

Will Fields, PhD

# **Evaluation of Game Event Data to Assess Team Performance**

# The Essential Nature of Sports

← Tweet

Pinned Tweet

 **Acting the Fulemin** @ATFulemin

I think a lot of people think the point of sports is that your team will win and then you will be happy. That is not the point of sports. The point of sports is to be sad in a group

7:40 AM · Aug 1, 2019

1,994 Retweets 376 Quote Tweets 6,054 Likes

 **Micah Blake McCurdy** @IneffectiveMath · Aug 1, 2019

Replying to @ATFulemin and @draglikepull

Perhaps quite a large group.

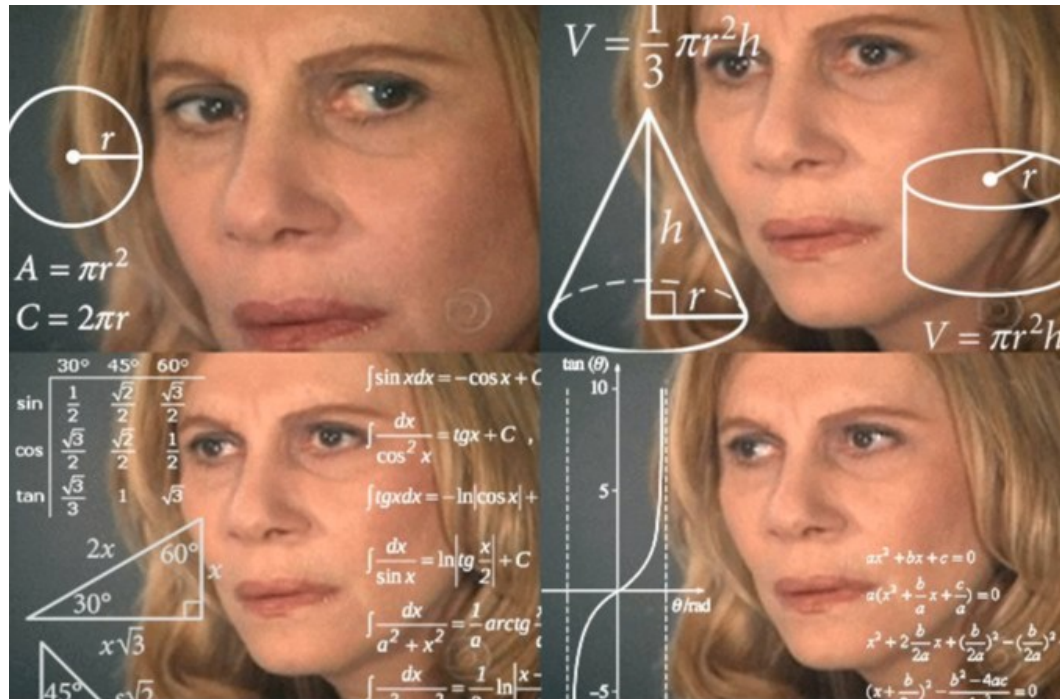
 **Micah Blake McCurdy** @IneffectiveMath · Apr 13, 2017

All must suffer.

 3   46 

# The Essential Nature of Analytics









- To be confused in a group











<https://knowyourmeme.com/photos/1279128-math-lady-confused-lady>

# Which Teams Are the Best?









Eastern

Metropolitan	GP	W	L	OTL	PTS	GF	GA	PPG	PAPG	PPS	PPA	PPD	PPF	PPS	PPA	PPD	PPF
1 	<a href="#">Columbus</a>	62	54	26	4	128	197	47	63	276	209	+10	28-10-6	5-5	6-2-15	80	
2 	<a href="#">NY Rangers</a>	62	52	24	6	123	471	44	68	264	207	+107	27-20-5	4-5	6-4-15	80	
3 	<a href="#">Pittsburgh</a>	62	46	26	11	109	426	37	43	272	228	+120	23-13-6	3-7	6-4-5	85	
4 	<a href="#">Washington</a>	62	44	36	12	108	450	36	38	276	248	+10	18-14-6	2-9	6-12	12	
5 	<a href="#">NY Islanders</a>	62	37	36	19	94	412	34	34	251	207	+6	20-14-8	1-14	3-6-5	13	
6 	<a href="#">Columbus</a>	62	37	36	7	81	494	26	33	262	305	-80	21-25-6	4-9	6-6-5	13	
7 	<a href="#">New Jersey</a>	62	27	46	4	83	384	18	24	249	307	-169	18-20-5	1-16	2-6-5	12	
8 	<a href="#">Philadelphia</a>	62	26	46	11	83	372	35	34	214	298	-187	14-21-6	1-1	2-8-10	13	









