NFL Power Rankings Through Bradley-Terry Modeling

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STATS 50

NOTE: I don’t have express written consent from the NFL to use their logos so blame them if this presentation is a

Bradley-Terry Modeling

Create a ranking: $\gamma_1, \gamma_2, \ldots, \gamma_{32}$ for all 32 NFL teams

What the rankings mean

- $P(team\ i\ beats\ team\ j) = \frac{\gamma_i}{\gamma_i + \gamma_j}$

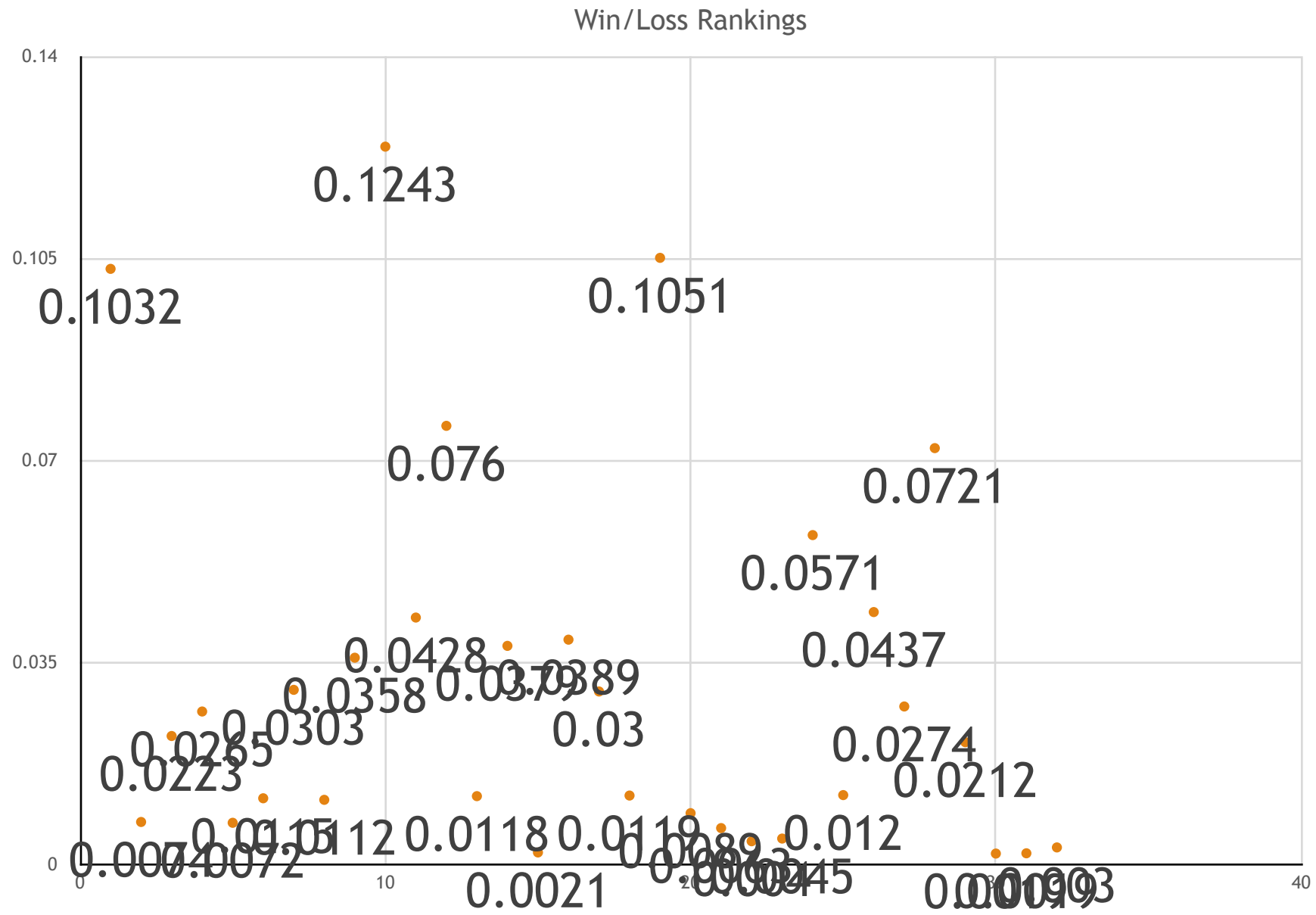
The Iteration method

- MLE of the log-likelihood fuction: $l(\boldsymbol{\gamma}) = \sum_{i=1}^{n} \sum_{j=1}^{n} [w_{ij} \ln\left(\frac{\gamma_i}{\gamma_i + \gamma_j}\right)]$
- $\gamma_i^{(k+1)} = W_i \left[\sum_{j \neq i} \frac{N_{ij}}{\gamma_i^{(k)} + \gamma_j^{(k)}}\right]^{-1}$
- Where W_i is the total number of wins by team i, w_{ij} is the number of times i beats j
- Where N_{ij} is the number of times teams i and j played each other

