Question 1a)

We use wt to rank the teams in decreasing order according to this vector. The top 25 teams and their corresponding weights for t=10,100, 1000 and 10,000 are given below
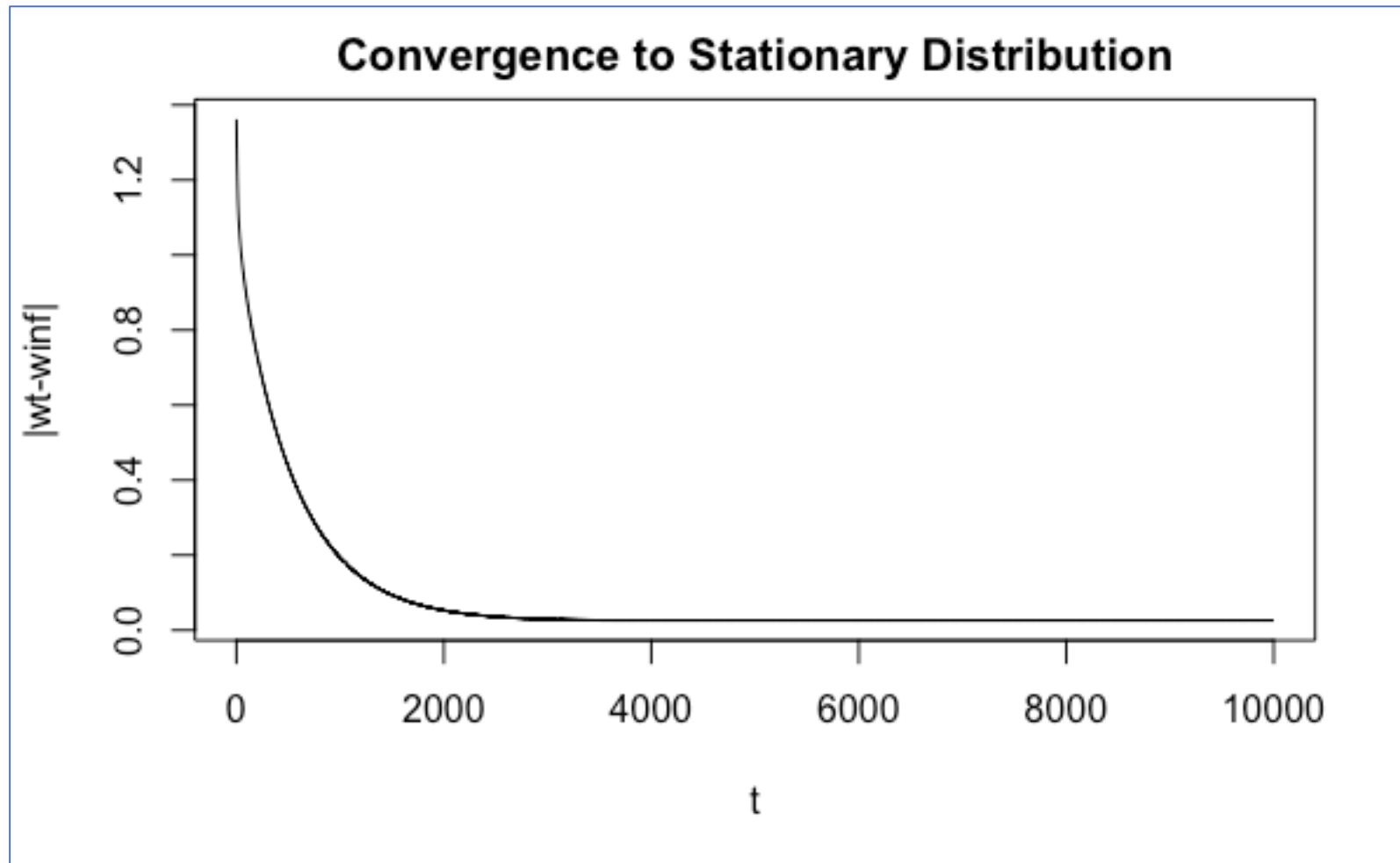
	Top 25 Teams (Descending Order) for Different t											
	t=10			t=100			t=1000			t=10000		
	index	team	weight	index	team	weight	index	team	weight	index	team	weight
1	371	Mary Hardin-Baylor	0.0148	441	NW Missouri St	0.0383	6	Alabama	0.0607	6	Alabama	0.0673
2	441	NW Missouri St	0.0132	6	Alabama	0.0334	134	Clemson	0.0604	134	Clemson	0.0670
3	6	Alabama	0.0124	134	Clemson	0.0330	441	NW Missouri St	0.0305	220	Florida St	0.0208
4	134	Clemson	0.0110	371	Mary Hardin-Baylor	0.0309	220	Florida St	0.0188	490	Ohio State	0.0199
5	669	UW-Oshkosh	0.0099	669	UW-Oshkosh	0.0168	490	Ohio State	0.0180	705	Washington	0.0176
6	609	St Thomas	0.0082	674	UW-Whitewater	0.0122	705	Washington	0.0159	691	Virginia Tech	0.0175

