

スタッツを使った試合の分析

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はじめに

実行に必要な準備

データについて

ここにデータの出所などを書く.

データの基本統計量

summary(x)

Date	Keio	K_points	Opp	
Length:192	Length:192	Min. : 7.0	Length:192	
Class :character	Class :character	1st Qu.:26.0	Class :character	
Mode :character	Mode :character	Median :31.0	Mode :character	
		Mean :36.6		
		3rd Qu.:62.0		
		Max. :67.0		
O_points	No	Player_1	Player_2	
Min. :17.0	Min. : 1.00	Length:192	Length:192	
1st Qu.:22.0	1st Qu.: 6.75	Class :character	Class :character	
Median :31.0	Median :12.50	Mode :character	Mode :character	
Mean :31.4	Mean :12.56			
3rd Qu.:34.0	3rd Qu.:18.25			
Max. :52.0	Max. :26.00			
Time	BC_Num	BC_Den	BC_A_B_C	BC_CLB
Min. : 2.0	Min. : 0.00	Min. : 0.00	Min. :0.0	Min. :0.0
1st Qu.:21.0	1st Qu.: 1.00	1st Qu.: 1.00	1st Qu.:1.0	1st Qu.:0.5
Median :57.5	Median : 2.00	Median : 2.00	Median :1.0	Median :0.8
Mean :49.9	Mean : 2.64	Mean : 2.81	Mean :0.9	Mean :0.7
3rd Qu.:78.5	3rd Qu.: 4.00	3rd Qu.: 4.00	3rd Qu.:1.0	3rd Qu.:1.0

Max.	:80.00	Max.	:14.00	Max.	:14.00	Max.	:1.00	Max.	:1.00
						NA's	:33	NA's	:33
	BC_A		BC_B		BC_C		BC_F		BC_DF_Bea
ten									
Min.	:0.000	Min.	:0.00	Min.	:0.00	Min.	:0.000	Min.	:0.00
1st Qu.	:0.000	1st Qu.	:0.00	1st Qu.	:0.00	1st Qu.	:0.000	1st Qu.	:0.00
Median	:0.000	Median	:1.00	Median	:0.00	Median	:0.000	Median	:0.00
Mean	:0.135	Mean	:1.89	Mean	:0.61	Mean	:0.172	Mean	:0.24
3rd Qu.	:0.000	3rd Qu.	:3.00	3rd Qu.	:1.00	3rd Qu.	:0.000	3rd Qu.	:0.00
Max.	:2.000	Max.	:8.00	Max.	:5.00	Max.	:2.000	Max.	:5.00
	AT_Second_man		AT_BIG_WR_Num		AT_BIG_WR_Den		AT_BIG		Breaches
Min.	:0.00	Min.	: 0.00	Min.	: 0.00	Min.	:0.00	Min.	:0.000
1st Qu.	:0.00	1st Qu.	: 3.00	1st Qu.	: 3.00	1st Qu.	:0.76	1st Qu.	:0.000
Median	:1.00	Median	: 5.00	Median	: 6.00	Median	:0.94	Median	:0.000
Mean	:1.31	Mean	: 5.99	Mean	: 7.18	Mean	:0.85	Mean	:0.167
3rd Qu.	:2.00	3rd Qu.	: 9.00	3rd Qu.	:10.00	3rd Qu.	:1.00	3rd Qu.	:0.000
Max.	:7.00	Max.	:20.00	Max.	:25.00	Max.	:1.00	Max.	:3.000
						NA's	:9		
	Offload_Passes_Num		Offload_Passes_Den		Kicks_Num		Kicks_Den		
Min.	:0.00	Min.	:0.000	Min.	: 0.00	Min.	: 0.00		
1st Qu.	:0.00	1st Qu.	:0.000	1st Qu.	: 0.00	1st Qu.	: 0.00		
Median	:0.00	Median	:0.000	Median	: 0.00	Median	: 0.00		
Mean	:0.26	Mean	:0.292	Mean	: 0.72	Mean	: 0.73		
3rd Qu.	:0.00	3rd Qu.	:0.000	3rd Qu.	: 1.00	3rd Qu.	: 1.00		
Max.	:3.00	Max.	:3.000	Max.	:10.00	Max.	:10.00		
	NT_Total		NT_Handling		NT_Offload		NT_Ball_Carry		NT_Ruck_Maul

Min. :0.00	Min. :0.00	Min. :0.000	Min. :0.000	Min. :0.000
1st Qu.:0.00	1st Qu.:0.00	1st Qu.:0.000	1st Qu.:0.000	1st Qu.:0.000
Median :1.00	Median :0.00	Median :0.000	Median :0.000	Median :0.000
Mean :0.97	Mean :0.24	Mean :0.026	Mean :0.068	Mean :0.203
3rd Qu.:2.00	3rd Qu.:0.00	3rd Qu.:0.000	3rd Qu.:0.000	3rd Qu.:0.000
Max. :5.00	Max. :3.00	Max. :1.000	Max. :2.000	Max. :2.000
NT_Set_Piece	NT_Kick	NT_Kick_Catch	NT_Discipline	AT_PN
Min. :0.00	Min. :0.000	Min. :0.000	Min. :0.000	Min. :0.000
1st Qu.:0.00	1st Qu.:0.000	1st Qu.:0.000	1st Qu.:0.000	1st Qu.:0.000
Median :0.00	Median :0.000	Median :0.000	Median :0.000	Median :0.000
Mean :0.34	Mean :0.026	Mean :0.047	Mean :0.016	Mean :0.281
3rd Qu.:1.00	3rd Qu.:0.000	3rd Qu.:0.000	3rd Qu.:0.000	3rd Qu.:0.000
Max. :4.00	Max. :1.000	Max. :1.000	Max. :1.000	Max. :3.000
First_Tackles_Num	First_Tackles_Den	T_A_B_C	T_CLB	
Min. : 0.00	Min. : 0.00	Min. :0.00	Min. :0.00	
1st Qu.: 1.00	1st Qu.: 1.00	1st Qu.:0.67	1st Qu.:0.00	
Median : 2.00	Median : 3.00	Median :0.89	Median :0.00	
Mean : 2.64	Mean : 3.33	Mean :0.78	Mean :0.16	
3rd Qu.: 4.00	3rd Qu.: 5.00	3rd Qu.:1.00	3rd Qu.:0.25	
Max. :10.00	Max. :12.00	Max. :1.00	Max. :1.00	
		NA's :21	NA's :21	
T_A	T_B	T_C	T_F	T_2nd_A
Min. :0.000	Min. :0.00	Min. :0.00	Min. :0.00	Min. :0.000
1st Qu.:0.000	1st Qu.:0.00	1st Qu.:1.00	1st Qu.:0.00	1st Qu.:0.000
Median :0.000	Median :0.00	Median :2.00	Median :0.00	Median :0.000

Mean	:0.073	Mean	:0.47	Mean	:2.09	Mean	:0.69	Mean	:0.0
31									
3rd Qu.:	:0.000	3rd Qu.:	:1.00	3rd Qu.:	:3.00	3rd Qu.:	:1.00	3rd Qu.:	:0.0
00									
Max.	:1.000	Max.	:5.00	Max.	:8.00	Max.	:4.00	Max.	:2.0
00									
	T_2nd_B		T_2nd_C		T_2nd_F		DF_Second_Man		DF_BIG_WR_N
um									
Min.	:0.00	Min.	:0.00	Min.	:0.000	Min.	:0.00	Min.	: 0.
00									
1st Qu.:	:0.00	1st Qu.:	:0.00	1st Qu.:	:0.000	1st Qu.:	:0.00	1st Qu.:	2.
00									
Median	:0.00	Median	:0.00	Median	:0.000	Median	:1.00	Median	: 3.
00									
Mean	:0.24	Mean	:0.53	Mean	:0.021	Mean	:0.85	Mean	: 4.
13									
3rd Qu.:	:0.00	3rd Qu.:	:1.00	3rd Qu.:	:0.000	3rd Qu.:	:1.00	3rd Qu.:	6.
00									
Max.	:3.00	Max.	:5.00	Max.	:1.000	Max.	:5.00	Max.	:16.
00									
DF_BIG_WR_Den		DF_BIG		DF_BD_Turnover_Total		DF_Jackal			
Min.	: 0.00	Min.	:0.00	Min.	:0.000	Min.	:0.000		
1st Qu.:	2.00	1st Qu.:	:0.80	1st Qu.:	:0.000	1st Qu.:	:0.000		
Median	: 4.00	Median	:1.00	Median	:0.000	Median	:0.000		
Mean	: 4.76	Mean	:0.89	Mean	:0.208	Mean	:0.057		
3rd Qu.:	7.00	3rd Qu.:	:1.00	3rd Qu.:	:0.000	3rd Qu.:	:0.000		
Max.	:18.00	Max.	:1.00	Max.	:3.000	Max.	:2.000		
		NA's	:15						
DF_Choke		DF_Boss		DF_Yank		DF_PN		Player_1a	
Min.	:0	Min.	:0.000	Min.	:0	Min.	:0.000	Length:	192
1st Qu.:	:0	1st Qu.:	:0.000	1st Qu.:	:0	1st Qu.:	:0.000	Class	:character
Median	:0	Median	:0.000	Median	:0	Median	:0.000	Mode	:character
Mean	:0	Mean	:0.151	Mean	:0	Mean	:0.286		
3rd Qu.:	:0	3rd Qu.:	:0.000	3rd Qu.:	:0	3rd Qu.:	:0.250		
Max.	:0	Max.	:3.000	Max.	:0	Max.	:3.000		

```
Player_2a
Length:192
Class :character
Mode :character
```

利用できないデータは NA になっている. 全てがゼロのデータ(特徴変数)があると
その特徴変数は推計に利用できない.

BC_A_B_C, BC_CLB にはそれぞれ NA(not available 利用できない)が 33 個ある.

AT_Big には NA は 9 個ある

T_A_B_C と T_CLB には NA が 21 個ある.

DF_BIG には NA が 15 個ある.

NA を含むデータは, 比率のデータで分母(と分子)がゼロの場合に利用できない
(NA)になったものである. これらの変数は推定する場合に NA を含む観察値を削
除して推定することになる.

DF_Choke, DF_Yank は全てのデータがゼロである.

この 2 つの特徴変数は推定から削除することになる.

```
# 主成分を抽出する部分
PC_total=prcomp(~Time+BC_Num+BC_Den+BC_A+BC_B+BC_C+BC_F+BC_DF_Beaten+AT_S
econd_man+AT_BIG_WR_Num+AT_BIG_WR_Den+AT_BIG+Breaches+Offload_Passes_Num+
Offload_Passes_Den+Kicks_Num+Kicks_Den+NT_Total+NT_Handling+NT_Offload+NT
_Ball_Carry+NT_Ruck_Maul+NT_Set_Piece+NT_Kick+NT_Kick_Catch+NT_Discipline
+AT_PN+First_Tackles_Num+First_Tackles_Den+T_A+T_B+T_C+T_F+T_2nd_A+T_2nd_
B+T_2nd_C+T_2nd_F+DF_Second_Man+DF_BIG_WR_Num+DF_BIG_WR_Den+DF_BIG+DF_BD_
Turnover_Total+DF_Jackal+DF_Boss+DF_PN,data=x,na.action=na.omit,scale=TRU
E)
summary(PC_total)

Importance of components:
               PC1      PC2      PC3      PC4      PC5      PC6      PC7
PC8
Standard deviation    2.875  1.9473  1.7157  1.630  1.5100  1.4444  1.3599  1.2
840
Proportion of Variance 0.184  0.0843  0.0654  0.059  0.0507  0.0464  0.0411  0.0
```

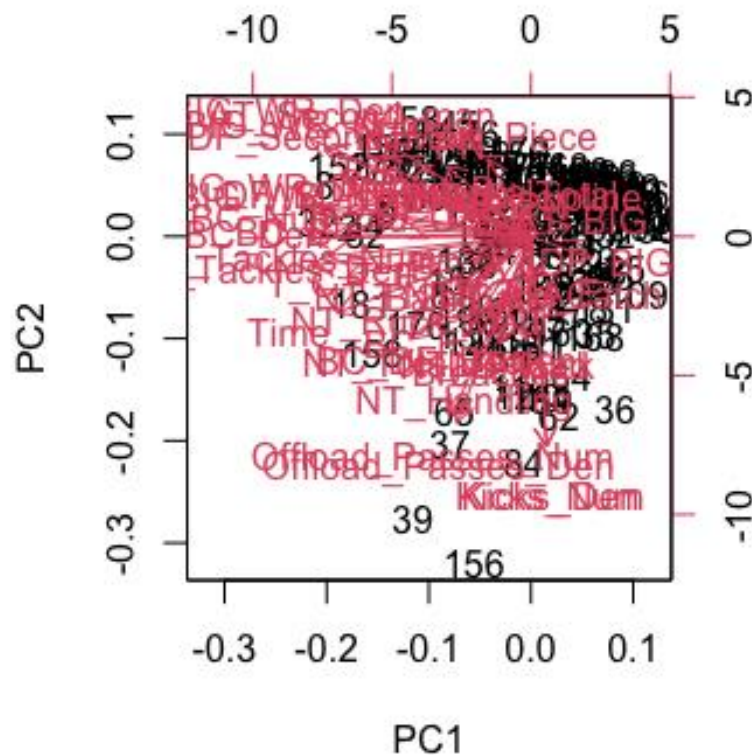
366								
Cumulative Proportion	0.184	0.2680	0.3334	0.392	0.4431	0.4895	0.5306	0.5672
	PC9	PC10	PC11	PC12	PC13	PC14	PC15	
PC16								
Standard deviation	1.2101	1.1335	1.1245	1.0896	1.039	1.0216	1.0107	0.9655
Proportion of Variance	0.0325	0.0285	0.0281	0.0264	0.024	0.0232	0.0227	0.0207
Cumulative Proportion	0.5997	0.6283	0.6564	0.6828	0.707	0.7299	0.7527	0.7734
	PC17	PC18	PC19	PC20	PC21	PC22	PC23	
PC24								
Standard deviation	0.925	0.9194	0.9130	0.9044	0.8845	0.8635	0.8134	0.7869
Proportion of Variance	0.019	0.0188	0.0185	0.0182	0.0174	0.0166	0.0147	0.0138
Cumulative Proportion	0.792	0.8112	0.8297	0.8479	0.8653	0.8818	0.8965	0.9103
	PC25	PC26	PC27	PC28	PC29	PC30	PC31	
Standard deviation	0.7534	0.7209	0.6959	0.63003	0.61871	0.59060	0.58398	
Proportion of Variance	0.0126	0.0115	0.0108	0.00882	0.00851	0.00775	0.00758	
Cumulative Proportion	0.9229	0.9345	0.9452	0.95404	0.96254	0.97030	0.97787	
	PC32	PC33	PC34	PC35	PC36	PC37		
PC38								
Standard deviation	0.55267	0.51874	0.46601	0.41098	0.12200	0.11028	0.08666	
Proportion of Variance	0.00679	0.00598	0.00483	0.00375	0.00033	0.00027	0.00017	
Cumulative Proportion	0.98466	0.99064	0.99547	0.99922	0.99955	0.99982	0.99999	
	PC39	PC40	PC41	PC42	PC43	PC44		
Standard deviation	0.02214	1.28e-15	4.76e-16	3.95e-16	3.09e-16	1.86e-16		
Proportion of Variance	0.00001	0.00e+00	0.00e+00	0.00e+00	0.00e+00	0.00e+00		
Cumulative Proportion	1.00000	1.00e+00	1.00e+00	1.00e+00	1.00e+00	1.00e+00		
	PC45							
Standard deviation	5.22e-17							
Proportion of Variance	0.00e+00							
Cumulative Proportion	1.00e+00							

```
kable(PC_total$rotation[,1:6],caption="主成分分析(AT と DF) : 2024 年")
```

主成分分析(AT と DF) : 2024 年

	PC1	PC2	PC3	PC4	PC5	PC6
Time	-0.233	-0.136	0.049	-0.073	0.092	-0.065
BC_Num	-0.255	0.023	0.285	0.157	0.179	-0.002
BC_Den	-0.266	-0.003	0.281	0.118	0.142	-0.007
BC_A	-0.069	-0.048	0.142	0.195	0.024	0.032
BC_B	-0.238	0.003	0.256	0.124	0.102	0.010
BC_C	-0.137	0.071	0.146	0.064	0.231	-0.037
BC_F	-0.115	-0.158	0.030	-0.211	-0.191	-0.030
BC_DF_Beaten	-0.081	-0.179	0.022	0.280	-0.062	-0.060
AT_Second_man	-0.173	0.166	-0.056	-0.110	-0.005	0.045
AT_BIG_WR_Num	-0.248	0.155	0.098	0.039	0.057	0.042
AT_BIG_WR_Den	-0.267	0.174	0.121	0.023	0.071	0.056
AT_BIG	0.048	0.019	-0.037	0.037	-0.060	-0.054
Breaches	-0.038	-0.191	0.011	0.212	-0.098	-0.123
Offload_Passes_Num	-0.095	-0.318	0.093	0.229	-0.175	0.090
Offload_Passes_Den	-0.089	-0.329	0.098	0.244	-0.215	0.073
Kicks_Num	0.019	-0.373	-0.058	-0.213	0.293	0.091
Kicks_Den	0.019	-0.373	-0.058	-0.216	0.296	0.092
NT_Total	-0.146	-0.183	0.163	-0.310	-0.175	-0.257
NT_Handling	-0.064	-0.237	0.004	-0.056	0.022	-0.061
NT_Offload	-0.035	-0.187	0.046	0.154	-0.227	-0.029
NT_Ball_Carry	-0.091	-0.090	0.015	0.006	0.073	-0.110
NT_Ruck_Maul	-0.108	-0.123	0.100	-0.252	-0.271	-0.026
NT_Set_Piece	-0.051	0.137	0.177	-0.223	-0.132	-0.289
NT_Kick	-0.006	-0.187	-0.014	-0.254	0.233	-0.006
NT_Kick_Catch	0.003	-0.089	0.017	-0.034	0.038	0.115
NT_Discipline	-0.004	0.050	-0.099	-0.056	-0.063	-0.089
AT_PN	-0.022	0.040	0.185	-0.253	-0.225	-0.367
First_Tackles_Num	-0.244	-0.035	-0.363	0.018	-0.074	-0.003
First_Tackles_Den	-0.263	-0.052	-0.317	0.026	-0.050	-0.088
T_A	0.000	-0.084	-0.075	-0.056	0.142	0.119

	PC1	PC2	PC3	PC4	PC5	PC6
T_B	-0.154	0.088	-0.212	0.127	-0.036	-0.044
T_C	-0.221	-0.070	-0.325	-0.029	-0.092	-0.001
T_F	-0.141	-0.060	-0.004	0.029	0.040	-0.236
T_2nd_A	-0.079	-0.090	-0.009	-0.123	0.024	0.221
T_2nd_B	-0.106	0.060	0.043	-0.117	0.098	0.036
T_2nd_C	-0.146	0.021	-0.013	-0.033	0.182	0.035
T_2nd_F	-0.006	-0.083	0.077	-0.089	-0.048	0.138
DF_Second_Man	-0.191	0.139	0.066	-0.167	0.090	0.109
DF_BIG_WR_Num	-0.255	0.051	-0.270	0.023	0.012	-0.037
DF_BIG_WR_Den	-0.275	0.063	-0.234	-0.001	-0.009	-0.053
DF_BIG	0.072	-0.040	-0.098	0.065	0.062	0.024
DF_BD_Turnover_Total	-0.106	0.055	0.085	-0.130	-0.274	0.469
DF_Jackal	-0.081	0.059	0.098	-0.106	-0.003	0.275
DF_Boss	-0.076	0.030	0.042	-0.090	-0.316	0.385
DF_PN	-0.102	0.124	-0.063	-0.113	-0.018	0.028



```
na_PC_ttl=PC_total$na.action
```

```
PC_AT=prcomp(~Time+BC_Num+BC_Den+BC_A+BC_B+BC_C+BC_F+BC_DF+Beaten+AT_Seco
nd_man+AT_BIG_WR_Num+AT_BIG_WR_Den+AT_BIG+Breaches+Offload_Passes_Num+Off
load_Passes_Den+Kicks_Num+Kicks_Den+NT_Total+NT_Handling+NT_Offload+NT_Ba
ll_Carry+NT_Ruck_Maul+NT_Set_Piece+NT_Kick+NT_Kick_Catch+NT_Discipline+AT
_PN,data=x,na.action=na.omit,scale=TRUE)
summary(PC_AT)
```

Importance of components:

	PC1	PC2	PC3	PC4	PC5	PC6	PC7	P
C8								
Standard deviation	2.373	1.855	1.5637	1.4158	1.2668	1.1553	1.0675	1.0
53								
Proportion of Variance	0.208	0.127	0.0906	0.0742	0.0594	0.0494	0.0422	0.0
41								
Cumulative Proportion	0.208	0.336	0.4264	0.5007	0.5601	0.6096	0.6518	0.6
93								
	PC9	PC10	PC11	PC12	PC13	PC14	PC15	
PC16								

```
Standard deviation      1.026 0.9967 0.9822 0.9261 0.8915 0.8065 0.7845 0.7592
Proportion of Variance 0.039 0.0368 0.0357 0.0318 0.0294 0.0241 0.0228 0.0214
Cumulative Proportion  0.732 0.7686 0.8043 0.8361 0.8655 0.8896 0.9124 0.9338

                PC17   PC18   PC19   PC20   PC21   PC22   PC23
Standard deviation      0.6952 0.6466 0.5752 0.5524 0.47519 0.12834 0.08865
Proportion of Variance 0.0179 0.0155 0.0123 0.0113 0.00836 0.00061 0.00029
Cumulative Proportion  0.9517 0.9672 0.9794 0.9907 0.99907 0.99968 0.99997

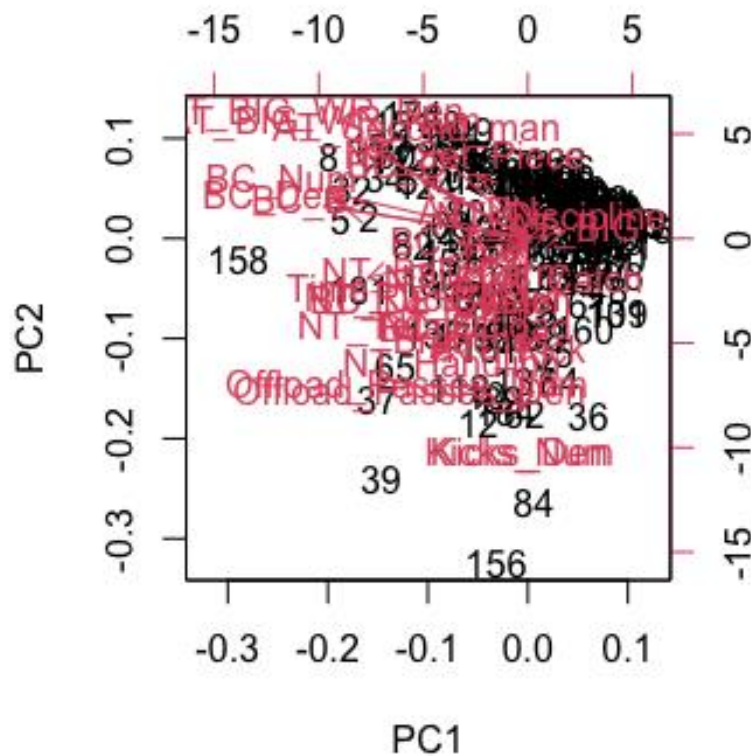
                PC24   PC25   PC26   PC27
Standard deviation      0.02650 3.9e-16 3.12e-16 2.1e-16
Proportion of Variance 0.00003 0.0e+00 0.00e+00 0.0e+00
Cumulative Proportion  1.00000 1.0e+00 1.00e+00 1.0e+00

kable(PC_AT$rotation[,1:6],caption="主成分分析(AT) : 2024 年")
```

主成分分析(AT) : 2024 年

	PC1	PC2	PC3	PC4	PC5	PC6
Time	-0.298	-0.094	0.096	0.134	-0.130	-0.036
BC_Num	-0.368	0.108	-0.129	0.137	-0.049	-0.016
BC_Den	-0.380	0.077	-0.085	0.104	0.007	-0.055
BC_A	-0.133	-0.009	-0.190	0.011	-0.084	-0.307
BC_B	-0.339	0.070	-0.098	0.060	0.025	-0.030
BC_C	-0.196	0.136	-0.051	0.219	-0.135	0.142
BC_F	-0.152	-0.174	0.249	-0.177	0.343	-0.248
BC_DF_Beaten	-0.130	-0.122	-0.274	-0.074	-0.318	-0.124
AT_Second_man	-0.166	0.205	0.134	0.048	0.169	0.014
AT_BIG_WR_Num	-0.303	0.219	0.007	0.067	0.189	0.162
AT_BIG_WR_Den	-0.321	0.238	0.013	0.086	0.122	0.076
AT_BIG	0.068	0.017	-0.003	-0.106	0.286	0.344
Breaches	-0.083	-0.191	-0.155	-0.135	-0.151	-0.140
Offload_Passes_Num	-0.180	-0.284	-0.259	-0.230	-0.088	0.134
Offload_Passes_Den	-0.177	-0.296	-0.271	-0.287	-0.044	0.194
Kicks_Num	-0.012	-0.411	0.113	0.379	-0.069	0.030
Kicks_Den	-0.012	-0.411	0.115	0.383	-0.071	0.033

	PC1	PC2	PC3	PC4	PC5	PC6
NT_Total	-0.229	-0.171	0.400	-0.191	-0.026	0.071
NT_Handling	-0.113	-0.242	0.082	-0.021	0.344	0.229
NT_Offload	-0.077	-0.171	-0.156	-0.307	0.095	0.244
NT_Ball_Carry	-0.124	-0.071	0.023	0.020	0.026	-0.106
NT_Ruck_Maul	-0.141	-0.118	0.286	-0.255	0.184	-0.349
NT_Set_Piece	-0.094	0.152	0.326	-0.135	-0.446	0.223
NT_Kick	-0.018	-0.216	0.197	0.302	-0.042	0.257
NT_Kick_Catch	-0.021	-0.083	0.014	0.093	0.046	-0.457
NT_Discipline	0.035	0.037	0.069	-0.063	-0.162	0.018
AT_PN	-0.074	0.047	0.386	-0.277	-0.376	0.004



```
PC_DF=prcomp(~First_Tackles_Num+First_Tackles_Den+T_A+T_B+T_C+T_F+T_2nd_A
```

```
+T_2nd_B+T_2nd_C+T_2nd_F+DF_Second_Man+DF_BIG_WR_Num+DF_BIG_WR_Den+DF_BIG
+DF_BD_Turnover_Total+DF_Jackal+DF_Boss+DF_PN,data=x,na.action=na.omit,scale=TRUE)
summary(PC_DF)

Importance of components:
      PC1      PC2      PC3      PC4      PC5      PC6      PC7
PC8
Standard deviation  2.279 1.451 1.2356 1.1566 1.0968 1.0378 0.9695 0.9
240
Proportion of Variance 0.288 0.117 0.0848 0.0743 0.0668 0.0598 0.0522 0.0
474
Cumulative Proportion 0.288 0.406 0.4903 0.5646 0.6315 0.6913 0.7435 0.7
910
      PC9      PC10      PC11      PC12      PC13      PC14      PC15
Standard deviation  0.9068 0.8832 0.8565 0.7691 0.6695 0.6112 0.11586
Proportion of Variance 0.0457 0.0433 0.0408 0.0329 0.0249 0.0208 0.00075
Cumulative Proportion 0.8366 0.8800 0.9207 0.9536 0.9785 0.9992 1.00000
      PC16      PC17      PC18
Standard deviation  9.17e-16 5.38e-16 1.34e-16
Proportion of Variance 0.00e+00 0.00e+00 0.00e+00
Cumulative Proportion 1.00e+00 1.00e+00 1.00e+00

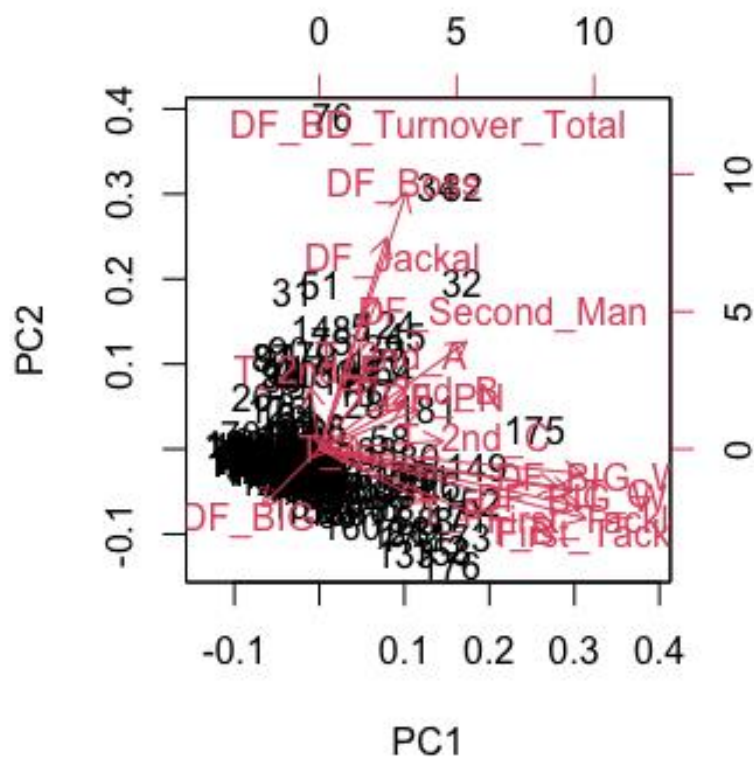
kable(PC_DF$rotation[,1:6],caption="主成分分析(DF) : 2024 年")
```

主成分分析(DF) : 2024 年

	PC1	PC2	PC3	PC4	PC5	PC6
First_Tackles_Num	0.394	-0.136	-0.175	0.059	0.188	0.091
First_Tackles_Den	0.400	-0.164	-0.153	0.092	-0.045	0.076
T_A	0.016	-0.005	-0.010	-0.244	0.377	0.654
T_B	0.243	-0.160	-0.081	-0.088	-0.060	0.271
T_C	0.358	-0.089	-0.171	0.146	0.200	-0.109
T_F	0.159	-0.125	-0.002	0.112	-0.580	-0.007
T_2nd_A	0.087	0.173	-0.130	-0.305	0.460	-0.320
T_2nd_B	0.125	0.103	0.506	-0.111	0.219	0.014
T_2nd_C	0.185	0.019	0.381	0.076	0.066	-0.243
T_2nd_F	-0.013	0.145	0.108	0.466	0.181	0.066
DF_Second_Man	0.221	0.253	0.374	-0.206	-0.091	-0.049
DF_BIG_WR_Num	0.379	-0.099	-0.042	-0.138	-0.030	-0.148
DF_BIG_WR_Den	0.396	-0.058	0.058	-0.011	-0.035	-0.134
DF_BIG	-0.085	-0.134	-0.370	-0.455	-0.076	-0.064

	PC1	PC2	PC3	PC4	PC5	PC6
DF_BD_Turnover_Total	0.131	0.605	-0.251	0.036	-0.108	0.039
DF_Jackal	0.088	0.355	0.031	-0.448	-0.271	-0.031
DF_Boss	0.101	0.497	-0.307	0.295	0.030	0.063
DF_PN	0.150	0.093	0.199	-0.031	-0.204	0.504

```
biplot(PC_DF)
```



```
na_PC_DF=PC_DF$na.action
```

主成分回帰の結果

主成分回帰分析は，目的となる変数(y)を説明するために，主成分分析の結果としてまとめられた変数を利用するものである．さきの主成分分析の結果からわかるように，各主成分の解釈が難しいと，回帰分析の解釈も難しくなる．

```
yK_ttl=x$K_points[-na_PC_ttl]
yK_AT=x$K_points[-na_PC_AT]
```

```
yK_DF=x$K_points[-na_PC_DF]
reg_KeioPoint_01=lm(yK_ttl ~ PC1+PC2+PC3+PC4+PC5, data=as.data.frame(PC_
otal$x))
summary(reg_KeioPoint_01)
```

Call:

```
lm(formula = yK_ttl ~ PC1 + PC2 + PC3 + PC4 + PC5, data = as.data.frame(P
C_total$x))
```

Residuals:

Min	1Q	Median	3Q	Max
-34.0	-16.6	-6.8	22.3	35.0

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	36.858	1.662	22.18	<2e-16 ***
PC1	0.531	0.580	0.92	0.36
PC2	-0.341	0.856	-0.40	0.69
PC3	0.984	0.972	1.01	0.31
PC4	0.915	1.023	0.89	0.37
PC5	-1.551	1.104	-1.40	0.16

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 21.6 on 163 degrees of freedom

Multiple R-squared: 0.0286, Adjusted R-squared: -0.00121

F-statistic: 0.96 on 5 and 163 DF, p-value: 0.444

```
reg_KeioPoint_02=lm(yK_AT ~ PC1+PC2+PC3+PC4+PC5, data=as.data.frame(PC_AT
$x))
summary(reg_KeioPoint_02)
```

Call:

```
lm(formula = yK_AT ~ PC1 + PC2 + PC3 + PC4 + PC5, data = as.data.frame(PC
_AT$x))
```

Residuals:

Min	1Q	Median	3Q	Max
-38.0	-16.2	-4.5	18.7	40.9

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	36.820	1.542	23.88	<2e-16 ***
PC1	0.407	0.652	0.62	0.533
PC2	-0.696	0.834	-0.84	0.405

```

PC3          -2.419      0.989    -2.45    0.015 *
PC4          -0.376      1.092    -0.34    0.731
PC5           3.030      1.220     2.48    0.014 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 20.9 on 177 degrees of freedom
Multiple R-squared:  0.0702,    Adjusted R-squared:  0.0439
F-statistic: 2.67 on 5 and 177 DF,  p-value: 0.0235

reg_KeioPoint_03=lm(yK_DF ~ PC1+PC2+PC3+PC4+PC5, data=as.data.frame(PC_DF
$x))
summary(reg_KeioPoint_03)

Call:
lm(formula = yK_DF ~ PC1 + PC2 + PC3 + PC4 + PC5, data = as.data.frame(PC
_DF$x))

Residuals:
    Min       1Q   Median       3Q      Max
-37.98 -14.38  -3.62   19.53   39.35

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)   36.644     1.537    23.85  < 2e-16 ***
PC1           -0.520     0.676    -0.77   0.443
PC2            4.609     1.062     4.34  2.4e-05 ***
PC3           -1.357     1.247    -1.09   0.278
PC4           -0.877     1.332    -0.66   0.511
PC5            3.116     1.405     2.22   0.028 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 20.4 on 171 degrees of freedom
Multiple R-squared:  0.132, Adjusted R-squared:  0.106
F-statistic:  5.2 on 5 and 171 DF,  p-value: 0.000183

stargazer(reg_KeioPoint_01,reg_KeioPoint_02,reg_KeioPoint_03,type = "html
",
  title= "表 1 主成分回帰の慶應の得点に対する効果の比較",
  out="pca_reg_KeioPoint.html")

<table style="text-align:center"><caption><strong>表 1 主成分回帰の慶應の
得点に対する効果の比較</strong></caption>
<tr><td colspan="4" style="border-bottom: 1px solid black"></td></tr><tr>

```

	Dependent variable:		
	yK_ttl	yK_AT	yK_DF
	(1)	(2)	(3)
PC1	0.531	0.407	-0.520
	(0.580)	(0.652)	(0.676)
PC2	-0.341	-0.696	>4.610 ^{***}
	(0.856)	(0.834)	(1.060)
PC3	0.984	-2.420 ^{**}	
	(0.972)	(0.989)	(1.250)
PC4	0.915	-0.376	-0.877
	(1.020)	(1.090)	(1.330)
PC5	-1.550	3.030 ^{**}	
	(1.100)	(1.220)	(1.400)
Constant	36.900 ^{***}		
	36.800 ^{***}	36.600 ^{***}	
	(1.660)	(1.540)	(1.540)
Observations	169	183	177
R ²	0.029	0.070	0.132
Adjusted R ²	-0.001		0.044
			0.106
Residual Std. Error	21.600 (df =		

```

163)</td><td>20.900 (df = 177)</td><td>20.400 (df = 171)</td></tr>
<tr><td style="text-align:left">F Statistic</td><td>0.960 (df = 5; 163)</
td><td>2.670<sup>**</sup> (df = 5; 177)</td><td>5.200<sup>***</sup> (df =
5; 171)</td></tr>
<tr><td colspan="4" style="border-bottom: 1px solid black"></td></tr><tr>
<td style="text-align:left"><em>Note:</em></td><td colspan="3" style="tex
t-align:right"><sup>*</sup>p<0.1; <sup>**</sup>p<0.05; <sup>***</sup>p<0.
01</td></tr>
</table>

```

htmltools::includeHTML("pca_reg_KeioPoint.html")

表1 主成分回帰の慶應の得点に対する効果の比較

Dependent variable:			
	yK_ttl (1)	yK_AT (2)	yK_DF (3)
PC1	0.531 (0.580)	0.407 (0.652)	-0.520 (0.676)
PC2	-0.341 (0.856)	-0.696 (0.834)	4.610*** (1.060)
PC3	0.984 (0.972)	-2.420** (0.989)	-1.360 (1.250)
PC4	0.915 (1.020)	-0.376 (1.090)	-0.877 (1.330)
PC5	-1.550 (1.100)	3.030** (1.220)	3.120** (1.400)
Constant	36.900*** (1.660)	36.800*** (1.540)	36.600*** (1.540)

Observations	169	183	177
R ²	0.029	0.070	0.132
Adjusted R ²	-0.001	0.044	0.106
Residual Std. Error	21.600 (df = 163)	20.900 (df = 177)	20.400 (df = 171)
F Statistic	0.960 (df = 5; 163)	2.670** (df = 5; 177)	5.200*** (df = 5; 171)

Note:

*p<0.1; **p<0.05; ***p<0.01

```
y0_ttl=x$0_points[-na_PC_ttl]
y0_AT=x$0_points[-na_PC_AT]
y0_DF=x$0_points[-na_PC_DF]

reg_OppPoint_01=lm(y0_ttl ~ PC1+PC2+PC3+PC4+PC5, data=as.data.frame(PC_total$x))
summary(reg_OppPoint_01)
```

Call:

```
lm(formula = y0_ttl ~ PC1 + PC2 + PC3 + PC4 + PC5, data = as.data.frame(PC_total$x))
```

Residuals:

Min	1Q	Median	3Q	Max
-18.45	-7.67	-1.41	4.97	21.99

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	30.893	0.798	38.69	<2e-16 ***
PC1	-0.308	0.279	-1.10	0.271
PC2	0.251	0.411	0.61	0.543
PC3	-0.848	0.467	-1.82	0.071 .
PC4	-1.026	0.491	-2.09	0.038 *
PC5	-0.268	0.530	-0.51	0.614

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 10.4 on 163 degrees of freedom

Multiple R-squared: 0.0552, Adjusted R-squared: 0.0262

F-statistic: 1.9 on 5 and 163 DF, p-value: 0.0965

```
reg_OppPoint_02=lm(y0_AT ~ PC1+PC2+PC3+PC4+PC5, data=as.data.frame(PC_AT
$x))
summary(reg_OppPoint_02)
```

Call:

```
lm(formula = y0_AT ~ PC1 + PC2 + PC3 + PC4 + PC5, data = as.data.frame(PC
_AT$x))
```

Residuals:

Min	1Q	Median	3Q	Max
-19.47	-7.21	-1.74	5.98	22.81

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	31.131	0.715	43.53	< 2e-16 ***
PC1	0.123	0.302	0.41	0.68394
PC2	0.193	0.387	0.50	0.61897
PC3	1.655	0.459	3.61	0.00040 ***
PC4	-0.136	0.507	-0.27	0.78813
PC5	-2.183	0.566	-3.86	0.00016 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 9.68 on 177 degrees of freedom

Multiple R-squared: 0.138, Adjusted R-squared: 0.114

F-statistic: 5.68 on 5 and 177 DF, p-value: 7e-05

```
reg_OppPoint_03=lm(y0_DF ~PC1+PC2+PC3+PC4+PC5, data=as.data.frame(PC_DF
$x))
summary(reg_OppPoint_03)
```

Call:

```
lm(formula = y0_DF ~ PC1 + PC2 + PC3 + PC4 + PC5, data = as.data.frame(PC
_DF$x))
```

Residuals:

Min	1Q	Median	3Q	Max
-17.24	-7.74	-1.40	4.38	23.05

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	31.096	0.764	40.72	<2e-16 ***
PC1	0.574	0.336	1.71	0.0894 .
PC2	-1.145	0.528	-2.17	0.0314 *
PC3	-0.428	0.620	-0.69	0.4904

PC4	0.719	0.662	1.09	0.2791
PC5	-2.068	0.698	-2.96	0.0035 **

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 10.2 on 171 degrees of freedom