Atlantic

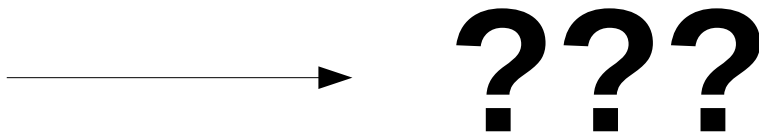
GP	W	L	OTL	PTS	GF	GA	PPG	PAPG	PPS	PPA	PPD	PPF	PPS	PPA	PPD	PPF
1 	<a href="#">Boston</a>	62	56	16	4	123	744	42	106	360	344	+10	32-11-9	3-3	7-3-17	13
2 	<a href="#">Toronto</a>	62	56	21	7	114	701	45	61	314	253	+162	31-10-1	2-9	7-1-5	80
3 	<a href="#">Tampa Bay</a>	62	51	21	9	110	471	38	48	287	235	+154	27-14-1	2-16	7-1-10	85
4 	<a href="#">Boston</a>	62	51	26	5	107	402	40	58	266	218	+126	26-12-2	2-12	6-6-10	12
5 	<a href="#">Buffalo</a>	62	33	34	14	76	457	28	18	232	290	-168	17-18-6	3-9	6-4-10	85
6 	<a href="#">Detroit</a>	62	32	43	10	74	431	21	28	230	312	-82	18-18-7	1-12	6-6-10	85
7 	<a href="#">Winnipeg</a>	62	33	42	7	79	416	28	30	217	298	-189	13-12-7	1-9	7-1-5	85
8 	<a href="#">Montreal</a>	62	23	49	11	86	318	14	14	211	318	-108	11-24-7	3-3	2-8-10	87

Western

Central	GP	W	L	OTL	PTS	GF	GA	PPG	PAPG	PPS	PPA	PPD	PPF	PPS	PPA	PPD	PPF
1 	<a href="#">Colorado</a>	62	58	14	7	114	726	46	62	312	253	+126	32-10-1	4-2	6-1-5	13	
2 	<a href="#">Minnesota</a>	62	49	22	7	111	689	37	46	312	253	+167	31-10-1	3-12	6-1-5	85	
3 	<a href="#">St Louis</a>	62	49	22	11	109	669	43	47	311	242	+169	28-13-1	2-16	7-1-5	12	
4 	<a href="#">Dallas</a>	62	48	16	4	68	588	31	41	258	248	+10	27-11-4	3-9	6-1-10	85	
5 	<a href="#">Nashville</a>	62	45	30	7	87	584	36	41	266	292	+116	26-14-2	4-12	6-4-12	12	
6 	<a href="#">Winnipeg</a>	62	38	32	11	84	443	33	37	262	297	-16	21-15-6	2-1	6-1-10	88	
7 	<a href="#">Chicago</a>	62	28	32	13	84	426	14	12	218	291	-173	14-22-6	1-12	6-1-12	87	
8 	<a href="#">Arizona</a>	62	23	40	7	87	348	18	14	207	313	-106	11-27-3	1-4	3-9-10	85	

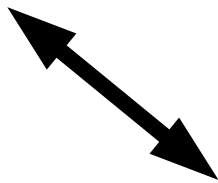
Pacific

GP	W	L	OTL	PTS	GF	GA	PPG	PAPG	PPS	PPA	PPD	PPF	PPS	PPA	PPD	PPF
1 	<a href="#">Calgary</a>	62	50	11	11	111	671	44	48	289	246	+140	28-11-7	2-2	6-1-12	13
2 	<a href="#">Edmonton</a>	62	46	27	4	104	434	38	44	280	252	+128	28-12-1	3-1	7-1-5	80
3 	<a href="#">Los Angeles</a>	62	44	27	11	88	454	38	40	239	236	+10	21-11-1	3-6	6-1-5	87
4 	<a href="#">Vegas</a>	62	43	31	4	84	471	34	38	248	248	+10	22-11-1	4-1	6-1-10	85
5 	<a href="#">Vancouver</a>	62	40	36	12	82	451	30	37	249	236	+113	20-11-7	3-16	6-1-12	87
6 	<a href="#">San Jose</a>	62	32	37	13	77	470	22	28	214	284	-160	14-18-6	3-13	3-4-13	13
7 	<a href="#">Seattle</a>	62	31	37	14	76	443	22	27	212	271	-169	17-19-6	4-16	3-6-12	12
8 	<a href="#">Seattle</a>	62	27	49	4	80	386	23	34	216	298	-189	14-22-3	3-1	6-6-10	13



