbalance in NFL Schedules: An Integer Programming Approach

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Background

• The National Football League (NFL): $9.5 billion in annual revenue
• A regular season consists of 17 weeks: 16 games and 1 bye
• Each team plays at least 1 Thursday game
• Distribution of games among opponents

<table>
<thead>
<tr>
<th>Division (Div.)</th>
<th>Intra-Conf. Divisional (iCD)</th>
<th>Inter-Conf. Divisional (iCD)</th>
<th>Standing Based (SB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFC</td>
<td>6 X 3</td>
<td>12 X 1</td>
<td>3 X 2</td>
</tr>
<tr>
<td>AFC</td>
<td>5 X 3</td>
<td>10 X 1</td>
<td>3 X 2</td>
</tr>
<tr>
<td>MTE</td>
<td>0.544</td>
<td>0.28</td>
<td>0.28</td>
</tr>
<tr>
<td>RMS</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>TRS</td>
<td>0.57</td>
<td>0.33</td>
<td>0.33</td>
</tr>
</tbody>
</table>

2014 NFL Schedule Anomalies

• 17 teams played 3 or more games against extra rested opponents
• Steelers: 4 sets of 2 back-to-back road games
• Buccaneers: 4 home games in 13 weeks
• Ravens, Packers and Bills: 1 divisional game in the last 5 weeks

Road Game Patterns

- Allowed Road Game Patterns
- Disallowed Road Game Patterns

Integer Programming (IP) Approach

• An IP is an optimization problem with: Typically linear constraints and objective
Some variables are restricted to be integer
• Decompose the scheduling problem into two problems: Two Phase Method (TPM)

Methods

• NFL-imposed rules not publicly available: Analyses of previous years’ schedules
Rules available in the literature
• 26 rules are classified into 7 families

Results

• In a modest amount of time our approach produced schedules with:
  No disadvantage due to bye weeks
  Minimum disadvantage due to short weeks
  Number of RS3s and 3 RS2s similar to the NFL
• Our model is flexible to address:
  Broadcasting requirements
  NFL’s cross season fairness
  International series complications

Sample Schedules for the 2015 Season Generated by TPM

• Modification of filtering process can choose a different schedule
• Schedule 2 is a desirable playing schedule even if not best in terms of MTE or RS3
• Undesirable road game patterns can be improved by allowing a modest increase in the number of teams with MTE

Sources of Imbalance in Rest Durations

The Buffalo Bills’ Complaints

• 2012: 3 games (2 divisional) against extra rested opponents
• 2013: 5 games (3 divisional) against extra rested opponents
• 2013: No such games for Chiefs, Patriots and Saints

Conclusions

• We simulated 1200 possible future schedules; 100 for each of 12 patterns
12-year rotating cycle of Intra and Inter conference opponents
In all patterns the number of teams with MTE = 2 was:
A ≤ 4 in 48% of the schedules
B ≤ 6 in 65% of the schedules
C ≤ 8 in 90% of the schedules

• Modifiable scheduling process can choose a different schedule
• Schedule 2 is a desirable playing schedule even if not best in terms of MTE or RS3
• Undesirable road game patterns can be improved by allowing a modest increase in the number of teams with MTE

The Four Fundamental Rules

• Bye Week Fairness
  Bills vs. Patriots
  Bills
  Bye
  Byes

• Distribution of Divisional Games

<table>
<thead>
<tr>
<th>Year</th>
<th>Average win % against all opponents</th>
<th>Average win % against rested opponents</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>51.9</td>
<td>57.5</td>
</tr>
<tr>
<td>2013</td>
<td>47.9</td>
<td>40.6</td>
</tr>
<tr>
<td>Avg. (09-13)</td>
<td>48.5</td>
<td>44.7</td>
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</table>