

Voting in French presidential elections according to socio-professional category

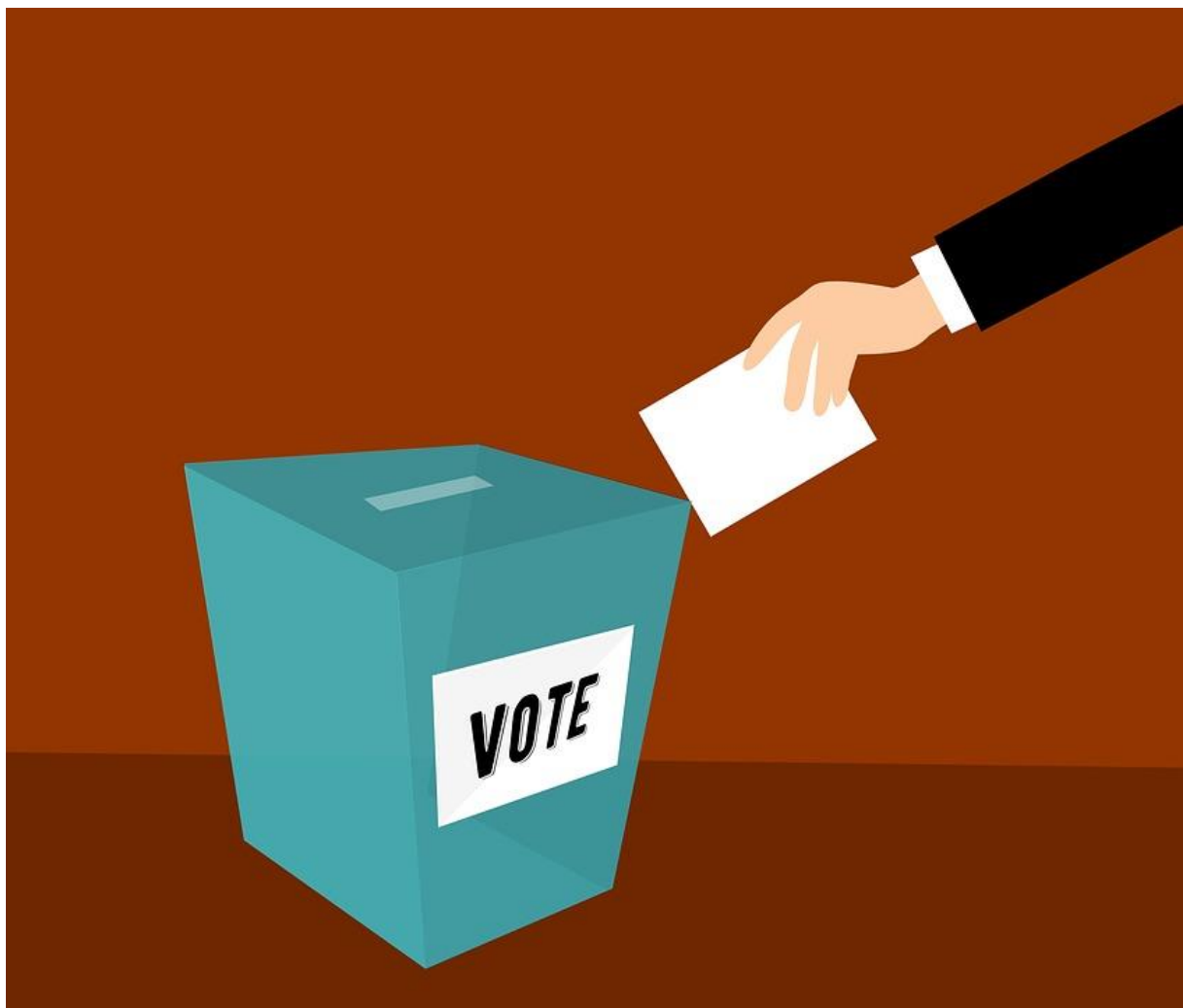


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Introduction

We decided to analyse the results of French presidential elections and a study on socio-professional categories. The goal is to see if the socio-professional category has an impact on the voting choice. To do this, we perform the analysis on the 95 French departments (Metropolitan France). As raw data, we will use results of presidential elections from 2012 and 2017 (1st turn) as well as a study on socio-professional categories. Departments 2A and 2B of Corsica were renamed 20 and 21 for reasons of simplicity.

Data

Source : <https://www.data.gouv.fr/fr/posts/les-donnees-des-elections/>

The first step was to clean the raw data. Indeed, we only take variables that interest us for the analysis. We decided to take the abstention rate, the rate of blank and void votes, as well as results for each candidate. We took the proportions (in %) so that there is no weight influence (departments more populated than others). These images are extracts from the cleaned data (csv files):

Presidential elections 2012:

	↑ ABS ↕	BN ↕	JOLY ↕	LE.PEN ↕	SARKOZY ↕	MELENCHON ↕	POUTOU ↕	ARTHAUD ↕	CHEMINADE ↕	BAYROU ↕	DUPONT.AIGNAN ↕	HOLLANDE ↕
1	16.76	1.97	2.26	20.71	30.41	9.61	1.03	0.56	0.27	10.16	2.24	22.75
2	19.39	1.71	1.16	26.33	24.20	10.19	1.30	0.84	0.25	6.68	1.96	27.10
3	17.66	2.40	1.57	18.32	24.02	13.58	1.25	0.72	0.22	8.65	1.98	29.68
4	16.97	2.05	2.91	20.71	25.47	15.15	1.38	0.48	0.28	7.42	1.83	24.36
5	17.07	2.08	3.63	17.70	26.11	14.03	1.33	0.56	0.24	9.86	2.05	24.49
6	20.58	1.53	2.15	23.50	37.19	8.49	0.69	0.27	0.21	6.69	1.59	19.21
7	15.85	1.99	2.80	20.04	23.76	14.07	1.37	0.63	0.26	9.15	1.94	25.98
8	20.61	1.59	1.22	24.50	24.43	9.28	1.29	0.77	0.24	7.52	1.81	28.93
9	15.90	1.86	2.85	16.79	18.72	16.86	1.45	0.55	0.23	6.67	1.51	34.36
10	18.64	2.09	1.41	25.12	30.33	7.93	1.01	0.61	0.25	8.37	2.17	22.79
11	16.51	1.95	2.09	23.22	21.63	13.15	1.26	0.52	0.21	6.04	1.47	30.41
12	14.70	2.44	2.34	14.10	25.51	12.26	1.33	0.53	0.24	12.55	1.70	29.44
13	19.58	1.58	2.11	23.38	27.50	13.43	0.80	0.35	0.22	6.35	1.35	24.51
14	16.82	1.62	2.13	16.22	27.34	10.56	1.34	0.66	0.25	10.10	2.05	29.34
15	16.84	2.18	1.56	15.12	28.61	8.98	1.24	0.60	0.24	11.16	1.66	30.84
16	17.89	2.18	1.83	17.72	23.06	11.32	1.47	0.70	0.25	8.81	2.04	32.79
17	18.11	2.00	2.21	17.45	28.10	10.38	1.42	0.57	0.23	9.08	2.09	28.47
18	19.62	2.16	1.58	19.73	24.96	13.81	1.22	0.76	0.24	8.84	2.11	26.76
19	14.64	2.05	1.38	13.31	21.59	10.55	1.01	0.42	0.18	6.93	1.65	42.97
20	25.73	1.78	2.29	24.39	31.41	9.85	1.17	0.31	0.21	5.01	1.07	24.28
21	16.99	1.85	2.10	18.84	28.57	9.51	1.06	0.56	0.24	9.37	1.95	27.79
22	14.29	1.80	2.78	13.58	23.86	12.20	1.33	0.67	0.24	10.60	1.71	33.02
23	17.77	2.39	1.76	16.27	22.23	13.01	1.49	0.72	0.25	8.33	1.93	34.02
24	15.16	2.20	2.13	17.01	22.93	13.71	1.37	0.57	0.24	8.07	1.87	32.09
25	17.20	2.02	2.35	19.19	28.49	10.96	1.18	0.65	0.26	8.80	1.84	26.28
26	16.87	1.79	2.87	20.96	26.12	12.10	1.11	0.71	0.26	8.88	1.94	25.05
27	18.49	1.79	1.66	22.75	27.78	10.34	1.37	0.65	0.27	8.41	2.11	24.65
28	19.00	1.82	1.60	20.72	29.39	8.96	1.22	0.67	0.26	9.22	2.24	25.71
29	15.84	1.67	2.95	11.98	24.46	11.52	1.48	0.60	0.27	11.27	1.78	33.70
30	17.15	1.68	2.12	25.51	24.86	13.33	1.01	0.47	0.23	6.91	1.46	24.11

Presidential elections 2017:

	↑ ABS ↕	BN ↕	MÉLENCHON ↕	MACRON ↕	FILLON ↕	LE.PEN ↕	HAMON ↕	DUPONT.AIGNAN ↕	POUTOU ↕	LASSALLE ↕	ASSELINEAU ↕	ARTHAUD ↕	CHEMINADE ↕
1	19.60	2.57	15.88	22.62	21.43	25.00	5.13	6.07	0.95	1.06	1.11	0.57	0.18
2	21.34	2.52	16.99	17.94	16.30	35.67	4.24	5.08	1.10	0.79	0.75	0.96	0.19
3	21.41	3.40	19.91	23.72	18.94	22.34	5.52	5.09	1.21	1.55	0.74	0.80	0.18
4	19.22	2.49	22.51	20.02	18.49	24.53	5.00	4.87	1.18	1.73	0.93	0.52	0.21
5	18.94	2.42	21.62	21.80	19.15	21.25	5.88	5.68	1.21	1.85	0.90	0.47	0.19
6	21.25	1.99	14.96	19.04	27.39	27.75	3.58	4.28	0.62	0.90	1.03	0.29	0.16
7	18.70	3.49	21.80	21.64	17.30	23.17	6.01	5.08	1.33	1.81	1.01	0.67	0.19
8	22.68	2.33	17.83	18.33	17.22	32.41	4.93	5.32	1.15	0.96	0.74	0.94	0.18
9	18.22	2.82	26.76	20.92	12.75	21.70	7.85	3.61	1.26	3.54	0.86	0.60	0.15
10	19.11	2.32	13.97	18.98	23.05	30.33	4.06	6.35	0.86	0.72	0.82	0.69	0.18
11	19.27	2.63	21.52	20.07	15.06	28.26	6.35	3.86	1.17	2.17	0.83	0.56	0.16
12	16.67	2.99	19.66	25.83	20.78	16.20	6.16	4.85	1.32	3.66	0.74	0.63	0.18
13	21.87	2.11	22.02	19.37	19.76	27.28	4.53	3.85	0.76	0.96	0.90	0.39	0.17
14	18.02	2.24	18.83	24.83	20.50	20.36	6.80	5.00	1.31	0.72	0.70	0.77	0.17
15	19.39	3.26	15.91	26.73	23.58	18.17	5.25	4.42	1.29	3.10	0.58	0.76	0.22
16	21.15	2.91	20.48	25.07	16.96	21.40	6.32	5.03	1.37	1.55	0.77	0.83	0.23
17	20.22	2.54	18.97	23.91	20.59	21.14	5.76	5.32	1.28	1.38	0.79	0.67	0.18
18	22.23	3.02	19.51	22.05	19.09	24.18	5.30	5.53	1.22	1.11	0.86	0.94	0.20
19	18.51	3.55	20.85	26.93	17.46	17.34	6.36	4.84	1.59	2.92	0.75	0.72	0.23
20	31.96	2.91	13.81	18.48	25.56	27.88	3.74	2.89	0.89	5.64	0.63	0.32	0.16
21	19.04	2.34	17.84	23.65	21.26	22.52	5.90	5.25	0.99	0.92	0.86	0.63	0.18
22	15.71	2.43	20.27	27.99	18.38	16.46	8.60	4.26	1.46	0.95	0.66	0.81	0.17
23	21.39	4.02	21.11	22.50	17.99	19.88	7.82	5.01	1.72	1.92	0.83	0.97	0.25
24	18.32	3.04	22.97	22.49	17.09	20.93	6.35	4.59	1.44	2.43	0.86	0.65	0.20
25	20.68	2.75	17.88	22.50	21.09	23.45	5.74	5.18	1.25	0.89	1.10	0.72	0.19
26	19.81	2.55	20.10	21.88	18.50	23.90	6.02	5.19	1.10	1.34	1.03	0.76	0.18
27	19.23	2.47	17.47	19.89	18.84	29.31	5.05	5.67	1.17	0.77	0.87	0.78	0.18
28	20.06	2.58	16.20	21.74	21.84	25.08	5.25	6.01	1.13	0.83	0.96	0.77	0.19
29	17.47	2.24	19.67	29.45	17.94	13.89	10.91	4.08	1.48	1.11	0.66	0.65	0.15
30	19.94	2.31	21.61	18.78	17.20	29.30	4.87	4.23	0.96	1.41	0.97	0.50	0.16