Multiple R-squared: 0.0955, Adjusted R-squared: 0.0691

F-statistic: 3.61 on 5 and 171 DF, p-value: 0.00394

```
stargazer(reg_OppPoint_01,reg_OppPoint_02,reg_OppPoint_03,type = "html",
  title= "表 2 主成分回帰の対戦相手の得点に対する効果の比較",
  out="pca_reg_OppPoint.html")
```

```
<table style="text-align:center"><caption><strong>表 2 主成分回帰の対戦相
手の得点に対する効果の比較</strong></caption>
<tr><td colspan="4" style="border-bottom: 1px solid black"></td></tr><tr>
<td style="text-align:left"></td><td colspan="3"><em>Dependent variable:<
/em></td></tr>
<tr><td></td><td colspan="3" style="border-bottom: 1px solid black"></td>
</tr>
<tr><td style="text-align:left"></td><td>y0_ttl</td><td>y0_AT</td><td>y0_
DF</td></tr>
<tr><td style="text-align:left"></td><td>(1)</td><td>(2)</td><td>(3)</td>
</tr>
<tr><td colspan="4" style="border-bottom: 1px solid black"></td></tr><tr>
<td style="text-align:left">PC1</td><td>-0.308</td><td>0.123</td><td>0.57
4<sup>*</sup></td></tr>
<tr><td style="text-align:left"></td><td>(0.279)</td><td>(0.302)</td><td>
(0.336)</td></tr>
<tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
<tr><td style="text-align:left">PC2</td><td>0.251</td><td>0.193</td><td>-
1.150<sup>*</sup></td></tr>
<tr><td style="text-align:left"></td><td>(0.411)</td><td>(0.387)</td><td>
(0.528)</td></tr>
<tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
<tr><td style="text-align:left">PC3</td><td>-0.848<sup>*</sup></td><td>1.
660<sup>*</sup></td><td>-0.428</td></tr>
<tr><td style="text-align:left"></td><td>(0.467)</td><td>(0.459)</td><td>
(0.620)</td></tr>
<tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
<tr><td style="text-align:left">PC4</td><td>-1.030<sup>*</sup></td><td>-
0.136</td><td>0.719</td></tr>
<tr><td style="text-align:left"></td><td>(0.491)</td><td>(0.507)</td><td>
(0.662)</td></tr>
<tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
<tr><td style="text-align:left">PC5</td><td>-0.268</td><td>-2.180<sup>*</sup></td></tr>
```

```

</sup></td><td>-2.070<sup>***</sup></td></tr>
<tr><td style="text-align:left"></td><td>(0.530)</td><td>(0.566)</td><td>
(0.698)</td></tr>
<tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
<tr><td style="text-align:left">Constant</td><td>30.900<sup>***</sup></td>
<td>31.100<sup>***</sup></td><td>31.100<sup>***</sup></td></tr>
<tr><td style="text-align:left"></td><td>(0.798)</td><td>(0.715)</td><td>
(0.764)</td></tr>
<tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
<tr><td colspan="4" style="border-bottom: 1px solid black"></td></tr>
<tr>
<td style="text-align:left">Observations</td><td>169</td><td>183</td><td>
177</td></tr>
<tr><td style="text-align:left">R<sup>2</sup></td><td>0.055</td><td>0.138
</td><td>0.096</td></tr>
<tr><td style="text-align:left">Adjusted R<sup>2</sup></td><td>0.026</td>
<td>0.114</td><td>0.069</td></tr>
<tr><td style="text-align:left">Residual Std. Error</td><td>10.400 (df =
163)</td><td>9.680 (df = 177)</td><td>10.200 (df = 171)</td></tr>
<tr><td style="text-align:left">F Statistic</td><td>1.900<sup>*</sup> (df
= 5; 163)</td><td>5.680<sup>***</sup> (df = 5; 177)</td><td>3.610<sup>**
*</sup> (df = 5; 171)</td></tr>
<tr><td colspan="4" style="border-bottom: 1px solid black"></td></tr>
<tr>
<td style="text-align:left"><em>Note:</em></td><td colspan="3" style="tex
t-align:right"><sup>*</sup>p<0.1; <sup>**</sup>p<0.05; <sup>***</sup>p<0.
01</td></tr>
</table>

```

htmltools::includeHTML("pca_reg_OppPoint.html")

表2 主成分回帰の対戦相手の得点に対する効果の比較

Dependent variable:			
	yO_ttl (1)	yO_AT (2)	yO_DF (3)
PC1	-0.308 (0.279)	0.123 (0.302)	0.574* (0.336)
PC2	0.251 (0.411)	0.193 (0.387)	-1.150** (0.528)

PC3	-0.848* (0.467)	1.660*** (0.459)	-0.428 (0.620)
PC4	-1.030** (0.491)	-0.136 (0.507)	0.719 (0.662)
PC5	-0.268 (0.530)	-2.180*** (0.566)	-2.070*** (0.698)
Constant	30.900*** (0.798)	31.100*** (0.715)	31.100*** (0.764)
Observations	169	183	177
R ²	0.055	0.138	0.096
Adjusted R ²	0.026	0.114	0.069
Residual Std. Error	10.400 (df = 163)	9.680 (df = 177)	10.200 (df = 171)
F Statistic	1.900* (df = 5; 163)	5.680*** (df = 5; 177)	3.610*** (df = 5; 171)

Note:

*p<0.1; **p<0.05; ***p<0.01

```

y_ttl=x$K_points[-na_PC_ttl]-x$O_points[-na_PC_ttl]
y_AT=x$K_points[-na_PC_AT]-x$O_points[-na_PC_AT]
y_DF=x$K_points[-na_PC_DF]-x$O_points[-na_PC_DF]

reg_dPoint_01=lm(y_ttl ~ PC1+PC2+PC3+PC4+PC5, data=as.data.frame(PC_total
$x))
summary(reg_dPoint_01)

Call:
lm(formula = y_ttl ~ PC1 + PC2 + PC3 + PC4 + PC5, data = as.data.frame(PC
_total$x))

Residuals:
    Min       1Q   Median       3Q      Max
-54.62 -22.92  -4.08  26.68  49.04

```

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	5.964	2.297	2.60	0.01 *
PC1	0.839	0.801	1.05	0.30
PC2	-0.592	1.183	-0.50	0.62
PC3	1.832	1.343	1.36	0.17
PC4	1.941	1.414	1.37	0.17
PC5	-1.283	1.526	-0.84	0.40

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 29.9 on 163 degrees of freedom

Multiple R-squared: 0.0344, Adjusted R-squared: 0.00474

F-statistic: 1.16 on 5 and 163 DF, p-value: 0.331

```
reg_dPoint_02=lm(y_AT ~ PC1+PC2+PC3+PC4+PC5, data=as.data.frame(PC_AT$x))
summary(reg_dPoint_02)
```

Call:

```
lm(formula = y_AT ~ PC1 + PC2 + PC3 + PC4 + PC5, data = as.data.frame(PC_
AT$x))
```

Residuals:

Min	1Q	Median	3Q	Max
-55.66	-25.04	-0.43	23.26	45.55

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	5.689	2.085	2.73	0.0070 **
PC1	0.283	0.881	0.32	0.7482
PC2	-0.889	1.127	-0.79	0.4315
PC3	-4.074	1.337	-3.05	0.0027 **
PC4	-0.239	1.477	-0.16	0.8714
PC5	5.213	1.650	3.16	0.0019 **

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 28.2 on 177 degrees of freedom

Multiple R-squared: 0.102, Adjusted R-squared: 0.0762

F-statistic: 4 on 5 and 177 DF, p-value: 0.00182

```
reg_dPoint_03=lm(y_DF ~ PC1+PC2+PC3+PC4+PC5, data=as.data.frame(PC_DF$x))
summary(reg_dPoint_03)
```

Call:

```
lm(formula = y_DF ~ PC1 + PC2 + PC3 + PC4 + PC5, data = as.data.frame(PC_
DF$x))
```

Residuals:

Min	1Q	Median	3Q	Max
-60.36	-21.21	-1.69	24.96	49.47

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	5.548	2.133	2.60	0.01009 *
PC1	-1.094	0.938	-1.17	0.24520
PC2	5.754	1.473	3.91	0.00014 ***
PC3	-0.928	1.731	-0.54	0.59241
PC4	-1.595	1.849	-0.86	0.38941
PC5	5.184	1.950	2.66	0.00858 **

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 28.4 on 171 degrees of freedom

Multiple R-squared: 0.126, Adjusted R-squared: 0.101

F-statistic: 4.94 on 5 and 171 DF, p-value: 0.000298

```
stargazer(reg_dPoint_01,reg_dPoint_02,reg_dPoint_03,type = "html",
  title= "表 3 主成分回帰の慶應と対戦相手の得点差に対する効果の比較",
  out="pca_reg_dPoint.html")
```

```
<table style="text-align:center"><caption><strong>表 3 主成分回帰の慶應と
対戦相手の得点差に対する効果の比較</strong></caption>
<tr><td colspan="4" style="border-bottom: 1px solid black"></td></tr><tr>
<td style="text-align:left"></td><td colspan="3"><em>Dependent variable:<
/em></td></tr>
<tr><td></td><td colspan="3" style="border-bottom: 1px solid black"></td>
</tr>
<tr><td style="text-align:left"></td><td>y_ttl</td><td>y_AT</td><td>y_DF<
/td></tr>
<tr><td style="text-align:left"></td><td>(1)</td><td>(2)</td><td>(3)</td>
</tr>
<tr><td colspan="4" style="border-bottom: 1px solid black"></td></tr><tr>
<td style="text-align:left">PC1</td><td>0.839</td><td>0.283</td><td>-1.09
0</td></tr>
<tr><td style="text-align:left"></td><td>(0.801)</td><td>(0.881)</td><td>
(0.938)</td></tr>
<tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
<tr><td style="text-align:left">PC2</td><td>-0.592</td><td>-0.889</td><td>
5.750<sup>***</sup></td></tr>
```

```

<tr><td style="text-align:left"></td><td>(1.180)</td><td>(1.130)</td><td>
(1.470)</td></tr>
<tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
<tr><td style="text-align:left">PC3</td><td>1.830</td><td>-4.070<sup>***<
/sup></td><td>-0.928</td></tr>
<tr><td style="text-align:left"></td><td>(1.340)</td><td>(1.340)</td><td>
(1.730)</td></tr>
<tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
<tr><td style="text-align:left">PC4</td><td>1.940</td><td>-0.239</td><td>
-1.600</td></tr>
<tr><td style="text-align:left"></td><td>(1.410)</td><td>(1.480)</td><td>
(1.850)</td></tr>
<tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
<tr><td style="text-align:left">PC5</td><td>-1.280</td><td>5.210<sup>***<
/sup></td><td>5.180<sup>***</sup></td></tr>
<tr><td style="text-align:left"></td><td>(1.530)</td><td>(1.650)</td><td>
(1.950)</td></tr>
<tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
<tr><td style="text-align:left">Constant</td><td>5.960<sup>**</sup></td><td>
5.690<sup>***</sup></td><td>5.550<sup>**</sup></td></tr>
<tr><td style="text-align:left"></td><td>(2.300)</td><td>(2.080)</td><td>
(2.130)</td></tr>
<tr><td style="text-align:left"></td><td></td><td></td><td></td></tr>
<tr><td colspan="4" style="border-bottom: 1px solid black"></td></tr>
<tr>
<td style="text-align:left">Observations</td><td>169</td><td>183</td><td>
177</td></tr>
<tr><td style="text-align:left">R<sup>2</sup></td><td>0.034</td><td>0.102
</td><td>0.126</td></tr>
<tr><td style="text-align:left">Adjusted R<sup>2</sup></td><td>0.005</td>
<td>0.076</td><td>0.101</td></tr>
<tr><td style="text-align:left">Residual Std. Error</td><td>29.900 (df =
163)</td><td>28.200 (df = 177)</td><td>28.400 (df = 171)</td></tr>
<tr><td style="text-align:left">F Statistic</td><td>1.160 (df = 5; 163)</
td><td>4.000<sup>***</sup> (df = 5; 177)</td><td>4.940<sup>***</sup> (df
= 5; 171)</td></tr>
<tr><td colspan="4" style="border-bottom: 1px solid black"></td></tr>
<tr>
<td style="text-align:left"><em>Note:</em></td><td colspan="3" style="tex
t-align:right"><sup>*</sup>p<0.1; <sup>**</sup>p<0.05; <sup>***</sup>p<0.
01</td></tr>
</table>

```

htmltools::includeHTML("pca_reg_dPoint.html")

表3 主成分回帰の慶應と対戦相手の得点差に対する効果の比較

Dependent variable:

	y_ttl (1)	y_AT (2)	y_DF (3)
PC1	0.839 (0.801)	0.283 (0.881)	-1.090 (0.938)
PC2	-0.592 (1.180)	-0.889 (1.130)	5.750*** (1.470)
PC3	1.830 (1.340)	-4.070*** (1.340)	-0.928 (1.730)
PC4	1.940 (1.410)	-0.239 (1.480)	-1.600 (1.850)
PC5	-1.280 (1.530)	5.210*** (1.650)	5.180*** (1.950)
Constant	5.960** (2.300)	5.690*** (2.080)	5.550** (2.130)
Observations	169	183	177
R ²	0.034	0.102	0.126
Adjusted R ²	0.005	0.076	0.101
Residual Std. Error	29.900 (df = 163)	28.200 (df = 177)	28.400 (df = 171)
F Statistic	1.160 (df = 5; 163)	4.000*** (df = 5; 177)	4.940*** (df = 5; 171)

Note:

*p<0.1; **p<0.05; ***p<0.01

非線形効果の導入

```
gam01_K_ttl=gam(yK_ttl~s(PC1)+s(PC2)+s(PC3)+s(PC4)+s(PC5),data=as.data.frame(PC_total$x))
summary(gam01_K_ttl)
```

Family: gaussian
Link function: identity

Formula:

yK_ttl ~ s(PC1) + s(PC2) + s(PC3) + s(PC4) + s(PC5)

Parametric coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	36.9	1.6	23	<2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

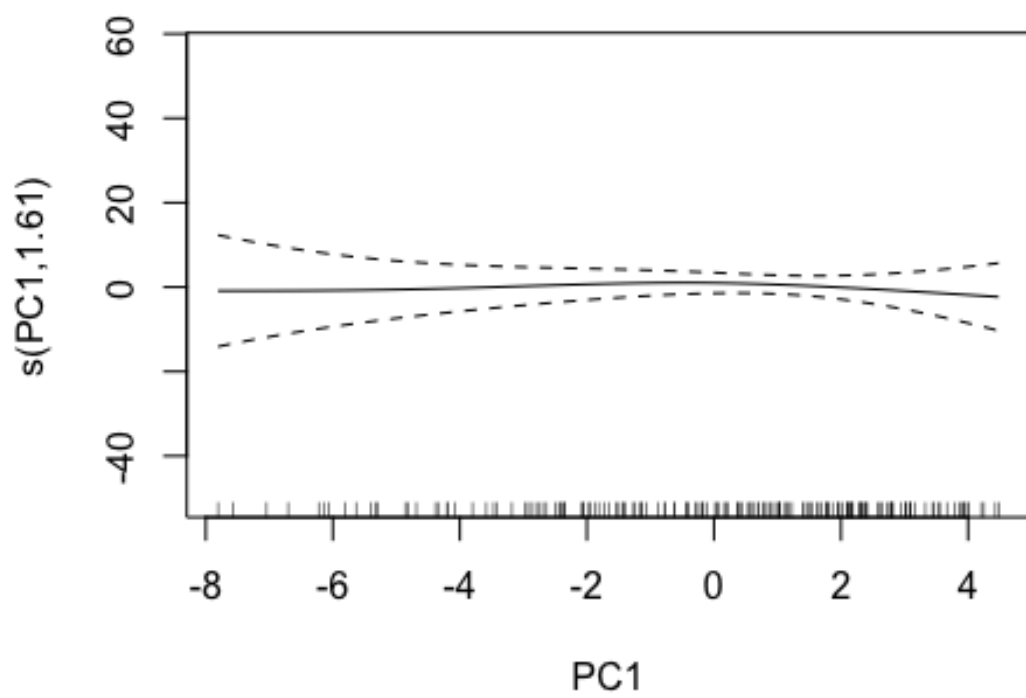
Approximate significance of smooth terms:

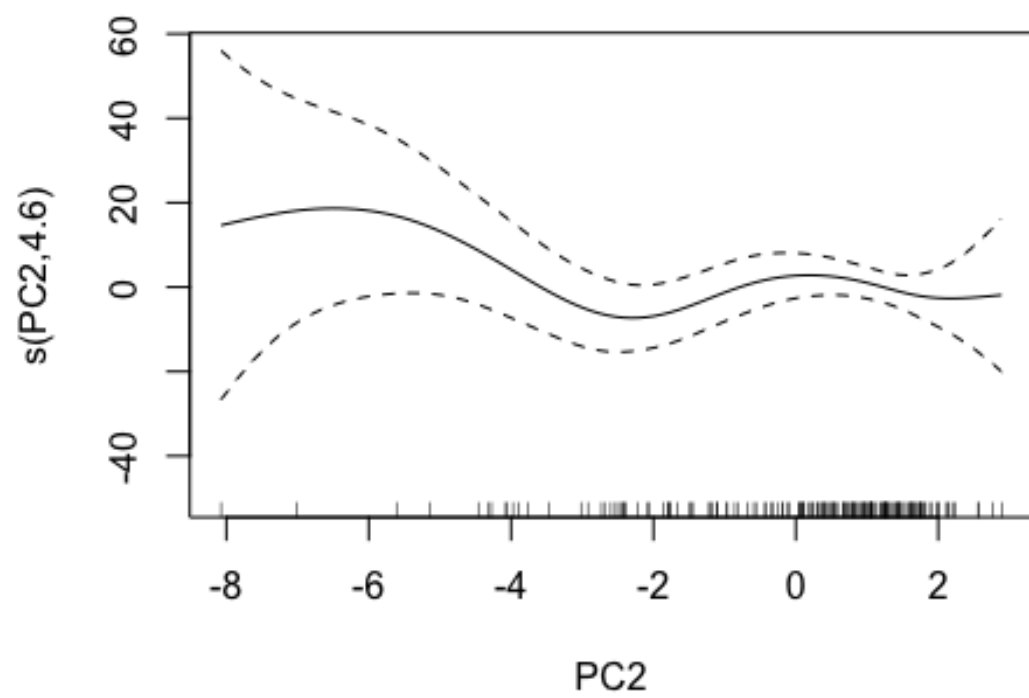
	edf	Ref.df	F	p-value
s(PC1)	1.61	2.00	0.24	0.79
s(PC2)	4.60	5.63	1.37	0.24
s(PC3)	2.56	3.26	1.66	0.19
s(PC4)	1.87	2.38	0.89	0.39
s(PC5)	1.00	1.00	2.40	0.12

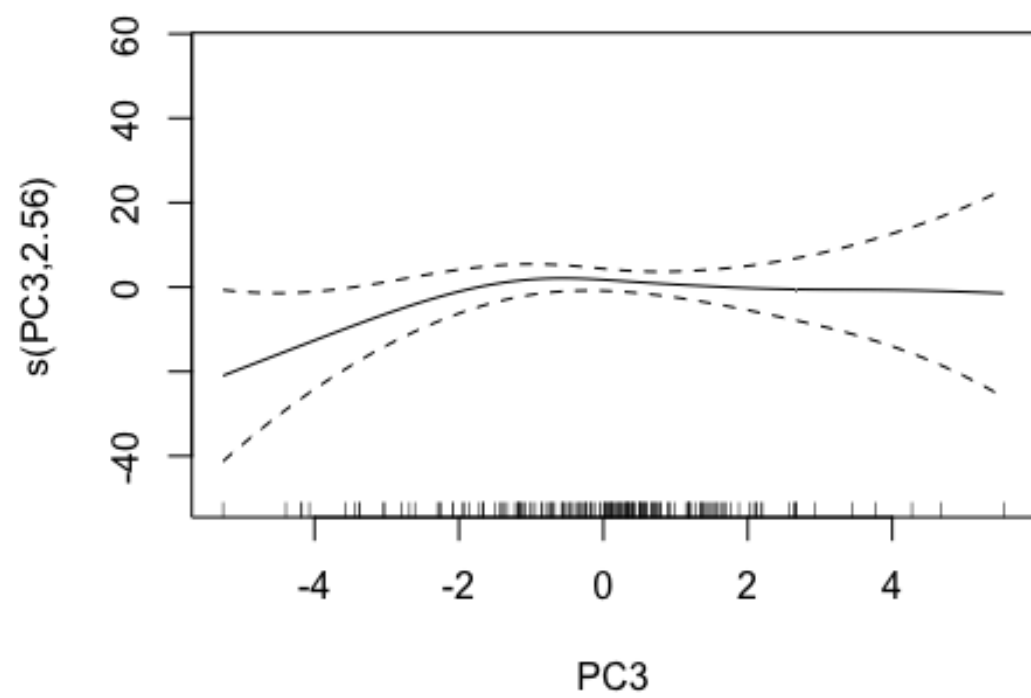
R-sq.(adj) = 0.0717 Deviance explained = 13.6%