# A Different Approach

**Tactics & Strategy**



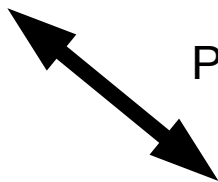
**Game Events**

# A Different Approach

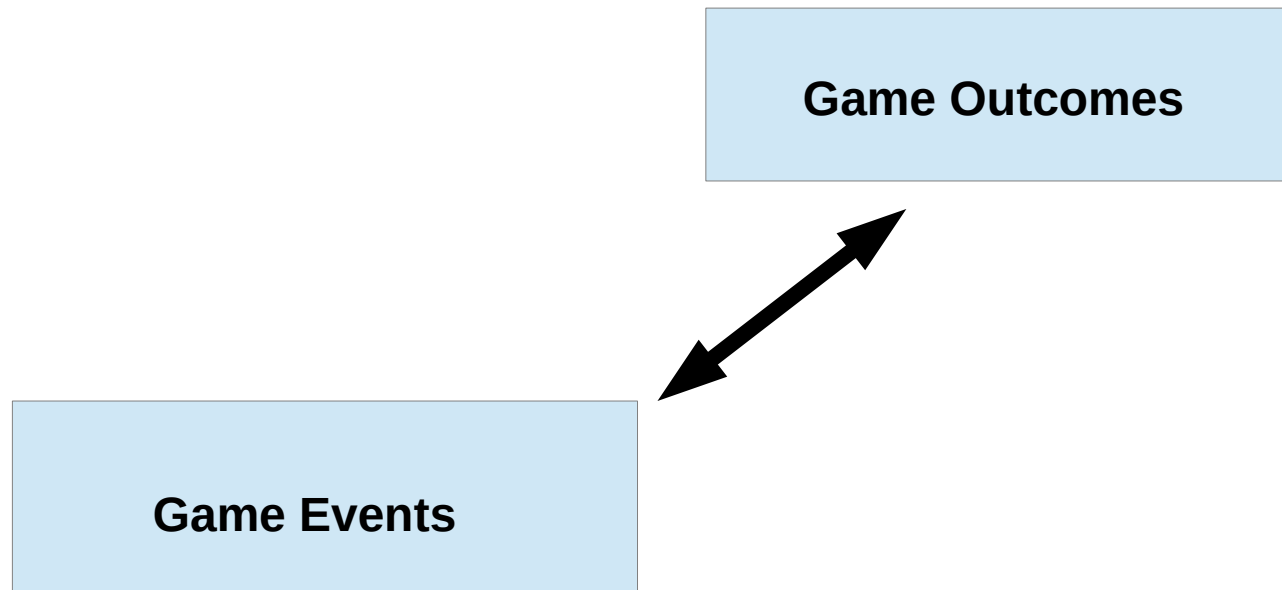
**Tactics & Strategy**

Principal Components Analysis

