Tragic game 7: Optimal player lineups with Linear Programming

Overview

During the Vancouver Canucks historical finals run in the 2011 Stanley cup finals they famously lost a heart-wrenching seven-game series to the Boston Bruins. Through this defeat many conclusions were drawn about the way the Canucks lost the series, however instead of listing out the qualities that led to defeat, this paper will aim to use concepts from linear programming to represent some of these shortcomings and ultimately decide if the Vancouver Canucks had a shot, or if the series was lost from the beginning.

Background

Most residents of Vancouver could recall the year 2011 was shaping up to be a fantastic year for the city's sports scene. After years of sports drought, Vancouver was a city filled with life. The previous year, the city hosted its very first Olympic games right there in the city. Throughout the Olympics run the city watched through incredible Candian success culminating with an iconic overtime shot from Sidney Crosby in a gold medal win over the USA.

Following in the shadow of this amazing success, Vancouver's home hockey team the Canucks were riding their most successful season of recent times boasting a 54:19 win-loss record. This put the Canucks at the top of the ladder in the western conference. On a victorious road to claim their potential first Stanley cup, they finally encountered the Boston Bruins fresh off a 46:25 record with the same drive to win as the Canucks. This is when tragedy struck.

In a gut-wrenching 7 game series, the Canucks were wiped in a final 4-0 victory for the Bruins. Fans of the Canucks were heartbroken at the sight of their home team losing the opportunity to bring a Stanley cup home for the first time and outrage ensued.

What really went wrong in this seven-game series that the Canucks were set to win? Many factors were at play from the pressure of winning to strategic playmaking. However one could argue that better line changes and player utilization would have greatly helped the Canucks wrap up their mind-blowing year with a championship.

Proposition

Since many factors can be involved in the strategic consideration of creating the lineups for hockey games, I would like to propose the question: In Hindsight how could the Canucks have used player data to better create lineups that optimize the potential of the team?

Objective Function

The objective function this will take on the form below, where the constant in front of the variable will take on the average amount of points the player scores in a minute, thus the decision variable x will

be measured in units of minutes. This way I am able to quantify in units of goals how many goals Vancouver could have scored against Boston over the seven-game series if they were playing optimally.

$$c_{player} x_{player}$$

Constraints

Before considering the objective function I need to figure out what constraints should be considered, it is important to further understand the climate of the series to get a better idea of what was happening. After laying these ideas, I will use these ideas to identify constraints when calculating optimality.

Special teams play

Power Play: An numbers advantage from the opposing teams player committing a penalty
Special Team: A player lineup catered towards a power play scenario, more defensive players if short-handed and more offensive players if advantaged.

One of the key contributing factors to the Canucks defeat was their inferior special teams' play. Not only did Boston's offensive special team outscore Vanoucvers offensive special team, but Boston's defensive team amazingly outscored Vancouver's defensive team. Incredibly Boston was able to score goals despite being down a player.

Since Scoring short-handed is a rarity that typically does not come down to team skill, but instead a lack of performance from the opposing team, I will not consider shorthand scoring, however, I will consider power-play scoring. With this in mind, Vancouver's power play lineup was: Alexander Edler, Christian Ehrhoff, Daniel Sedin, Hendrick Sedin, and Ryan Kesler. The next four most utilized during power plays being: Dan Hamhuis, Kevin Bieksa, Mikeal Samuelson, and Sami Salo

For the sake of simplicity, I will assume they are the ONLY power play lineup. In other words, the moment that a power play occurs they will be subbed onto the ice with no other players getting power play ice time. Their playing time can be represented by the variables:

$$x_{pae},\ x_{pce}.\ x_{pds},\ x_{phs},\ x_{prk},\ x_{pdh},\ x_{pkb},\ x_{pms},\ x_{pss}$$

P represents power play minutes

For this constraint, there are still the coefficients and the constant. Since the variables are represented as units of time, then the upper bound is represented by the total amount of power play minutes the canucks had in the series, which was 91 mins. Thus the constraint will be:

$$x_{pae} + x_{pce} + x_{pds} + x_{phs} + x_{prk} + x_{pdh} + x_{pkb} + x_{pms} + x_{pss} = 91$$

Penalties

_____Much of the issue in the series was as much an issue of Vancouver under delivering but also Boston over-delivering on the offensive end. Another key contributor to Vancouver's demise was the superior offensive power plays that Boston had. Thus in order to optimize Vancouver's scoring potential, I will look to minimize Vancouver's penalty minutes.

