Which League is Best?

Comparing the difficulty of different hockey leagues around the world

Research Questions

1) What response variable can be created to compare player statistics controlling for age, league strength, position, etc?

2) Which league is the best? Which leagues are better?

Background: Hockey Leagues

- Scouting for the NHL is a challenging process
  - Players from over 45 professional ice hockey leagues around the world.
  - Leagues can have a variety of players, rules, and ages.
    - Junior leagues, rink regulations, season length, etc.
- **How do we compare all of the hockey leagues for player evaluation?**
  - Create and evaluate different models to characterize league strength over time.

Variables

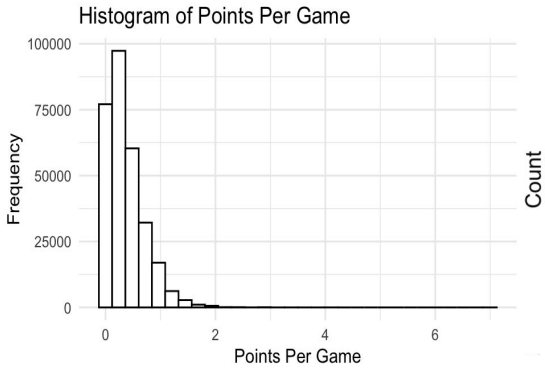
- 18 variables given in original data set
  - Player ID, name, league, season, goals, assists, points per game
- Created age variable for a player's age at a specific season

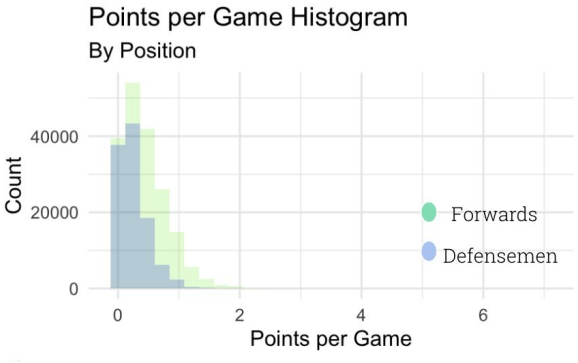
	player_id	player_name.x	league_id	team	season	age	position	PPG
1	6146	Sidney Crosby	qmjhl	Rimouski Océanic	20032004	16	F	2.29
2	6146	Sidney Crosby	qmjhl	*NA*	20032004	16	F	1.78
3	6146	Sidney Crosby	qmjhl	Rimouski Océanic	20042005	17	F	2.71
4	6146	Sidney Crosby	nhl	Pittsburgh Penguins	20052006	18	F	1.26

Response Variable

- Points per Game
  - Total points / Games Played
  - Accounts for different number of games played
- Other ones we created:
  - Goals per Game, Assists per Game, Weighted Points per Game, etc
- Percentile of PPG
  - Controlling for position, league, and age
- Standardized PPG
  - log(1+x) or sqrt(1+x)
  - Kind of like a “z-score”

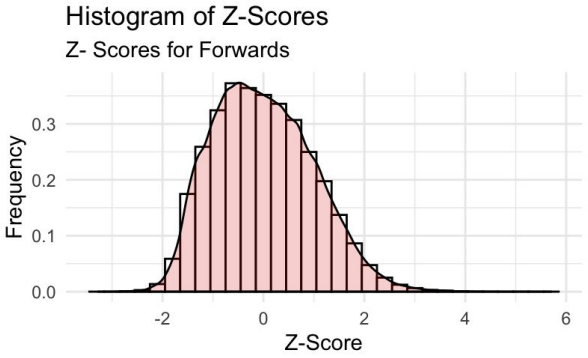
Transformation Process

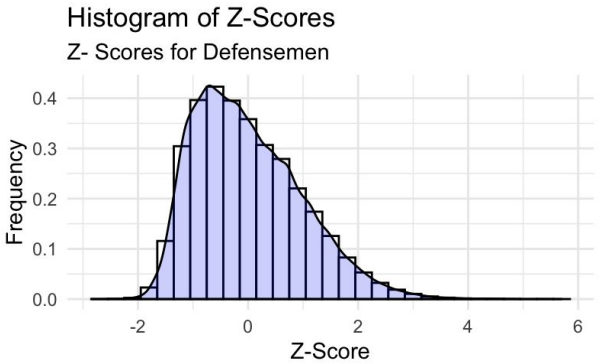




Response Variable Transformation
1) Started with PPG
2) Took Log(PPG +1)
3) Calculated mean and standard deviation grouped by league, age, position, and season
4) Calculated Z-Score for each player

Transformation Process





Creating Paired-Comparison Model

1. **Building Comparison Dataframe**
    a. Aggregated table of all pairwise comparisons of player-league-seasons for each player.
    b. Eliminate any pairs that have the same league, pairs that are further than one season apart, and playoff data.