Study on socio-professional categories:

	JEUN	VIEU	AGRI	ACCE	CPIS	PINT	EMPL	OUVR	CHOM
1	20.6	25.0	0.8	3.7	8.1	15.7	16.7	16.6	8.7
2	19.6	27.5	1.2	2.7	4.5	11.5	16.8	18.3	15.0
3	15.7	35.2	2.0	3.4	4.2	10.8	15.8	14.4	11.6
4	16.9	34.4	1.6	5.2	5.4	12.7	16.0	11.7	12.0
5	17.3	31.2	2.0	5.1	5.4	14.5	17.6	11.2	8.3
6	16.0	32.6	0.2	4.7	8.6	13.1	17.8	9.5	11.3
7	17.7	32.6	1.6	4.3	5.1	12.7	15.3	14.3	11.5
8	19.0	28.3	1.4	3.0	4.2	11.3	16.0	18.2	14.9
9	16.4	34.7	1.8	4.1	4.6	11.9	16.6	12.6	13.1
10	18.3	28.8	1.9	3.0	5.1	12.0	16.2	16.9	12.9
11	17.1	34.6	1.9	4.4	4.8	11.3	16.5	11.9	15.9
12	15.8	36.1	4.5	4.4	4.4	11.4	14.9	12.6	8.2
13	17.8	27.8	0.3	3.4	8.8	14.2	16.5	10.4	14.3
14	18.3	27.2	1.0	3.5	6.7	13.5	17.0	14.5	11.3
15	14.6	35.6	5.7	4.2	3.8	10.0	15.3	13.3	7.7
16	16.3	32.5	1.9	3.6	5.1	11.4	15.7	15.7	11.9
17	16.1	35.1	1.6	4.3	5.1	11.4	16.6	12.7	12.6
18	16.5	33.2	1.6	3.3	5.2	11.8	16.4	14.8	11.8
19	14.9	36.0	2.2	3.9	4.6	11.7	16.0	13.4	8.6
20	16.3	34.2	1.6	3.8	5.2	11.6	16.5	13.8	12.2
21	17.0	26.9	1.2	3.3	7.7	14.7	16.4	14.1	9.5
22	17.7	34.6	2.4	3.7	5.2	11.6	14.7	14.5	9.6
23	14.0	39.1	4.8	3.6	4.0	9.2	15.2	12.0	10.7
24	15.2	37.4	2.1	4.7	4.1	10.2	15.8	13.6	11.8
25	18.6	26.5	0.9	3.0	7.1	13.8	15.3	18.1	11.0
26	18.9	29.5	1.5	4.1	6.4	13.8	15.3	14.5	12.3
27	20.4	25.9	0.8	3.4	6.4	13.9	16.5	18.3	11.7
28	19.8	26.7	1.1	3.1	6.8	14.4	17.4	16.3	10.5
29	17.7	30.9	1.4	3.3	6.6	13.2	16.0	13.7	10.4
30	18.1	30.7	0.9	4.4	6.1	13.0	16.5	12.2	15.9

Here is the signification of the variables:

JEUN	under 15 years %
VIEU	more than 60 years %
AGRI	farmers % relative to the labour force
ACCE	craftsmen, traders and entrepreneurs %
CPIS	executives, higher intellectual professions %
PINT	intermediate professions %
EMPL	employees %
OUVR	working class %
CHOM	unemployed people %

Basic statistics

These files are now ready to be imported in R to perform the analysis. First, we can look at basic statistics:

```
> summary(elec2012)
```

ABS	BN	JOLY	LE.PEN	SARKOZY	MELENCHON	POUTOU	ARTHAUD
Min. :13.86	Min. :1.200	Min. :1.160	Min. : 6.20	Min. :18.72	Min. : 7.22	Min. :0.670	Min. :0.2700
1st Qu.:16.46	1st Qu.:1.785	1st Qu.:1.760	1st Qu.:15.56	1st Qu.:24.20	1st Qu.: 9.85	1st Qu.:1.105	1st Qu.:0.4950
Median :17.66	Median :1.910	Median :2.100	Median :19.17	Median :25.83	Median :11.17	Median :1.270	Median :0.6100
Mean :17.94	Mean :1.948	Mean :2.168	Mean :18.88	Mean :26.44	Mean :11.29	Mean :1.227	Mean :0.5966
3rd Qu.:19.32	3rd Qu.:2.100	3rd Qu.:2.510	3rd Qu.:22.36	3rd Qu.:28.42	3rd Qu.:12.46	3rd Qu.:1.360	3rd Qu.:0.7050
Max. :26.54	Max. :2.660	Max. :4.180	Max. :27.03	Max. :37.19	Max. :16.99	Max. :1.730	Max. :0.8900


```
> summary(elec2017)
```