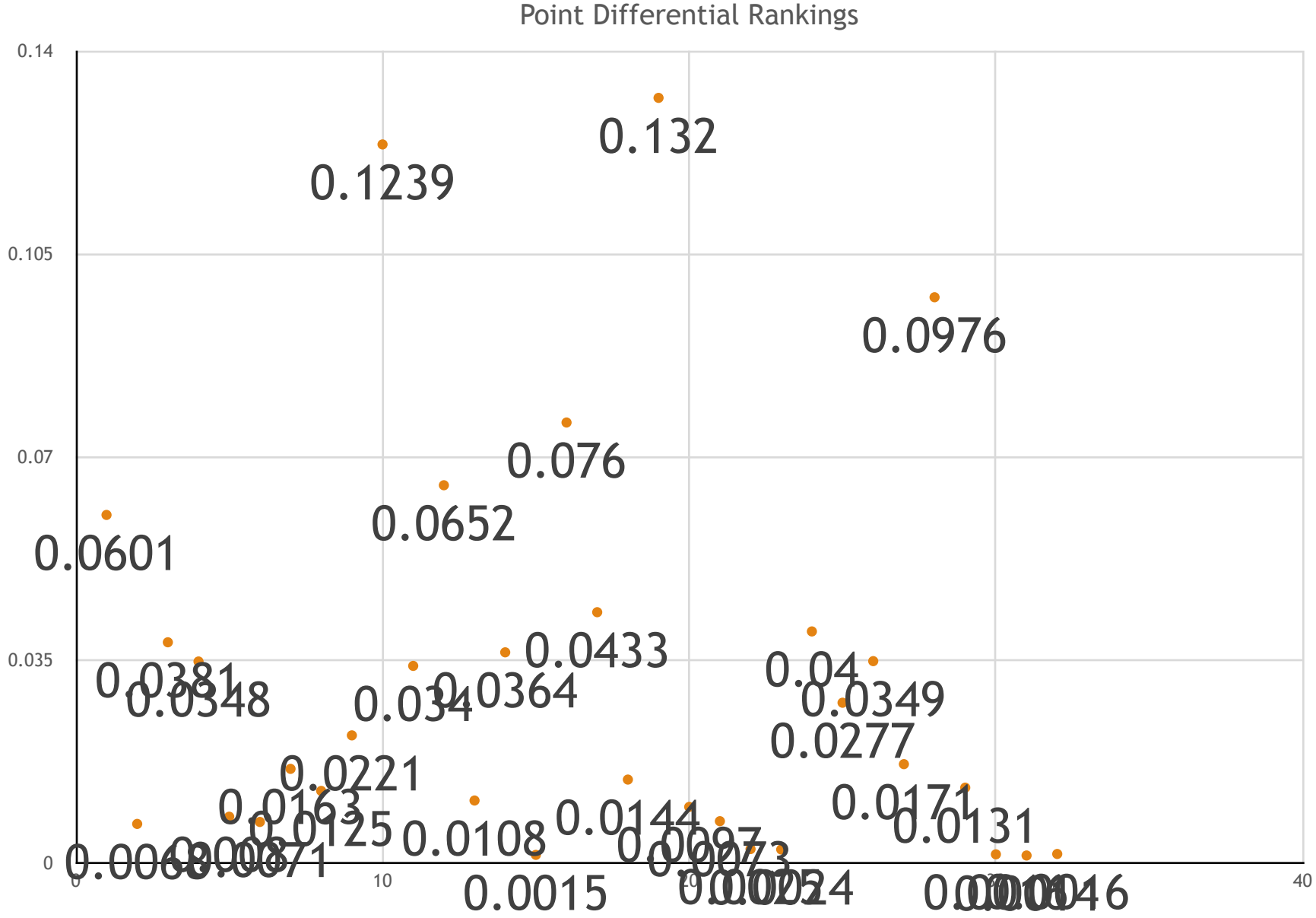
The Data

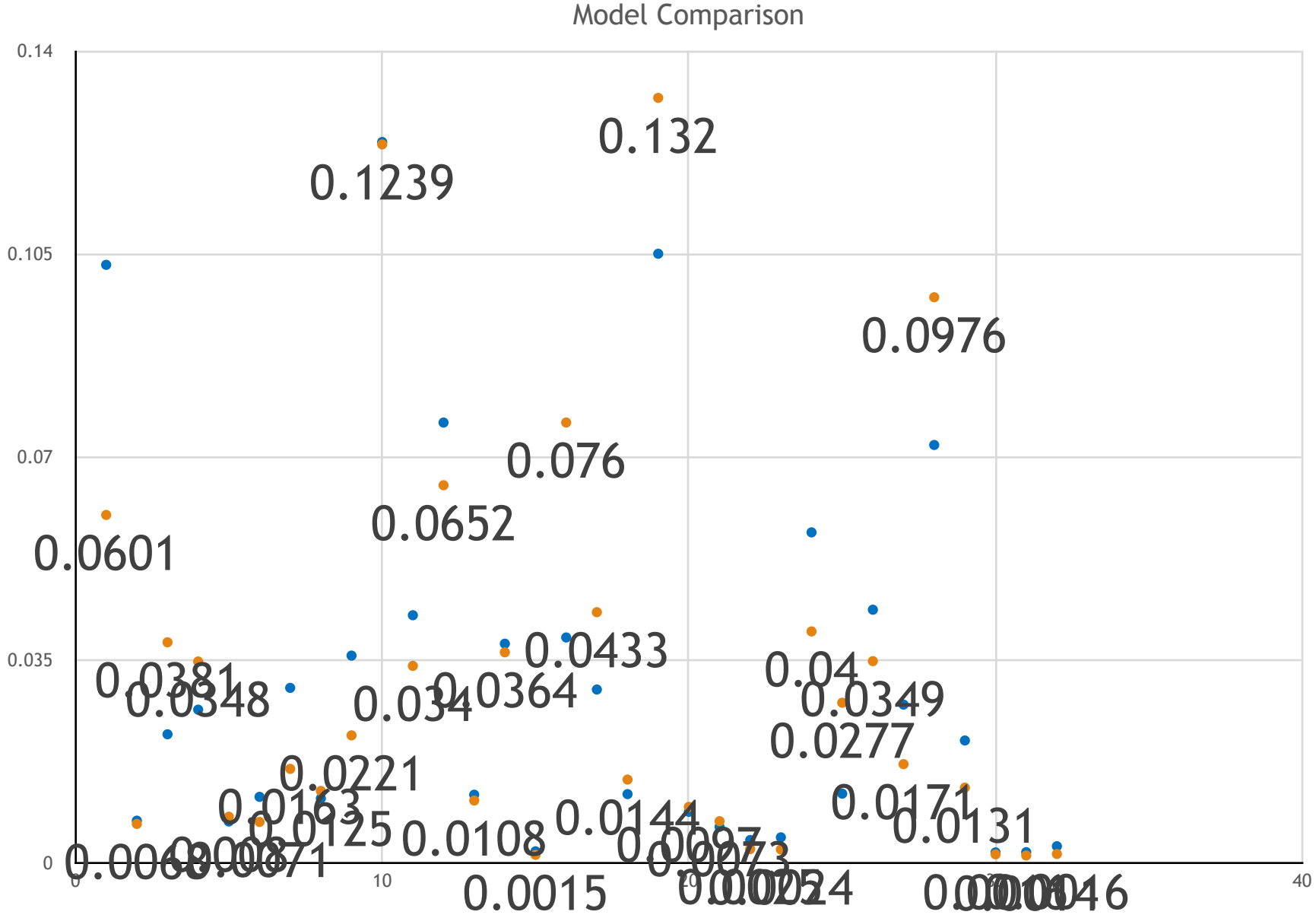
	ARI	ATL	BAL	BUF	CAR	CHI	CIN	CLE	DAL	DEN	DET	GB	HOU	IND	JAC	KC	MIA	MIN	NE	NO	NYG	NYJ	OAK	PHI	PIT	SD	SF	SEA	STL	TB	TEN	WAS
ARI									11		8					3					11		11	4		1	9		17			10
ATL	11				2															3										52		
BAL		22			28			2									15			7					20					31	14	
BUF						3		16			3						19	1				55										
CAR						7	0				17									31										6		
CHI		14																8				8					8			8		
CIN		14	10		0								9		10					17										1	26	
CLE		2					21													2			10		21					5	1	
DAL						13							3		14					21	13							7	3		16	
DEN	21			7										7		20	3					14	24			14	25					
DET		1				17						12					4	14		1	21	7								17		
GB		6			21	62											3	35	5			7		33								
HOU				6				16							14								16								38	11
IND			7				27	1					5		47						16										24	22
JAC								18													1											
KC				4													19		27			14				3		4	27			
MIA				13		3									14				13			3	24			37						
MIN		13			18																	6							28	4		3
NE				15		28	26			22	25			22				23				2	7			9						
NO					18							21						11							3					6		
NYG		10											13																		29	31
NYJ																							5		7							
OAK																4											11					
PHI					24		21		23				10	3	17						27								6		19	3
PIT			20		18			3					7	17	8																3	
SD			1	12											19							31	10					9	3			
SF									11							5				3	6			5					14			4
SEA	16				4					6		20									21		6	10			16					10
STL										15													52				3	2		2		24
TB																									3							20
TEN															2	16																
WAS									3						31																2	