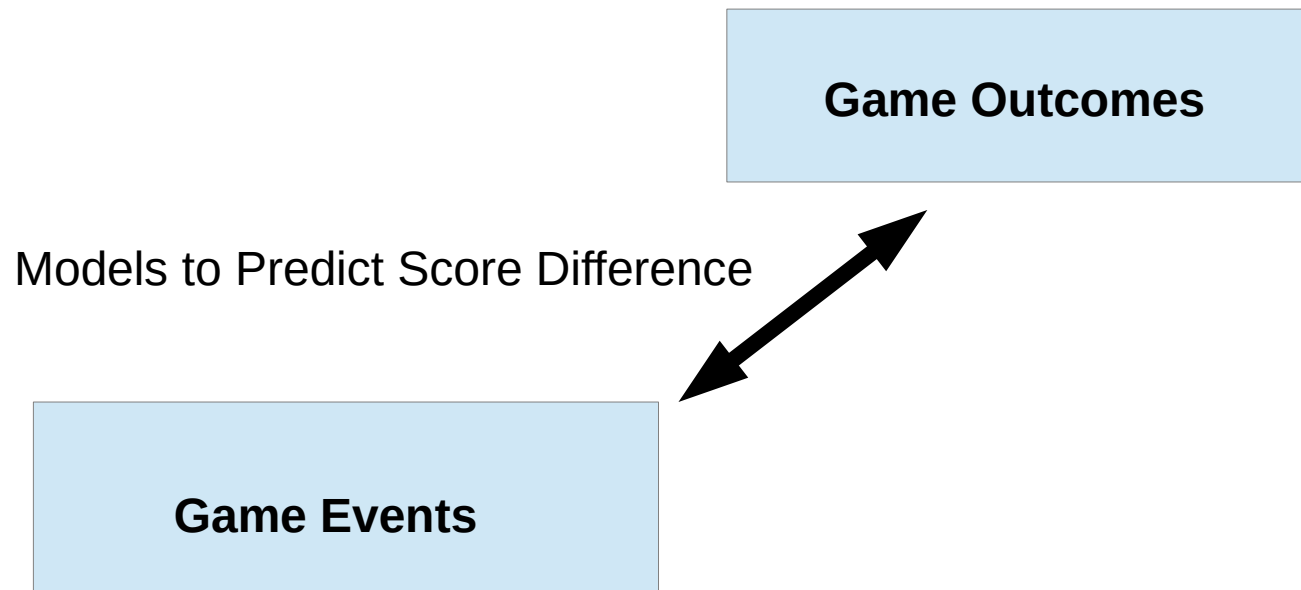
**Game Events**



# A Different Approach

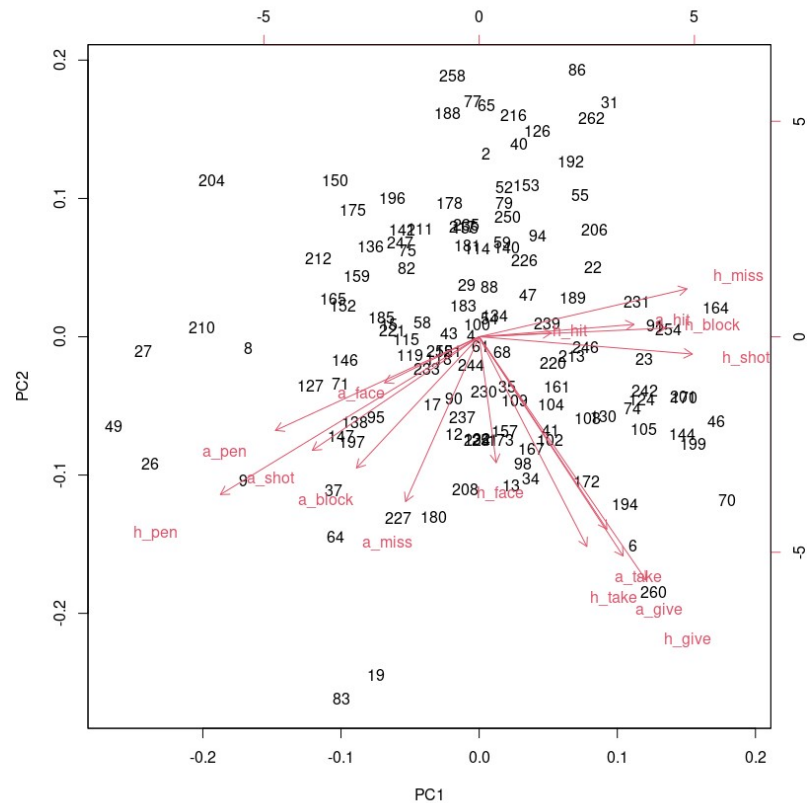


# A Different Approach

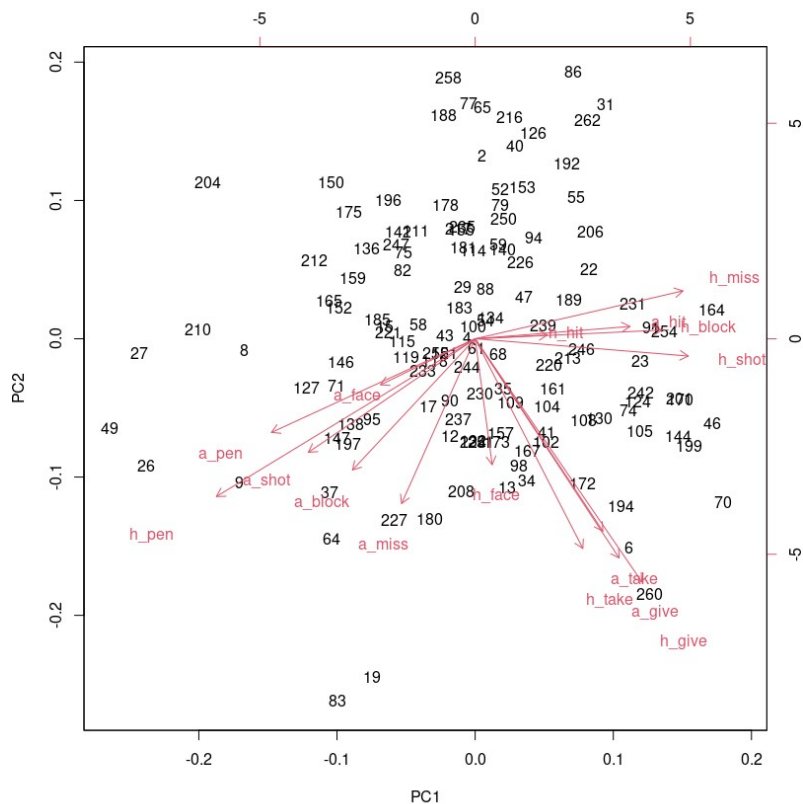




# How Do Teams Play?