		Top 25 Teams (Descending Order) for Different t											
		t=10			t=100			t=1000			t=10000		
7	674	UW-Whitewater	0.0082	220	Florida St	0.0104	691	Virginia Tech	0.0158	390	Michigan	0.0164
8	599	St Francis IN	0.0081	248	Grand Valley St	0.0103	390	Michigan	0.0148	441	NW Missouri St	0.0163
9	436	Mount Union	0.0078	302	John Carroll	0.0102	512	Pittsburgh	0.0147	512	Pittsburgh	0.0162
10	300	James Madison	0.0074	490	Ohio State	0.0099	493	Oklahoma	0.0144	493	Oklahoma	0.0159
11	527	Reinhardt	0.0070	211	Ferris St	0.0094	507	Penn State	0.0137	507	Penn State	0.0151
12	302	John Carroll	0.0069	609	St Thomas	0.0093	752	Wisconsin	0.0131	752	Wisconsin	0.0145
13	565	Shepherd	0.0068	705	Washington	0.0089	352	Louisville	0.0126	352	Louisville	0.0140
14	95	California PA	0.0067	691	Virginia Tech	0.0088	388	Miami FL	0.0124	388	Miami FL	0.0138
15	466	North Dakota St	0.0065	436	Mount Union	0.0087	582	Southern Cal	0.0116	582	Southern Cal	0.0128
16	49	Baker	0.0064	390	Michigan	0.0082	459	North Carolina	0.0114	459	North Carolina	0.0126
17	15	Alfred	0.0063	512	Pittsburgh	0.0081	495	Oklahoma St	0.0113	495	Oklahoma St	0.0125
18	248	Grand Valley St	0.0062	493	Oklahoma	0.0080	216	Florida	0.0113	216	Florida	0.0125