DEN	10	0.124346
NE	19	0.105084
ARI	1	0.103176
GB	12	0.075982
SEA	28	0.072122
PHI	24	0.057056
SD	26	0.043723
DET	11	0.042774
KC	16	0.038942
IND	14	0.037868
DAL	9	0.035815
CIN	7	0.03025
MIA	17	0.029967
SF	27	0.027368
BUF	4	0.026498
BAL	3	0.022254
STL	29	0.02118
PIT	25	0.012017
MIN	18	0.011938
HOU	13	0.011835
CHI	6	0.011467
CLE	8	0.011197
NO	20	0.008889
ATL	2	0.007361
CAR	5	0.00722
NYG	21	0.006302
OAK	23	0.004487
NYJ	22	0.004024
WAS	32	0.002952
JAC	15	0.002079
TEN	31	0.001937
TB	30	0.00189



NE	19	0.131954
DEN	10	0.12393
SEA	28	0.097586
KC	16	0.075993
GB	12	0.06518
ARI	1	0.060062
MIA	17	0.043296
PHI	24	0.039981
BAL	3	0.038111
IND	14	0.036377
SD	26	0.034861
BUF	4	0.034798
DET	11	0.034041
PIT	25	0.02769
DAL	9	0.022065
SF	27	0.017103
CIN	7	0.01629
MIN	18	0.014445
STL	29	0.013053
CLE	8	0.012489
HOU	13	0.010834
NO	20	0.009734
CAR	5	0.008045
NYG	21	0.007271
CHI	6	0.00714
ATL	2	0.006801
NYJ	22	0.002469
OAK	23	0.002395
WAS	32	0.001621
TB	30	0.00156
JAC	15	0.001465
TEN	31	0.001358




Model Comparison
0.14
0.105
0.07
0.035
0
0.132
0.1239
0.0976
0.076
0.0652
0.0601
0.0433
0.04
0.0381
0.0348
0.0364
0.034
0.0349
0.0277
0.0221
0.0171
0.0163
0.0144
0.0131
0.0125
0.0108
0.0015
10
40

Power Rankings Comparison

The BT models are generally consistent with news analyst rankings

- Does well when comparing the “echelons” of teams
  - Elite Teams
  - Good Teams
  - Fringe Playoff Teams
  - Not Good Teams
  - Bottom Feeder Teams