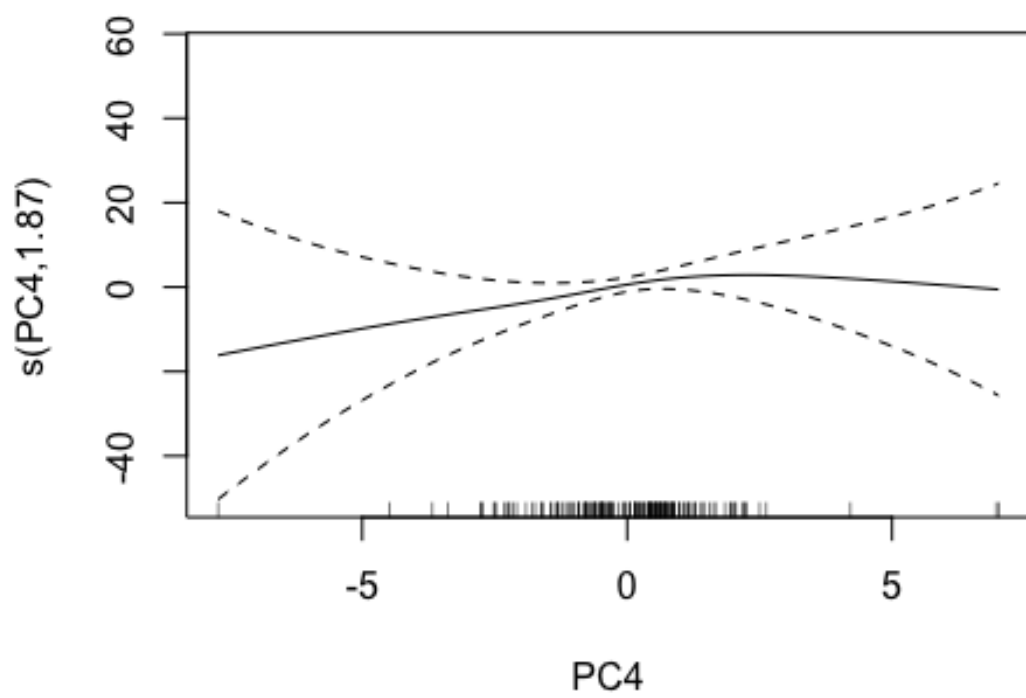
GCV = 467.87 Scale est. = 432.87 n = 169

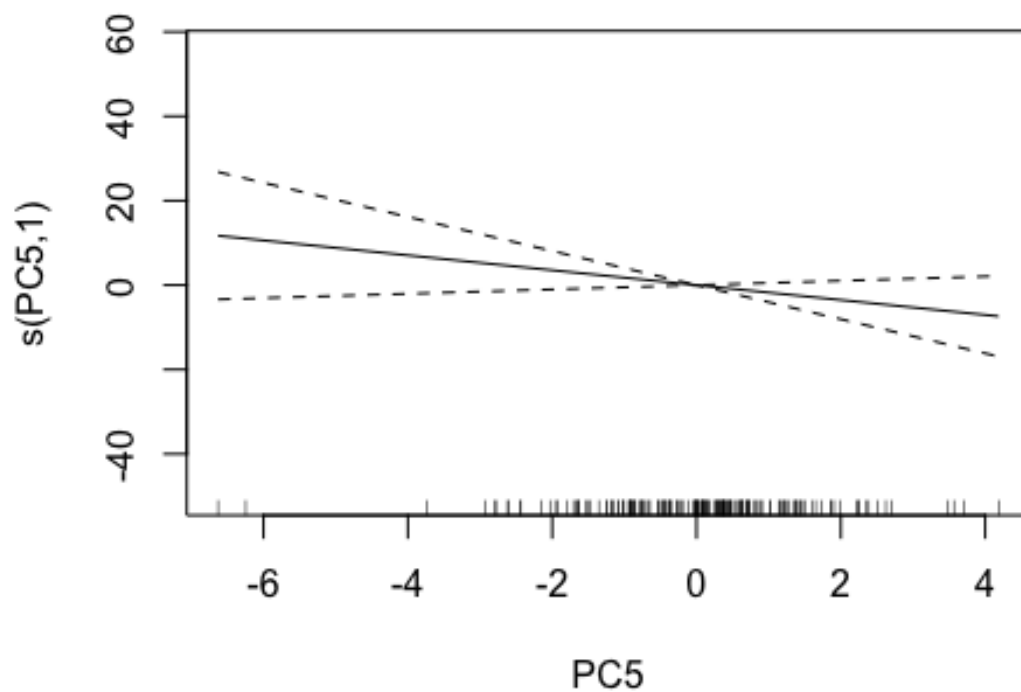
`plot(gam01_K_ttl)`











```
gam01_K_AT=gam(yK_AT~s(PC1)+s(PC2)+s(PC3)+s(PC4)+s(PC5),data=as.data.frame(PC_AT$x))
summary(gam01_K_AT)
```

Family: gaussian
Link function: identity

Formula:
yK_AT ~ s(PC1) + s(PC2) + s(PC3) + s(PC4) + s(PC5)

Parametric coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	36.8	1.5	24.5	<2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Approximate significance of smooth terms:

	edf	Ref.df	F	p-value
s(PC1)	1.00	1.00	0.00	0.973

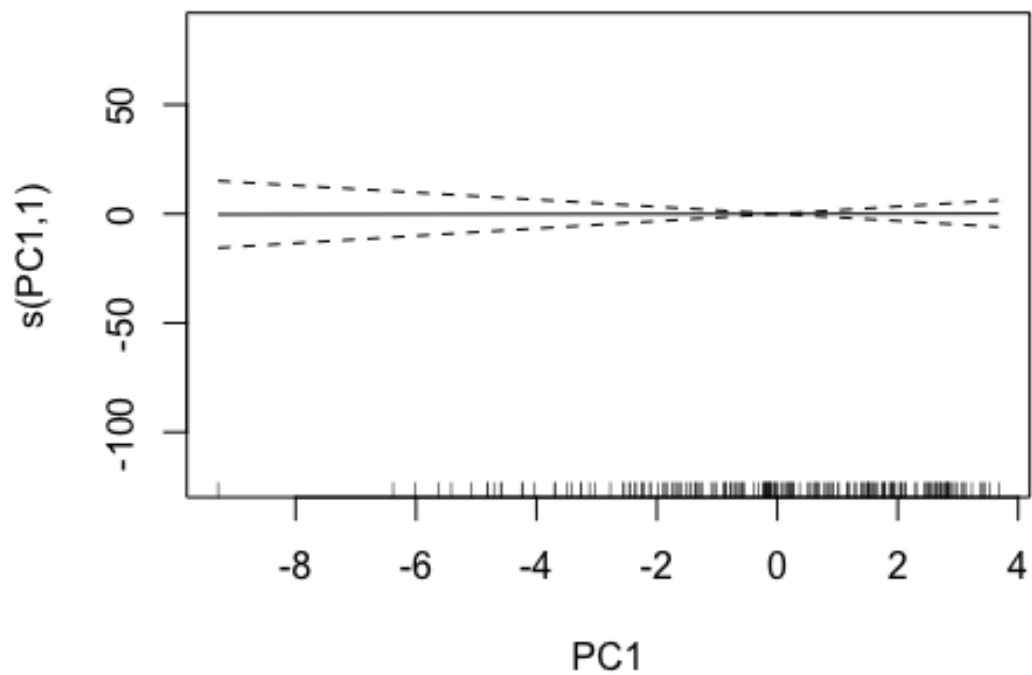
```

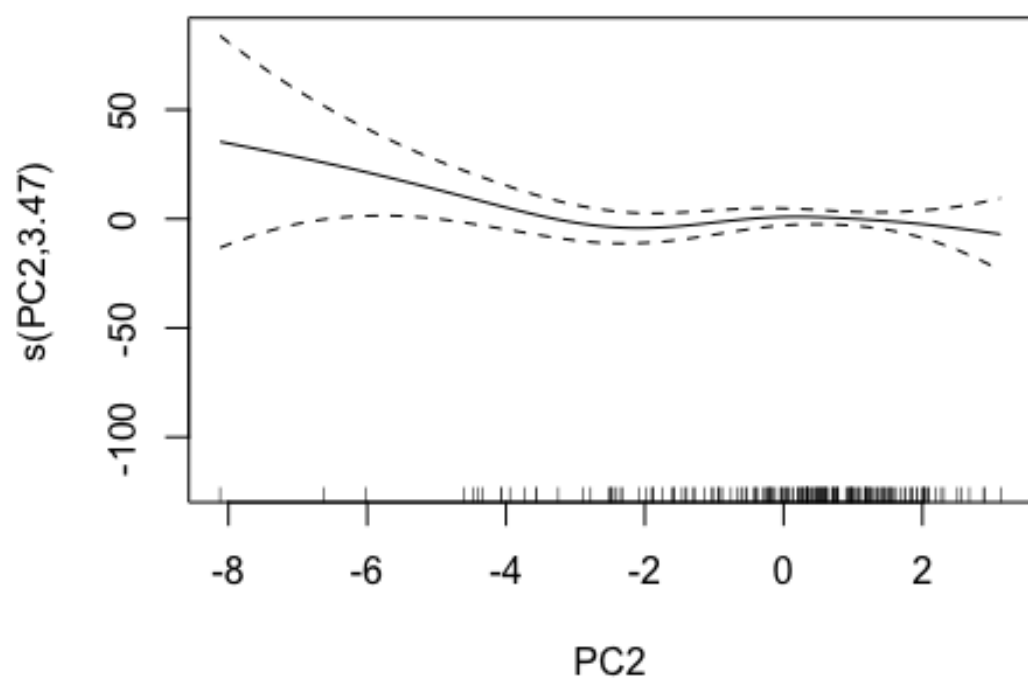
s(PC2) 3.47    4.36 1.63    0.239
s(PC3) 6.77    7.81 1.99    0.048 *
s(PC4) 1.00    1.00 0.03    0.862
s(PC5) 1.00    1.00 6.46    0.012 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

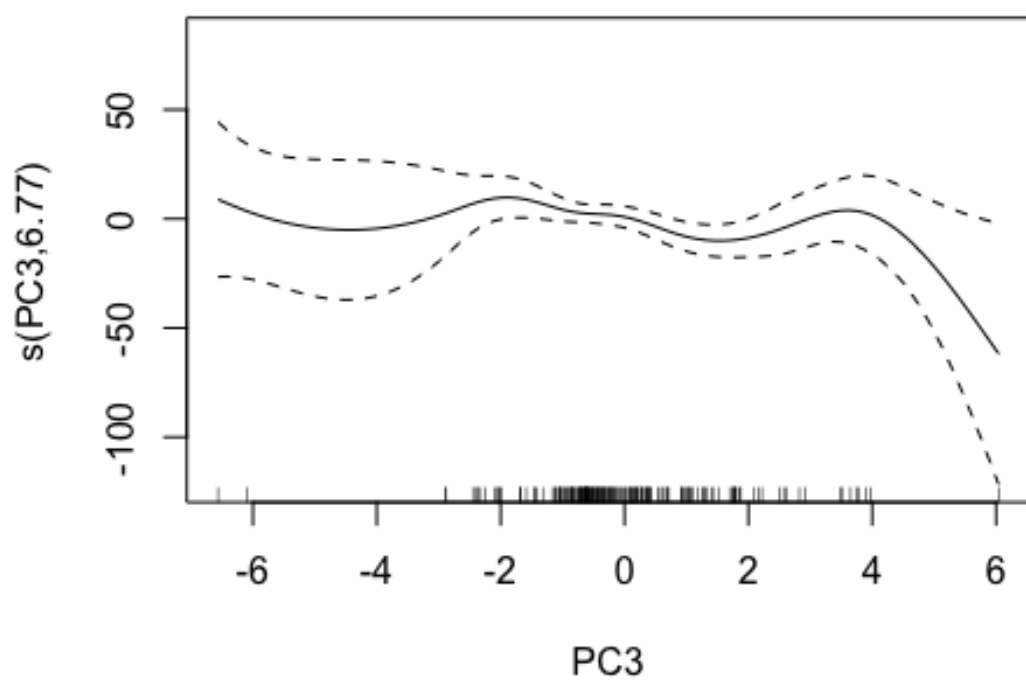
R-sq.(adj) =  0.0944   Deviance explained =   16%
GCV = 446.81   Scale est. = 412.03      n = 183

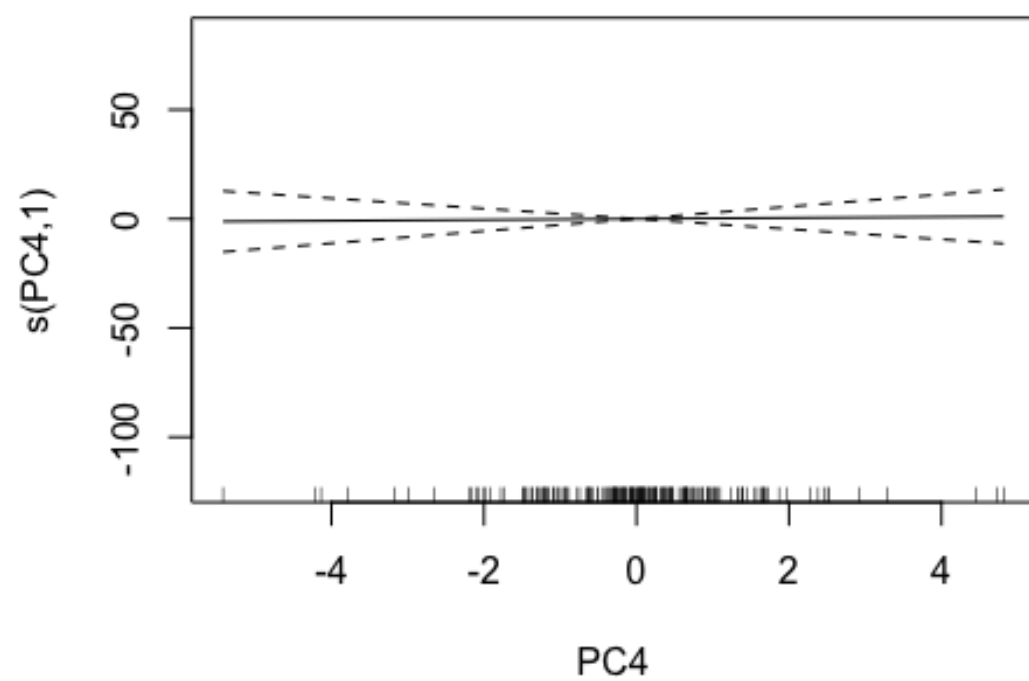
plot(gam01_K_AT)

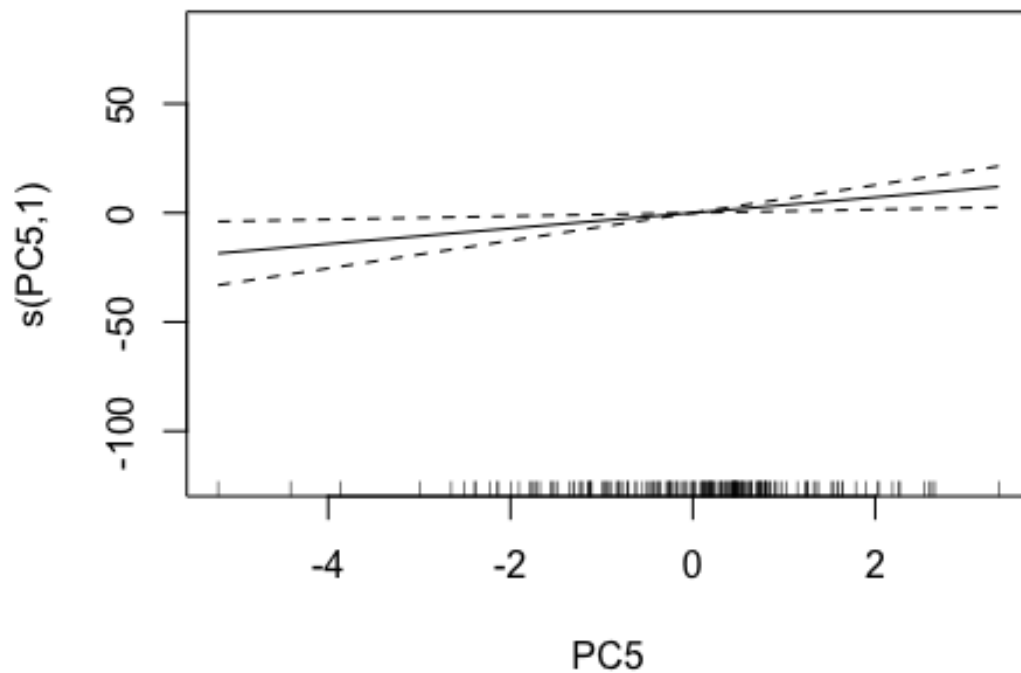
```











```
gam01_K_DF=gam(yK_DF~s(PC1)+s(PC2)+s(PC3)+s(PC4)+s(PC5),data=as.data.frame(PC_DF$x))
summary(gam01_K_DF)
```

Family: gaussian
Link function: identity

Formula:
yK_DF ~ s(PC1) + s(PC2) + s(PC3) + s(PC4) + s(PC5)