# How Do Teams Play?



THIS IS YOUR MACHINE LEARNING SYSTEM?

YUP! YOU POUR THE DATA INTO THIS BIG PILE OF LINEAR ALGEBRA, THEN COLLECT THE ANSWERS ON THE OTHER SIDE.

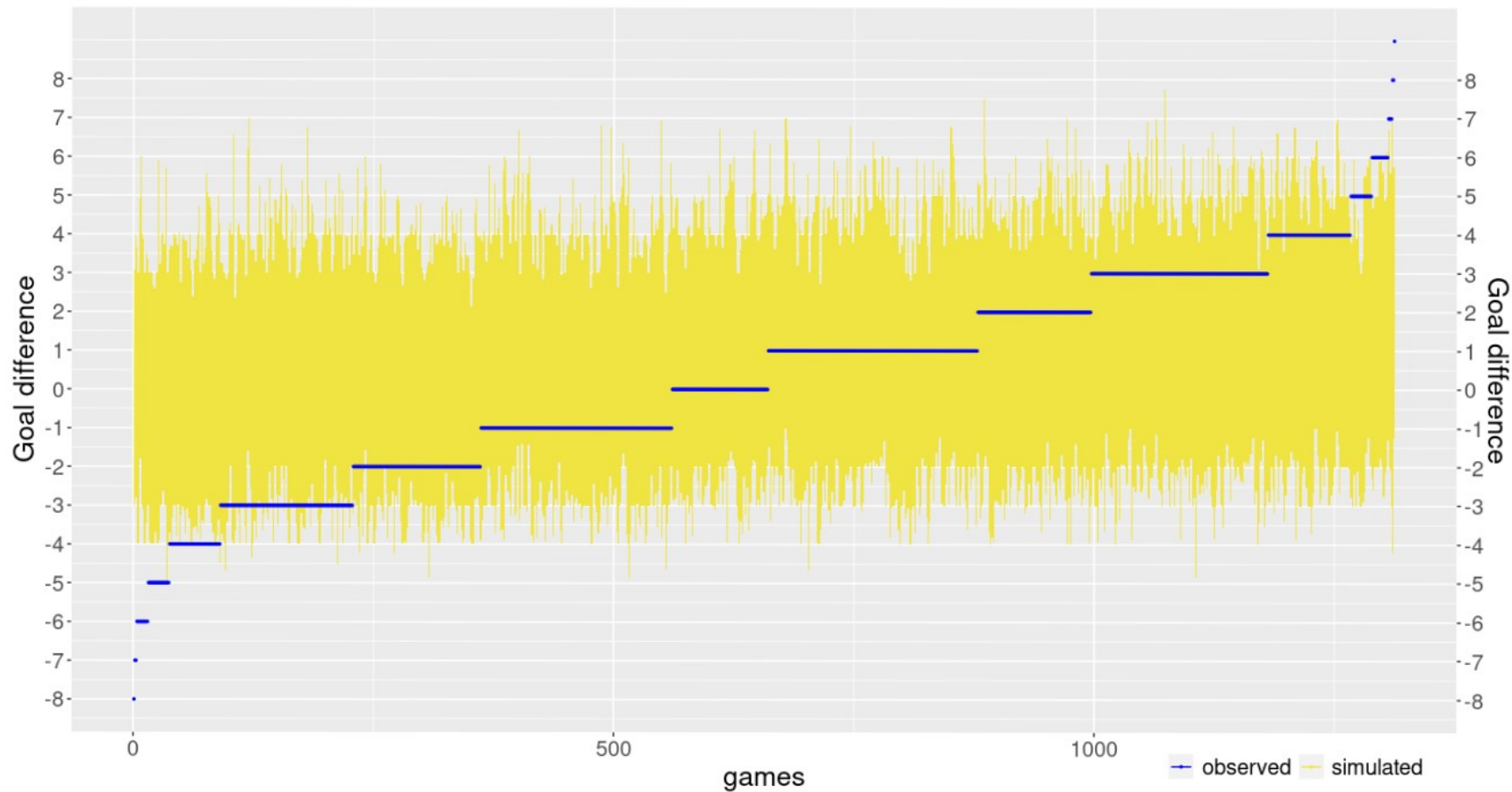
WHAT IF THE ANSWERS ARE WRONG?