ABS	BN	MÉLENCHON	MACRON	FILLON	LE.PEN	HAMON	DUPONT.AIGNAN
Min. :15.71	Min. :1.360	Min. :13.81	Min. :17.73	Min. :12.75	Min. : 4.99	Min. : 3.440	Min. :1.670
1st Qu.:18.54	1st Qu.:2.340	1st Qu.:17.02	1st Qu.:20.58	1st Qu.:17.27	1st Qu.:18.18	1st Qu.: 5.150	1st Qu.:4.435
Median :19.80	Median :2.580	Median :19.37	Median :22.50	Median :18.60	Median :22.85	Median : 5.840	Median :5.010
Mean :19.80	Mean :2.628	Mean :19.24	Mean :23.10	Mean :19.58	Mean :22.54	Mean : 6.085	Mean :5.008
3rd Qu.:21.26	3rd Qu.:2.850	3rd Qu.:20.98	3rd Qu.:25.57	3rd Qu.:21.27	3rd Qu.:27.02	3rd Qu.: 6.820	3rd Qu.:5.680
Max. :31.96	Max. :4.020	Max. :34.02	Max. :34.83	Max. :29.14	Max. :35.67	Max. :10.910	Max. :7.180

POUTOU	LASSALLE	ASSELINEAU	ARTHAUD	CHEMINADE
Min. :0.620	Min. :0.510	Min. :0.5800	Min. :0.2700	Min. :0.1300
1st Qu.:1.040	1st Qu.:0.835	1st Qu.:0.7500	1st Qu.:0.5450	1st Qu.:0.1700
Median :1.170	Median :1.100	Median :0.8300	Median :0.7100	Median :0.1800
Mean :1.166	Mean :1.531	Mean :0.8774	Mean :0.6799	Mean :0.1853
3rd Qu.:1.315	3rd Qu.:1.735	3rd Qu.:0.9600	3rd Qu.:0.8100	3rd Qu.:0.2000
Max. :1.720	Max. :7.550	Max. :1.6100	Max. :1.0600	Max. :0.2500


```
> summary(socioeco)
```

JEUN	VIEU	AGRI	ACCE	CPIS	PINT	EMPL	OUVR
Min. :14.00	Min. :20.10	Min. :0.000	Min. :2.300	Min. : 3.800	Min. : 9.20	Min. :13.30	Min. : 5.00
1st Qu.:16.65	1st Qu.:26.35	1st Qu.:0.700	1st Qu.:3.000	1st Qu.: 4.800	1st Qu.:11.75	1st Qu.:15.70	1st Qu.:12.35
Median :17.80	Median :29.80	Median :1.400	Median :3.400	Median : 5.700	Median :12.70	Median :16.20	Median :14.30
Mean :17.82	Mean :29.73	Mean :1.459	Mean :3.508	Mean : 6.887	Mean :13.09	Mean :16.36	Mean :14.22
3rd Qu.:18.90	3rd Qu.:33.10	3rd Qu.:1.900	3rd Qu.:4.050	3rd Qu.: 7.600	3rd Qu.:14.35	3rd Qu.:16.75	3rd Qu.:16.30
Max. :22.30	Max. :39.10	Max. :5.700	Max. :5.200	Max. :27.600	Max. :18.10	Max. :21.40	Max. :18.40

CHOM
Min. : 7.50
1st Qu.: 9.95
Median :11.30
Mean :11.35
3rd Qu.:12.20
Max. :16.90

Correlation matrix

Basic statistics only tell us how values are distributed. We can also compute the correlation matrix on raw data or centred and reduced data (it is the same) to find some relations between variables:

	ABS	BN	JOLY	LE.PEN	SARKOZY	MELENCHON	POUTOU	ARTHAUD	CHEMINADE	BAYROU	DUPONT.AIGNAN	HOLLANDE
ABS	1.00000000	-0.46031614	-0.16234094	0.24867384	0.25039553	-0.11509294	-0.44470757	-0.16357847	0.06932515	-0.38513883	-0.1411244	-0.18858719
BN	-0.46031614	1.00000000	-0.26064157	-0.02897423	-0.32573247	0.07248912	0.52806601	0.46567118	0.02069426	0.24555298	0.3002745	0.13577072
JOLY	-0.16234094	-0.26064157	1.00000000	-0.52714270	0.19499877	0.23082687	-0.20334382	-0.51675869	0.16647781	0.37180132	-0.2375012	0.02263634
LE.PEN	0.24867384	-0.02897423	-0.52714270	1.00000000	0.03064053	-0.24633879	0.02478287	0.29707018	0.03896017	-0.56617458	0.1217789	-0.64920750
SARKOZY	0.25039553	-0.32573247	0.19499877	0.03064053	1.00000000	-0.72696911	-0.44801230	-0.29155766	0.21578626	0.26952321	0.1082046	-0.65742452
MELENCHON	-0.11509294	0.07248912	0.23082687	-0.24633879	-0.72696911	1.00000000	0.06587362	-0.18551551	-0.24762837	-0.30215174	-0.3422821	0.53389672
POUTOU	-0.44470757	0.52806601	-0.20334382	0.02478287	-0.44801230	0.06587362	1.00000000	0.58148143	0.12493452	0.28218192	0.2844890	0.13596814
ARTHAUD	-0.16357847	0.46567118	-0.51675869	0.29707018	-0.29155766	-0.18551551	0.58148143	1.00000000	0.25278594	0.10459907	0.4951324	-0.05191478
CHEMINADE	0.06932515	0.02069426	0.16647781	0.03896017	0.21578626	-0.24762837	0.12493452	0.25278594	1.00000000	0.30704745	0.3904033	-0.31180691
BAYROU	-0.38513883	0.24555298	0.37180132	-0.56617458	0.26952321	-0.30215174	0.28218192	0.10459907	0.30704745	1.00000000	0.2698429	-0.02451697
DUPONT.AIGNAN	-0.14112444	0.30027452	-0.23750115	0.12177892	0.10820460	-0.34228205	0.28448900	0.49513240	0.39040332	0.26984292	1.0000000	-0.26107390
HOLLANDE	-0.18858719	0.13577072	0.02263634	-0.64920750	-0.65742452	0.53389672	0.13596814	-0.05191478	-0.31180691	-0.02451697	-0.2610739	1.00000000

