

Using Salaries to Predict Winning Percentages
Justin Dickinson & Nick Gray

Putting together a winning team is the goal of any front office in sports. Some owners and general managers believe wins can be bought by paying higher salaries to bring in the “best” players. However, there are other, intangible factors that go into forming a winning team that may be more important than paychecks. Is there a correlation between higher salaries and winning percentage over the course of the past six seasons for the four major North American professional sports leagues, the MLB, NBA, NFL, and NHL? To address this question, data has been gathered from sportrac.com for the payouts of each team for the six seasons from 2011-2016, and data on winning percentages for each season has been gathered from espn.com. With the data compiled, SAS is used to run linear regressions on the data, including residual plots and predicted values. The correlation coefficient is also found using SAS.

After looking at the scatter plots and fits for each set of data, it is clear that there is little correlation between salary and winning percentage, regardless of league with the MLB having the highest correlation coefficient of 0.35925 and the NFL the lowest at 0.10928 (the NBA's is 0.21045 and the NHL's is 0.22050) (fig. 1, 2). This indicates a weak, positive linear relationship between salary and winning percentage. Closer inspection of the residual plots reveals how difficult it would be to predict a winning percentage based on a team's salary (fig. 3). There is no relation to be found, and indeed the sum of the residuals for each league is zero. Looking at the estimates for the slope parameter, we see an increase in winning percentage of approximately 0.001 for each \$1,922,290, \$669,018, \$1,128,821, and \$367,725 spent respectively in the MLB, NBA, NFL, and NHL (fig. 6). Also notice that 0 is not included in the

95% confidence interval for any slope parameter, which indicates that there is a relation between salary and winning percentage, even if it is a small and unpredictable one.

We can further analyze how a team's payroll would be an unreliable estimator of their winning percentage by looking at the predicted values (fig. 4). Here, values representing the 90th percentile and the 10th percentile have been predicted. For a team paying in the 90th percentile of salaries, it would be expected that they would have one of the better teams. At the very least, they would expect to be significantly better than a team in the 10th percentile of salaries. But the differences in the predicted values are not as great as one would expect. The NBA had the highest difference at 0.0852, while the MLB, NFL, NHL each had a difference of 0.0583, 0.0551, and 0.0544 respectively. Also note the 90th percentiles of winning percentages for the MLB: 0.5860, NBA: 0.6380, NFL: 0.7500, and NHL: 0.6650. We can see that the predicted value for the 90th percentile of salaries does not correspond to the actual winning percentage that would make a team better than 90% of other teams; it is notably less in all leagues. Finally, by analyzing the 95% confidence interval for the predicted value it is clear that there is wide variation when attempting to predict winning percentage using a team's salary (fig. 5). The width of the 95% confidence interval for a team paying in the 90th percentile in the NFL is 0.7695 and covers all but 11 of the observed values (94.3%). The width for a team in paying in the 10th percentile is the same, 0.7695, and covers all but 4 of the observed values (97.9%). The other leagues also exhibit similar behavior.

In conclusion, the factors that contribute to a winning team go far beyond how much that team is willing to pay its players. While there is a weak, positive linear relationship between team salaries and winning percentage, it is not enough to justify making this a team's primary strategy to win games. As the predicted values and their confidence intervals clearly indicate, a

team in the bottom tenth of salaries can easily outperform a team in the top tenth. So what other factors contribute to a winning team? These would be harder to measure, but chemistry between players is of the utmost importance. Just because two players are great does not necessarily mean that they will play well together. Coaching is also a significant factor, particularly when developing younger players and when getting superstars to coexist together. In the end, no amount of money can guarantee success in today's professional sports.

SAS coding: Justin Dickinson, Nick Gray

Data gathering: Justin Dickinson, Nick Grey

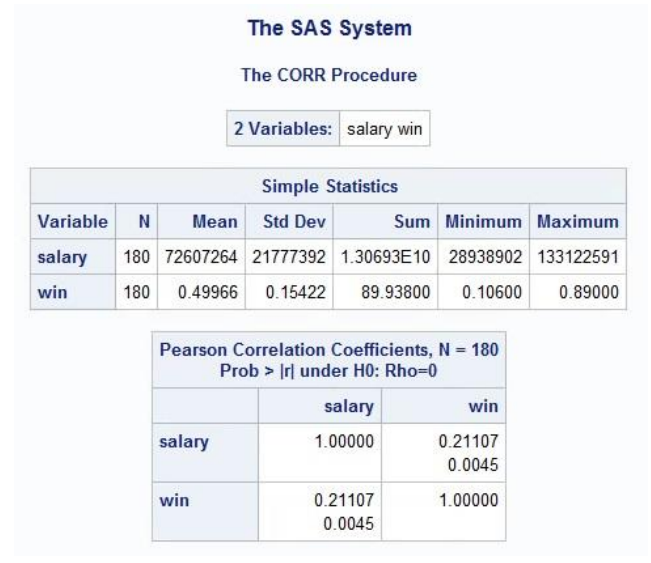
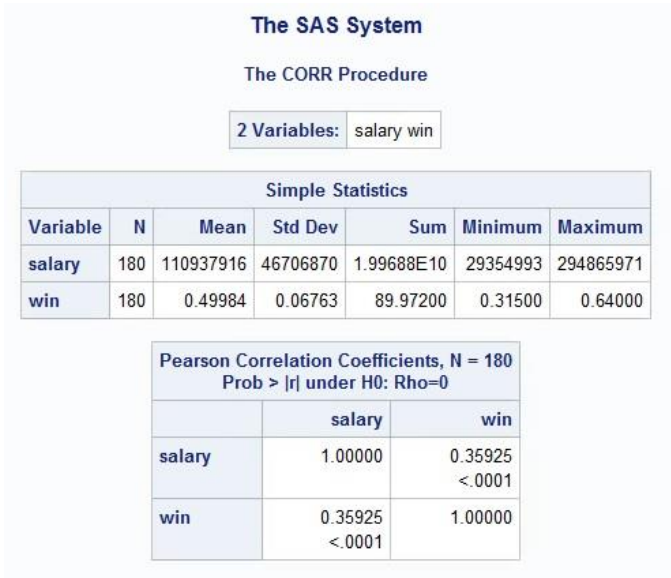
Writing: Justin Dickinson

Editing: Nick Gray

Fig. 1 - Correlation Coefficients:

MLB:

NBA:



NFL:

NHL:

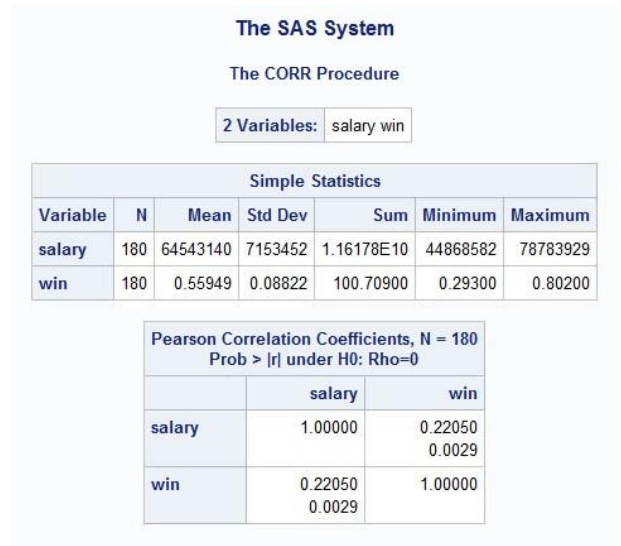
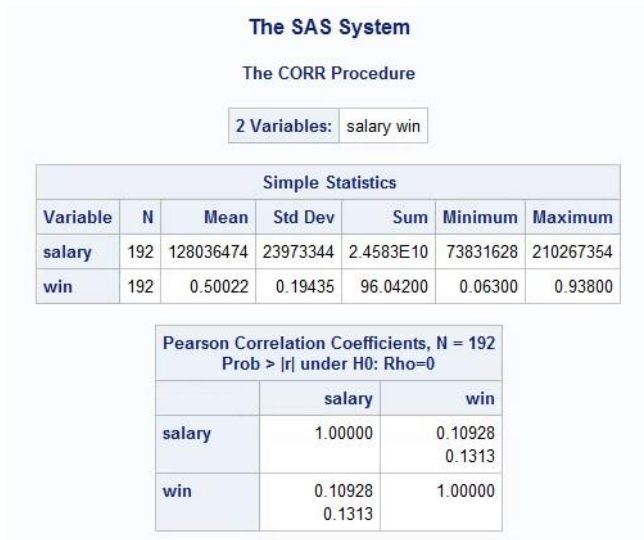
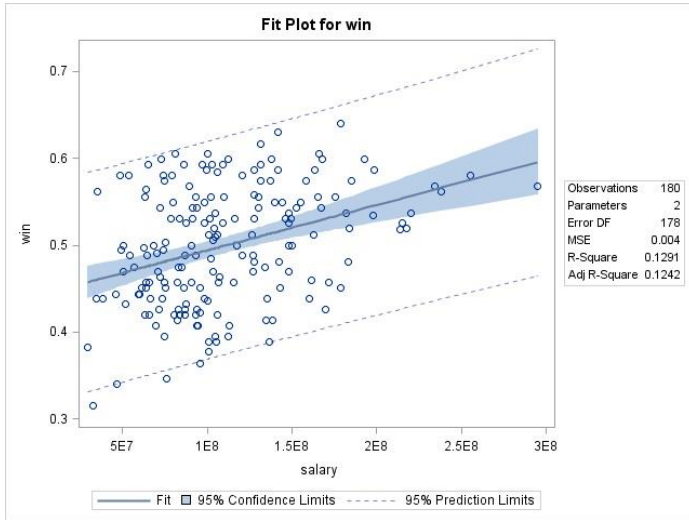
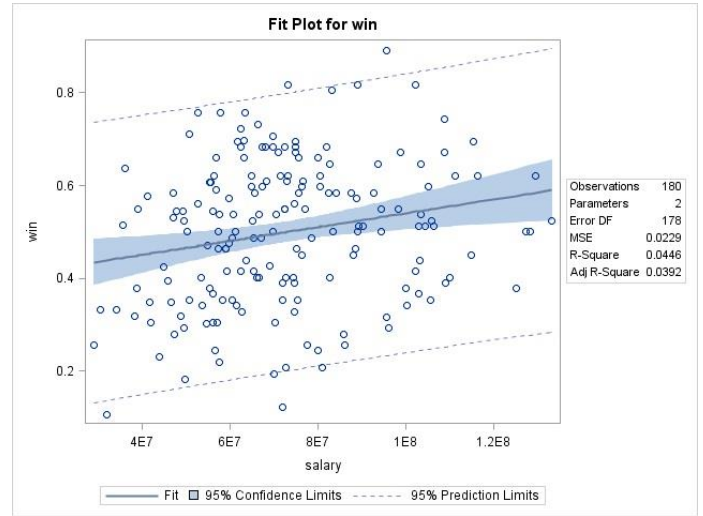


Fig. 2 - Fit plots

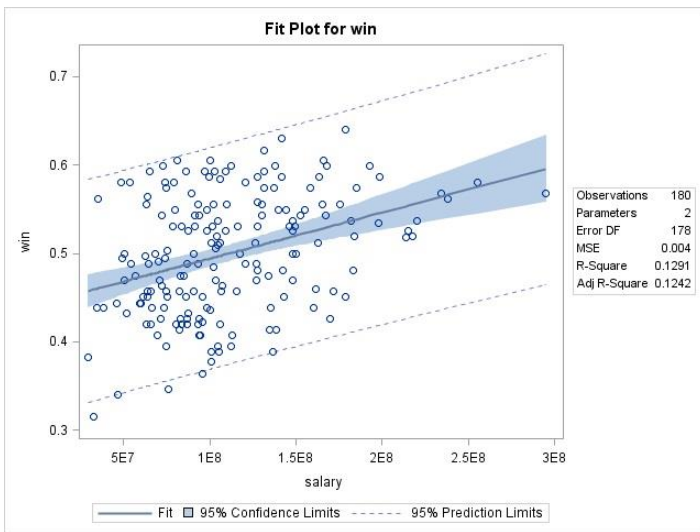
MLB:



NBA:



NFL:



NHL:

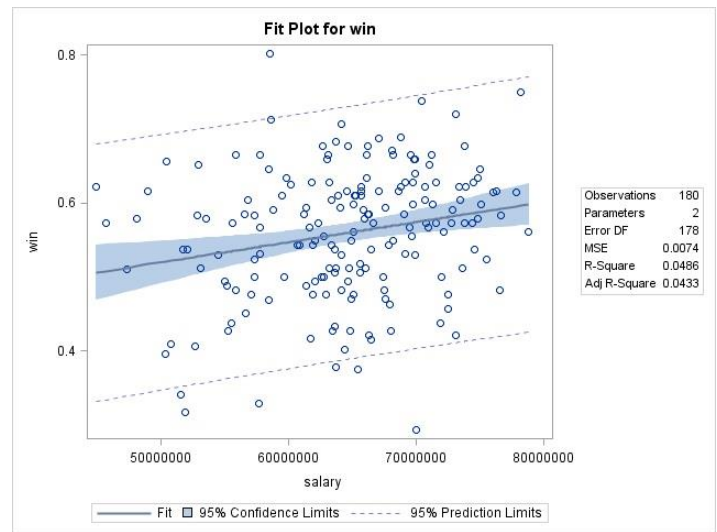
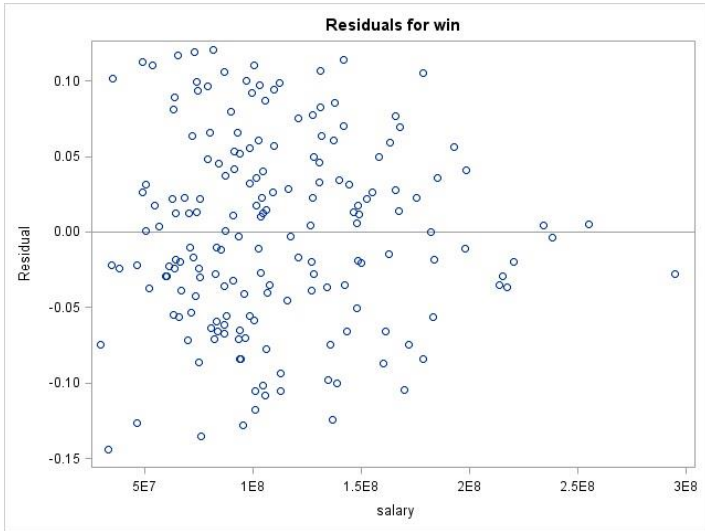
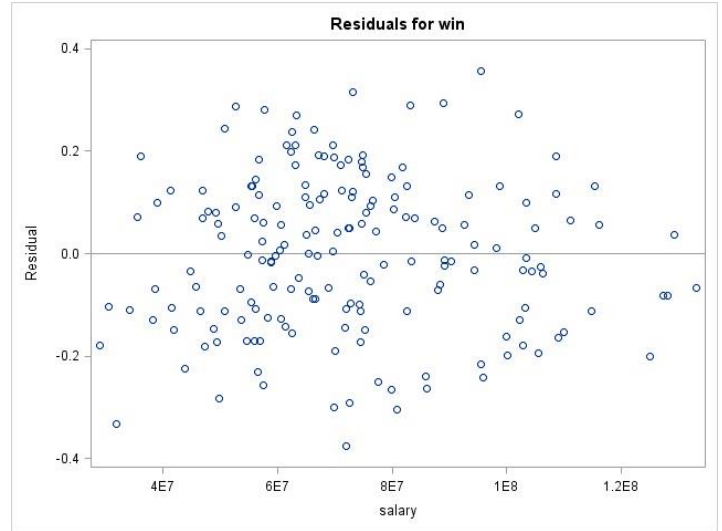


