Not all goals are equally important - a study for the NHL

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Motivation

Niklas (and many others) dream of:
Motivation

First try
Motivation

A bit easier …
Outline

- Motivation
- Methods and Results
- Conclusion
### Performance metrics - traditional

| RANK | SPELARE     | NR | LAG  | POS | GP  | G  | A  | TP | PIM | GWG | PPG | SOG | HITS | BKS | + | - | +/- | TOI/GP |
|------|-------------|----|------|-----|-----|----|----|----|----|-----|-----|-----|-----|-----|----|---|---|-----|--------|
| 1    | Ryan Lasch  | 81 | Frölunda | F   | 37  | 10 | 25 | 35 | 16 | 3   | 2   | 66  | 9   | 2   | 23 | 31 | -8 | 19:02  |
| 2    | Joakim Lindström | 10 | Skellefteå | F   | 38  | 13 | 21 | 34 | 14 | 3   | 4   | 132 | 4   | 8   | 29 | 25 | 4  | 17:15  |
| 3    | Derek Roy   | 9  | Linköping | F   | 39  | 5  | 29 | 34 | 22 | 0   | 2   | 74  | 4   | 20  | 29 | 20 | 9  | 17:15  |

- **Offensive**: G: goals, A: assists, TP: points, GWG: game winning goals, PPG: powerplay goals, SOG: Shots on goal
- **Defensive**: HITS: hits, BKS: blocked shots
- +/-: plus-minus
- PIM: penalty minutes
- **Time**: GP: games played, TOI: time on ice
Performance metrics - advanced

- **Corsi**: shots

- **xG** (Expected Goals): assigns a value to each shot, based on the likelihood of the shot resulting in a goal.

- These metrics have made it into the ice hockey discourse
Performance metrics - advanced

Critique on advanced metrics: context

Some new approaches:
- Using Markov games
- THOR (Total Hockey Rating)
Motivation

Our goal:

Metrics that

- Are variants on traditional metrics
- Are easy to understand for practitioners
- Take into account context
- Are related to the importance of goals
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Data

- Play-by-play data from Sportlogiq
- Seasons (only regular season)
  - In paper: 2013-2014
Goal frequency per minute

![Histogram showing goal frequency over time with three periods labeled as Per. 1, Per. 2, and Per. 3. The x-axis represents time in minutes, and the y-axis represents goal frequency. The graph shows fluctuations in goal frequency across the three periods.]
Game Points Importance Value for a goal

- Game points for NHL: 2pts for win, 1pt for tie and loss after overtime, 0pts for loss in regulation time.
Game Points Importance Value for a goal

- Outcome in regulation time: win, tie, loss

- Context:
  <time, goal differential, manpower differential>

\[
P(outcome \mid context) = \frac{Occ(context \mid outcome)}{Occ(context)}
\]
Game Points Importance Value for a goal in a context

Change of probability of winning the game by scoring the goal

\[ \text{context} = \text{contextBG} \]

\[
\text{GPIV}(\text{context}) = 2 \times [P(\text{win} | \text{contextAG}) - P(\text{win} | \text{contextBG})] \\
+ 1 \times [P(\text{tie} | \text{contextAG}) - P(\text{tie} | \text{contextBG})]
\]

Change of probability of the game ending in a tie by scoring the goal
GPIV vs Goal Differential
GPIV vs Manpower Differential
Cumulative Distribution Function for GPIV
New metrics

- Traditional metrics:
  - Goal contributes 1 directly (Goals, +/-) or indirectly (Assists)

- Variants of Goals, Assists, Points, +/-:
  - Goal contributes with its context-based GPIV
# Top 10 players for GPIV-P

<table>
<thead>
<tr>
<th>P-Rank</th>
<th>GPIV-P-Rank</th>
<th>Rank-diff</th>
<th>Player</th>
<th>Position</th>
<th>P</th>
<th>GPIV-P</th>
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<tbody>
<tr>
<td>2-3</td>
<td>1</td>
<td>1</td>
<td>Sidney Crosby</td>
<td>C</td>
<td>69</td>
<td>25.734</td>
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<tr>
<td>6-7</td>
<td>2</td>
<td>4</td>
<td>Alex Ovechkin</td>
<td>R</td>
<td>64</td>
<td>25.085</td>
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<tr>
<td>4</td>
<td>3</td>
<td>1</td>
<td>Joe Pavelski</td>
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<td>67</td>
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<td>-3</td>
<td>Tyler Seguin</td>
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<td>70</td>
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<tr>
<td>5</td>
<td>5</td>
<td>0</td>
<td>Phil Kessel</td>
<td>R</td>
<td>66</td>
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<tr>
<td>6-7</td>
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<td>0</td>
<td>Ryan Getzlaf</td>
<td>C</td>
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<td>21.366</td>
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<tr>
<td>2-3</td>
<td>7</td>
<td>-5</td>
<td>Corey Perry</td>
<td>R</td>
<td>69</td>
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<td>20-22</td>
<td>8</td>
<td>12</td>
<td>Blake Wheeler</td>
<td>R</td>
<td>51</td>
<td>20.295</td>
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<tr>
<td>20-22</td>
<td>9</td>
<td>11</td>
<td>Anze Kopitar</td>
<td>C</td>
<td>51</td>
<td>19.812</td>
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<tr>
<td>23-24</td>
<td>10</td>
<td>13</td>
<td>Eric Staal</td>
<td>C</td>
<td>50</td>
<td>19.791</td>
</tr>
</tbody>
</table>
Rank changes P, G, A
Some new results

- Not in paper.
Correlations for 7 seasons

- Pearson
- Spearman
- MIC

Value

Season

Assists, Goals, Plus-minus, Points
Goals vs GPIV-Goals

- 07-08
- 08-09
- 09-10
- 10-11
- 11-12
- 12-13
- 13-14

GPIV goals vs Goals for different years.
Assists vs GPIV-Assists
Points vs GPIV-Points

- 07-08
- 08-09
- 09-10
- 10-11
- 11-12
- 12-13
- 13-14

Graphs showing the relationship between Points and GPIV points for different years.
+/- vs GPIV-+/-
Trends for some players
Outline

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Conclusions

- Introduced variants of traditional metrics that take the importance of goals into account
- Strong correlation for G, A, P between new and traditional metrics
- Pass the eye test
Future Work

- Deeper analysis over different seasons
- Use GPIV in Markov model-based approach for performance evaluation as a reward function in a Q-learning algorithm
Thanks

- Rasmus Säfvenberg
- Sofie Jörgensen

For the results on multiple seasons
(not in paper)