Paired Comparisons Observation Example

Player Name	League	Season	Z- Score
Kris Letang	QMJHL	2006-07	1.829
Kris Letang	NHL	2006-07	1.158
Kris Letang	AHL	2007-08	1.557

League 1	Season 1	Z-Score 1	League 2	Season 2	Z-Score 2	Z-Score Difference
QMJHL	2006-07	1.829	NHL	2006-07	1.158	.671
NHL	2006-07	1.158	AHL	2007-08	1.557	-.399

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2. **Data Matrix**
   a. For each comparison, the first league is assigned a value of -1, the second is assigned 1, and 0 otherwise.

Paired Comparisons Data Matrix Example

SHL	LIIGA	DEL	KHL	OHL	ALLSVENSKAN	CZECH	NHL
0	0	0	0	-1	0	0	0
0	0	0	0	0	1	0	0
-1	1	0	0	0	0	0	0
0	-1	0	0	0	0	0	1
1	-1	0	0	0	0	0	0
-1	0	0	0	0	0	0	0
1	-1	0	0	0	0	0	0
0	0	0	0	0	1	0	0
1	-1	0	0	0	0	0	0
-1	1	0	0	0	0	0	0
-1	1	0	0	0	0	0	0
1	-1	0	0	0	0	0	0
-1	0	0	0	0	0	0	1