However, this table is difficult to read because there are a lot of decimals and it is not easy to find extreme values (near -1 or 1). So that it is easier to read, we wrote a function to display only extreme values according to a threshold and with less decimals.

```
highCor<-function(table,threshold){
  for(i in seq(1,length(table[,1]))){
    for(j in seq(1,length(table[1,]))){
      if(table[i,j]>-threshold && table[i,j]<threshold || i==j){
        table[i,j]<-NA
      }
    }
  }
  print(table,digits=2,na.print=".")
}
```

So, we obtain this for the 3 datasets:

```
> highCor(elec2012_cor,0.5)
      ABS  BN  JOLY  LE.PEN  SARKOZY  MELENCHON  POUTOU  ARTHAUD  CHEMINADE  BAYROU  DUPONT.AIGNAN  HOLLANDE
ABS      .      .      .      .      .      .      .      .      .      .      .      .
BN      .      .      .      .      .      .      .      .      .      .      .      .
JOLY     .      .      .      .      .      .      .      .      .      .      .      .
LE.PEN   .      .      .      .      .      .      .      .      .      .      .      .
SARKOZY  .      .      .      .      .      .      .      .      .      .      .      .
MELENCHON .      .      .      .      .      .      .      .      .      .      .      .
POUTOU   .      .      .      .      .      .      .      .      .      .      .      .
ARTHAUD  .      .      .      .      .      .      .      .      .      .      .      .
CHEMINADE .      .      .      .      .      .      .      .      .      .      .      .
BAYROU   .      .      .      .      .      .      .      .      .      .      .      .
DUPONT.AIGNAN .      .      .      .      .      .      .      .      .      .      .      .
HOLLANDE .      .      .      .      .      .      .      .      .      .      .      .

> highCor(elec2017_cor,0.5)
      ABS  BN  MÉLENCHON  MACRON  FILLON  LE.PEN  HAMON  DUPONT.AIGNAN  POUTOU  LASSALLE  ASSELINEAU  ARTHAUD  CHEMINADE
ABS      .      .      .      .      .      .      .      .      .      .      .      .      .
BN      .      .      .      .      .      .      .      .      .      .      .      .      .
MÉLENCHON .      .      .      .      .      .      .      .      .      .      .      .      .
MACRON    .      .      .      .      .      .      .      .      .      .      .      .      .
FILLON    .      .      .      .      .      .      .      .      .      .      .      .      .
LE.PEN    .      .      .      .      .      .      .      .      .      .      .      .      .
HAMON     .      .      .      .      .      .      .      .      .      .      .      .      .
DUPONT.AIGNAN .      .      .      .      .      .      .      .      .      .      .      .      .
POUTOU    .      .      .      .      .      .      .      .      .      .      .      .      .
LASSALLE  .      .      .      .      .      .      .      .      .      .      .      .      .
ASSELINEAU .      .      .      .      .      .      .      .      .      .      .      .      .
ARTHAUD   .      .      .      .      .      .      .      .      .      .      .      .      .
CHEMINADE .      .      .      .      .      .      .      .      .      .      .      .      .

> highCor(socioeco_cor,0.6)
      JEUN  VIEU  AGRI  ACCE  CPIS  PINT  EMPL  OUVR  CHOM
JEUN      .  -0.81  .      .      .      .      .      .      .
VIEU -0.81  .      .      .      .      .      .      .      .
AGRI      .  0.69  .      .      .      .      .      .      .
ACCE      .  0.63  .      .      .      .      .      .      .
CPIS      . -0.63  .      .      .      .      .      .      .
PINT  0.64 -0.85 -0.67  .      .      .      .      .      .
EMPL      .      .      .      .      .      .      .      .      .
OUVR      .      .      .      .      .      .      .      .      .
CHOM      .      .      .      .      .      .      .      .      .
```

We can clearly see some relations between variables. We can see for example that Mélenchon is negatively correlated with Sarkozy, Macron is negatively correlated with Le Pen and farmers are positively correlated with old people.

This correlation matrix is the basis of the analysis. It is used to compute eigen values and vectors.