Parametric coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	36.64	1.49	24.6	<2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Approximate significance of smooth terms:

	edf	Ref.df	F	p-value
s(PC1)	3.62	4.50	1.23	0.27581

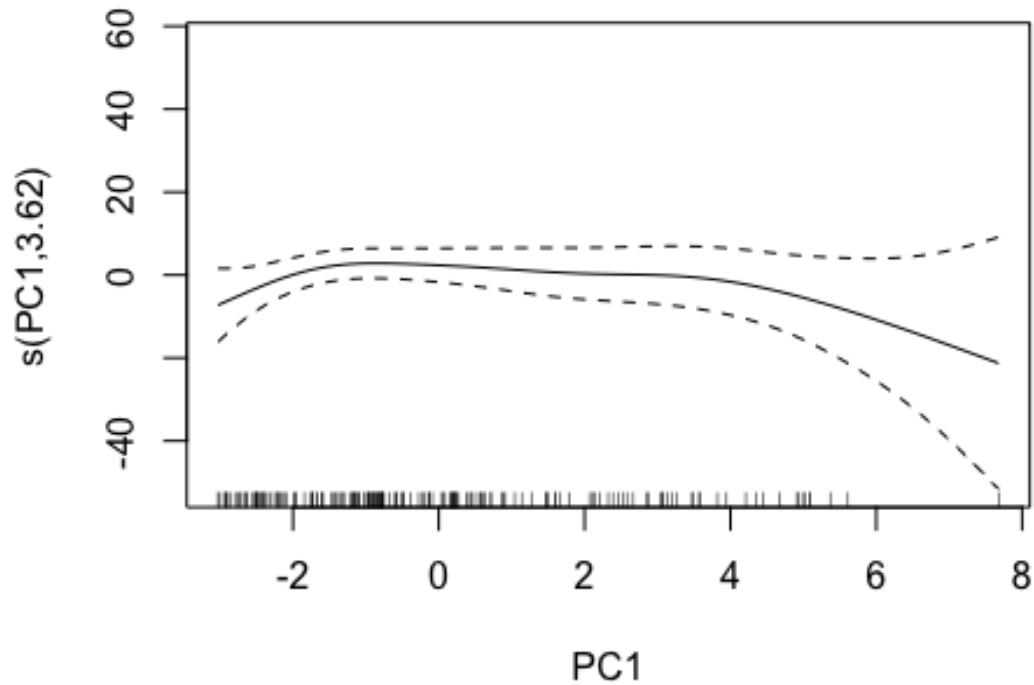
```

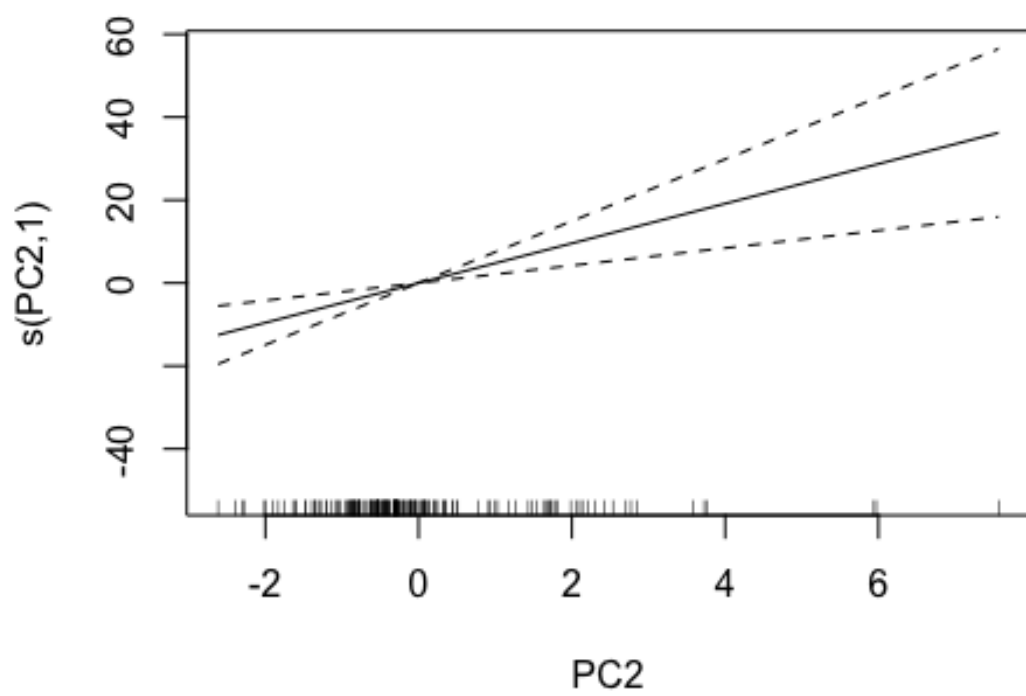
s(PC2) 1.00    1.00 12.78 0.00046 ***
s(PC3) 3.10    3.94  1.48 0.25023
s(PC4) 1.79    2.31  1.00 0.36213
s(PC5) 2.97    3.78  2.01 0.08529 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

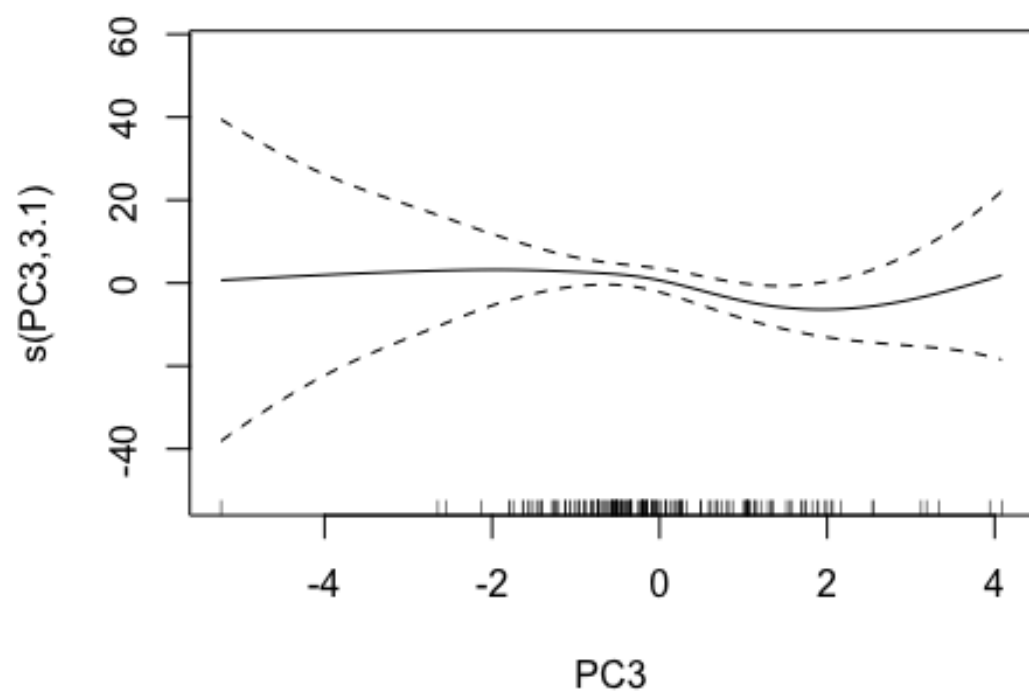
R-sq.(adj) =  0.163   Deviance explained = 22.2%
GCV = 423.8   Scale est. = 391.53    n = 177

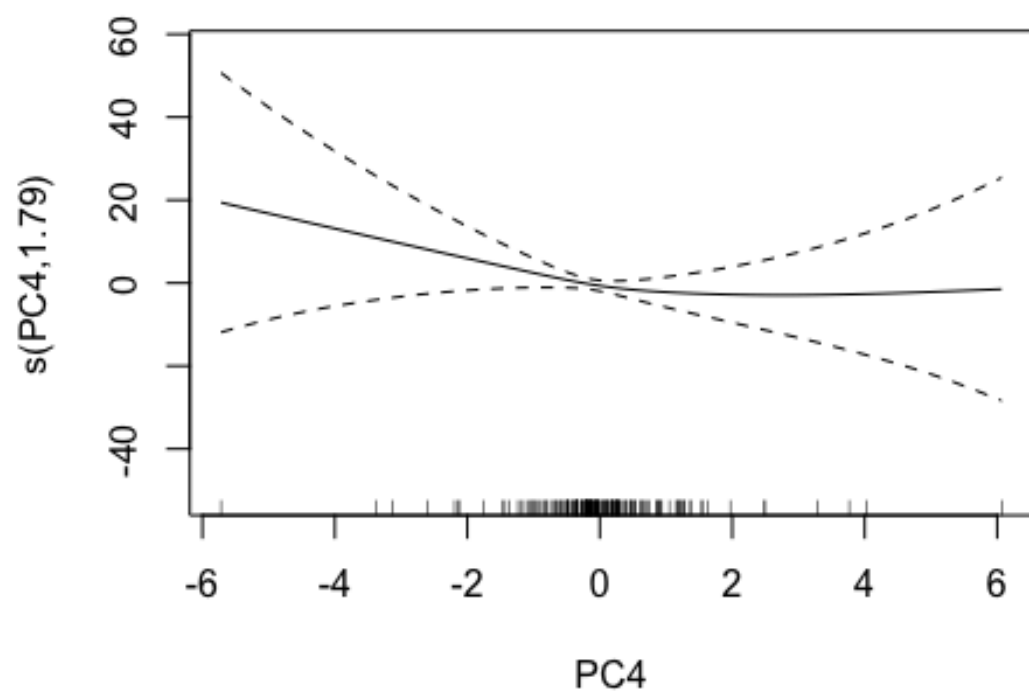
plot(gam01_K_DF)

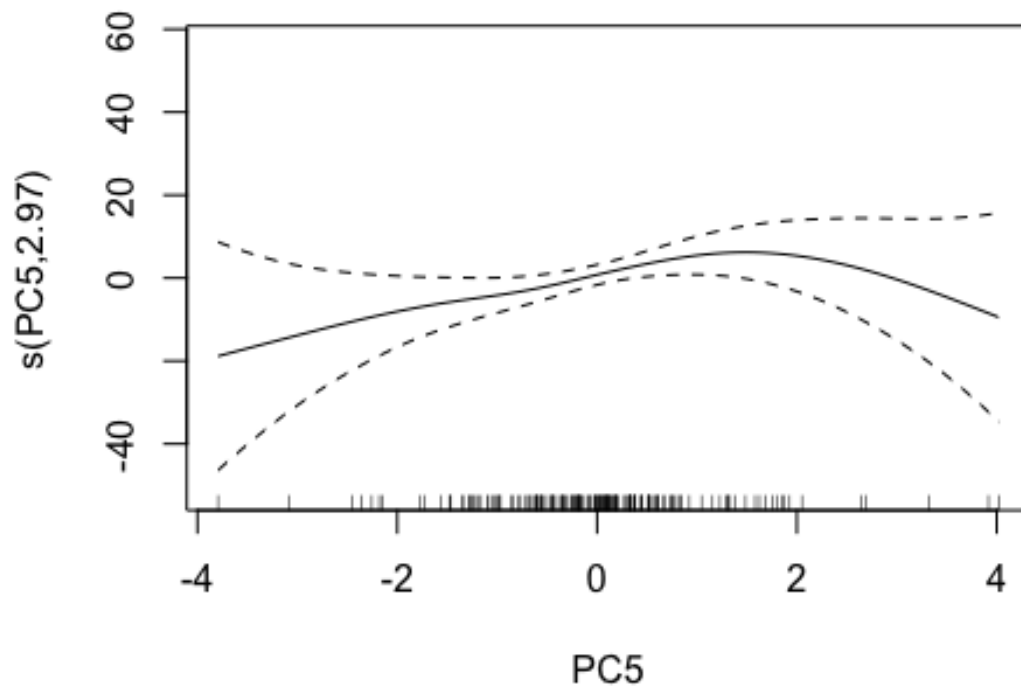
```











```
gam01_0_ttl=gam(y0_ttl~s(PC1)+s(PC2)+s(PC3)+s(PC4)+s(PC5),data=as.data.frame(PC_total$x))
summary(gam01_0_ttl)
```

Family: gaussian
Link function: identity

Formula:
y0_ttl ~ s(PC1) + s(PC2) + s(PC3) + s(PC4) + s(PC5)

Parametric coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	30.89	0.74	41.8	<2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Approximate significance of smooth terms:

	edf	Ref.df	F	p-value
s(PC1)	3.97	4.92	1.34	0.2738

```

s(PC2) 2.77    3.50 1.34  0.2369
s(PC3) 5.77    6.93 2.52  0.0178 *
s(PC4) 1.00    1.00 9.23  0.0028 **
s(PC5) 3.20    4.03 0.98  0.4141

```

```
---
```

```

Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

R-sq.(adj) =  0.164   Deviance explained = 24.7%

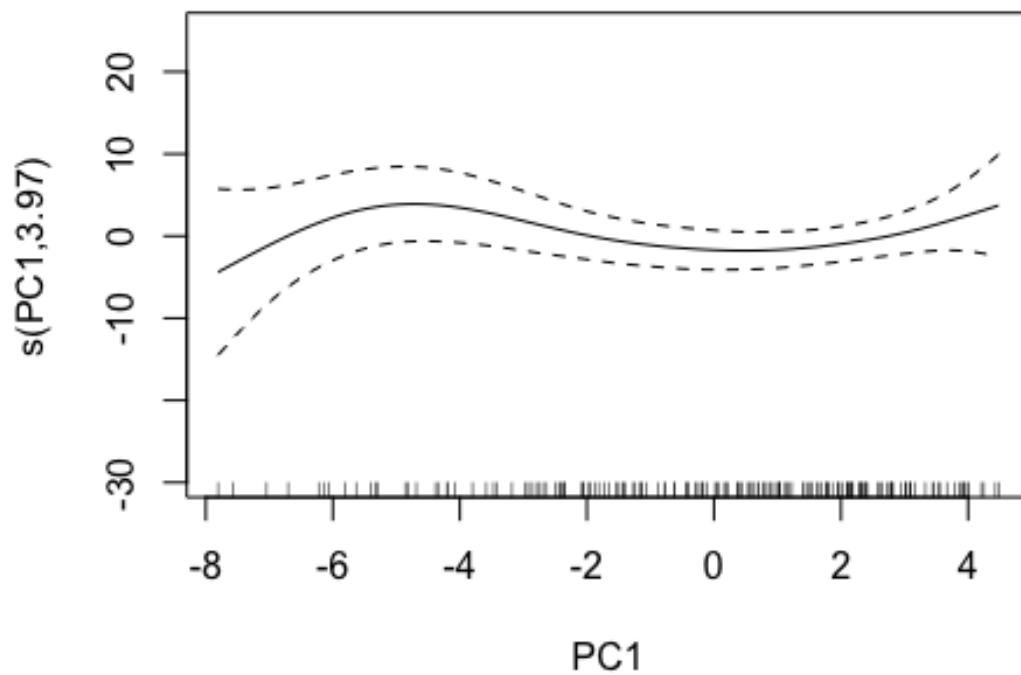
```

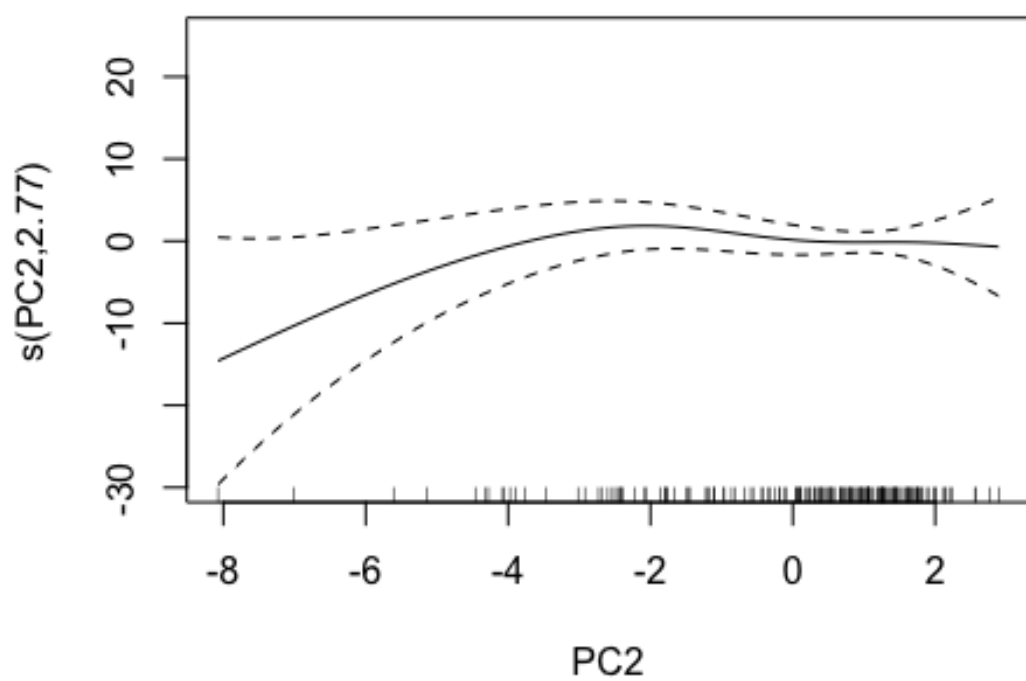
```

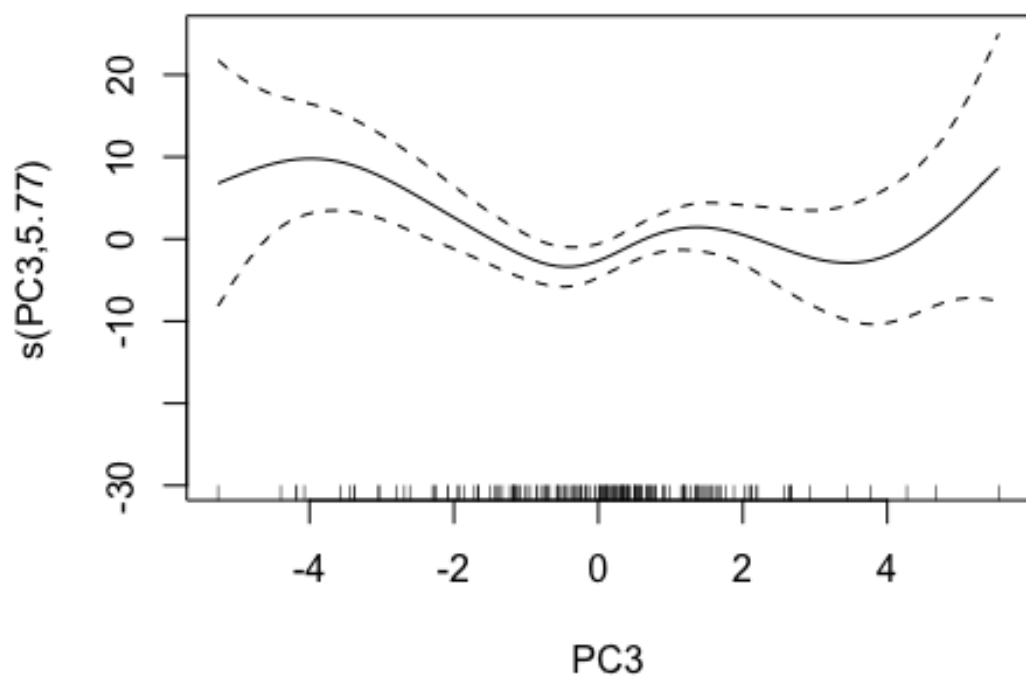
GCV = 103.36   Scale est. = 92.533       n = 169

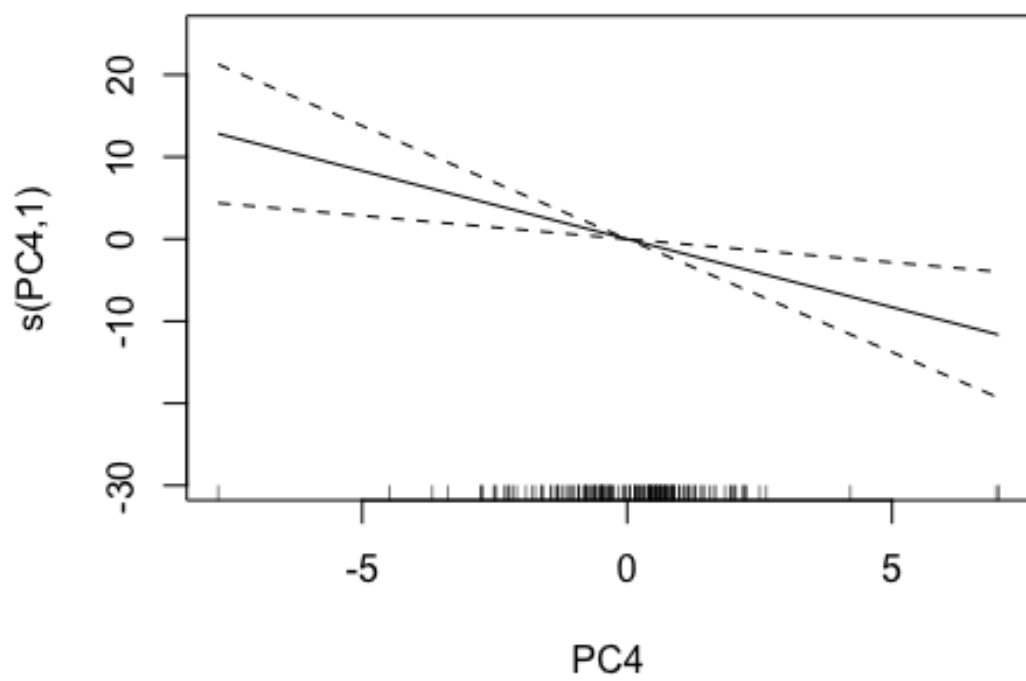
```

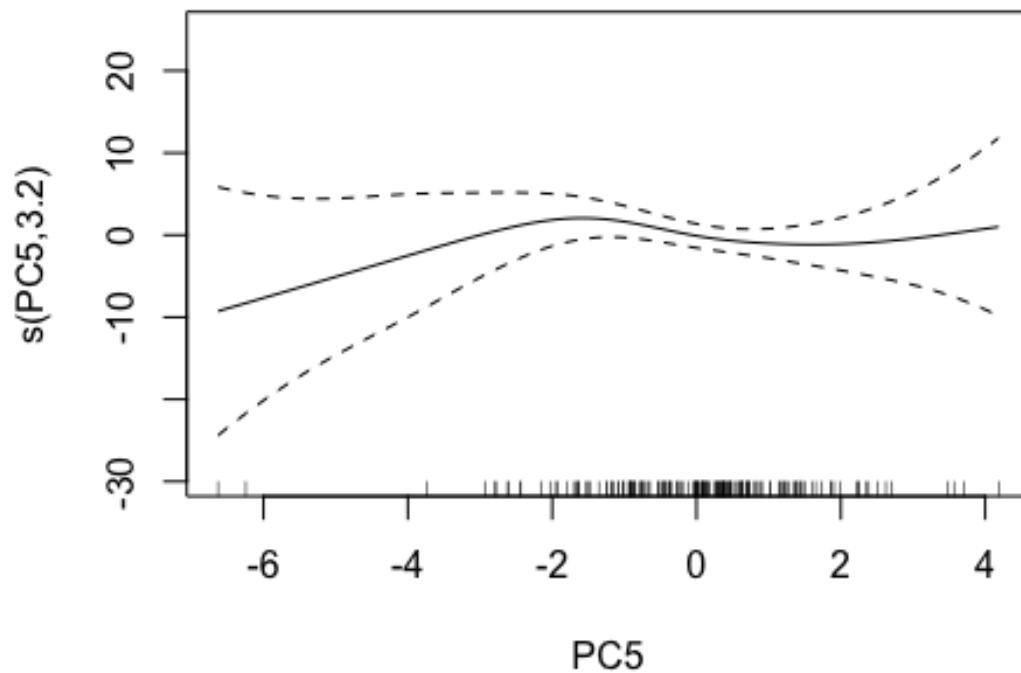
```
plot(gam01_0_ttl)
```











```
gam01_0_AT=gam(y0_AT~s(PC1)+s(PC2)+s(PC3)+s(PC4)+s(PC5),data=as.data.frame(PC_AT$x))
summary(gam01_0_AT)
```