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2. **Data Matrix**
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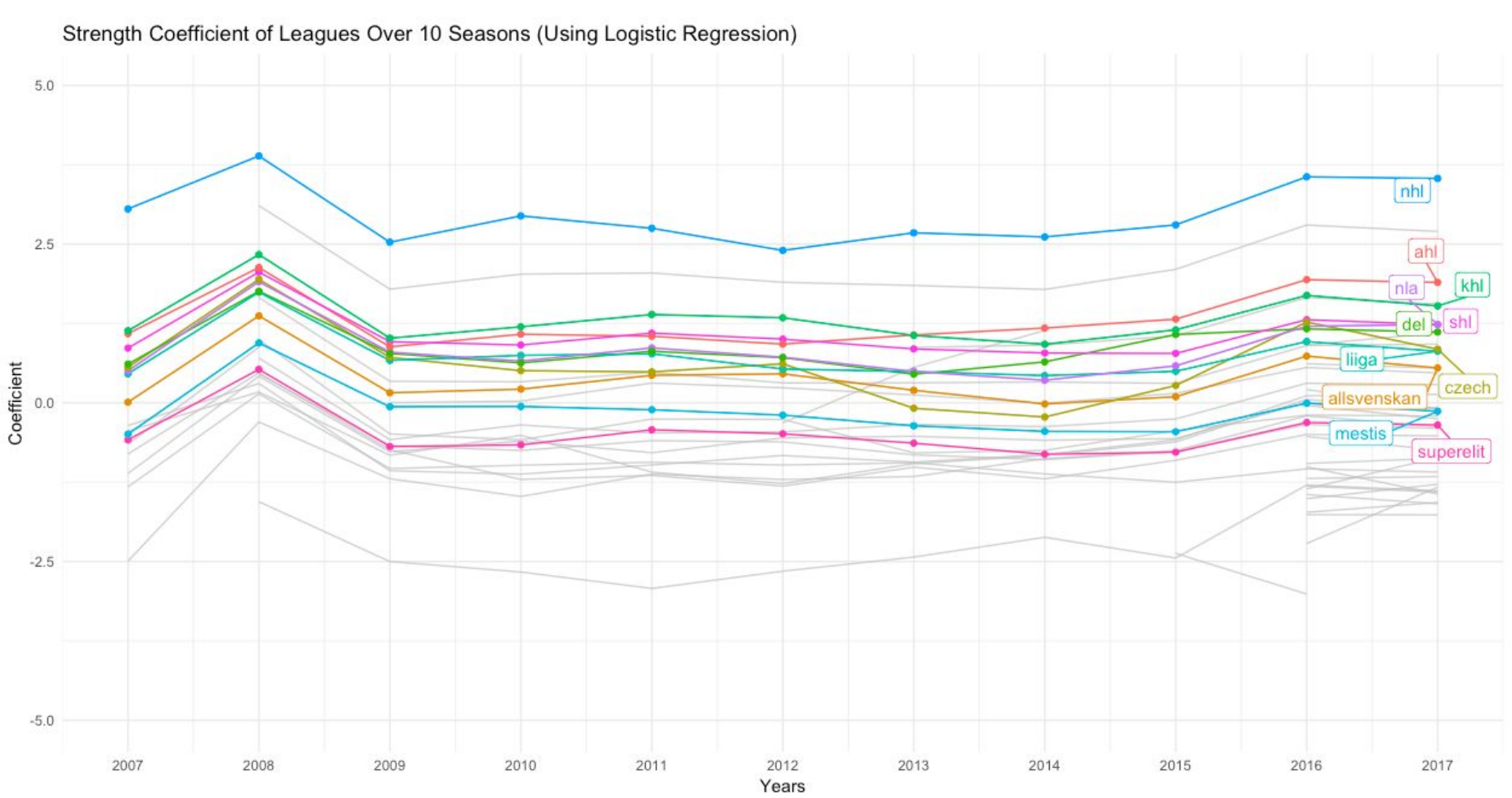