Eigen vectors

These are the corresponding eigen values and vectors:

```
> eigen(elec2012_cor)
eigen() decomposition
$values
[1] 3.048053e+00 2.932263e+00 2.306867e+00 9.590417e-01 8.331776e-01 5.406769e-01 4.635538e-01 3.566225e-01 2.641855e-01 1.715202e-01
[11] 1.240371e-01 9.855940e-07

> eigen(elec2017_cor)
eigen() decomposition
$values
[1] 3.844025e+00 2.870357e+00 1.955948e+00 1.550500e+00 9.346727e-01 6.183691e-01 3.872251e-01 2.939055e-01 1.831087e-01 1.608214e-01
[11] 1.061530e-01 9.491346e-02 1.008854e-06

> eigen(socioeco_cor)
eigen() decomposition
$values
[1] 4.16554760 1.85488086 1.20173728 0.84043736 0.46230224 0.28633901 0.08733250 0.08644695 0.01497618
```

```
> elec2012_pca$loadings
```

Loadings:

	Comp.1	Comp.2	Comp.3
ABS	0.336	0.105	0.249
BN	-0.444		
JOLY	0.189	-0.203	-0.460
LE. PEN		0.331	0.469
SARKOZY	0.346	0.345	-0.267
MELENCHON		-0.467	0.135
POUTOU	-0.475		
ARTHAUD	-0.417	0.255	0.148
CHEMINADE		0.289	-0.239
BAYROU	-0.161		-0.571
DUPONT. AIGNAN	-0.250	0.352	-0.107
HOLLANDE	-0.184	-0.467	

```
> elec2017_pca$loadings
```

Loadings:

	Comp.1	Comp.2	Comp.3
ABS	0.189	0.204	0.404
BN	0.213	-0.425	
MÉLENCHON	-0.256	-0.161	0.511
MACRON	-0.399	-0.170	-0.260
FILLON		0.266	-0.541
LE. PEN	0.431	0.156	0.175
HAMON	-0.407	-0.260	
DUPONT. AIGNAN	0.374		-0.209
POUTOU		-0.536	
LASSALLE	-0.123	-0.168	0.191
ASSELINEAU		0.254	0.288
ARTHAUD	0.327	-0.339	-0.120
CHEMINADE	0.263	-0.251	

Here, we only show the 3 first eigen vectors but there are as many eigen vectors as eigen values and variables. The goal of PCA is to reduce the number of variables/dimensions. We generally take at most the 3 most important PC because it is easy to represent on 2D graphs (one 2D graph for 2 PC and three 2D graphs for 3 PC). Eigen values and vectors are classified in decreasing order (the first one has the most information and the last one the least). An eigen vector contains the weights of initial variables to make the corresponding principal component.

To choose how many PC to take, we can use elbow curves (see next page). We can also look at the proportion of information contained in the k first components with the formula:

$$\frac{\lambda_1 + \dots + \lambda_k}{\lambda_1 + \dots + \lambda_n} \times 100$$

λ : eigen value, n: number of eigen values

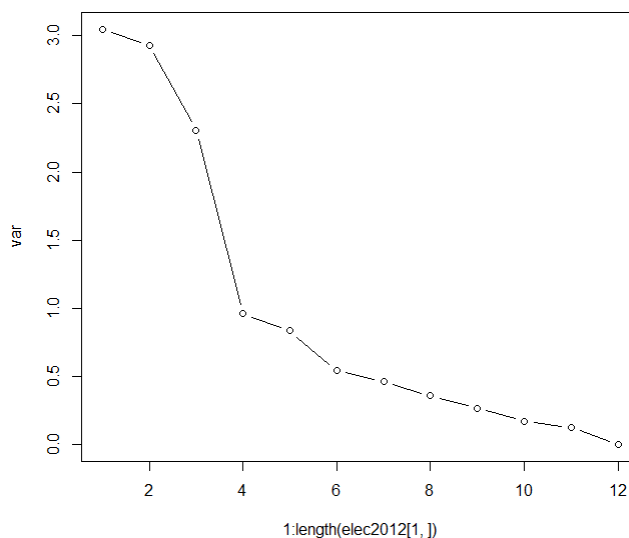

```
> socioeco_pca$loadings
```

Loadings:

	Comp.1	Comp.2	Comp.3
JEUN	0.388	0.271	0.162
VIEU	-0.471		-0.141
AGRI	-0.402		0.314
ACCE	-0.292	-0.305	-0.232
CPIS	0.328	-0.473	
PINT	0.434	-0.239	0.132
EMPL	0.284	0.187	-0.301
OUVR		0.652	0.335
CHOM		0.300	-0.761

Elbow curves

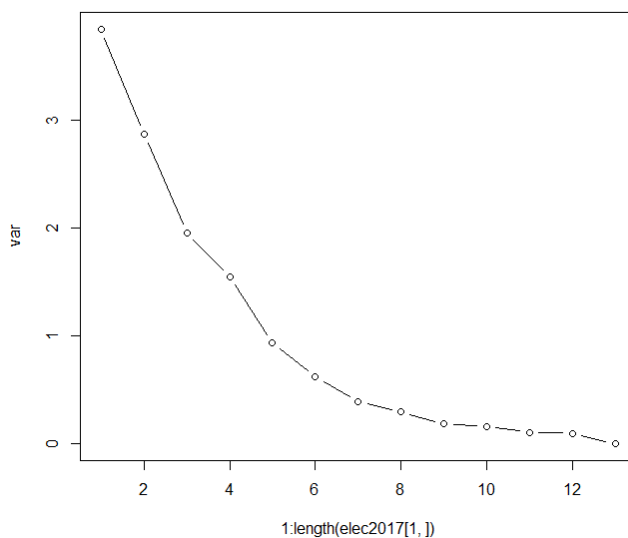
```
cat("\nInformation comp 1 and 2:", (elec2012_pca$sdev[1]^2+elec2012_pca$sdev[2]^2)/length(elec2012_pca$sdev)*100, "%\n")
```



Elections 2012:

Information comp 1, 2: 49.8 %
Information comp 1, 2, 3: 69.1 %

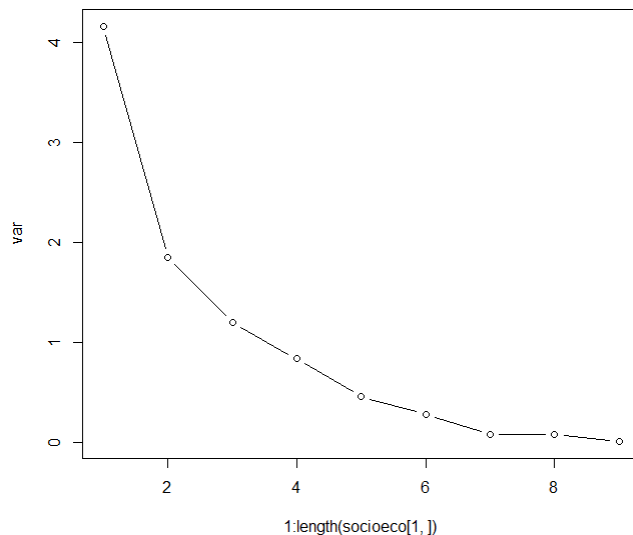
We choose 3 PC. There is a clear elbow for the fourth eigen value.