Fig 3 - Residual plots

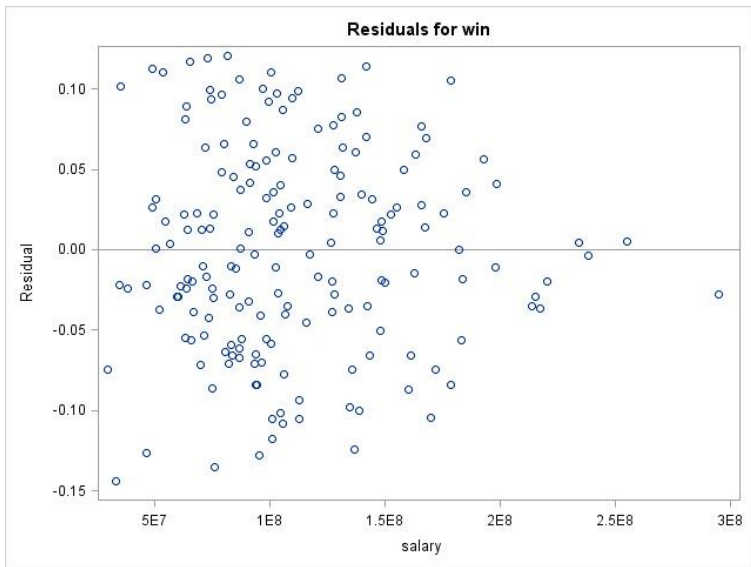
MLB:



NBA:



NFL:



NHL:

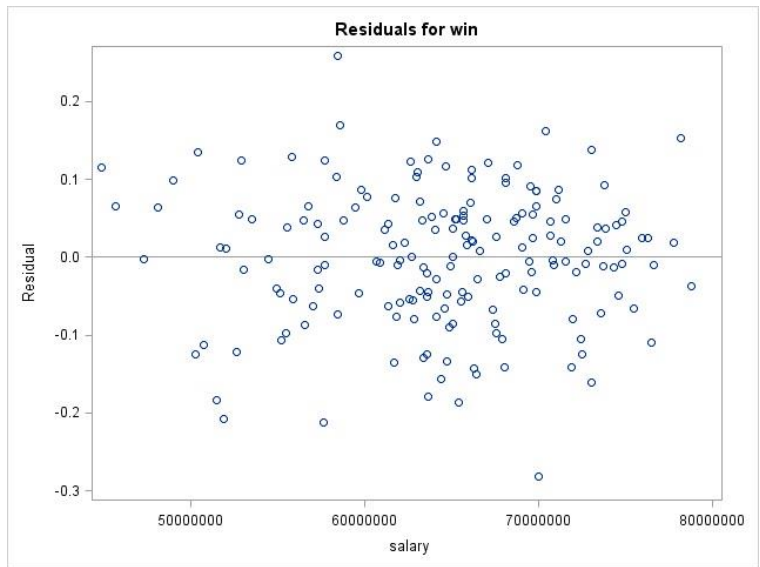


Fig 4 - Percentiles

MLB:

Quantiles (Definition 5)	
Level	Quantile
100% Max	294865971
99%	255058812
95%	198212113
90%	173623816
75% Q3	138090031
50% Median	101370501
25% Q1	75703376
10%	62064228
5%	49715905
1%	32741411
0% Min	29354993

NBA:

Quantiles (Definition 5)	
Level	Quantile
100% Max	133122591
99%	129344164
95%	110531395
90%	103848784
75% Q3	85981390
50% Median	70000798
25% Q1	57062208
10%	47139788
5%	40151801
1%	30523614
0% Min	28938902

NFL:

Quantiles (Definition 5)	
Level	Quantile
100% Max	210267354
99%	179435138
95%	166003402
90%	158218094
75% Q3	146265715
50% Median	128723972
25% Q1	108436416
10%	96706464
5%	90459767
1%	74145465
0% Min	73831628

NHL:

Quantiles (Definition 5)	
Level	Quantile
100% Max	78783929
99%	78205257
95%	75052773
90%	73661955
75% Q3	69758525
50% Median	65044234
25% Q1	60400554
10%	54723779
5%	51595919
1%	45655277
0% Min	44868582

Fig. 5 - Predicted values

Output Statistics (MLB)							
Obs	salary	Dependent Variable	Predicted Value	Std Error Mean Predict	95% CL Predict		Residual
181	174000000	-	0.5327	0.007941	0.4068	0.6585	-
182	62000000	-	0.4744	0.006843	0.3488	0.6000	-

Output Statistics (NBA)							
Obs	salary	Dependent Variable	Predicted Value	Std Error Mean Predict	95% CL Predict		Residual
181	104000000	.	0.5466	0.0198	0.2457	0.8474	.
182	47000000	.	0.4614	0.0174	0.1611	0.7617	.

Output Statistics (NFL)							
Obs	salary	Dependent Variable	Predicted Value	Std Error Mean Predict	95% CL Predict		Residual
193	159000000	.	0.5276	0.0229	0.1429	0.9124	.
194	96700000	.	0.4725	0.0230	0.0877	0.8572	.

Output Statistics (NHL)							
Obs	salary	Dependent Variable	Predicted Value	Std Error Mean Predict	95% CL Predict		Residual
181	74000000	.	0.5852	0.0107	0.4136	0.7568	.
182	54000000	.	0.5308	0.0115	0.3590	0.7026	.

Fig. 6 - Reg Procedure statistics

MLB:

NBA:

The REG Procedure
Model: MODEL1
Dependent Variable: win

Number of Observations Read	180
Number of Observations Used	180

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.10568	0.10568	26.38	<.0001
Error	178	0.71313	0.00401		
Corrected Total	179	0.81881			

Root MSE	0.06330	R-Square	0.1291
Dependent Mean	0.49984	Adj R-Sq	0.1242
Coeff Var	12.66310		

Parameter Estimates							
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > t	95% Confidence Limits	
Intercept	1	0.44213	0.01219	36.28	<.0001	0.41808	0.46618
salary	1	5.20213E-10	1.0129E-10	5.14	<.0001	3.20329E-10	7.20097E-10

The SAS System

The REG Procedure
Model: MODEL1
Dependent Variable: win

Number of Observations Read	180
Number of Observations Used	180

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.18967	0.18967	8.30	0.0045
Error	178	4.06753	0.02285		
Corrected Total	179	4.25720			

Root MSE	0.15117	R-Square	0.0446
Dependent Mean	0.49966	Adj R-Sq	0.0392
Coeff Var	30.25414		

Parameter Estimates							
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > t	95% Confidence Limits	
Intercept	1	0.39113	0.03932	9.95	<.0001	0.31353	0.46872
salary	1	1.494729E-9	5.18828E-10	2.88	0.0045	4.70885E-10	2.518574E-9