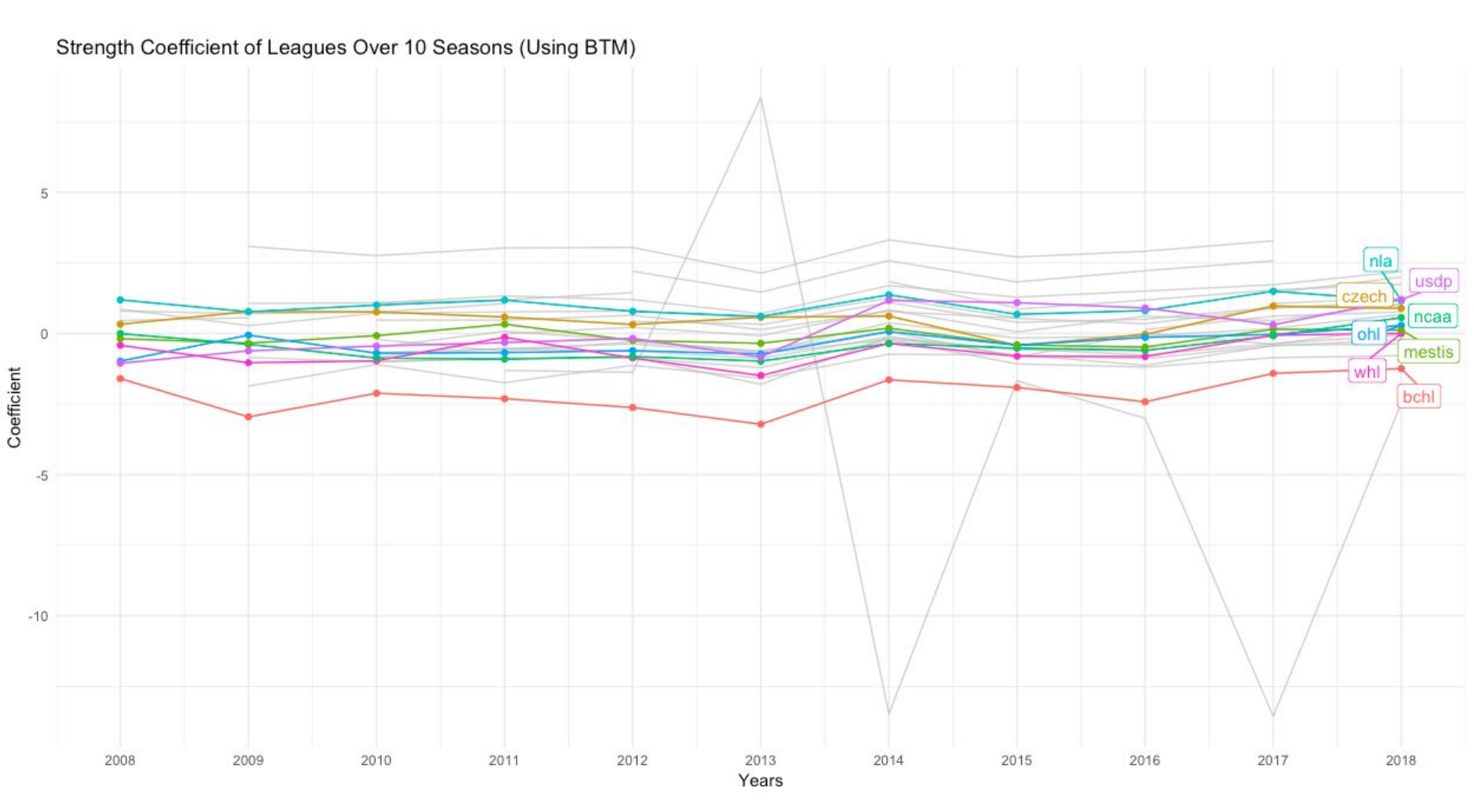
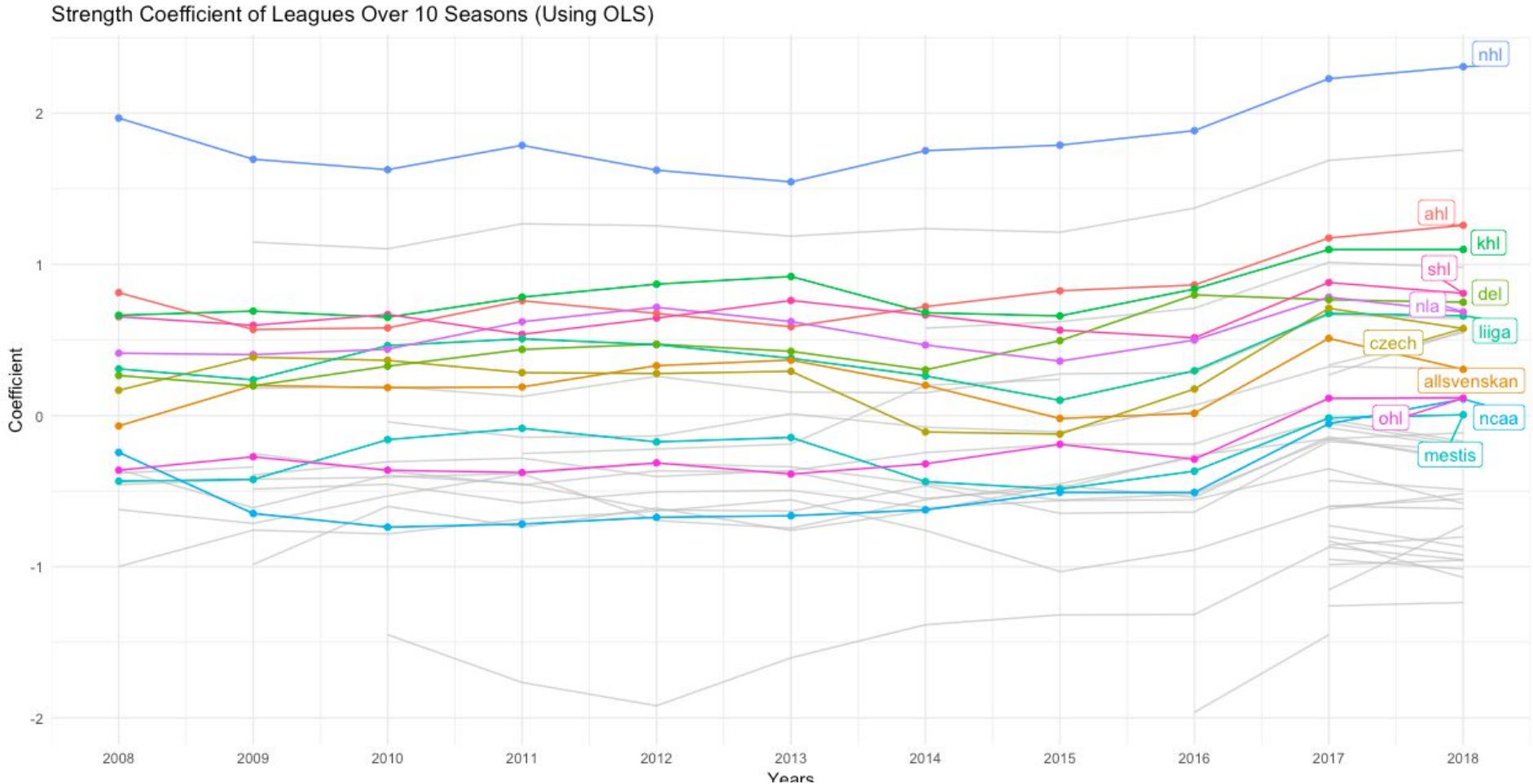
3. **Outcome Vector**
   a. Single value for each observation; either continuous or binary depending on the regression used.
4. **Result**
   a. Strength Coefficients for each League in each Season