Out of the total roster, six of the players stand out in terms of penalty minutes, Daniel Sedin. Alex Burrows, Maxim Lapierre, Kevin Bieksa, Ryan Kesler, and Aaron Rome. Between them, these players racked up a total of 132 minutes of penalty time or an average of 0.18 minutes of penalty time for every minute played.

No.	Player	Pos	Age	GP	G	A	PTS	+/-	PIM	EV	PP	SH	GW	EV	PP	SH	S	S%	SHFT	TOI	ATOI
22	Daniel Sedin	LW	30	7	1	3	4	-5	24	1	0	0	0				27	3.7	174	137:07	19:35
14	Alexandre Burrows	LW	29	7	2	1	3	-4	28	1	1	0	1				13	15.4	192	131:02	18:43
40	Maxim Lapierre	C	25	7	2	1	3	-1	12	2	0	0	1				20	10.0	135	88:39	12:40
36	Jannik Hansen	LW	24	7	1	2	3	1	2	1	0	0	0				18	5.6	149	105:27	15:04
13	Raffi Torres	LW	29	7	1	2	3	-1	6	1	0	0	1				4	25.0	124	86:27	12:21
23	Alexander Edler	D	24	7	0	2	2	-4	2	0	0	0	0				16	0.0	208	170:10	24:19
33	Henrik Sedin	C	30	7	1	0	1	-7	6	0	1	0	0				10	10.0	181	141:53	20:16
6	Sami Salo	D	36	7	0	1	1	-2	0	0	0	0	0				12	0.0	211	141:30	20:13
3	Kevin Bieksa	D	29	7	0	1	1	-4	14	0	0	0	0				26	0.0	204	175:04	25:01
5	Christian Ehrhoff	D	28	7	0	1	1	-7	0	0	0	0	0				22	0.0	200	164:48	23:33
20	Chris Higgins	LW	27	7	0	1	1	-3	0	0	0	0	0				14	0.0	168	109:28	15:38
17	Ryan Kesler	C	26	7	0	1	1	-6	35	0	0	0	0				18	0.0	184	145:57	20:51
29	Aaron Rome	D	27	3	0	0	0	1	19	0	0	0	0				1	0.0	49	38:57	12:59

Since we are trying to minimize their playing time then we will set the constraint as such:

$$\frac{24}{137}x_{ds} + \frac{28}{131}x_{ab} + \frac{12}{88}x_{ml} + \frac{14}{175}x_{kb} + \frac{35}{145}x_{rk} + \frac{19}{38}x_{ar} \leq 132$$

This way I can ensure that these players play less than or at most a total of 132 minutes of penalty time to mitigate Boston's powerplay potential.

Ice Time and Fatigue

_____Since the seven-game series against Boston was the last seven games of an exhausting 82 game season for Vancouver fatigue is definitely a factor when considering their performance. Naturally when fatigue begins to set in the players will not be able to perform at any of their previous levels. Oftentimes in the playoffs players are primarily playing on the motivation of winning a Stanley cup, thus numbers and stat lines tend to be impacted by the player's accumulated fatigue.

Below are two charts, the top showing the series performance and below showing the regular-season performance:

					Scoring					Goals				Assists						Ice Time	
No.	Player	Pos	Age	GP	G ▼	A	PTS	+/-	PIM	EV	PP	SH	GW	EV	PP	SH	S	S%	SHFT	TOI	ATOI
14	Alexandre Burrows	LW	29	7	2	1	3	-4	28	1	1	0	1				13	15.4	192	131:02	18:43
40	Maxim Lapierre	C	25	7	2	1	3	-1	12	2	0	0	1				20	10.0	135	88:39	12:40
22	Daniel Sedin	LW	30	7	1	3	4	-5	24	1	0	0	0				27	3.7	174	137:07	19:35
36	Jannik Hansen	LW	24	7	1	2	3	1	2	1	0	0	0				18	5.6	149	105:27	15:04
13	Raffi Torres	LW	29	7	1	2	3	-1	6	1	0	0	1				4	25.0	124	86:27	12:21
33	Henrik Sedin	C	30	7	1	0	1	-7	6	0	1	0	0				10	10.0	181	141:53	20:16