NFL:

NHL:

The SAS System

The REG Procedure
Model: MODEL1
Dependent Variable: win

Number of Observations Read	192
Number of Observations Used	192

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.08615	0.08615	2.30	0.1313
Error	190	7.12810	0.03752		
Corrected Total	191	7.21425			

Root MSE	0.19369	R-Square	0.0119
Dependent Mean	0.50022	Adj R-Sq	0.0067
Coeff Var	38.72132		

Parameter Estimates							
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > t	95% Confidence Limits	
Intercept	1	0.38679	0.07615	5.08	<.0001	0.23660	0.53699
salary	1	8.8588E-10	5.84608E-10	1.52	0.1313	-2.6728E-10	2.039036E-9

The SAS System

The REG Procedure
Model: MODEL1
Dependent Variable: win

Number of Observations Read	180
Number of Observations Used	180

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.06774	0.06774	9.10	0.0029
Error	178	1.32548	0.00745		
Corrected Total	179	1.39322			

Root MSE	0.08629	R-Square	0.0486
Dependent Mean	0.55949	Adj R-Sq	0.0433
Coeff Var	15.42345		

Parameter Estimates							
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > t	95% Confidence Limits	
Intercept	1	0.38397	0.05855	6.56	<.0001	0.26843	0.49951
salary	1	2.719427E-9	9.01644E-10	3.02	0.0029	9.40141E-10	4.498714E-9