Model Building

- Multiple variations that utilized different response variables and regressions to calculate the coefficients.
- **Response Variables:**
  - Raw Points Per Game
  - Adjusted Points Per Game (Z-Score)
- **Regressions:**
  - Logistic Binomial regression
  - Ordinary Least Squares regression (linear regression)
  - BTm Binomial regression.
- **Binary vs. Continuous**
  - What counts as a “win”?

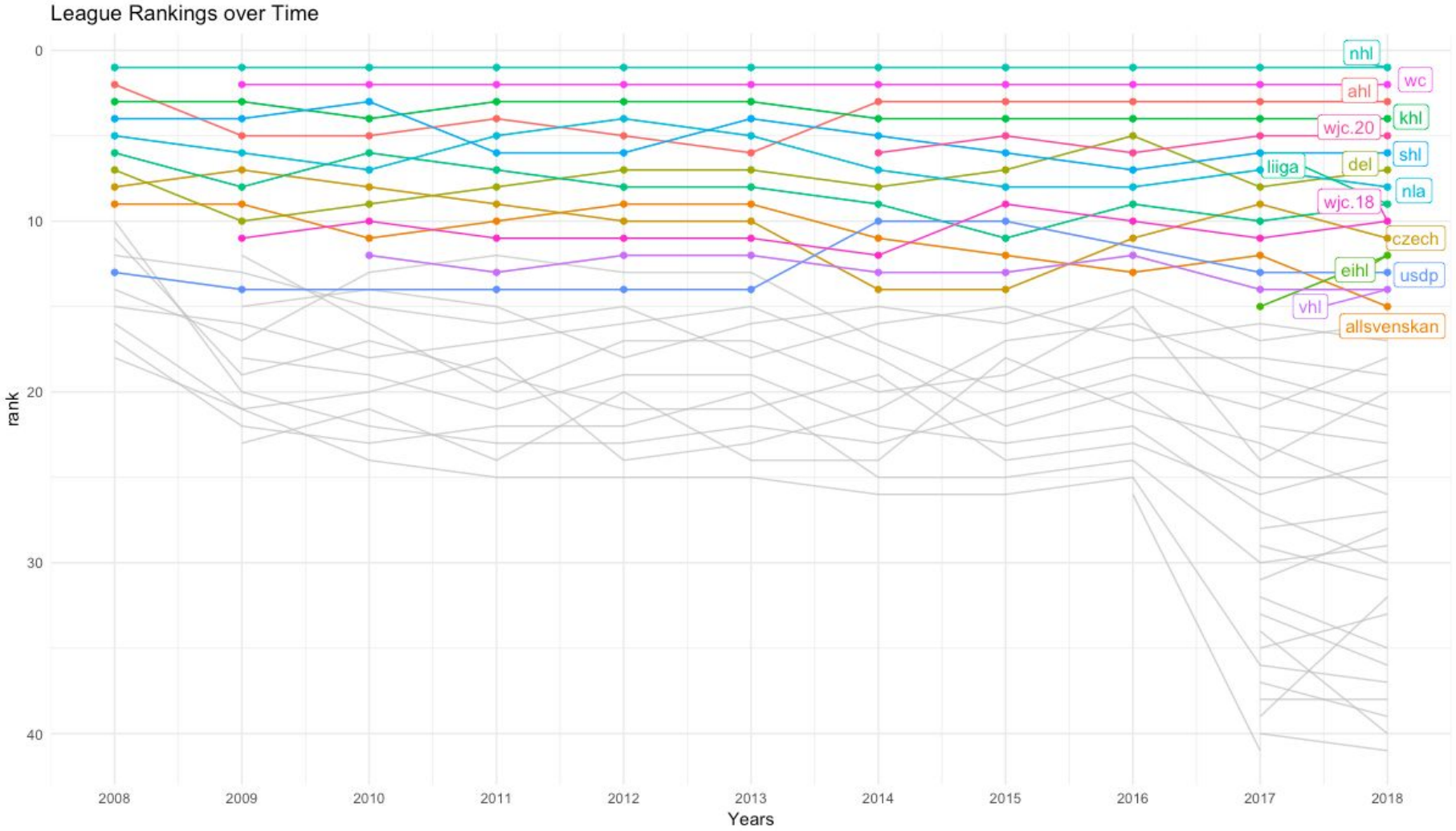

Strength Coefficient of Leagues Over 10 Seasons (Using Logistic Regression)
5.0
2.5
0.0
-2.5
-5.0
Coefficient
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Years
nhl
ahl
nla
khl
del
shl
liiga
czech
allsvenskan
mestis
superelit


Strength Coefficient of Leagues Over 10 Seasons (Using BTM)
Coefficient
5
0
-5
-10
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Years
nla
usdp
czech
ncaa
ohl
mestis
whl
bchl


Strength Coefficient of Leagues Over 10 Seasons (Using OLS)
Coefficient
2
1
0
-1
-2
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Years
nhl
ahl
khl
shl
del
nla
liiga
czech
allsvenskan
ohl
ncaa
mestis

Comparing Coefficients from Models

League	Logistic	BTM	OLS
NHL	2.405	2.516	1.523
WC	1.818	1.942	1.172
WJC.20	1.361	1.428	0.912
KHL	1.217	1.339	0.776
SHL	1.205	NA	0.759
AHL	1.194	1.266	0.757
USDP	1.137	1.171	0.671
WJC.18	1.102	1.140	0.665
DEL	0.954	1.062	0.590
NLA	0.839	0.969	0.564


League Rankings over Time
rank
0
10
20
30
40
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Years
nhl
wc
ahl
khl
wjc.20
shl
liiga
del
nla
wjc.18
czech
eihl
usdp
vhl
allsvenskan