					Scoring					Goals				Assists					Ice Time		Point Shares							
Rk	Player	Age	Pos	GP	G ▼	A	PTS	+/-	PIM	EV	PP	SH	GW	EV	PP	SH	S	S%	TOI	ATOI	OPS	DPS	PS	BLK	HIT	FOW	FOL	FO%
1	Daniel Sedin	30	LW	82	41	63	104	30	32	23	18	0	10	39	24	0	266	15.4	1521	18:33	11.5	2.8	14.3	12	13	4	13	23.5
2	Ryan Kesler	26	C	82	41	32	73	24	66	23	15	3	7	16	15	1	260	15.8	1681	20:30	7.6	2.7	10.4	80	124	859	637	57.4
3	Alexandre Burrows	29	LW	72	26	22	48	26	77	24	1	1	4	21	0	1	152	17.1	1226	17:02	4.6	2.4	6.9	24	84	6	8	42.9
4	Henrik Sedin	30	C	82	19	75	94	26	40	11	8	0	4	48	27	0	157	12.1	1579	19:16	7.8	2.7	10.5	21	15	721	666	52.0
5	Mikael Samuelsson	34	RW	75	18	32	50	8	36	13	5	0	2	18	14	0	215	8.4	1247	16:38	3.8	1.6	5.5	21	76	9	19	32.1
6	Mason Raymond	25	LW	70	15	24	39	8	10	12	2	1	5	20	4	0	197	7.6	1106	15:48	2.7	1.5	4.2	14	38	26	39	40.0

Notably, despite Daniel Sedin and Ryan Kesler to the majority of the Canucks goals during the regular season they were not able to translate that into the seven-game series, mainly due to inadequate rest times stunting their success. They happened to also be two of the most utilized players in the regular season.

Thus we consider the top six scores of the regular season: Daniel Sedin, Ryan Kesler, Alex Burrows, Hendrik Sedin, Mikael Samuelson, and Mayson Raymond and allow none of them to exceed their regular-season average time on ice (ATOI). To maintain their energy. Since some of these players also contribute to powerplay special teams, we take that into consideration as well.

$$x_{ds} + x_{pds} \leq 7 \cdot 18, \quad x_{rk} + x_{prk} \leq 7 \cdot 20, \quad x_{ab} \leq 7 \cdot 17, \quad x_{hs} + x_{phs} \leq 7 \cdot 19, \quad x_{ms} + x_{pms} \leq 7 \cdot 16, \quad x_{mr} \leq 7 \cdot 15$$

Note seven was multiplied because it is a seven-game series

Play Styles

One key issue in the series with Boston was the Canucks inferior defence. Looking at the statistics in figure 1, it's quite apparent that although prior to game seven each team had won three games, the Canucks had only barely edged out the Bruins while the Bruins were able to sweep the Canucks in their victories.

Series Scores

Game 1, June 1			Game 2, June 4			Game 3, June 6			Game 4, June 8			Game 5, June 10			Game 6, June 13			Game 7, June 15		
BOS	0	Final	BOS	2	Final	VAN	1	Final	VAN	0	Final	BOS	0	Final	VAN	2	Final	**BOS**	**4**	**Final**
VAN	**1**		**VAN**	**3**	**OT**	**BOS**	**8**		**BOS**	**4**		**VAN**	**1**		**BOS**	**5**		VAN	0	

Statistics courtesy of www.hockey-reference.com

The main contributing factor to this landslide difference from the Bruins was the lacklustre defence played by the Canucks. Figure two shows two rudimentary defensive playoff statistics for both team hits and blocks.

	Dennis Seidenberg	57	74
	Tomáš Kaberle	4	21
	Andrew Ference	32	40
	Johnny Boychuk	62	34
	Zdeno Chara	56	32
	Adam McQuaid	30	32

Bruins above and Canucks below

	Christian Ehrhoff	28	26
	Alexander Edler	78	60
	Kevin Bieksa	88	32
	Dan Hamhuis	43	38
	Sami Salo	21	17
	Aaron Rome	31	15
	Christopher Tanev	1	11
	Andrew Alberts	29	10
	Keith Ballard	14	15

Chart courtesy of www.quanthockey.com

Although each teams top defencemen Zdeno Chara from Boston and Kevin Bieksa from Vancouver were performing at roughly equal levels when taking into consideration the average performance from the team's defence as a whole we see that in table 1:

	Average Hits	Average Blocks
Vancouver Canucks	37.0	24.8
Bostons Bruins	**40.2**	**38.8**

Table 1

As shown above, on average the Vancouver defence was playing at a lesser level than the Boston defence when comparing their hits and blocks.

