Moneypuck

Linear Programming and Hockey

Daniel Gemara

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Motivation

- Evaulate individual performance in a team sport.
- See the different factors that go into hockey.

Factors

Not everything that can be counted counts, and not everything that counts can be counted.

-Albert Einstein

"People in both [baseball and the stock market] operate with beliefs and biases. To the extent you can eliminate both and replace them with data, you gain a clear advantage"

-Michael Lewis, Moneyball

Toronto Maple Leafs Lineup

Forwards		
Left Wingers	**Centers**	**Right Wingers**
Zach Hyman	Auston Matthews	William Nylander
Leo Komarov	Nazem Kadri	Connor Brown
James van Riemsdyk	Tyler Bozak	Mitchell Marner
Matt Martin	Brian Boyle	Kasperi Kapanen

Defensemen	
Right Defensemen	**Left Defensemen**
Morgan Rielly	Matt Hunwick
Jake Gardiner	Roman Polak
Martin Marincin	Connor Carrick

Goalies
Frederik Andersen
Curtis McElhinney

Example

Video

Traditional Metrics

Depends on position and style:

- Defensive center
- Offensive defenseman
- Shutdown defenseman
- What should we consider? How do we compare against each other?

Traditional Metrics

Confusing, often relying on goals and assists for offensive forwards, face-off wins/losses and points for 2-way centers, +/- for defensemen, which is why we need an encompassing metric to tell a better story.

New Age Metrics

Game Score

$$Game\ Score = Offense + Defense + Other$$

$$Game\ Score = 0.75G + 0.7A1 + 0.55A2 + 0.075SOG + 0.05BLK + 0.05(CF - CA) + 0.15(GF - GA) - 0.75GA + 0.1SV + 0.15(PD - PT) + 0.01(FOW - FOL)$$

and then converted into "wins added above replacement" depending on position.

Other Methods

Point shares, WAR, etc.

All Star Model

$$Max\, z = \sum_{i=1}^{n} y_i x_i \tag{1}$$

$$x_F = 6 \tag{2}$$

$$x_D = 3 \tag{3}$$

$$x_G = 2 \tag{4}$$

$$Team(x_i) \geq 1 \tag{5}$$

$$x_i = binary \tag{6}$$

R Code

Find the optimal All Star teams using R .

All Star Teams

Atlantic	Metropolitan	Pacific	Central
Brad Marchand	**Sidney Crosby**	**Connor McDavid**	**Patrick Kane**
Nikita Kucherov	**Alex Ovechkin**	**Jeff Carter**	Artemi Panarin
David Pastrnak	**John Tavares**	**Joe Pavelski**	**Vladamir Tarasenko**
Auston Matthews	Jeff Skinner	Tanner Pearson	**Tyler Seguin**
Henrik Zetterberg	**Taylor Hall**	**Ryan Kesler**	Blake Wheeler
Vincent Trochek	Mats Zuccarello	Mickael Backlund	**Nathan MacKinnon**
Victor Hedman	Zach Werenski	**Brent Burns**	PK Subban
Torey Krug	Kevin Shattenkirk	Dougie Hamilton	**Duncan Keith**
Erik Karlsson	Shayne Gostisbehere	**Drew Doughty**	Dustin Byfuglien
Carey Price	**Braden Holtby**	**Mike Smith**	**Corey Crawford**
Robin Lehner	**Sergei Bobrovsky**	Ryan Miller	**Devan Dubnyk**

CapFriendly

Expansion Draft

$$Max\ z = \sum_{i=1}^{n} y_i x_i$$

Constraints:

$$x_C \geq 4$$

$$x_{RW} \geq 4$$

$$x_{LW} \geq 4$$

$$x_D \geq 9$$

$$x_G \geq 3$$

$$\sum x_i = 30$$

$$\sum x_i c_i \geq 43,800,000$$

$$\sum x_i c_i \leq 73,000,000$$

$$Team(x_i) = 1$$

$$x_i = binary$$

R Code

Find the optimal team under constraints using R.

Las Vegas Golden Knights Roster

Forwards		
Left Wingers	Centers	Right Wingers
Dustin Brown (LAK)	Sam Gagner (CBJ)	Jakob Silfverberg (ANA)
Jason Zucker (MIN)	Colin Wilson (NSH)	Michael Grabner (NYR)
Adam Lowry (WPG)	Brian Boyle (TOR)	Lee Stemniak (CAR)
Justin Abdelkader (DET)	Lars Eller (WSH)	Matt Read (PHI)

Defensemen	
David Schlemko (SJS)	Trevor Van Riemsdyk (CHI)
Adam McQuaid (BOS)	Cody Franson (BUF)
Jordie Benn (MTL)	Calvin de Haan (NYI)

Goalies
Matt Murray (PIT)
Mike Condon (OTT)

Results

How is this team projected to do?

Sensisitivity Analysis

Shadow Price for a constraint is the amount by which the optimal z-value is improved if the right-hand side of the constraint is increased by 1.

Limitations

- Is this what Las Vegas should do?
- Is this realistic?
  - QoC,QoT
- Different objective function

Conclusion

Thank you very much for listening.

Any questions?