Family: gaussian
Link function: identity

Formula:
y0_AT ~ s(PC1) + s(PC2) + s(PC3) + s(PC4) + s(PC5)

Parametric coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	31.131	0.697	44.7	<2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Approximate significance of smooth terms:

	edf	Ref.df	F	p-value
s(PC1)	1.50	1.85	0.30	0.6803

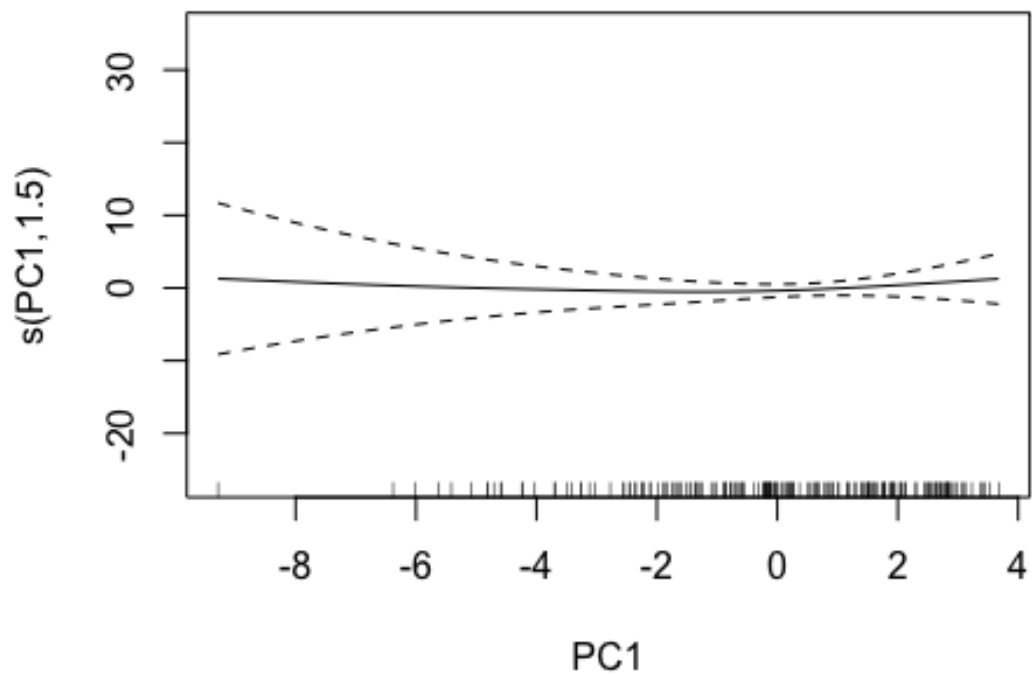
```

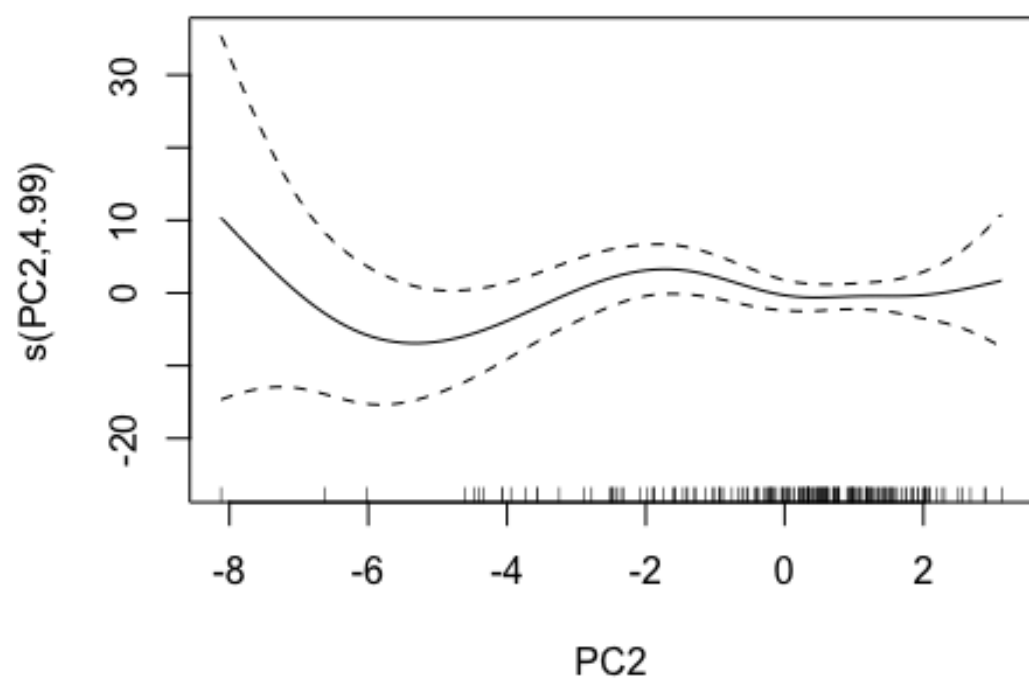
s(PC2) 4.99    6.03    1.17    0.3226
s(PC3) 3.28    4.09    4.68    0.0012 **
s(PC4) 1.00    1.00    0.03    0.8600
s(PC5) 1.00    1.00   16.07    9.2e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

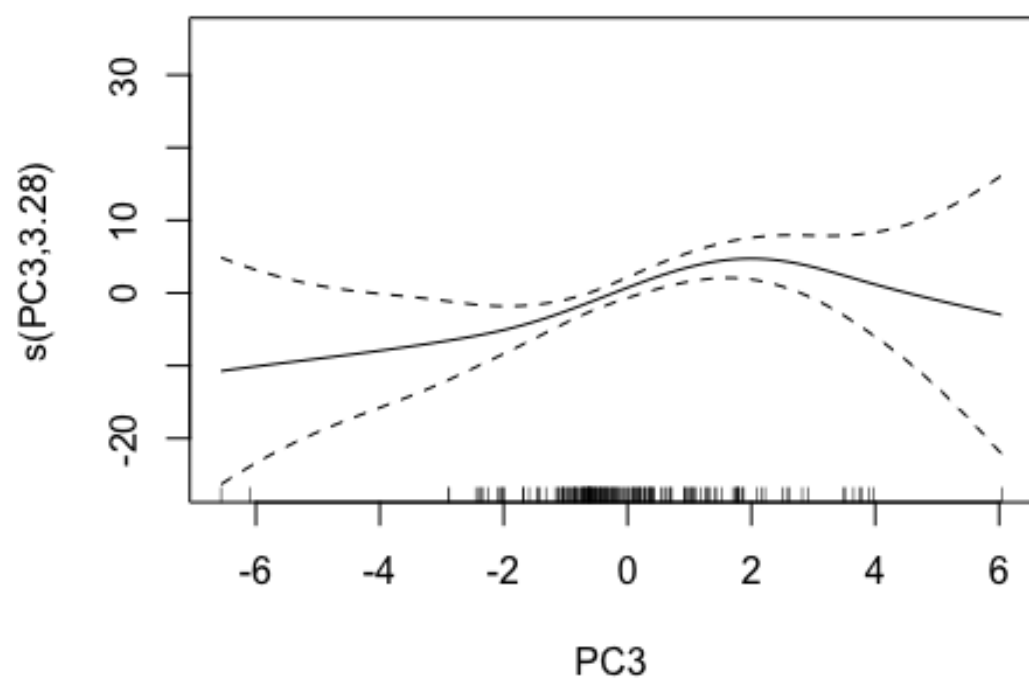
R-sq.(adj) =  0.16   Deviance explained = 21.4%
GCV = 95.444   Scale est. = 88.781    n = 183

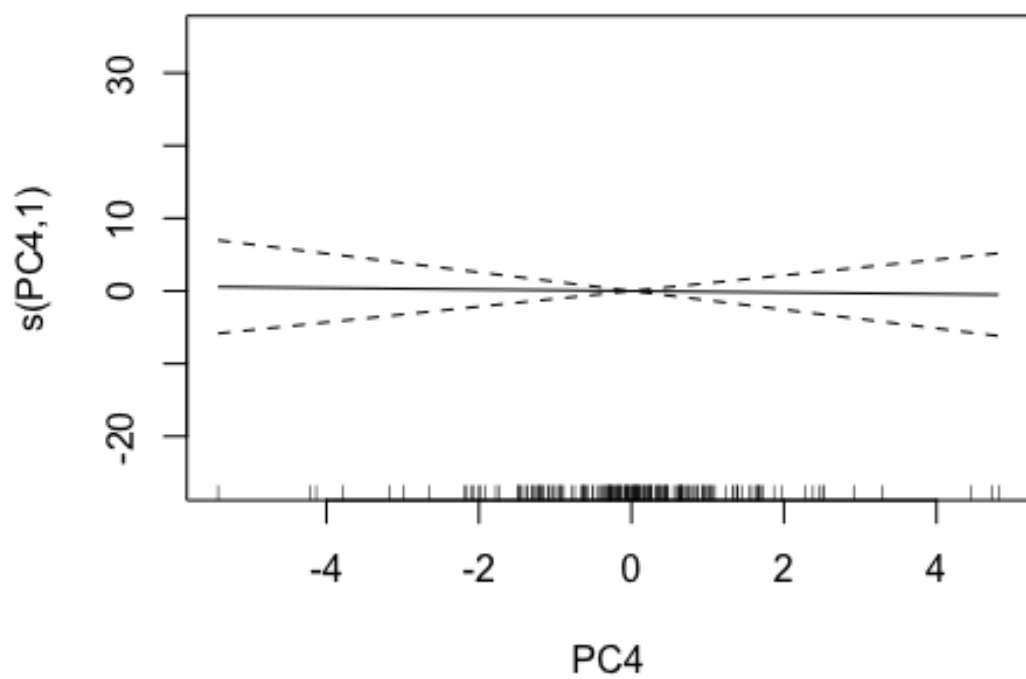
plot(gam01_0_AT)

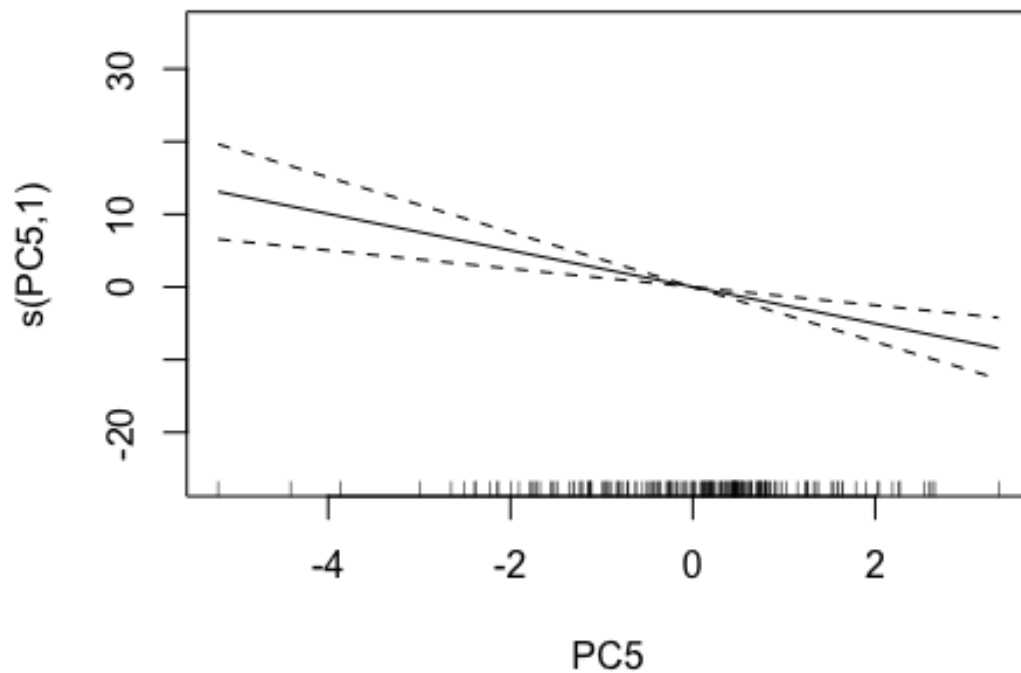
```











```
gam01_0_DF=gam(y0_DF~s(PC1)+s(PC2)+s(PC3)+s(PC4)+s(PC5),data=as.data.frame(PC_DF$x))
summary(gam01_0_DF)
```

Family: gaussian
Link function: identity

Formula:
y0_DF ~ s(PC1) + s(PC2) + s(PC3) + s(PC4) + s(PC5)

Parametric coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	31.096	0.734	42.4	<2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Approximate significance of smooth terms:

	edf	Ref.df	F	p-value
s(PC1)	2.42	3.04	3.20	0.024 *

```
s(PC2) 1.00    1.00 0.09    0.759
s(PC3) 3.38    4.27 0.88    0.518
s(PC4) 2.85    3.68 2.41    0.058 .
s(PC5) 3.74    4.68 1.28    0.232
```

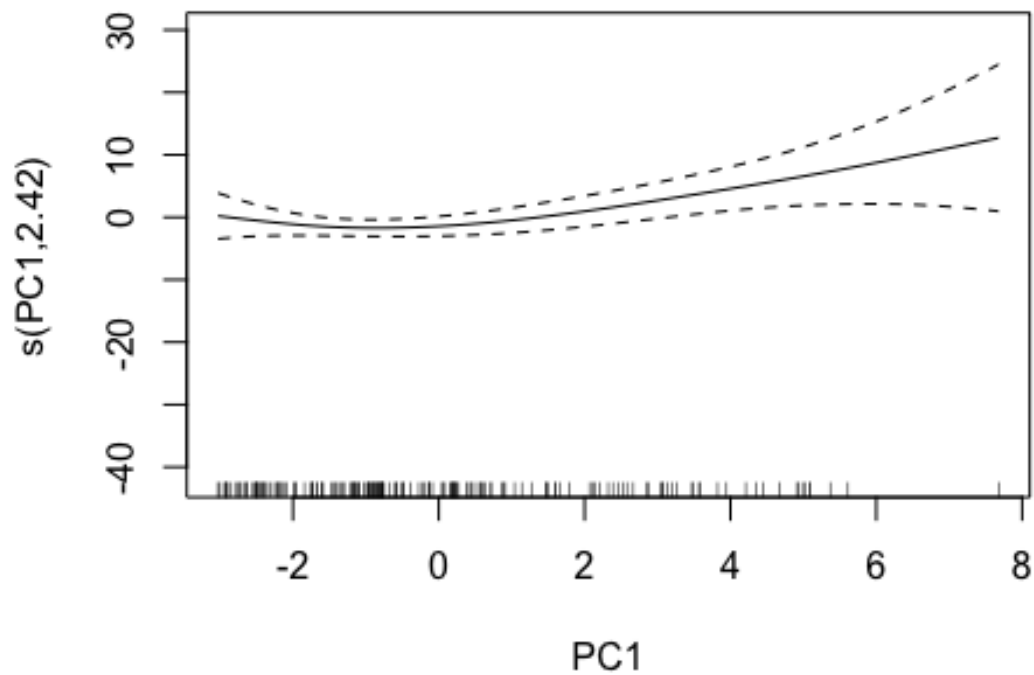
```
---
```

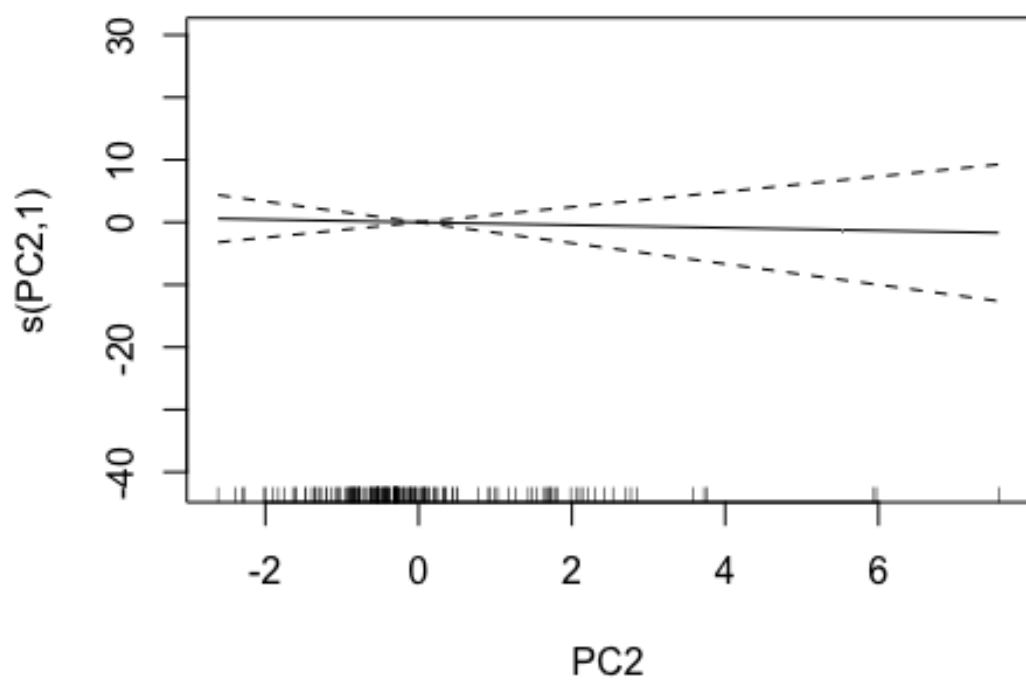
```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

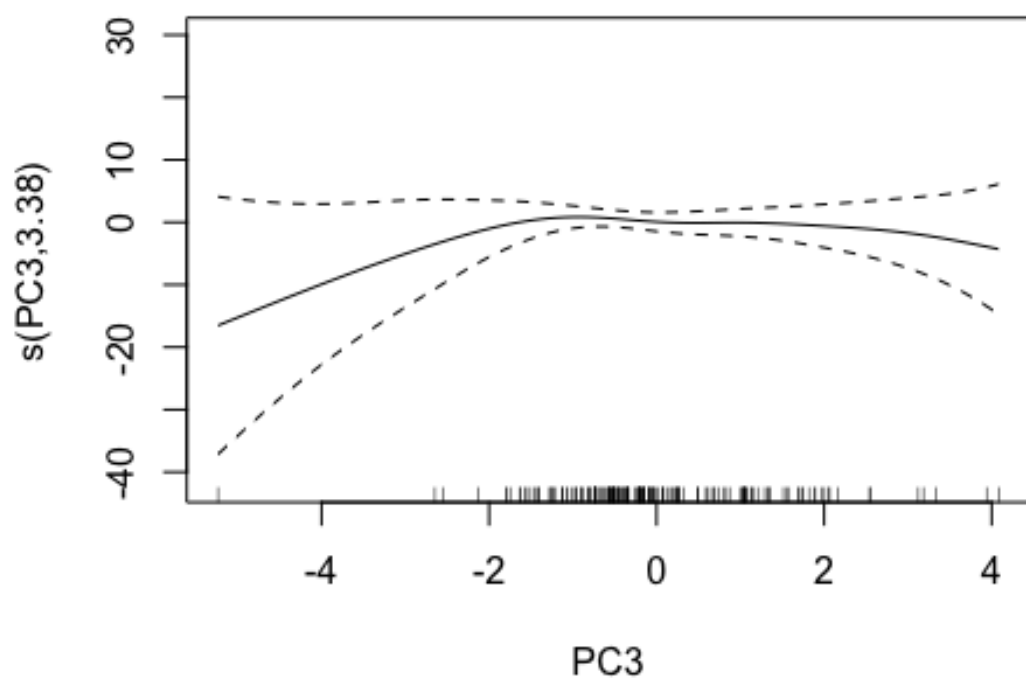
```
R-sq.(adj) =  0.14    Deviance explained = 20.5%
```

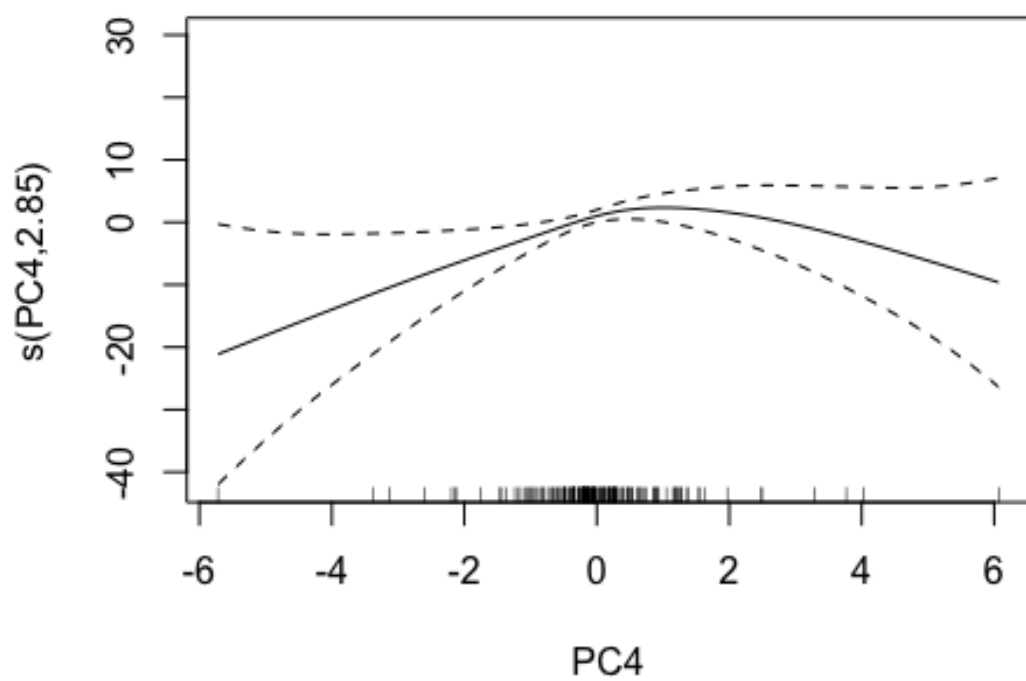
```
GCV = 103.81    Scale est. = 95.371      n = 177
```

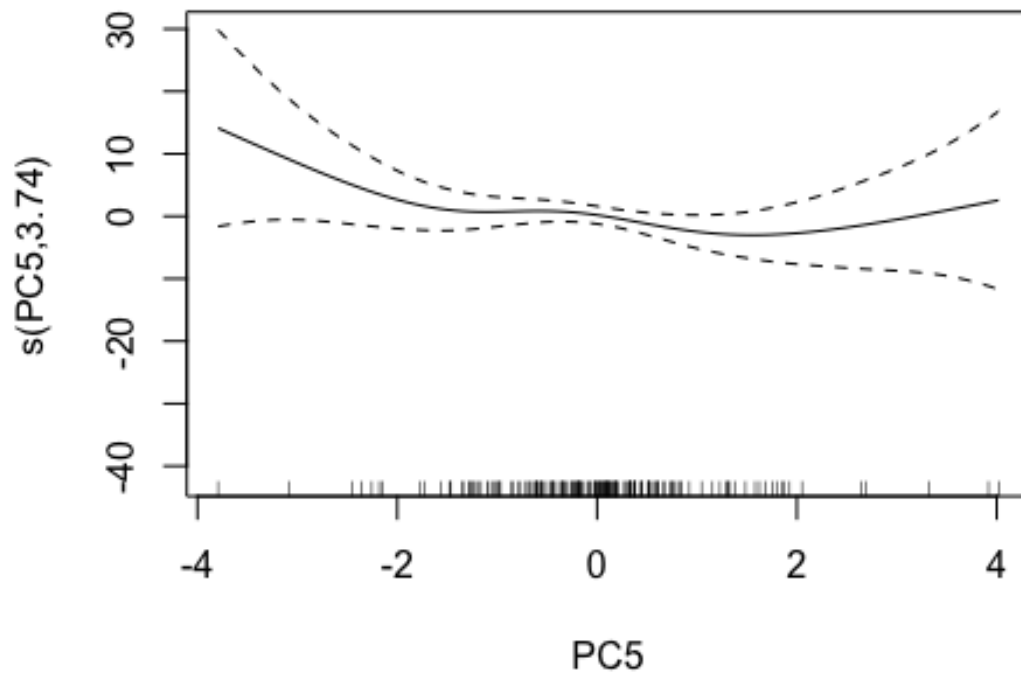
```
plot(gam01_0_DF)
```