				Scoring					Goals				Assists					Ice Time		Point Shares				
Rk	Player	Age	Pos	GP	G	A	PTS	+/-	PIM	EV	PP	SH	GW	EV	PP	SH	S	S%	TOI	ATOI	OPS	DPS	PS	BLK	HIT
1	Daniel Sedin	30	LW	82	41	63	104	30	32	23	18	0	10	39	24	0	266	15.4	1521	18:33	11.5	2.8	14.3	12	13
2	Henrik Sedin	30	C	82	19	75	94	26	40	11	8	0	4	48	27	0	157	12.1	1579	19:16	7.8	2.7	10.5	21	15
3	Ryan Kesler	26	C	82	41	32	73	24	66	23	15	3	7	16	15	1	260	15.8	1681	20:30	7.6	2.7	10.4	80	124
4	Mikael Samuelsson	34	RW	75	18	32	50	8	36	13	5	0	2	18	14	0	215	8.4	1247	16:38	3.8	1.6	5.5	21	76
5	Christian Ehrhoff	28	D	79	14	36	50	19	52	8	6	0	3	13	22	1	209	6.7	1895	23:59	4.8	5.6	10.4	108	54
6	Alexandre Burrows	29	LW	72	26	22	48	26	77	24	1	1	4	21	0	1	152	17.1	1226	17:02	4.6	2.4	6.9	24	84
7	Mason Raymond	25	LW	70	15	24	39	8	10	12	2	1	5	20	4	0	197	7.6	1106	15:48	2.7	1.5	4.2	14	38
8	Alexander Edler	24	D	51	8	25	33	13	24	3	5	0	1	13	12	0	121	6.6	1239	24:17	3.0	3.7	6.8	86	83
9	Manny Malhotra	30	C	72	11	19	30	9	22	7	3	1	2	15	3	1	111	9.9	1164	16:10	1.1	1.6	2.7	74	57
10	Raffi Torres	29	LW	80	14	15	29	4	78	11	3	0	4	14	1	0	115	12.2	999	12:29	1.8	1.2	3.0	19	134
11	Jannik Hansen	24	LW	82	9	20	29	13	32	9	0	0	2	19	0	1	113	8.0	1206	14:43	0.7	1.8	2.5	26	149
12	Dan Hamhuis	28	D	64	6	17	23	29	34	4	2	0	1	12	5	0	109	5.5	1451	22:41	1.5	5.5	7.0	89	76
13	Kevin Bieksa	29	D	66	6	16	22	32	73	5	1	0	2	14	2	0	105	5.7	1483	22:28	1.3	5.8	7.2	93	104
14	Jeff Tambellini	26	LW	62	9	8	17	10	18	8	1	0	0	5	3	0	114	7.9	731	11:47	0.7	1.2	1.9	21	113
15	Tanner Glass	27	LW	73	3	7	10	-5	72	3	0	0	1	7	0	0	45	6.7	652	8:56	-0.5	0.5	0.0	29	130
16	Sami Salo	36	D	27	3	4	7	-3	14	2	1	0	0	2	2	0	39	7.7	549	20:21	0.5	0.9	1.4	28	6
17	Keith Ballard	28	D	65	2	5	7	10	53	2	0	0	0	5	0	0	53	3.8	1034	15:54	-0.2	3.0	2.8	111	99

Thus using an additional statistic called DPS or defensive point share (a measure of how many goals are attributed to one's defense), then I will select five of the teams top defenders. These five are: Christian Erhoff, Alex Elder, Dan Hamhuis, Kevin Bieksa, and Keith Ballard. The constraint is such:

$Total\ time\ played\ bewteen\ all\ players:\ 7102$

$Total\ Blocks\ between\ players:\ 487 => average\ blocks\ for\ seven\ games\ \frac{487}{7102} \cdot 420\,(time\ of\ 7games) = 29\ blocks$

$Total\ Hits\ between\ players:\ 416 => average\ hits\ for\ seven\ games\ \frac{416}{7102} \cdot 420 = 24.5\ hits$

$$29\ blocks \leq \frac{108}{1895}x_{ce} + \frac{86}{1239}x_{ae} + \frac{89}{1451}x_{dh} + \frac{93}{1483}x_{kb} + \frac{111}{1034}x_{kball}$$

$$24.5\ hits \leq \frac{54}{1895}x_{ce} + \frac{83}{1239}x_{ae} + \frac{76}{1451}x_{dh} + \frac{104}{1483}x_{kb} + \frac{99}{1034}x_{kball}$$

Note the coefficients in front of the variable represent their total number of the stat divided by their total minutes played

This constraint represents the total amount of blocks and hits executed by these players must exceed the expected number of blocks and hits for the seven games calculated using regular season stats. Thus this optimizes defensive performance leading to more Canucks goals.