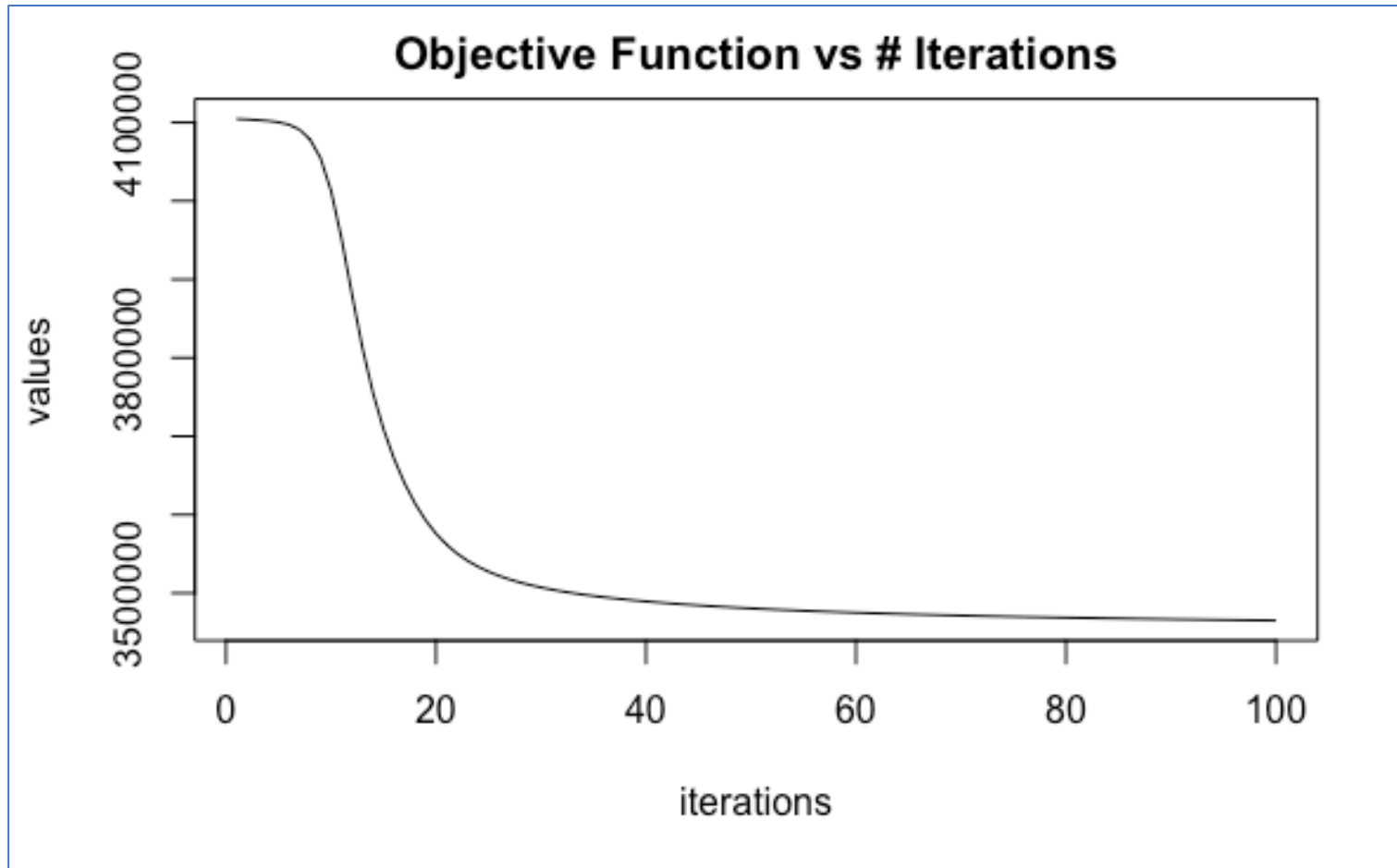|		Top 25 Teams (Descending Order) for Different t										
		t=10			t=100			t=1000			t=10000	
19	458	North Alabama	0.0061	203	Emporia St	0.0080	629	Tennessee	0.0108	629	Tennessee	0.0120
20	262	Harding	0.0058	507	Penn State	0.0076	37	Auburn	0.0108	37	Auburn	0.0120
21	364	Marian IN	0.0056	752	Wisconsin	0.0073	243	Georgia Tech	0.0100	243	Georgia Tech	0.0111
22	464	North Central	0.0055	352	Louisville	0.0070	322	LSU	0.0095	322	LSU	0.0105
23	650	Trinity CT	0.0055	388	Miami FL	0.0069	729	Western Michigan	0.0095	729	Western Michigan	0.0105
24	737	Wheaton	0.0055	459	North Carolina	0.0065	612	Stanford	0.0095	612	Stanford	0.0105
25	433	Morningside	0.0054	582	Southern Cal	0.0064	300	James Madison	0.0087	634	Texas A&M	0.0095

Question 1b)
We plot $||wt-winf||$. As expected, the difference converges to 0. Since as t increases, wt converges to the stationary distribution

Convergence to Stationary Distribution

Question 2a)

Following is a plot of the objective function – the divergence penalty as a function of the number of iterations. We see that the objective function values converge.

Question 2b)

For each column of W , we list the 10 words having the largest weight and show the weight. Following is a 5X5 table. We can think of this as 25 topics which our algorithm has learnt.