SAS code

```
data nfl;
input league $ year team $ salary win;
datalines;
NFL 2016 ARI 154722369 0.469
NFL 2016 ATL 146479295 0.688
NFL 2016 BAL 166583607 0.500
NFL 2016 BUF 158550899 0.438
NFL 2016 CAR 126342985 0.375
NFL 2016 CHI 157868051 0.188
NFL 2016 CIN 152182772 0.406
NFL 2016 CLE 112035095 0.063
NFL 2016 DAL 160516272 0.813
NFL 2016 DEN 179435138 0.563
NFL 2016 DET 148850813 0.563
NFL 2016 GB 144278426 0.625
NFL 2016 HOU 147328937 0.563
NFL 2016 IND 154033006 0.500
NFL 2016 JAX 165495847 0.188
NFL 2016 KC 172704279 0.750
NFL 2016 MIA 142988978 0.625
NFL 2016 MIN 160192133 0.500
NFL 2016 NE 153830457 0.875
NFL 2016 NO 161876792 0.438
NFL 2016 NYG 168881947 0.688
NFL 2016 NYJ 172615850 0.313
NFL 2016 OAK 155537350 0.750
NFL 2016 PHI 210267354 0.438
NFL 2016 PIT 144668720 0.688
NFL 2016 SD 170569851 0.313
NFL 2016 SEA 142248665 0.656
NFL 2016 SF 136959692 0.125
NFL 2016 STL 150142345 0.250
NFL 2016 TB 159048409 0.563
NFL 2016 TEN 141503358 0.563
NFL 2016 WSH 150341764 0.531
NFL 2015 ARI 138729072 0.813
NFL 2015 ATL 135724876 0.500
NFL 2015 BAL 135680760 0.313
NFL 2015 BUF 166003402 0.500
NFL 2015 CAR 152402805 0.938
NFL 2015 CHI 142389517 0.375
NFL 2015 CIN 150957196 0.750
NFL 2015 CLE 142047741 0.188
NFL 2015 DAL 147040865 0.250
NFL 2015 DEN 146217265 0.750
NFL 2015 DET 116619938 0.438
NFL 2015 GB 143705478 0.625
NFL 2015 HOU 149784999 0.563
NFL 2015 IND 149833166 0.500
NFL 2015 JAX 146314164 0.313
NFL 2015 KC 135369267 0.688
NFL 2015 MIA 152428056 0.375
NFL 2015 MIN 132043220 0.688
NFL 2015 NE 156798730 0.750
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Group 20: Justin Dickinson, Nick Gray

STAT:2010

NFL	2015	NO	155837014	0.438
NFL	2015	NYG	149877986	0.375
NFL	2015	NYJ	158218094	0.625
NFL	2015	OAK	137187401	0.438
NFL	2015	PHI	150101181	0.438
NFL	2015	PIT	156185275	0.625
NFL	2015	SD	164296421	0.250
NFL	2015	SEA	159639451	0.625
NFL	2015	SF	124451510	0.313
NFL	2015	STL	126979414	0.438
NFL	2015	TB	131855173	0.375
NFL	2015	TEN	137336159	0.188
NFL	2015	WSH	159604520	0.563
NFL	2014	ARI	133247413	0.688
NFL	2014	ATL	166718107	0.375
NFL	2014	BAL	150746135	0.625
NFL	2014	BUF	130246765	0.563
NFL	2014	CAR	103972171	0.469
NFL	2014	CHI	135160217	0.313
NFL	2014	CIN	124491276	0.656
NFL	2014	CLE	150280508	0.438
NFL	2014	DAL	107466533	0.750
NFL	2014	DEN	136506725	0.750
NFL	2014	DET	123776714	0.688
NFL	2014	GB	140026653	0.750
NFL	2014	HOU	118103347	0.563
NFL	2014	IND	112454065	0.688
NFL	2014	JAX	106800268	0.188
NFL	2014	KC	134734379	0.563
NFL	2014	MIA	135399109	0.500
NFL	2014	MIN	123683526	0.438
NFL	2014	NE	127327017	0.750
NFL	2014	NO	129011838	0.438
NFL	2014	NYG	132035536	0.375
NFL	2014	NYJ	105104848	0.250
NFL	2014	OAK	124645965	0.188
NFL	2014	PHI	133864521	0.625
NFL	2014	PIT	137006716	0.688
NFL	2014	SD	121584085	0.563
NFL	2014	SEA	145747952	0.750
NFL	2014	SF	137688209	0.500
NFL	2014	STL	134372840	0.375
NFL	2014	TB	130289968	0.125
NFL	2014	TEN	131022088	0.125
NFL	2014	WSH	136886181	0.250
NFL	2013	ARI	108609442	0.625
NFL	2013	ATL	119798981	0.250
NFL	2013	BAL	132300972	0.500
NFL	2013	BUF	117163765	0.375
NFL	2013	CAR	95257709	0.750
NFL	2013	CHI	126744106	0.500
NFL	2013	CIN	131023738	0.688
NFL	2013	CLE	103471247	0.250
NFL	2013	DAL	134588892	0.500
NFL	2013	DEN	136293471	0.813
NFL	2013	DET	143347614	0.438
NFL	2013	GB	157910896	0.531

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STAT:2010

NFL	2013	HOU	101120749	0.125
NFL	2013	IND	126946212	0.688
NFL	2013	JAX	81793027	0.250
NFL	2013	KC	149026788	0.688
NFL	2013	MIA	140395844	0.500
NFL	2013	MIN	132518716	0.344
NFL	2013	NE	100773390	0.750
NFL	2013	NO	110335750	0.688
NFL	2013	NYG	118188050	0.438
NFL	2013	NYJ	105750722	0.500
NFL	2013	OAK	91663564	0.250
NFL	2013	PHI	120735781	0.625
NFL	2013	PIT	108364004	0.500
NFL	2013	SD	108508827	0.563
NFL	2013	SEA	128436106	0.813
NFL	2013	SF	123010003	0.750
NFL	2013	STL	125598266	0.438
NFL	2013	TB	122361545	0.250
NFL	2013	TEN	113361218	0.438
NFL	2013	WSH	83631710	0.188
NFL	2012	ARI	138878931	0.313
NFL	2012	ATL	119163310	0.813
NFL	2012	BAL	144057726	0.625
NFL	2012	BUF	134692941	0.375
NFL	2012	CAR	92827512	0.438
NFL	2012	CHI	100897631	0.625
NFL	2012	CIN	95887926	0.625
NFL	2012	CLE	111650464	0.313
NFL	2012	DAL	113624591	0.500
NFL	2012	DEN	105873846	0.813
NFL	2012	DET	111570327	0.250
NFL	2012	GB	90290896	0.688
NFL	2012	HOU	117503358	0.750
NFL	2012	IND	95234259	0.688
NFL	2012	JAX	103561848	0.125
NFL	2012	KC	101454201	0.125
NFL	2012	MIA	109855150	0.438
NFL	2012	MIN	96408087	0.625
NFL	2012	NE	122617899	0.750
NFL	2012	NO	145429822	0.438
NFL	2012	NYG	111777497	0.563
NFL	2012	NYJ	104775167	0.375
NFL	2012	OAK	83747155	0.250
NFL	2012	PHI	109774324	0.250
NFL	2012	PIT	107542729	0.500
NFL	2012	SD	112547985	0.438
NFL	2012	SEA	117327789	0.688
NFL	2012	SF	114024571	0.719
NFL	2012	STL	92831033	0.469
NFL	2012	TB	126264969	0.438
NFL	2012	TEN	98399972	0.375
NFL	2012	WSH	107639429	0.625
NFL	2011	ARI	146490268	0.500
NFL	2011	ATL	138573501	0.625
NFL	2011	BAL	121710420	0.750
NFL	2011	BUF	114160624	0.375
NFL	2011	CAR	175670572	0.375

NFL	2011	CHI	82133198	0.500
NFL	2011	CIN	103280704	0.563
NFL	2011	CLE	74145465	0.250
NFL	2011	DAL	118474990	0.500
NFL	2011	DEN	101304836	0.500
NFL	2011	DET	105540589	0.625
NFL	2011	GB	100114574	0.938
NFL	2011	HOU	126464418	0.625
NFL	2011	IND	103150976	0.125
NFL	2011	JAX	90459767	0.313
NFL	2011	KC	127284796	0.438
NFL	2011	MIA	112350956	0.375
NFL	2011	MIN	100861600	0.188
NFL	2011	NE	96706464	0.813
NFL	2011	NO	87038040	0.813
NFL	2011	NYG	98250804	0.563
NFL	2011	NYJ	127800753	0.500
NFL	2011	OAK	132877731	0.500
NFL	2011	PHI	106490079	0.500
NFL	2011	PIT	121515273	0.750
NFL	2011	SD	100093974	0.500
NFL	2011	SEA	94492978	0.438
NFL	2011	SF	103223984	0.813
NFL	2011	STL	93795039	0.125
NFL	2011	TB	73831628	0.250
NFL	2011	TEN	82818064	0.563
