Moneypuck Linear Programming and Hockey

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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

$$\label{eq:Game Score} Game \, Score = \, Offense + \, Defense + \, Other \\ Game \, Score = \\ 0.75\,G + 0.7A1 + 0.55A2 + 0.075\,SOG + 0.05\,BLK + 0.05(CF - CA) + \\ 0.15(GF - GA) - 0.75\,GA + 0.1SV + 0.15(PD - PT) + 0.01(FOW - FOL) \\ \text{and then converted into "wins added above replacement" depending on position.}$$

Other Methods

Point shares, WAR, etc.



What we can do



(a) 2017 All Star Game



(b) Las Vegas Golden Knights

All Star Model

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

$$x_F = 6 (2)$$

$$x_D = 3 (3)$$

$$x_G=2 (4)$$

$$Team(x_i) \ge 1$$
 (5)

$$x_i = binary$$
 (6)

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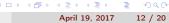
R Code

Find the optimal All Star teams using ${\sf R}$.



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:

$$x_C \ge 4$$
 $\sum x_i = 30$ $x_{RW} \ge 4$ $\sum x_i c_i \ge 43,800,000$ $x_{LW} \ge 4$ $\sum x_i c_i \le 73,000,000$ $x_D \ge 9$ $Team(x_i) = 1$ $x_i = binary$

R Code

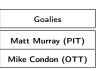
Find the optimal team under constraints using R.



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)	





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.



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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?