BT W/L	BT PtDiff	ESPN	NFL.com
DEN	NE	GB	GB
NE	DEN	NE	NE
ARI	SEA	DEN	DEN
GB	KC	SEA	SEA
SEA	GB	ARI	IND
PHI	ARI	IND	ARI
SD	MIA	PHI	PHI
DET	PHI	DAL	DAL
KC	BAL	DET	DET
IND	IND	PIT	PIT
DAL	SD	SD	KC
CIN	BUF	BAL	CIN
MIA	DET	CIN	SD
SF	PIT	KC	BAL
BUF	DAL	MIA	MIA
BAL	SF	SF	HOU
STL	CIN	BUF	BUF
PIT	MIN	HOU	STL
MIN	STL	CLE	SF
HOU	CLE	STL	CLE
CHI	HOU	ATL	MIN
CLE	NO	MIN	ATL
NO	CAR	NO	CAR
ATL	NYG	CAR	NO
CAR	CHI	CHI	NYG
NYG	ATL	NYG	CHI
OAK	NYJ	WAS	TB
NYJ	OAK	NYJ	WAS
WAS	WAS	OAK	OAK
JAC	TB	TB	JAC
TEN	JAC	JAC	NYJ
TB	TEN	TEN	TEN

Playoff Predictions

W/L	Predictions			Pt. Diff
E(wins)		NFC		E(wins)
12.36	GB	1	GB	12.29
12.21	ARI	2	ARI	11.98
11.47	PHI	3	PHI	11.45
6.81	NO	4	NO	7.02
10.93	DET	5	SEA	11.35
10.91	SEA	6	DET	10.87
		AFC		
12.54	NE	1	DEN	12.65
12.51	DEN	2	NE	12.53
11.23	IND	3	IND	11.36
10.23	BAL	4	BAL	10.49
9.13	KC	5	PIT	9.7
8.64	CIN	6	KC	9.39

NFC		Wk 15	Wk 16	Wk 17		
1	ARI	STL	SEA	SF		
gamma	0.1032441	0.021184	0.072156	0.027371		E(wins)
prob		0.829751	0.588619	0.790446	2.208816	12.21
2	GB	BUF	TB	DET		
	0.0759796	0.026495	0.001888	0.042766		
		0.741449	0.975757	0.639851	2.357057	12.36
3	PHI	DAL	WAS	NYG		
	0.0570369	0.035806	0.002949	0.006298		
		0.614338	0.950835	0.900565	2.465737	11.47
4	ATL	PIT	NO	CAR		
	0.0073539	0.012	0.00888	0.007214		
		0.379976	0.452987	0.504814	1.337778	6.34
5	SEA	SF	ARI	STL		
	0.0721564	0.027371	0.103244	0.021184		
		0.724991	0.411381	0.773048	1.90942	10.91
6	DET	MIN	CHI	GB		
	0.0427662	0.011932	0.011463	0.07598		
		0.781854	0.788622	0.360149	1.930625	10.93
7	DAL	PHI	IND	WAS		
	0.035806	0.057037	0.037821	0.002949		
		0.385662	0.486317	0.923901	1.795881	10.8
8	SF	SEA	SD	ARI		
	0.0273709	0.072156	0.043738	0.103244		
		0.275009	0.384915	0.209554	0.869478	7.87
9	NO	CHI	ATL	TB		
	0.0088804	0.011463	0.007354	0.001888		
		0.436528	0.547013	0.824691	1.808231	6.81
10	CAR	TB	CLE	ATL		
	0.0072137	0.001888	0.011181	0.007354		
		0.792587	0.392153	0.495186	1.679927	5.68

Things Learned from the Models

Strengths

- Very good at factoring in “Strength of Schedule”
- Doesn’t rely on “eye test” and other non-quantitative measurements

Weaknesses

- Equal weighting for early season results
- Doesn’t account for key factors
  - Injuries
  - On field performance vs. stat-sheet scores (i.e. garbage time TDs)

Extensions

Home Field Advantage

Turnover Luck
- Recovering fumbles

A better point differential adjustment
- Get rid of garbage time scoring?