```
gam01_d_ttl=gam(y_ttl~s(PC1)+s(PC2)+s(PC3)+s(PC4)+s(PC5),data=as.data.frame(PC_total$x))
summary(gam01_d_ttl)
```

Family: gaussian
Link function: identity

Formula:
y_ttl ~ s(PC1) + s(PC2) + s(PC3) + s(PC4) + s(PC5)

Parametric coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	5.96	2.15	2.77	0.0063 **

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Approximate significance of smooth terms:

	edf	Ref.df	F	p-value
s(PC1)	3.22	4.02	0.96	0.425

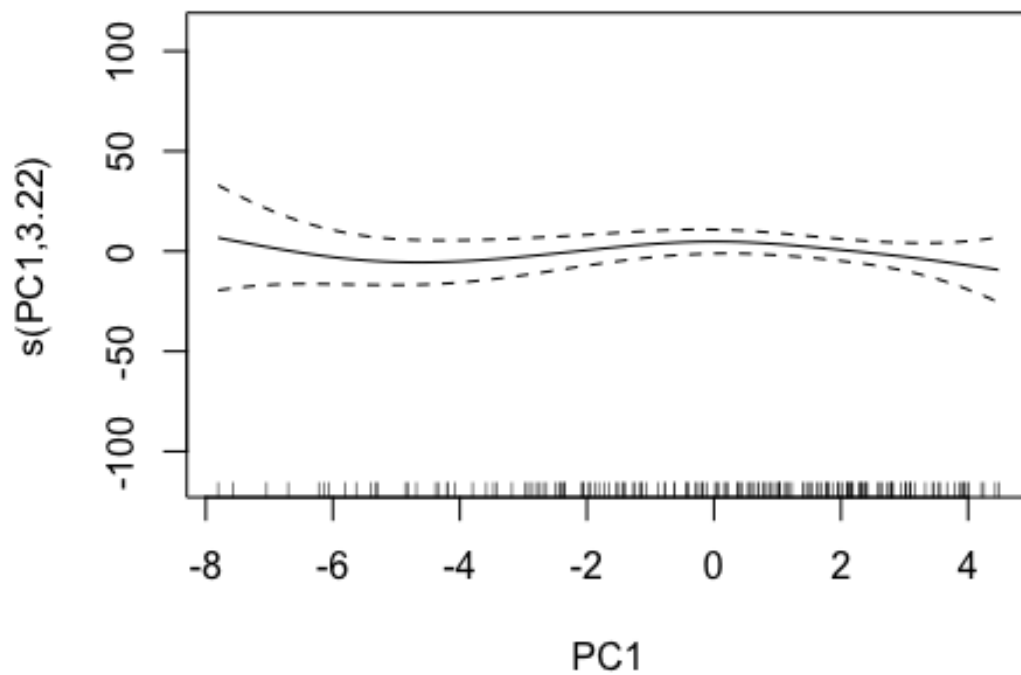
```

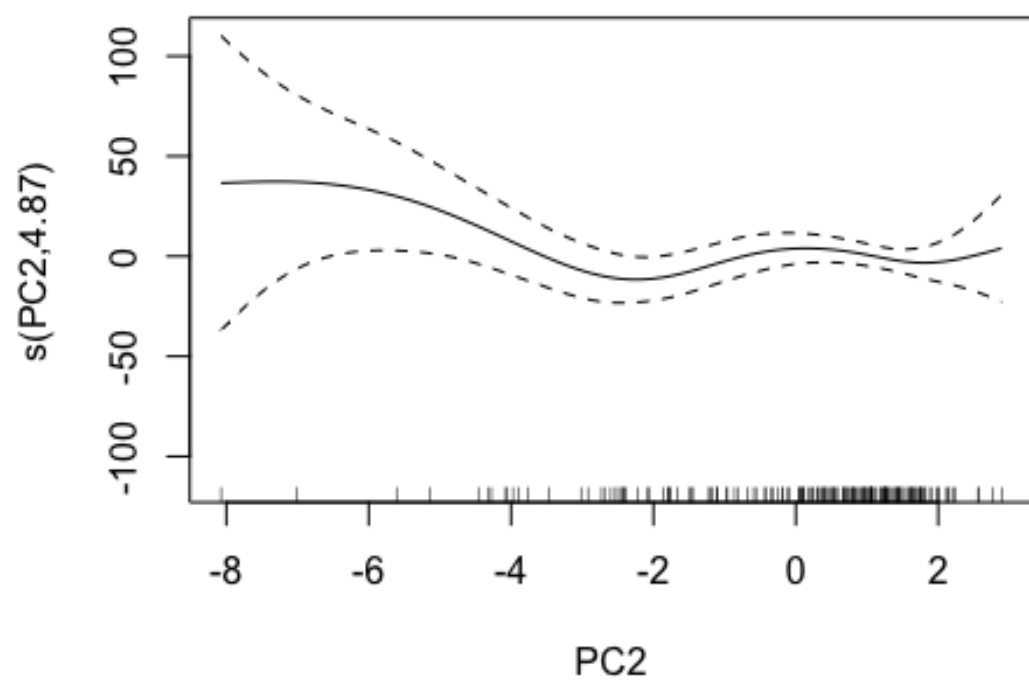
s(PC2) 4.87    5.91 1.71    0.121
s(PC3) 2.84    3.61 2.05    0.100
s(PC4) 4.03    4.97 1.92    0.089 .
s(PC5) 1.00    1.00 2.10    0.149
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

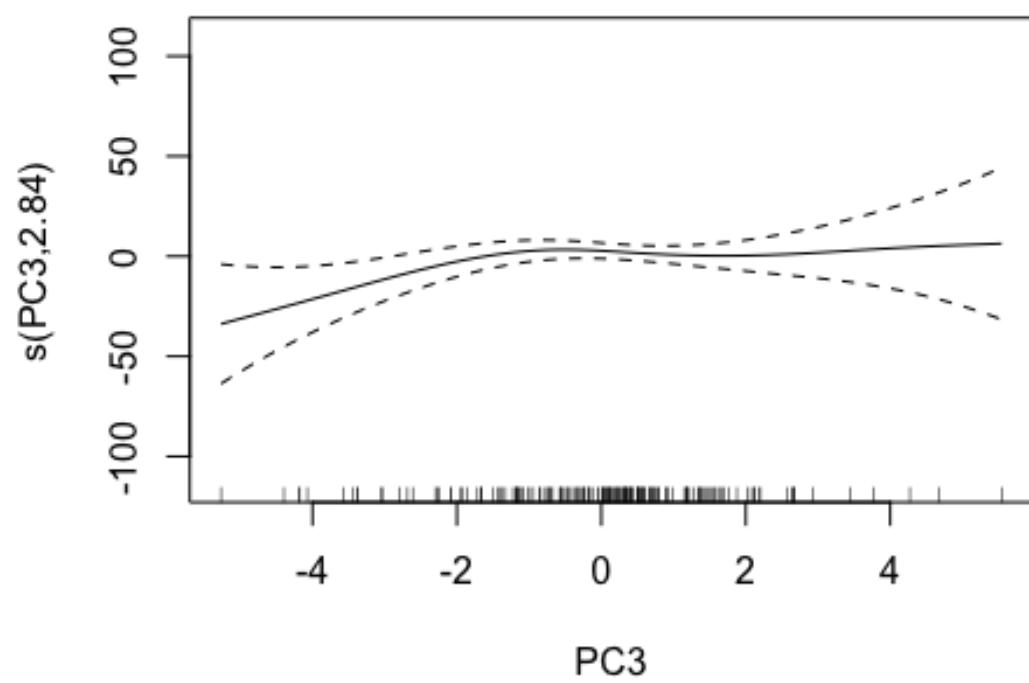
R-sq.(adj) =  0.126   Deviance explained = 20.9%
GCV = 870.16   Scale est. = 782.82    n = 169

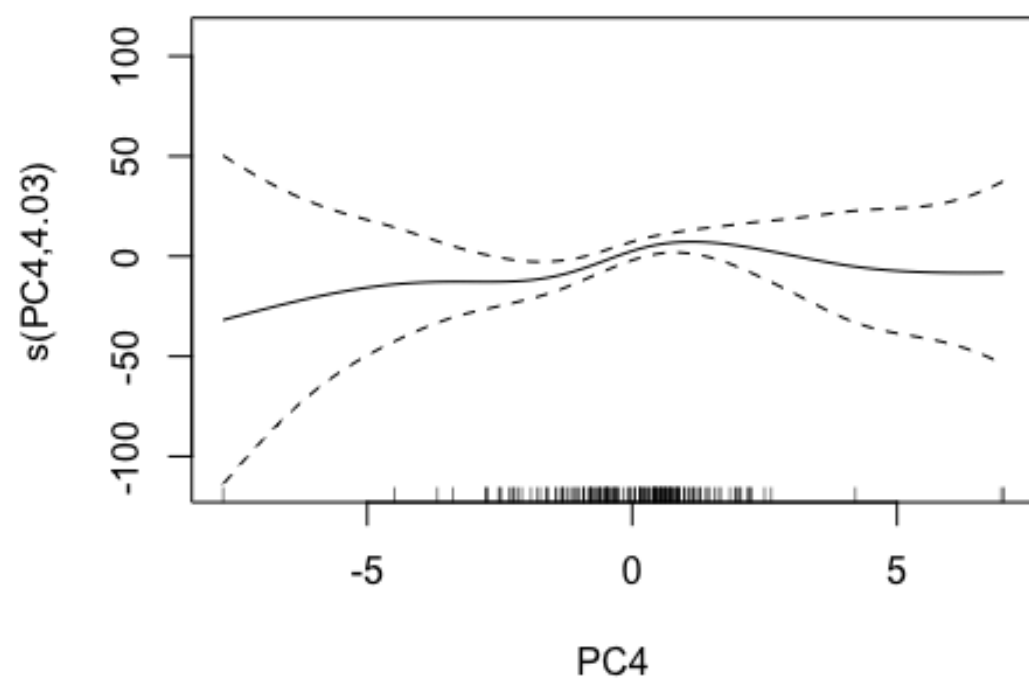
plot(gam01_d_ttl)

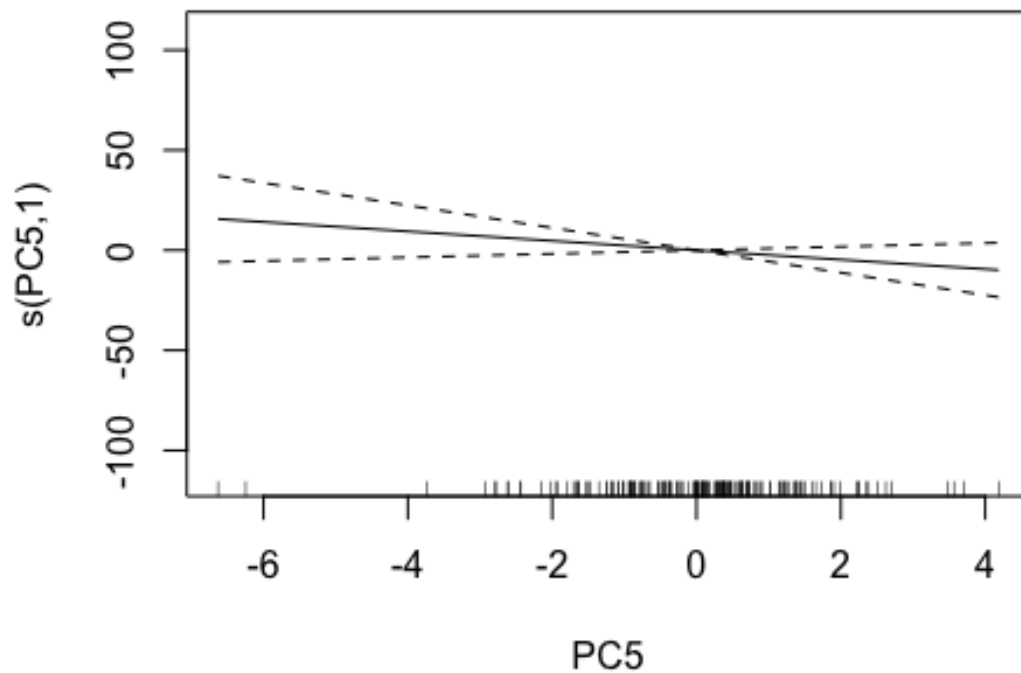
```











```
gam01_d_AT=gam(y_AT~s(PC1)+s(PC2)+s(PC3)+s(PC4)+s(PC5),data=as.data.frame
(PC_AT$x))
summary(gam01_d_AT)
```

Family: gaussian
Link function: identity

Formula:
y_AT ~ s(PC1) + s(PC2) + s(PC3) + s(PC4) + s(PC5)

Parametric coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	5.69	2.03	2.81	0.0056 **

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Approximate significance of smooth terms:

	edf	Ref.df	F	p-value
s(PC1)	1.21	1.39	0.05	0.9078

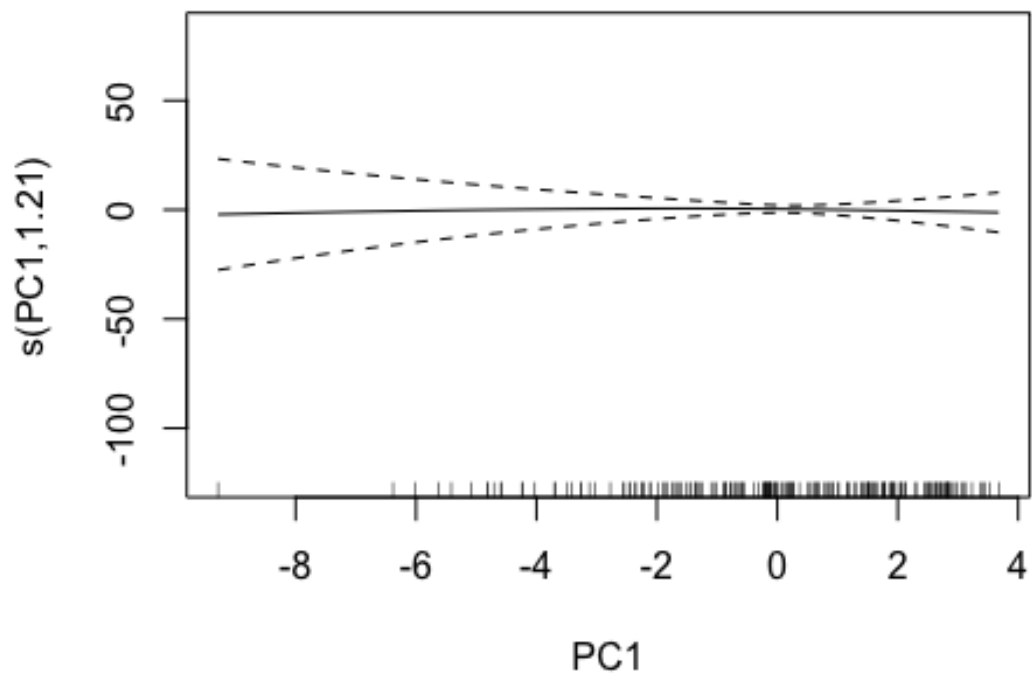
```