NFL	2011	WSH	103588315	0.313
NFL	-	Q90	159000000	-
NFL	-	Q10	96700000	-

;

run;**data** mlb;**input** league \$ year team \$ salary win;**datalines;**

MLB	2016	ARI	86787262	0.426
MLB	2016	ATL	96053960	0.422
MLB	2016	BAL	144510116	0.549
MLB	2016	BOS	184876027	0.574
MLB	2016	CHC	178644802	0.640
MLB	2016	CHW	127749023	0.481
MLB	2016	CIN	86646705	0.420
MLB	2016	CLE	105707013	0.584
MLB	2016	COL	107464606	0.463
MLB	2016	DET	197857508	0.534
MLB	2016	HOU	103871954	0.519
MLB	2016	KC	148317111	0.500
MLB	2016	LAA	171848917	0.457
MLB	2016	LAD	238201035	0.562
MLB	2016	MIA	70212945	0.491
MLB	2016	MIL	61317660	0.451
MLB	2016	MIN	95492627	0.364
MLB	2016	NYM	148213209	0.537
MLB	2016	NYY	217511936	0.519
MLB	2016	OAK	83080386	0.426
MLB	2016	PHI	98479110	0.438
MLB	2016	PIT	102238955	0.484

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STAT:2010

MLB	2016	SD	83608764	0.420
MLB	2016	SEA	146238812	0.531
MLB	2016	SF	181938955	0.537
MLB	2016	STL	149088318	0.531
MLB	2016	TB	63298008	0.420
MLB	2016	TEX	163097079	0.586
MLB	2016	TOR	155009381	0.549
MLB	2016	WSH	141803882	0.586
MLB	2015	ARI	87084261	0.488
MLB	2015	ATL	134801640	0.414
MLB	2015	BAL	117267173	0.500
MLB	2015	BOS	183110200	0.481
MLB	2015	CHC	137749478	0.599
MLB	2015	CHW	100251321	0.436
MLB	2015	CIN	112538172	0.395
MLB	2015	CLE	75493748	0.503
MLB	2015	COL	106130545	0.420
MLB	2015	DET	161360921	0.460
MLB	2015	HOU	78822478	0.531
MLB	2015	KC	127535052	0.586
MLB	2015	LAA	147787472	0.525
MLB	2015	LAD	294865971	0.568
MLB	2015	MIA	73451864	0.438
MLB	2015	MIL	93228172	0.420
MLB	2015	MIN	105918228	0.512
MLB	2015	NYM	109560709	0.556
MLB	2015	NYY	220215667	0.537
MLB	2015	OAK	80441769	0.420
MLB	2015	PHI	136810172	0.389
MLB	2015	PIT	100357667	0.605
MLB	2015	SD	106375963	0.457
MLB	2015	SEA	126929272	0.469
MLB	2015	SF	183627534	0.519
MLB	2015	STL	131234787	0.617
MLB	2015	TB	73981276	0.494
MLB	2015	TEX	152330606	0.543
MLB	2015	TOR	137023568	0.574
MLB	2015	WSH	162752067	0.512
MLB	2014	ARI	104574189	0.395
MLB	2014	ATL	120604422	0.488
MLB	2014	BAL	109369911	0.593
MLB	2014	BOS	160009058	0.438
MLB	2014	CHC	86493648	0.451
MLB	2014	CHW	95550980	0.451
MLB	2014	CIN	103363129	0.469
MLB	2014	CLE	87311577	0.525
MLB	2014	COL	94435379	0.407
MLB	2014	DET	175398714	0.556
MLB	2014	HOU	51629150	0.432
MLB	2014	KC	98128096	0.549
MLB	2014	LAA	165678251	0.605
MLB	2014	LAD	255058812	0.580
MLB	2014	MIA	56671396	0.475
MLB	2014	MIL	103407595	0.506
MLB	2014	MIN	87478085	0.432
MLB	2014	NYM	93262328	0.488
MLB	2014	NYY	213743373	0.518

Group 20: Justin Dickinson, Nick Gray

STAT:2010

MLB	2014	OAK	91003851	0.543
MLB	2014	PHI	178470079	0.451
MLB	2014	PIT	71918243	0.543
MLB	2014	SD	85167493	0.475
MLB	2014	SEA	104572266	0.537
MLB	2014	SF	167342338	0.543
MLB	2014	STL	130407929	0.556
MLB	2014	TB	82848224	0.475
MLB	2014	TEX	138430583	0.414
MLB	2014	TOR	126657812	0.512
MLB	2014	WSH	131189194	0.593
MLB	2013	ARI	90567792	0.500
MLB	2013	ATL	97005805	0.593
MLB	2013	BAL	98259368	0.525
MLB	2013	BOS	167659798	0.599
MLB	2013	CHC	112775165	0.407
MLB	2013	CHW	105592842	0.389
MLB	2013	CIN	102380598	0.556
MLB	2013	CLE	89536136	0.568
MLB	2013	COL	64013988	0.457
MLB	2013	DET	158198472	0.574
MLB	2013	HOU	32741411	0.315
MLB	2013	KC	83888747	0.531
MLB	2013	LAA	142193964	0.481
MLB	2013	LAD	234142815	0.568
MLB	2013	MIA	29354993	0.383
MLB	2013	MIL	75019210	0.457
MLB	2013	MIN	69853134	0.407
MLB	2013	NYM	90883979	0.457
MLB	2013	NYN	215219357	0.525
MLB	2013	OAK	65335162	0.593
MLB	2013	PHI	143205865	0.451
MLB	2013	PIT	79028199	0.580
MLB	2013	SD	70766095	0.469
MLB	2013	SEA	66664962	0.438
MLB	2013	SF	148071513	0.469
MLB	2013	STL	112249552	0.599
MLB	2013	TB	63581554	0.564
MLB	2013	TEX	127847907	0.558
MLB	2013	TOR	115570857	0.457
MLB	2013	WSH	101576132	0.531
MLB	2012	ARI	68137539	0.500
MLB	2012	ATL	73806390	0.580
MLB	2012	BAL	74400869	0.574
MLB	2012	BOS	169708602	0.426
MLB	2012	CHC	101089359	0.377
MLB	2012	CHW	109219803	0.525
MLB	2012	CIN	72783999	0.599
MLB	2012	CLE	65621289	0.420
MLB	2012	COL	75018310	0.395
MLB	2012	DET	130360784	0.543
MLB	2012	HOU	46326739	0.340
MLB	2012	KC	59831210	0.444
MLB	2012	LAA	139536769	0.549
MLB	2012	LAD	116142432	0.531
MLB	2012	MIA	93906691	0.426
MLB	2012	MIL	101164869	0.512

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MLB 2012 MIN 93542827 0.407
MLB 2012 NYM 82428596 0.457
MLB 2012 NYY 198566717 0.586
MLB 2012 OAK 53356073 0.580
MLB 2012 PHI 150096642 0.500
MLB 2012 PIT 54581269 0.488
MLB 2012 SD 50384513 0.469
MLB 2012 SEA 72077330 0.463
MLB 2012 SF 120831139 0.580
MLB 2012 STL 93844869 0.543
MLB 2012 TB 63181433 0.556
MLB 2012 TEX 131614346 0.574
MLB 2012 TOR 75144022 0.451
MLB 2012 WSH 81261385 0.605
MLB 2011 ARI 48813638 0.580
MLB 2011 ATL 79773731 0.549
MLB 2011 BAL 71478286 0.426
MLB 2011 BOS 165525726 0.556
MLB 2011 CHC 135351698 0.438
MLB 2011 CHW 126777427 0.488
MLB 2011 CIN 64251229 0.488
MLB 2011 CLE 49058106 0.494
MLB 2011 COL 63651670 0.451
MLB 2011 DET 99326015 0.586
MLB 2011 HOU 75913003 0.346
MLB 2011 KC 34441273 0.438
MLB 2011 LAA 127384600 0.531
MLB 2011 LAD 104522615 0.509
MLB 2011 MIA 59360393 0.444
MLB 2011 MIL 86402469 0.593
MLB 2011 MIN 100713594 0.389
MLB 2011 NYM 134072841 0.475
MLB 2011 NYY 192776964 0.599
MLB 2011 OAK 66096048 0.457
MLB 2011 PHI 141938468 0.630
MLB 2011 PIT 46188060 0.444
MLB 2011 SD 38199210 0.438
MLB 2011 SEA 82115148 0.414
MLB 2011 SF 91048750 0.531
MLB 2011 STL 92951812 0.556
MLB 2011 TB 34905857 0.562
MLB 2011 TEX 103069721 0.593
MLB 2011 TOR 50373704 0.500
MLB 2011 WSH 62810795 0.497
MLB - Q90 174000000 -
MLB - Q10 62000000 -

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NBA 2016 ATL 105882053 0.524
NBA 2016 BOS 93465328 0.646
NBA 2016 BKN 79949142 0.244
NBA 2016 CHA 103204062 0.439
NBA 2016 CHI 94355878 0.500

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Group 20: Justin Dickinson, Nick Gray