JUST STIR THE PILE UNTIL THEY START LOOKING RIGHT.

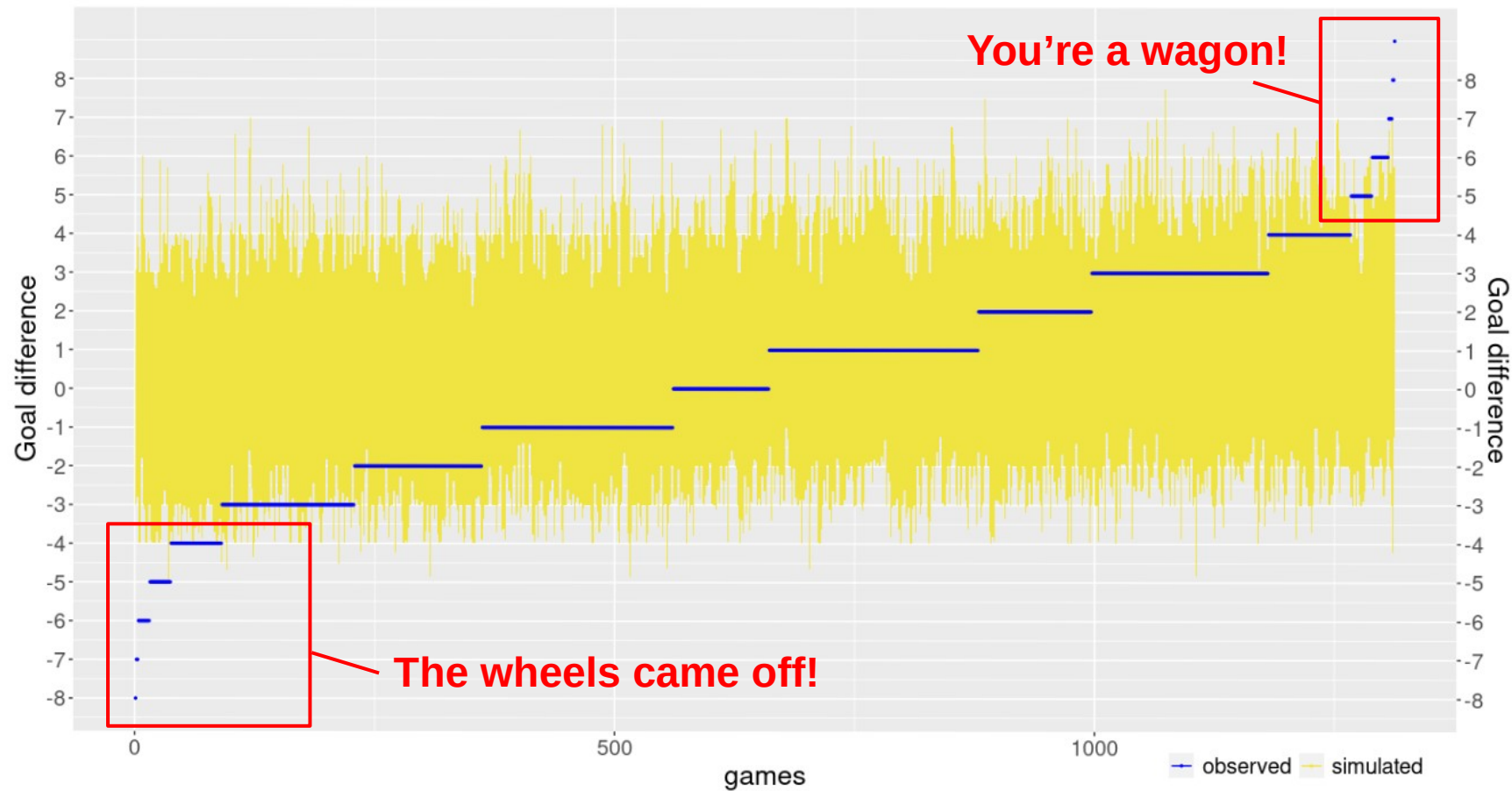


<https://xkcd.com/1838>

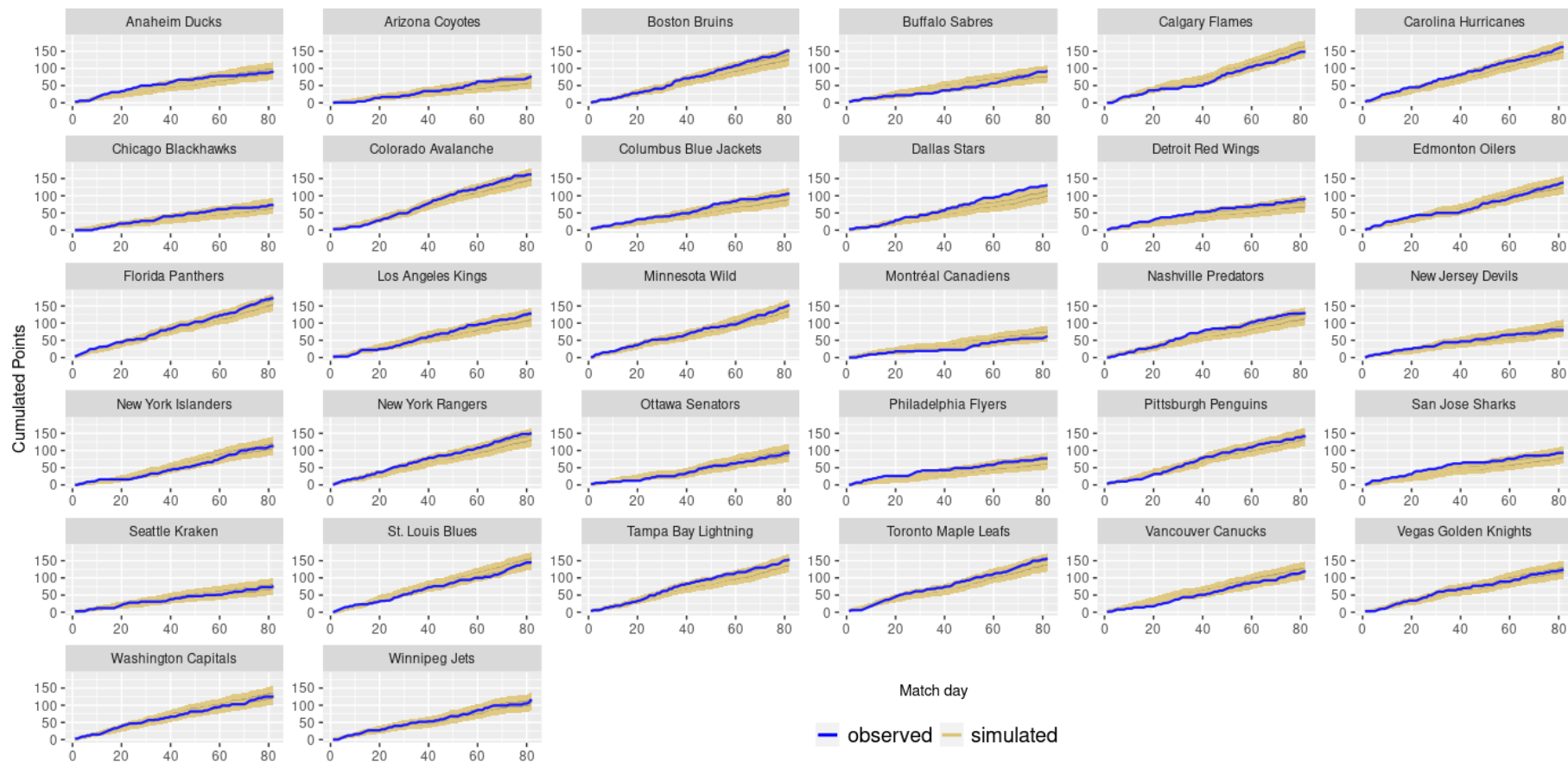
# Score Differences Look Better



# Modeled Score Differences Capture Observed Data



# Projected Points



# Problem: “Goodhart’s Law”

- "When a measure becomes a target, it ceases to be a good measure"
- Solution: make an analysis that will get you to where you want to go, don't just copy something mindlessly



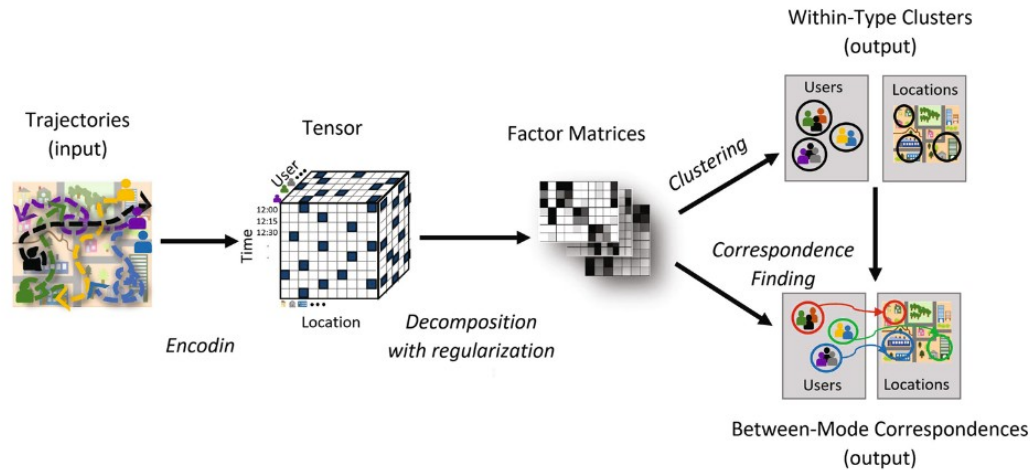
# Too Many Men Tribute

- New acronym: TEB - Trade, Extend, Buyout
- A brief prospectus for future work