The Linear Program

Assumptions

Prior to stating the linear program, it is important to identify some key assumptions about the constraints and how this affects the analysis of the problem.

First: While Vancouver's side of the puzzle is getting optimized, Boston's defense will not be considered, in other words they will not be adapting their own defense in response to the elevated offense from the Canucks.

Second: Although important, effectiveness of the Canucks defense is also not being considered in a traditional sense. Instead, the Canucks defense is being considered in terms of how many goals the team scored due to stopping Boston's offense. For example, if the Canucks defense is able to stop one of Boston's goals, then they have effectively "scored" by preventing Boston from scoring. Thus this perspective better fits the model, however could be slightly inaccurate as it is speculative.

Third: The performance of the golatenders on both sides is not being considered. Although that was another key contributor to the downfall

Problem Statement

With all constraints set up the linear program looks like the following:

Objective:

$$\frac{1}{6}x_{pae} + \frac{1}{6}x_{pce} + \frac{11}{60}x_{pds} + \frac{11}{60}x_{phs} + \frac{11}{60}x_{prk} + \frac{5}{60}x_{pdh} + \frac{7}{60}x_{pkb} + \frac{9}{60}x_{pms} + \frac{9}{60}x_{pss} + \frac{6}{1451}x_{dh} + \frac{41}{1521}x_{ds} + \frac{26}{1226}x_{ab} + \frac{1}{219}x_{ml} + \frac{6}{1483}x_{kb} + \frac{41}{1681}x_{rk} + \frac{1}{975}x_{ar} + \frac{14}{1895}x_{ce} + \frac{8}{1237}x_{ae} + \frac{2}{1034}x_{kball} + \frac{19}{1579}x_{hs} + \frac{18}{1247}x_{ms} + \frac{15}{1106}x_{mr}$$

Powerplay:

$$x_{pae} + x_{pce} + x_{pds} + x_{phs} + x_{prk} + x_{pch} + x_{pdh} + x_{pkb} + x_{pms} + x_{pss} \leq 91$$

$$-x_{pae} - x_{pce} - x_{pds} - x_{phs} - x_{prk} - x_{pch} - x_{pdh} - x_{pkb} - x_{pms} - x_{pss} \leq -91$$

Penalty:

$$\frac{24}{137}x_{ds} + \frac{28}{131}x_{ab} + \frac{12}{88}x_{ml} + \frac{14}{175}x_{kb} + \frac{35}{145}x_{rk} + \frac{19}{38}x_{ar} \leq 132$$

Defence:

$$-\frac{108}{1895}x_{ce} - \frac{86}{1239}x_{ae} - \frac{89}{1451}x_{dh} - \frac{93}{1483}x_{kb} - \frac{111}{1034}x_{kball} \leq -29$$

$$-\frac{51}{1895}x_{ce} - \frac{83}{1239}x_{ae} - \frac{76}{1451}x_{dh} - \frac{104}{1483}x_{kb} - \frac{99}{1034}x_{kball} \leq -24.5$$

Fatigue:

$$x_{ds} + x_{pds} \leq 7 \cdot 18, \quad x_{rk} + x_{prk} \leq 7 \cdot 20, \quad x_{ab} \leq 7 \cdot 17, \quad x_{hs} + x_{phs} \leq 7 \cdot 19, \quad x_{ms} + x_{pms} \leq 7 \cdot 16, \quad x_{mr} \leq 7 \cdot 15$$

Results

In [8]:
```
for a in prob.variables():
    print(a.name, "=", a.varValue)
```

```
Players_ab = 119.0
Players_ae = 0.0
Players_ar = 0.0
Players_ce = 0.0
Players_dh = 472.79775
Players_ds = 126.0
Players_hs = 42.0
Players_kb = 0.0
Players_kball = 0.0
Players_ml = 371.79112
Players_mr = 105.0
Players_ms = 112.0
Players_pae = 0.0
Players_pce = 0.0
Players_pdh = 0.0
Players_pds = 0.0
Players_phs = 91.0
Players_pkb = 0.0
Players_pms = 0.0
Players_prk = 0.0
Players_pss = 0.0
Players_rk = 140.0
```

In [9]:
```
print("Total Goals", value(prob.objective))
```

```
Total Goals 33.2169176777614
```

As shown by the results of the calculation, playing optimally would result in a staggering 33 goals in total meaning 11 more goals on top of what was scored by Boston. However, taking one quick glance at the player's playing times, some things are infeasible. First, it is simply not possible to have Hendrick Sedin be the only player playing 91 minutes of power play time. Second, it is not feasible to have Dan Hamhuis and Maxim Lapierre playing for that many minutes.