STAT:2010

NBA	2016	CLE	129344164	0.622
NBA	2016	DAL	109889361	0.402
NBA	2016	DEN	78555921	0.488
NBA	2016	DET	114743165	0.451
NBA	2016	GSW	102145449	0.817
NBA	2016	HOU	98769668	0.671
NBA	2016	IND	89202004	0.512
NBA	2016	LAC	116217505	0.622
NBA	2016	LAL	95481403	0.317
NBA	2016	MEM	133122591	0.524
NBA	2016	MIA	128154905	0.500
NBA	2016	MIL	104290804	0.512
NBA	2016	MIN	99918175	0.378
NBA	2016	NOP	102182146	0.415
NBA	2016	NYK	124938080	0.378
NBA	2016	OKC	88791479	0.573
NBA	2016	ORL	105558872	0.354
NBA	2016	PHI	100072509	0.341
NBA	2016	PHX	95899959	0.293
NBA	2016	POR	127248789	0.500
NBA	2016	SAC	108973982	0.390
NBA	2016	SAS	108640620	0.744
NBA	2016	TOR	111173428	0.622
NBA	2016	UTA	80498192	0.622
NBA	2016	WAS	105042249	0.598
NBA	2015	ATL	82337675	0.585
NBA	2015	BOS	75460421	0.585
NBA	2015	BKN	86069078	0.256
NBA	2015	CHA	84026368	0.585
NBA	2015	CHI	106240798	0.512
NBA	2015	CLE	115316267	0.695
NBA	2015	DAL	90249127	0.512
NBA	2015	DEN	82541425	0.402
NBA	2015	DET	70341267	0.537
NBA	2015	GSW	95469067	0.890
NBA	2015	HOU	89064257	0.500
NBA	2015	IND	72467040	0.549
NBA	2015	LAC	103406763	0.646
NBA	2015	LAL	72517283	0.207
NBA	2015	MEM	102877926	0.512
NBA	2015	MIA	92650613	0.585
NBA	2015	MIL	74338031	0.402
NBA	2015	MIN	71760686	0.354
NBA	2015	NOP	102787486	0.366
NBA	2015	NYK	74447499	0.390
NBA	2015	OKC	108590602	0.671
NBA	2015	ORL	68841336	0.427
NBA	2015	PHI	71962716	0.122
NBA	2015	PHX	85893702	0.280
NBA	2015	POR	60555583	0.537
NBA	2015	SAC	72671296	0.402
NBA	2015	SAS	88961787	0.817
NBA	2015	TOR	72398665	0.683
NBA	2015	UTA	66949515	0.488
NBA	2015	WAS	83380073	0.500
NBA	2014	ATL	62487671	0.722
NBA	2014	BOS	60436154	0.488

Group 20: Justin Dickinson, Nick Gray

STAT:2010

NBA	2014	BKN	88435068	0.463
NBA	2014	CHA	66618738	0.402
NBA	2014	CHI	68196226	0.610
NBA	2014	CLE	82604102	0.646
NBA	2014	DAL	76520947	0.610
NBA	2014	DEN	56142354	0.366
NBA	2014	DET	71966882	0.390
NBA	2014	GSW	73118340	0.817
NBA	2014	HOU	74686796	0.683
NBA	2014	IND	75144604	0.463
NBA	2014	LAC	81853818	0.683
NBA	2014	LAL	77528291	0.256
NBA	2014	MEM	74773881	0.671
NBA	2014	MIA	76207510	0.451
NBA	2014	MIL	61169305	0.500
NBA	2014	MIN	69895759	0.195
NBA	2014	NOP	77111880	0.549
NBA	2014	NYK	80937143	0.207
NBA	2014	OKC	98188823	0.549
NBA	2014	ORL	56016975	0.305
NBA	2014	PHI	57532390	0.220
NBA	2014	PHX	59593688	0.476
NBA	2014	POR	73142896	0.622
NBA	2014	SAC	75227263	0.354
NBA	2014	SAS	70929908	0.671
NBA	2014	TOR	76162364	0.598
NBA	2014	UTA	58913364	0.463
NBA	2014	WAS	74590100	0.561
NBA	2013	ATL	58841508	0.463
NBA	2013	BOS	70105837	0.305
NBA	2013	BKN	103376676	0.537
NBA	2013	CHA	49516884	0.524
NBA	2013	CHI	87455396	0.585
NBA	2013	CLE	66121652	0.402
NBA	2013	DAL	67332239	0.598
NBA	2013	DEN	63693348	0.439
NBA	2013	DET	60522780	0.354
NBA	2013	GSW	71294306	0.622
NBA	2013	HOU	56766841	0.659
NBA	2013	IND	67154570	0.683
NBA	2013	LAC	74875736	0.695
NBA	2013	LAL	74475179	0.329
NBA	2013	MEM	72843110	0.610
NBA	2013	MIA	79904758	0.659
NBA	2013	MIL	49759976	0.183
NBA	2013	MIN	65375830	0.488
NBA	2013	NOP	65363018	0.415
NBA	2013	NYK	87926679	0.451
NBA	2013	OKC	69769358	0.683
NBA	2013	ORL	47290425	0.280
NBA	2013	PHI	43870793	0.232
NBA	2013	PHX	46989151	0.585
NBA	2013	POR	63164586	0.659
NBA	2013	SAC	61459998	0.341
NBA	2013	SAS	63275776	0.756
NBA	2013	TOR	65652123	0.585
NBA	2013	UTA	56893335	0.305

Group 20: Justin Dickinson, Nick Gray

STAT:2010

NBA	2013	WAS	66615345	0.537
NBA	2012	ATL	57537642	0.537
NBA	2012	BOS	69572590	0.500
NBA	2012	BKN	80362514	0.598
NBA	2012	CHA	28938902	0.256
NBA	2012	CHI	72328985	0.549
NBA	2012	CLE	49469516	0.293
NBA	2012	DAL	57231080	0.500
NBA	2012	DEN	61533386	0.695
NBA	2012	DET	50667994	0.354
NBA	2012	GSW	59801341	0.573
NBA	2012	HOU	39032552	0.549
NBA	2012	IND	64800015	0.598
NBA	2012	LAC	68077811	0.683
NBA	2012	LAL	94332449	0.549
NBA	2012	MEM	62416973	0.683
NBA	2012	MIA	83145671	0.805
NBA	2012	MIL	57350881	0.463
NBA	2012	MIN	55352710	0.378
NBA	2012	NOP	62522932	0.329
NBA	2012	NYK	75431134	0.659
NBA	2012	OKC	66354927	0.732
NBA	2012	ORL	56528117	0.244
NBA	2012	PHI	59304231	0.415
NBA	2012	PHX	41861090	0.305
NBA	2012	POR	53441995	0.402
NBA	2012	SAC	53575342	0.341
NBA	2012	SAS	69574187	0.707
NBA	2012	TOR	62260549	0.415
NBA	2012	UTA	64944605	0.524
NBA	2012	WAS	58296629	0.354
NBA	2011	ATL	55503683	0.606
NBA	2011	BOS	56768577	0.591
NBA	2011	BKN	34190962	0.333
NBA	2011	CHA	31946665	0.106
NBA	2011	CHI	52603295	0.758
NBA	2011	CLE	38259830	0.318
NBA	2011	DAL	55958183	0.545
NBA	2011	DEN	41271049	0.576
NBA	2011	DET	38680197	0.379
NBA	2011	GSW	46513321	0.348
NBA	2011	HOU	35610979	0.515
NBA	2011	IND	36045497	0.636
NBA	2011	LAC	55359894	0.606
NBA	2011	LAL	64806990	0.621
NBA	2011	MEM	56241235	0.621
NBA	2011	MIA	63188859	0.697
NBA	2011	MIL	54890871	0.470
NBA	2011	MIN	45760297	0.394
NBA	2011	NOP	48759135	0.318
NBA	2011	NYK	49300336	0.545
NBA	2011	OKC	50716896	0.712
NBA	2011	ORL	52671187	0.561
NBA	2011	PHI	46969298	0.530
NBA	2011	PHX	50124954	0.500
NBA	2011	POR	44857860	0.424
NBA	2011	SAC	30523614	0.333

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NBA 2011 SAS 57723676 0.758
NBA 2011 TOR 41579040 0.348
NBA 2011 UTA 47768779 0.545
NBA 2011 WAS 54556963 0.303
NBA - Q90 104000000 -
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NHL 2016 ANA 69877792 0.640
NHL 2016 ARI 55199339 0.427
NHL 2016 BOS 74772546 0.579
NHL 2016 BUF 72439309 0.476
NHL 2016 CAR 54483383 0.530
NHL 2016 CGY 74332972 0.573
NHL 2016 CHI 71180721 0.665
NHL 2016 CBJ 63000234 0.659
NHL 2016 COL 69968694 0.293
NHL 2016 DAL 67509048 0.482
NHL 2016 DET 55863279 0.482
NHL 2016 EDM 69680520 0.628
NHL 2016 FLA 64600437 0.494
NHL 2016 LAK 75503203 0.524
NHL 2016 MIN 75007092 0.646
NHL 2016 MTL 74453080 0.628
NHL 2016 NSH 70791103 0.573
NHL 2016 NJD 63384193 0.427