words1	weights1	words2	weights2	words3	weights3	words4	weights4	words5	weights5
thing	0.0212	music	0.0224	police	0.0240	law	0.0202	minute	0.0179
ask	0.0154	art	0.0113	charge	0.0194	state	0.0186	cut	0.0123
tell	0.0144	performance	0.0107	man	0.0141	bill	0.0150	turn	0.0099
lot	0.0141	play	0.0106	case	0.0141	require	0.0128	keep	0.0098
feel	0.0133	dance	0.0098	officer	0.0137	approve	0.0104	race	0.0095
really	0.0127	perform	0.0097	crime	0.0113	rule	0.0102	pound	0.0094
happen	0.0112	artist	0.0093	arrest	0.0112	proposal	0.0100	hot	0.0091
put	0.0093	song	0.0090	lawyer	0.0110	allow	0.0098	inch	0.0089
little	0.0092	program	0.0085	trial	0.0105	issue	0.0092	finish	0.0085
big	0.0081	concert	0.0077	court	0.0105	pass	0.0092	place	0.0085
words6	weights6	words7	weights7	words8	weights8	words9	weights9	words10	weights10
share	0.0221	political	0.0195	school	0.0480	editor	0.0171	pay	0.0214
stock	0.0215	campaign	0.0173	student	0.0327	article	0.0120	money	0.0204
company	0.0177	party	0.0141	child	0.0182	write	0.0090	tax	0.0148
price	0.0177	leader	0.0139	class	0.0173	question	0.0076	budget	0.0148
market	0.0171	election	0.0138	college	0.0156	page	0.0074	program	0.0135
percent	0.0156	candidate	0.0129	education	0.0137	book	0.0071	cost	0.0135
trade	0.0153	vote	0.0121	parent	0.0137	view	0.0068	cut	0.0134

investor	0.0112	democratic	0.0106	teacher	0.0124	point	0.0063	worker	0.0120
fall	0.0103	republican	0.0106	program	0.0118	writer	0.0062	plan	0.0108
analyst	0.0102	support	0.0091	teach	0.0094	history	0.0056	state	0.0107

words11	weights11	words12	weights12	words13	weights13	words14	weights14	words15	weights15
american	0.0138	life	0.0212	building	0.0269	company	0.0429	father	0.0597
states	0.0136	man	0.0170	city	0.0201	executive	0.0210	son	0.0498
government	0.0133	family	0.0146	build	0.0145	business	0.0182	mrs	0.0469
military	0.0124	friend	0.0115	house	0.0142	president	0.0160	mother	0.0442
war	0.0117	woman	0.0102	site	0.0119	sell	0.0142	daughter	0.0361
country	0.0115	live	0.0102	area	0.0110	industry	0.0122	graduate	0.0294
official	0.0114	young	0.0090	space	0.0107	sale	0.0122	retire	0.0246
force	0.0089	world	0.0088	project	0.0103	chief	0.0112	marry	0.0243
leader	0.0083	child	0.0083	apartment	0.0102	offer	0.0100	receive	0.0200
international	0.0070	old	0.0074	open	0.0100	customer	0.0093	president	0.0184

words16	weights16	words17	weights17	words18	weights18	words19	weights19	words20	weights20
game	0.0246	car	0.0261	food	0.0221	color	0.0095	percent	0.0310
team	0.0215	hour	0.0152	restaurant	0.0127	wear	0.0089	rate	0.0258
play	0.0198	trip	0.0116	serve	0.0116	white	0.0081	economy	0.0158
win	0.0167	drive	0.0114	taste	0.0109	design	0.0079	rise	0.0130
player	0.0164	travel	0.0109	eat	0.0102	photograph	0.0074	increase	0.0129
season	0.0159	morning	0.0108	dinner	0.0094	image	0.0071	economic	0.0122
second	0.0129	night	0.0106	cook	0.0088	paint	0.0070	bank	0.0120
victory	0.0101	train	0.0100	fresh	0.0084	art	0.0070	average	0.0114
score	0.0092	driver	0.0098	oil	0.0082	display	0.0066	growth	0.0109
coach	0.0088	ride	0.0090	chicken	0.0079	wall	0.0065	low	0.0097

words21	weights21	words22	weights22	words23	weights23	words24	weights24	words25	weights25

system	0.0149	drug	0.0166	letter	0.0102	film	0.0143	area	0.0146
computer	0.0111	doctor	0.0139	file	0.0095	character	0.0131	town	0.0138
technology	0.0100	report	0.0138	issue	0.0091	play	0.0130	water	0.0119
develop	0.0075	health	0.0137	member	0.0091	movie	0.0128	fire	0.0118
program	0.0073	medical	0.0125	lawyer	0.0089	story	0.0111	land	0.0108
design	0.0064	patient	0.0115	ask	0.0088	write	0.0110	mile	0.0104
scientist	0.0061	cause	0.0107	board	0.0079	love	0.0103	local	0.0103
cost	0.0055	study	0.0101	official	0.0077	book	0.0103	resident	0.0102
information	0.0055	treatment	0.0100	case	0.0073	man	0.0088	state	0.0091
create	0.0055	hospital	0.0091	comment	0.0069	life	0.0087	thousand	0.0086