# Too Many Men Tribute

- Trade: tensor decomposition to quantify patterns of events



**Fig. 1** In MCRD, moving object trajectory data, the input to the method, are encoded into a tensor. Next, decomposition with regularization is used to extract factor matrices for all data types. After that, clusters are found within each data type based on the factor matrices. The last step uses the number of significant factors between elements of multiple data types to find correspondences between clusters



# Too Many Men Tribute

- Trade: tensor factorization to quantify patterns of events
- Extend: refined time series models for predicting score differences

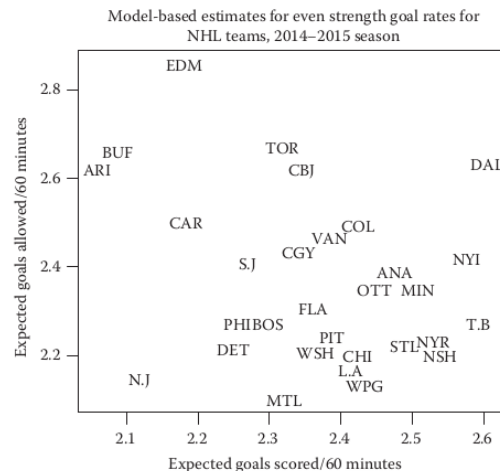


FIGURE 13.4

Model estimates for the rate at which NHL teams would score and allow goals at full strength 5v5 play, accounting for score differential, home/away bias, opponent matchups, and face-off prowess. Rates displayed are for when the team is playing on the road.

# Too Many Men Tribute

- Trade for: tensor factorization to quantify patterns of events
- Sign to an extension: refined time series models for predicting score differences
- Buyout: principal components analysis



# Questions? Comments? Feedback?



<https://github.com/openfields>  
wfields7 at gmail dot com  
[@openfields@mastodon.skrimmage.com](mailto:@openfields@mastodon.skrimmage.com)