NHL 2016 NYI 71538335 0.573
NHL 2016 NYR 73375352 0.622
NHL 2016 OTT 75098453 0.598
NHL 2016 PHI 74563822 0.537
NHL 2016 PIT 62630622 0.677
NHL 2016 SJS 73385869 0.604
NHL 2016 STL 70675984 0.604
NHL 2016 TBL 55570477 0.573
NHL 2016 TOR 48095820 0.579
NHL 2016 VAN 66299256 0.421
NHL 2016 WSH 73058661 0.720
NHL 2016 WPG 64113622 0.530
NHL 2015 ANA 63192523 0.628
NHL 2015 ARI 65050932 0.476
NHL 2015 BOS 69478695 0.567
NHL 2015 BUF 62019704 0.494
NHL 2015 CAR 57310738 0.524
NHL 2015 CGY 67570257 0.470
NHL 2015 CHI 71531510 0.628
NHL 2015 CBJ 67937548 0.463
NHL 2015 COL 62767942 0.500
NHL 2015 DAL 66132966 0.665
NHL 2015 DET 70882623 0.567
NHL 2015 EDM 68030462 0.427
NHL 2015 FLA 69087745 0.628
NHL 2015 LAK 73829268 0.622

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Group 20: Justin Dickinson, Nick Gray

STAT:2010

NHL	2015	MIN	69866538	0.530
NHL	2015	MTL	71938679	0.500
NHL	2015	NSH	61178945	0.585
NHL	2015	NJD	63197460	0.512
NHL	2015	NYI	65260798	0.610
NHL	2015	NYR	76261193	0.616
NHL	2015	OTT	65602493	0.518
NHL	2015	PHI	69056693	0.585
NHL	2015	PIT	74775446	0.634
NHL	2015	SJS	69675193	0.598
NHL	2015	STL	71038311	0.652
NHL	2015	TBL	72843083	0.591
NHL	2015	TOR	73041937	0.421
NHL	2015	VAN	72493645	0.457
NHL	2015	WSH	70403880	0.738
NHL	2015	WPG	57038400	0.476
NHL	2014	ANA	63051307	0.665
NHL	2014	ARI	51508866	0.341
NHL	2014	BOS	66146613	0.585
NHL	2014	BUF	57667804	0.329
NHL	2014	CAR	63606399	0.433
NHL	2014	CGY	58765613	0.591
NHL	2014	CHI	70685706	0.622
NHL	2014	CBJ	60865177	0.543
NHL	2014	COL	68135163	0.549
NHL	2014	DAL	65037535	0.561
NHL	2014	DET	65703118	0.610
NHL	2014	EDM	63642298	0.378
NHL	2014	FLA	62724405	0.555
NHL	2014	LAK	65907026	0.579
NHL	2014	MIN	65174296	0.610
NHL	2014	MTL	68095647	0.671
NHL	2014	NSH	59821039	0.634
NHL	2014	NJD	61846503	0.476
NHL	2014	NYI	64519319	0.616
NHL	2014	NYR	68809019	0.689
NHL	2014	OTT	56749896	0.604
NHL	2014	PHI	73580710	0.512
NHL	2014	PIT	71278364	0.598
NHL	2014	SJS	60666109	0.543
NHL	2014	STL	68140408	0.665
NHL	2014	TBL	69836530	0.659
NHL	2014	TOR	66420970	0.415
NHL	2014	VAN	67038057	0.616
NHL	2014	WSH	68577042	0.616
NHL	2014	WPG	63322574	0.604
NHL	2013	ANA	64127746	0.707
NHL	2013	ARI	67790362	0.543
NHL	2013	BOS	58607129	0.713
NHL	2013	BUF	51870158	0.317
NHL	2013	CAR	65536767	0.506
NHL	2013	CGY	64857262	0.470
NHL	2013	CHI	52940153	0.652
NHL	2013	CBJ	61607432	0.567
NHL	2013	COL	63639715	0.683
NHL	2013	DAL	69618888	0.555
NHL	2013	DET	57731641	0.567

Group 20: Justin Dickinson, Nick Gray

STAT:2010

NHL	2013	EDM	50784209	0.409
NHL	2013	FLA	64391803	0.402
NHL	2013	LAK	63828423	0.610
NHL	2013	MIN	65060425	0.598
NHL	2013	MTL	59443457	0.610
NHL	2013	NSH	63578615	0.537
NHL	2013	NJD	51682971	0.537
NHL	2013	NYI	64093628	0.482
NHL	2013	NYR	56498998	0.585
NHL	2013	OTT	66461613	0.537
NHL	2013	PHI	62330584	0.573
NHL	2013	PIT	69561811	0.665
NHL	2013	SJS	66147431	0.677
NHL	2013	STL	64643845	0.677
NHL	2013	TBL	65665708	0.616
NHL	2013	TOR	65966280	0.512
NHL	2013	VAN	63594029	0.506
NHL	2013	WSH	64926986	0.549
NHL	2013	WPG	63682588	0.512
NHL	2012	ANA	67064166	0.688
NHL	2012	ARI	69147976	0.531
NHL	2012	BOS	58394524	0.646
NHL	2012	BUF	57338887	0.500
NHL	2012	CAR	71864226	0.438
NHL	2012	CGY	55473333	0.438
NHL	2012	CHI	58481666	0.802
NHL	2012	CBJ	45655277	0.573
NHL	2012	COL	52657142	0.406
NHL	2012	DAL	62560377	0.500
NHL	2012	DET	57272000	0.583
NHL	2012	EDM	58438118	0.469
NHL	2012	FLA	65407726	0.375
NHL	2012	LAK	77798035	0.615
NHL	2012	MIN	66629643	0.573
NHL	2012	MTL	50423809	0.656
NHL	2012	NSH	64757500	0.427
NHL	2012	NJD	59638722	0.500
NHL	2012	NYI	72726167	0.573
NHL	2012	NYR	52796666	0.583
NHL	2012	OTT	76622679	0.583
NHL	2012	PHI	47294166	0.510
NHL	2012	PIT	78205257	0.750
NHL	2012	SJS	64031667	0.594
NHL	2012	STL	60134999	0.625
NHL	2012	TBL	61673364	0.417
NHL	2012	TOR	61365000	0.594
NHL	2012	VAN	75973333	0.615
NHL	2012	WSH	67547080	0.594
NHL	2012	WPG	57705244	0.531
NHL	2011	ANA	55170251	0.488
NHL	2011	ARI	65833807	0.591
NHL	2011	BOS	65660357	0.622
NHL	2011	BUF	63374553	0.543
NHL	2011	CAR	67387628	0.500
NHL	2011	CGY	62025331	0.549
NHL	2011	CHI	48970332	0.616
NHL	2011	CBJ	50288332	0.396

NHL	2011	COL	52061583	0.537
NHL	2011	DAL	61868709	0.543
NHL	2011	DET	68748666	0.622
NHL	2011	EDM	56577834	0.451
NHL	2011	FLA	73743200	0.573
NHL	2011	LAK	53515278	0.579
NHL	2011	MIN	54964175	0.494
NHL	2011	MTL	62861732	0.476
NHL	2011	NSH	66068336	0.634
NHL	2011	NJD	44868582	0.622
NHL	2011	NYI	76512000	0.482
NHL	2011	NYR	55838333	0.665
NHL	2011	OTT	78783929	0.561
NHL	2011	PHI	61792917	0.628
NHL	2011	PIT	69848167	0.659
NHL	2011	SJS	66227778	0.585
NHL	2011	STL	57690832	0.665
NHL	2011	TBL	64723755	0.512
NHL	2011	TOR	61365000	0.488
NHL	2011	VAN	73778333	0.677
NHL	2011	WSH	72130460	0.561
NHL	2011	WPG	53063292	0.512
NHL	-	Q90	74000000	-
NHL	-	Q10	54000000	-

```

;
run;

proc reg data=nfl;
model win = salary / clb cli;
id salary;
plot win*salary / symbol = '.';
plot residual. * predicted. / symbol = '.';
run;
proc corr data=nfl;
var salary win;
run;

proc reg data=mlb;
model win = salary / clb cli;
id salary;
plot win*salary / symbol = '.';
plot residual. * predicted. / symbol = '.';
run;
proc corr data=mlb;
var salary win;
run;

proc reg data=nba;
model win = salary / clb cli;
id salary;
plot win*salary / symbol = '.';
plot residual. * predicted. / symbol = '.';
run;
proc corr data=nba;
var salary win;
run;

```

```
proc reg data=nhl;
model win = salary / clb cli;
id salary;
plot win*salary / symbol = '.';
plot residual. * predicted. / symbol = '.';
run;
proc corr data=nhl;
var salary win;
run;

proc univariate plot data=nfl;
var salary;
var win;
run;

proc univariate plot data=nba;
var salary;
var win;
run;

proc univariate plot data=mlb;
var salary;
var win;
run;

proc univariate plot data=nhl;
var salary;
var win;
run;
```