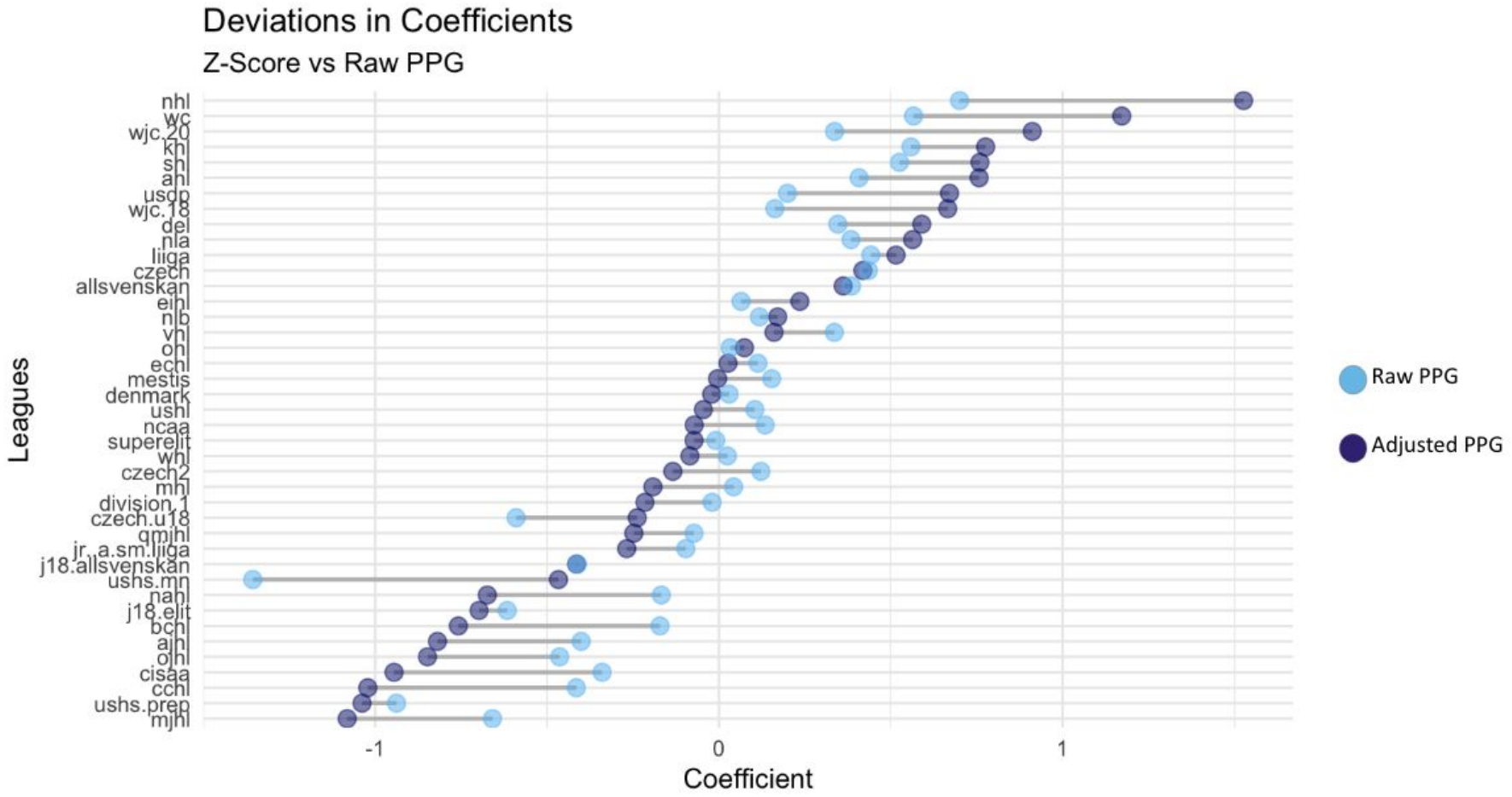
Ranking Results for different Models

Rank	Log	Brad	Difference
1	NHL	NHL	0
2	WC	WC	0
3	KHL	WJC.20	3
4	SHL	KHL	-1
5	Liiga	SHL	-1
6	WJC.20	AHL	2
7	Czech	USDP	6
8	AHL	WJC.18	6
9	Allsvenskan	DEL	2
10	NLA	NLA	0

Model Evaluation and Selection

- Split paired data into 70/30 for training and test samples.
- Ran model w/ different regressions on test data set:
  - Logistic, BTm, and Linear regression
- Predicted the probability of a win for all leagues based off of the Adjusted PPG
- Set threshold for “winning”
  - Greater than threshold, predicted outcome = 1
  - Less than threshold, predicted outcome = 0
- Compared the predicted outcomes to the actual outcomes to calculated prediction accuracy for each model

Model Type	Outcome Type	Prediction Accuracy
Self-Made Model: Logistic	Binary	66.19%
Bradley Terry Model	Binary	71.82%
Self-Made Model: OLS	Continuous	74.51%


Deviations in Coefficients
Z-Score vs Raw PPG
Leagues
nhl
wc
wjc.20
khl
shl
ahl
usdp
wjc.18
del
nla
liiga
czech
allsvenskan
eihl
nlb
vhl
oh
echl
mestis
denmark
ushl
ncaa
superelit
whl
czech2
mhl
division.1
czech.u18
qmjhl
jr. a.sm.liiga
j18.allsvenskan
ushs.mn
nahl
j18.elit
bchl
ajhl
ojhl
cisaa
cchl
ushs.prep
mjhl
-1
0
1
Coefficient
Raw PPG
Adjusted PPG

Scouting Implementation

- **How can we use this?**
  - Perhaps a scout is interested in gauging how a player's performance in another professional league would translate to the NHL, or vice versa.