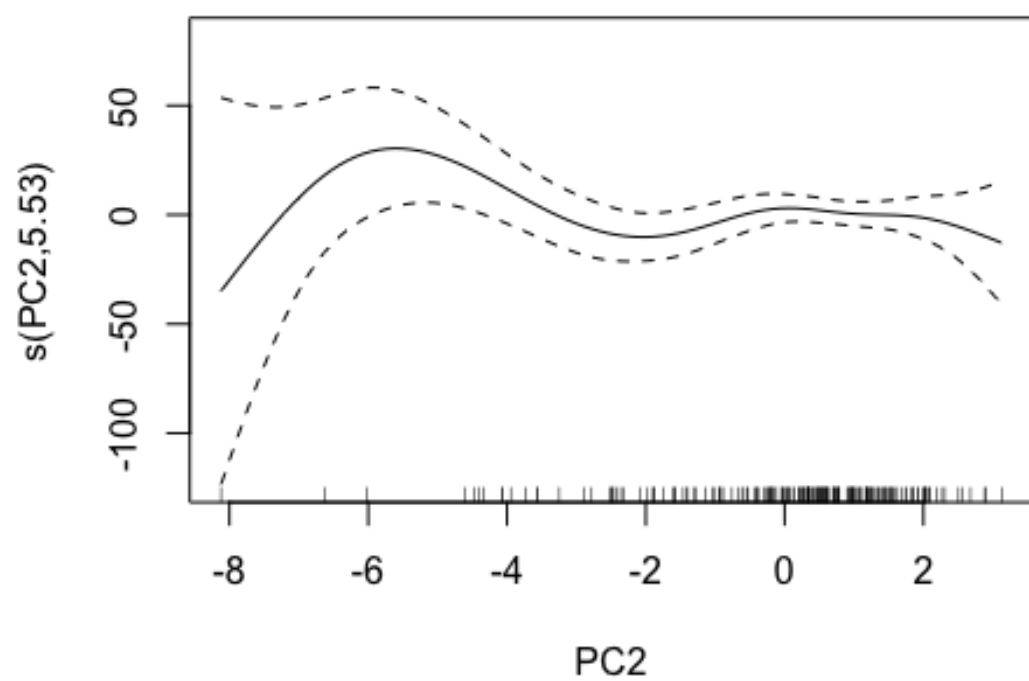
s(PC2) 5.53    6.62    1.50    0.1658
s(PC3) 3.91    4.71    2.84    0.0165 *
s(PC4) 1.00    1.00    0.00    0.9538
s(PC5) 1.00    1.00   10.75    0.0013 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

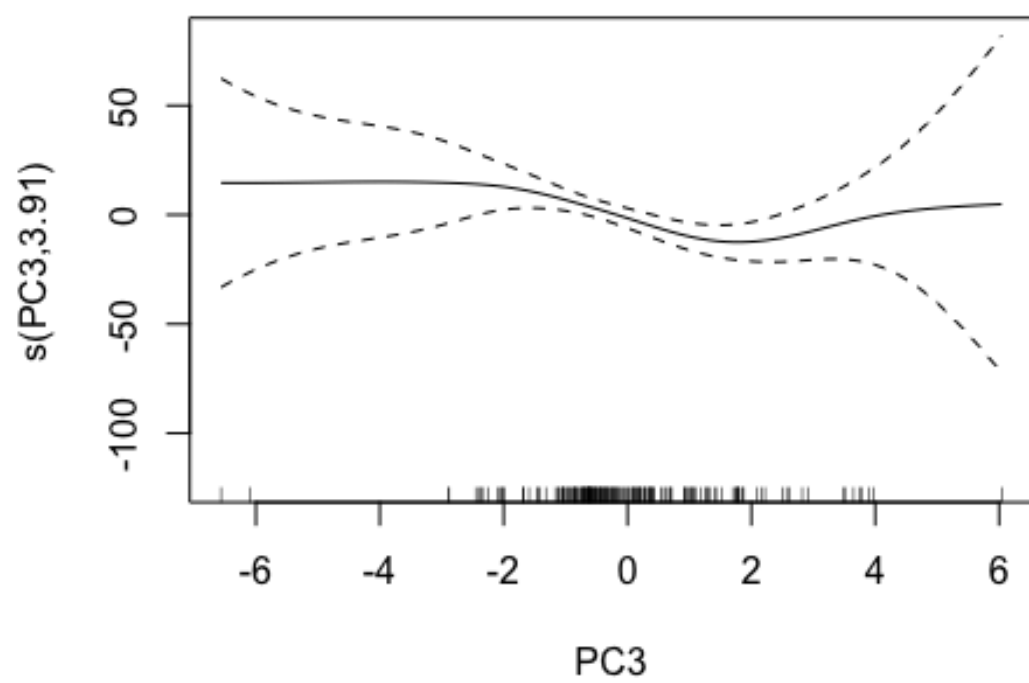
R-sq.(adj) =  0.128   Deviance explained = 18.8%
GCV = 811.72   Scale est. = 751.16      n = 183

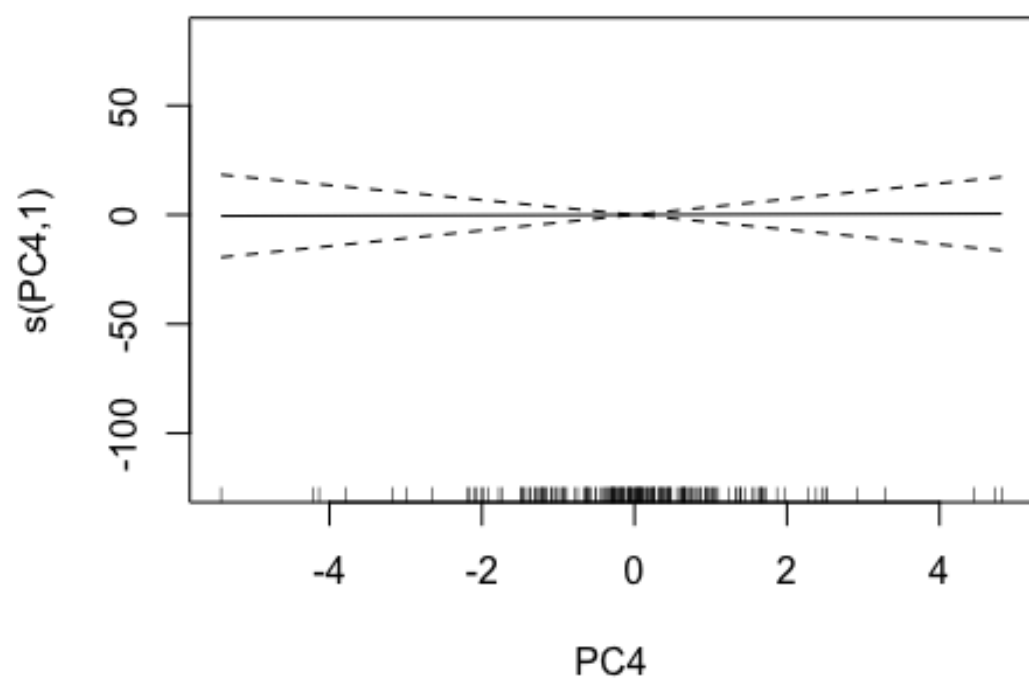
plot(gam01_d_AT)

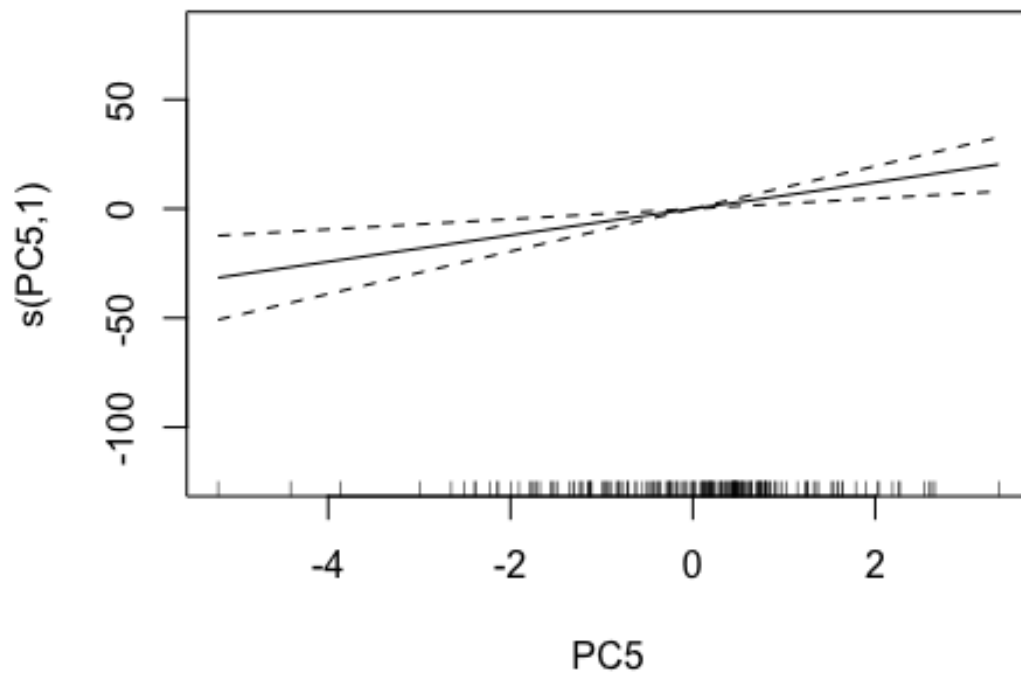
```











```
gam01_d_DF=gam(y_DF~s(PC1)+s(PC2)+s(PC3)+s(PC4)+s(PC5),data=as.data.frame
(PC_DF$x))
summary(gam01_d_DF)
```

Family: gaussian
Link function: identity

Formula:
y_DF ~ s(PC1) + s(PC2) + s(PC3) + s(PC4) + s(PC5)

Parametric coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	5.55	2.08	2.67	0.0083 **

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Approximate significance of smooth terms:

	edf	Ref.df	F	p-value
s(PC1)	2.36	2.98	1.76	0.1672

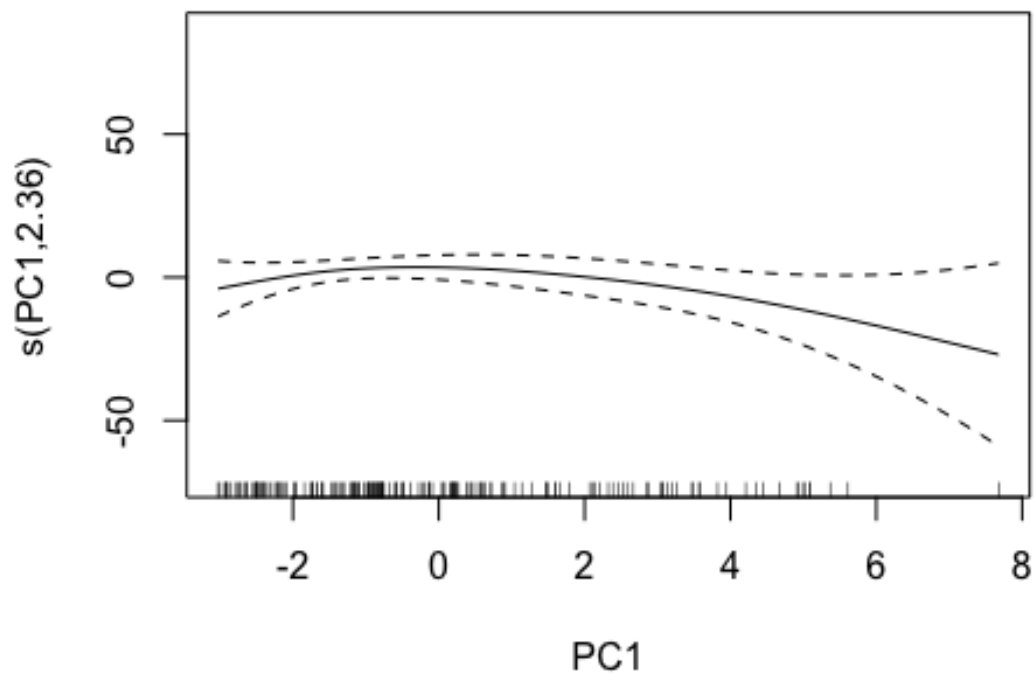
```

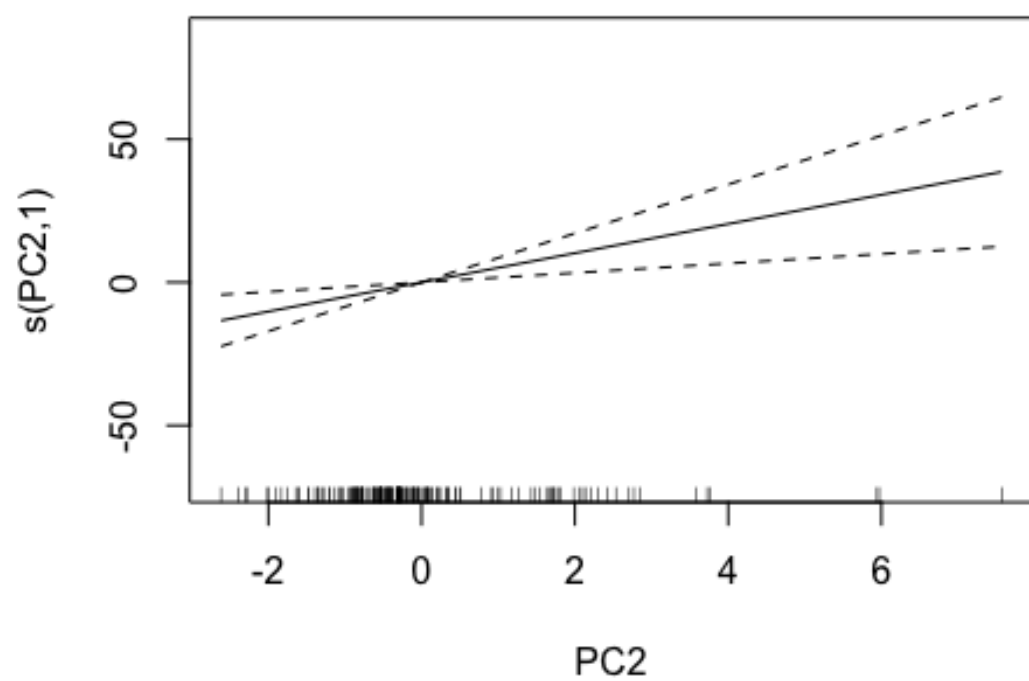
s(PC2) 1.00    1.00 8.75  0.0036 **
s(PC3) 1.00    1.00 1.24  0.2674
s(PC4) 2.23    2.90 1.56  0.1982
s(PC5) 3.15    4.01 2.19  0.0709 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

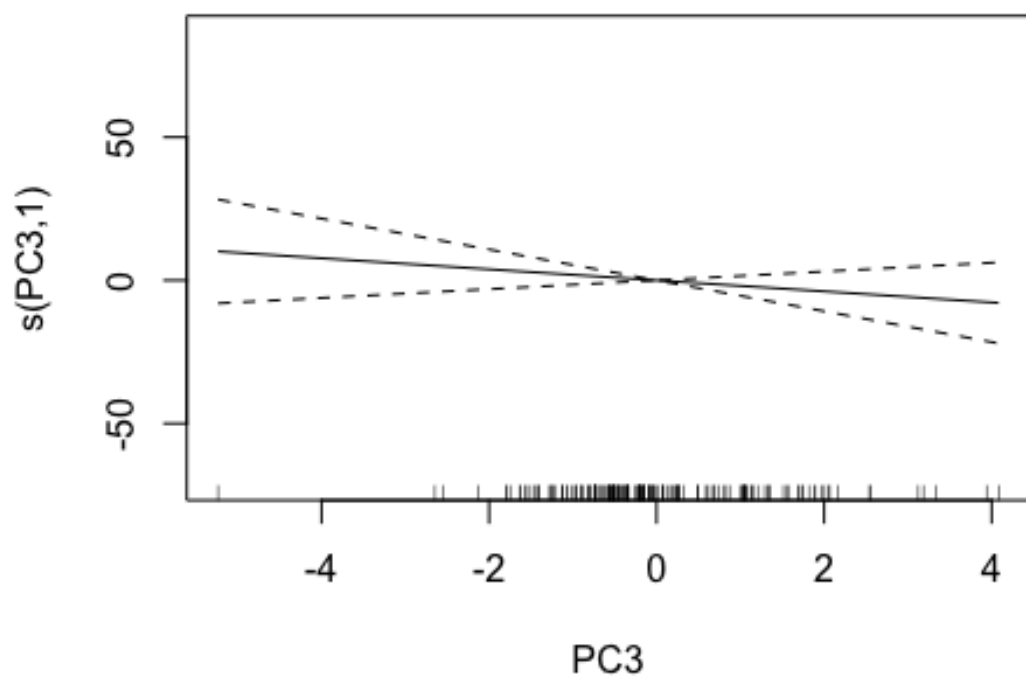
R-sq.(adj) =  0.147   Deviance explained = 19.4%
GCV = 812.7   Scale est. = 763.38    n = 177

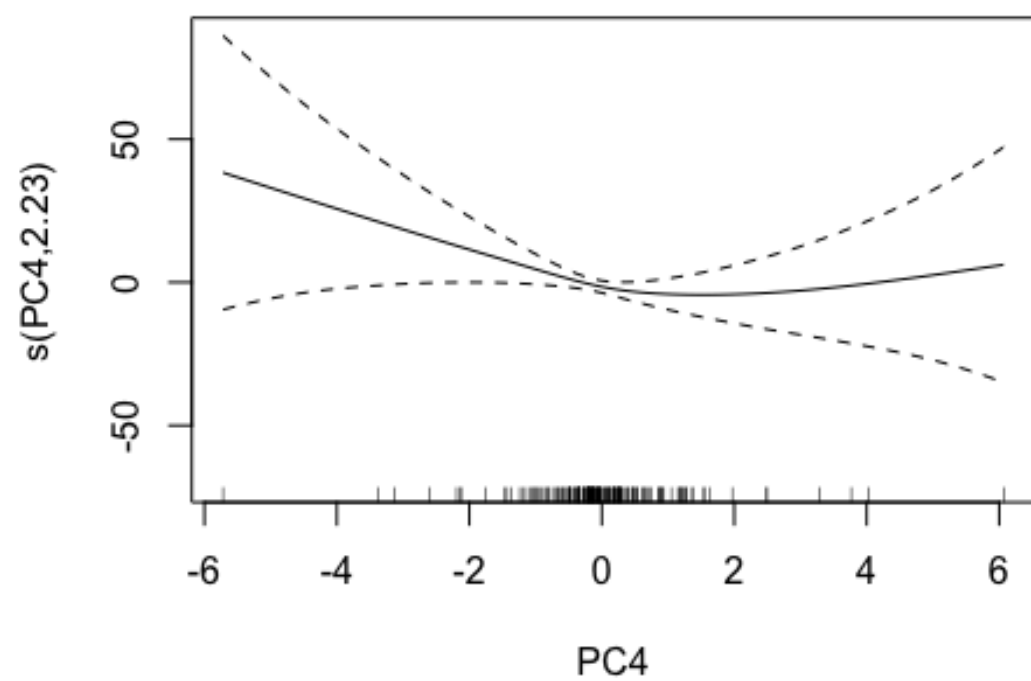
plot(gam01_d_DF)

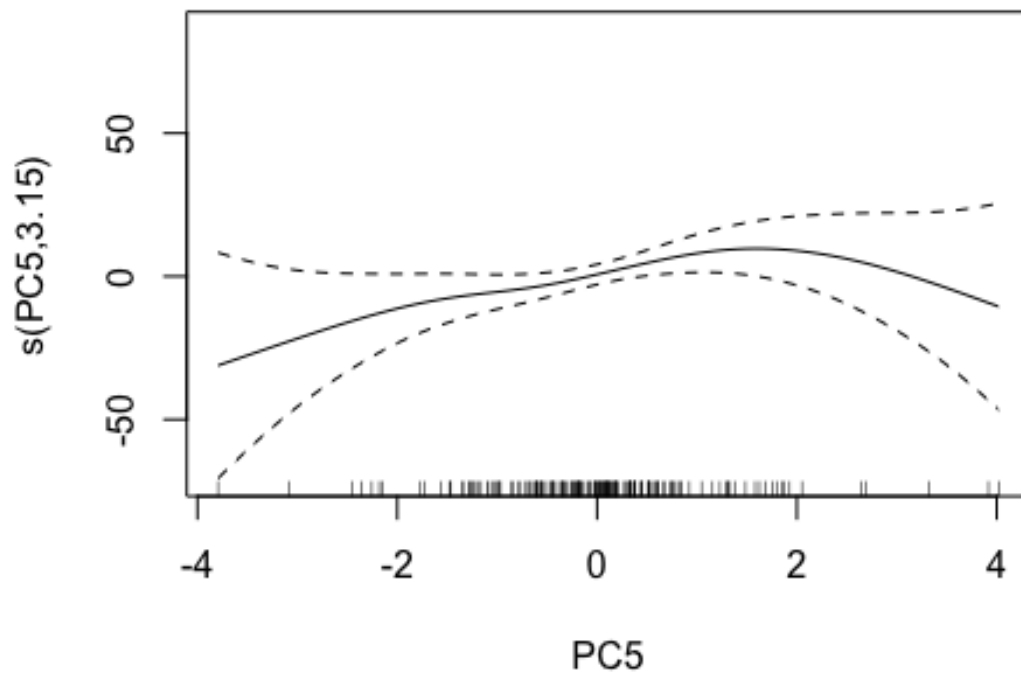
```











参考文献

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- [3] Marek Hlavac (2022) “Well-Formatted Regression and Summary Statistics Tables”. Ver. 5.2.3, R package “stargazer”.