Thus, as a result, I will recalculate using more constraints. The first constraint will force every power play player to play at least ten minutes, second will be upper bound constraints on every players playing time to be 7*average time on ice for the regular season. The last constraint will constrain every player's playing time to at least ten minutes. As a result, this is the distribution of playing times amongst the players:

```
Players_ab = 119.0
Players_ae = 168.0
Players_ar = 64.088815
Players_ce = 168.0
Players_dh = 144.0
Players_ds = 116.0
Players_hs = 122.0
Players_kb = 154.0
Players_kball = 10.0
Players_ml = 77.0
Players_mr = 105.0
Players_ms = 102.0
Players_pae = 10.0
Players_pce = 10.0
Players_pdh = 10.0
Players_pds = 10.0
Players_phs = 11.0
Players_pkb = 10.0
Players_pms = 10.0
Players_prk = 10.0
Players_pss = 10.0
Players_rk = 130.0
```

```
In [140]: 1 print("Total Goals", value(prob.objective))

          Total Goals 31.18519067578122
```

From this new linear program with all players getting at least some playing time, it's apparent that the efficiency of the team goes down to 31 goals instead of 33.

Sensitivity

```
powerplay
Slack: -0.0
Shadow: 0.1713004
penalty
Slack: -0.0
Shadow: 0.0020512821
blocks
Slack: 11.799169
Shadow: -0.0
hits
Slack: 10.575170999999997
Shadow: -0.0
```

As we can see from the linear program, the power play minutes and the penalties were the most restrictive constraints since neither offer any slack. Let's explore two different scenarios, one where Boston commits many more penalties. And one where the Canucks commit even more penalties.

First let's consider a series where Boston committed 10 % more penalties allowing Vancouvers total powerplay time to increase from 91 minutes to 100. We see that with this 9 minute increase in power play time the Canucks are able to score almost two more goals which, in the context of hockey is a significant increase in goals scored.

```
Total Goals 31.18519067578122
```

```
Total Goals 32.7268942856609
```

Now lets consider if Boston played cleaner hockey and gave the Canuck's 10% less minutes of power play time. We see that now the Canucks were able to score just under two goals which is significant.

```
Total Goals 29.300886263706253
```

Next, lets consider what would Happen if the Canucks committed more penalties. Similarly to the prior, lets allow the Canucks to commit 10% more penalties thus bringing the max penalty minutes from 132 to 145. Immediately, it is apparent that the increase in goals made is miniscule, and this makes sense since during the regular season, the Canucks shorthand lineups played exceptionally well. This is also reflected in the shadow price of the penalty constraint.

```
Total Goals 31.158524009114558
```

Boston's Linear Program

This would not be a complete and accurate picture if I did not include Boston's side of the linear program. In this final section, I will consider Boston's Linear Program using the same guidelines laid out when formulating the Canucks linear program. We arrive at the following:

```
Total Goals 28.955343143305818

  powerplay
  Slack: -0.0
  Shadow: 0.15943823
  penalty
  Slack: -0.0
  Shadow: 0.0020512821
  blocks
  Slack: 11.799169
  Shadow: -0.0
  hits
  Slack: 10.575170999999997
  Shadow: -0.0
```

It is apparent right away that based on each team's regular season statistics, the Canucks held a distinct advantage over Boston in a seven game series. This is also apparent through both teams power play shadow price. During the regular season the Canucks had the strongest power play scoring ability, certainly higher than Boston's. This is evident in the Canuck's larger shadow price.

Conclusion

What happened in 2011 was truly a stain on sports in Vancouver. Many things worked out wonderfully in the regular season, however things eventually fell short in the postseason. Boston's victory over the Canucks was as much the Canuck/s playing poorly as much as it was the Bruins playing exceptionally well. Through this project I have numerically confirmed many of the sports analysis that were done on the series and confirmed things with linear programming.

It's safe to say that, HAD the Canuck's played their regular season might then Vancouver may have a Stanley cup sitting on home turf. What the series came down to was an unfortunate performance during their power play opportunities, shortcomings in defense, and absurdly fatigued players.