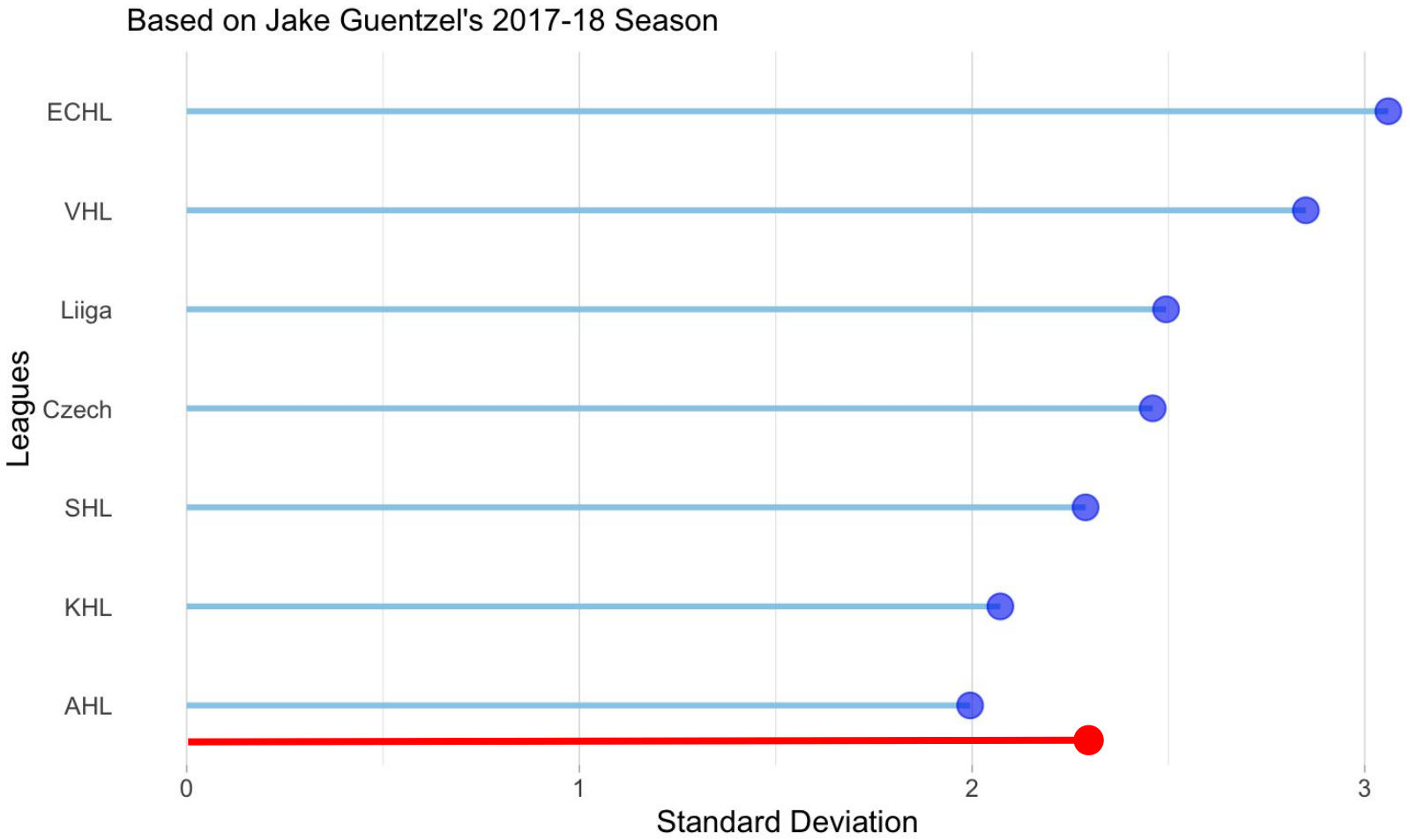
  - Given the Strength Coefficients and aPPG, how well can we predict performance in another league?

Using Strength Coefficient In Context

1) Take original z-score from player from certain league/year
2) Get Strength Coefficient from model
3) Get Strength Coefficient from a different league in the same season
    a) NHL(strength coefficient) - AHL(strength coefficient)
4) Add difference in strength coefficients to the players Z-score
5) Sum is the predicted adjusted z-score of PPG for a player in the league

Example : Jake Guentzel- Z- Score = .9414 in 2017-2018

1) Z- Score = .9414 in 2017-2018
2) NHL strength coefficient in 2017-18 = 2.228490
3) AHL strength coefficient in 2017-2018 = 1.1743023
4) Difference = 1.054118
5) Predicted adjusted Z-score in AHL = 1.995
    a) Better than about 95 percent of players in the AHL
6) AHL actual adjusted z-score is 2.30


Based on Jake Guentzel's 2017-18 Season
ECHL
VHL
Liiga
Czech
SHL
KHL
AHL
Leagues
0
1
2
3
Standard Deviation

Conclusions

- The NHL is consistently the top league no matter what response variable is used or which regression model is used
- Certain leagues perform stronger depending on whether or not we account for age
  - younger leagues perform better
  - mid-tier leagues don’t see much variation
- Coefficients could be used to find comparisons for leagues of similar strength, or gauge player strength in separate league.
- Future iterations with our model could be used to predict league rankings in upcoming years

Thank You!