Elections 2017:

Information comp 1, 2: 51.6 %
Information comp 1, 2, 3: 66.7 %

We choose 3 PC. There is no clear elbow but we don't have enough information with only 2 PC and 4 PC would be too complicated to analyse.



Socio-professional categories:

Information comp 1, 2: 66.9 %
Information comp 1, 2, 3: 80.2 %

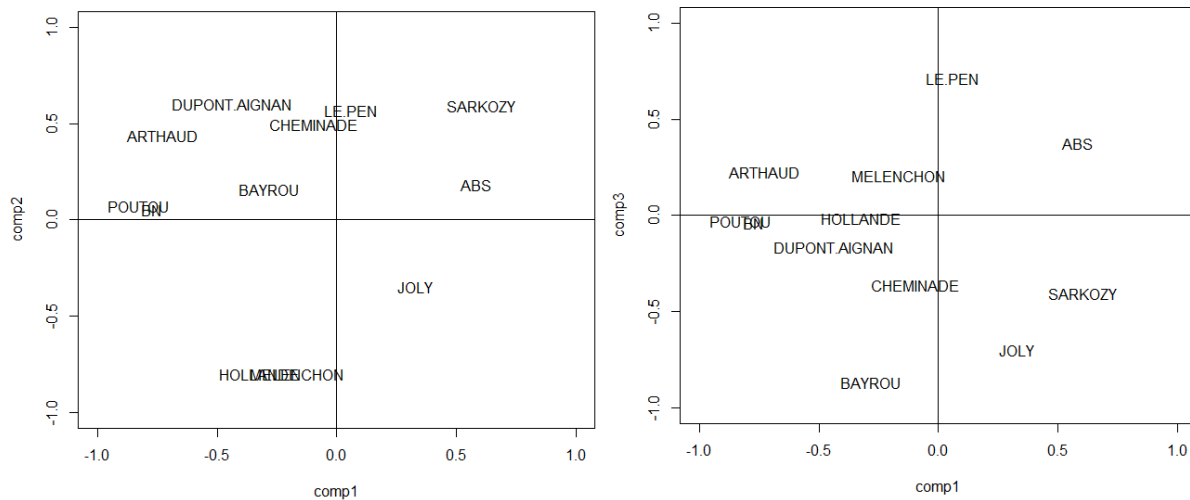
We choose 2 PC. We can see an elbow for the second eigen value, but 1 PC is not enough to make an analysis. So we take one more.

Meaning of the axis

Then, we can sort values in decreasing order in eigen vectors so that it is easier to see high positive and negative values. This will allow us to determine the meaning of the axes. Correlation circles of variables can also be helpful.

Elections 2012:

Comp1		Comp2		Comp3	
	[,1]		[,1]		[,1]
SARKOZY	0.34602593	DUPONT. AIGNAN	0.35172522	LE. PEN	0.469099803
ABS	0.33581140	SARKOZY	0.34451679	ABS	0.248633240
JOLY	0.18885206	LE. PEN	0.33094223	ARTHAUD	0.147721086
LE. PEN	0.03565760	CHEMINADE	0.28879059	MELENCHON	0.135395579
CHEMINADE	-0.05335058	ARTHAUD	0.25465435	HOLLANDE	-0.008632064
MELENCHON	-0.09406844	ABS	0.10529948	POUTOU	-0.020280390
BAYROU	-0.16050026	BAYROU	0.09252199	BN	-0.024359187
HOLLANDE	-0.18423796	POUTOU	0.04182432	DUPONT. AIGNAN	-0.107388435
DUPONT. AIGNAN	-0.25014465	BN	0.03121155	CHEMINADE	-0.238961153
ARTHAUD	-0.41652918	JOLY	-0.20288838	SARKOZY	-0.266906381
BN	-0.44425696	MELENCHON	-0.46701531	JOLY	-0.459820931
POUTOU	-0.47510833	HOLLANDE	-0.46710515	BAYROU	-0.570600749



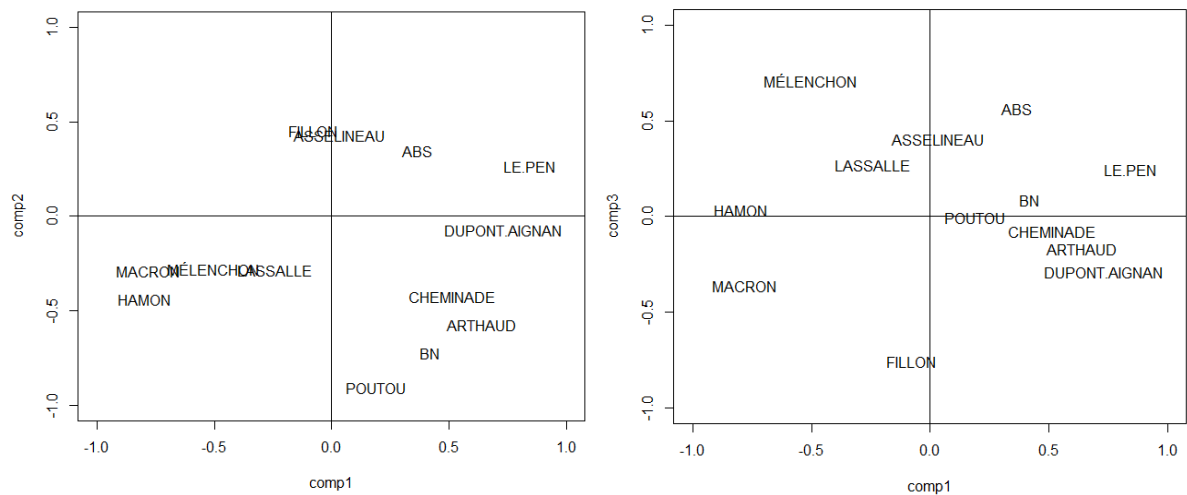
With this, we can make a table:

PC	-	+
1	POUTOU, BN, ARTHAUD	SARKOZY, ABS
2	HOLLANDE, MELENCHON	DUPONT-AIGNAN, SARKOZY, LE PEN
3	BAYROU, JOLY	LE PEN

For the first axis, we can say that a negative value means that people vote for far-left workers parties and a positive value vote for Sarkozy or abstain. The second axis seems to oppose left (negative) and right (positive) candidates. The third one opposes center candidates (negative) and Le Pen (positive).

Elections 2017:

Comp1		Comp2		Comp3	
	[,1]		[,1]		[,1]
LE.PEN	0.43078087	FILLON	0.26584524	MÉLENCHON	0.51071625
DUPONT.AIGNAN	0.37371580	ASSELINEAU	0.25393027	ABS	0.40410204
ARTHAUD	0.32733496	ABS	0.20393398	ASSELINEAU	0.28806825
CHEMINADE	0.26305121	LE.PEN	0.15598605	LASSALLE	0.19108086
BN	0.21317623	DUPONT.AIGNAN	-0.04173796	LE.PEN	0.17510274
ABS	0.18869870	MÉLENCHON	-0.16110796	BN	0.06305554
POUTOU	0.09686105	LASSALLE	-0.16833015	HAMON	0.02468262
ASSELINEAU	0.01701032	MACRON	-0.17042287	POUTOU	-0.00255383
FILLON	-0.04048242	CHEMINADE	-0.25143803	CHEMINADE	-0.05386474
LASSALLE	-0.12331022	HAMON	-0.26010236	ARTHAUD	-0.11998439
MÉLENCHON	-0.25569071	ARTHAUD	-0.33869341	DUPONT.AIGNAN	-0.20865540
MACRON	-0.39943349	BN	-0.42541002	MACRON	-0.26023924
HAMON	-0.40734312	POUTOU	-0.53599156	FILLON	-0.54089121

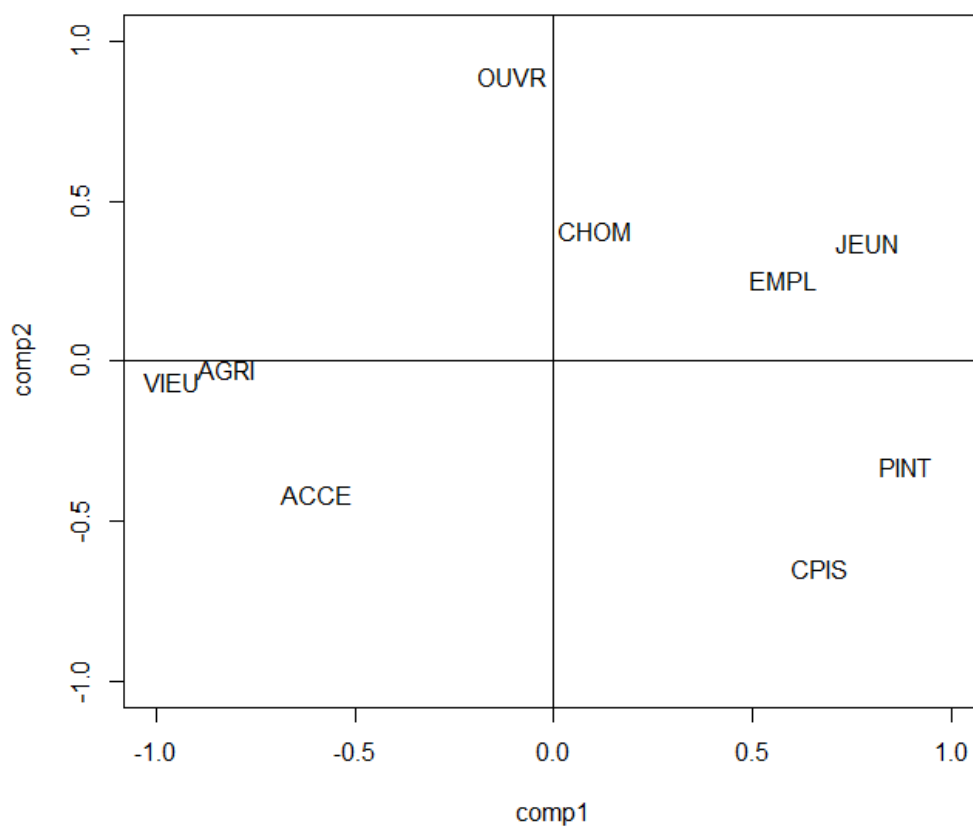


PC	-	+
1	HAMON, MACRON	LE PEN, DUPONT-AIGNAN, ARTHAUD
2	POUTOU, BN, ARTHAUD	FILLON, ASSELINEAU
3	FILLON	MELENCHON, ABS

For the first axis, a negative value means that people vote for center-left parties and a positive value for extreme parties. The second one opposes far-left workers parties (negative) and right parties (positive). The last one confronts Fillon and Mélenchon/abstention.

Socio-professional categories:

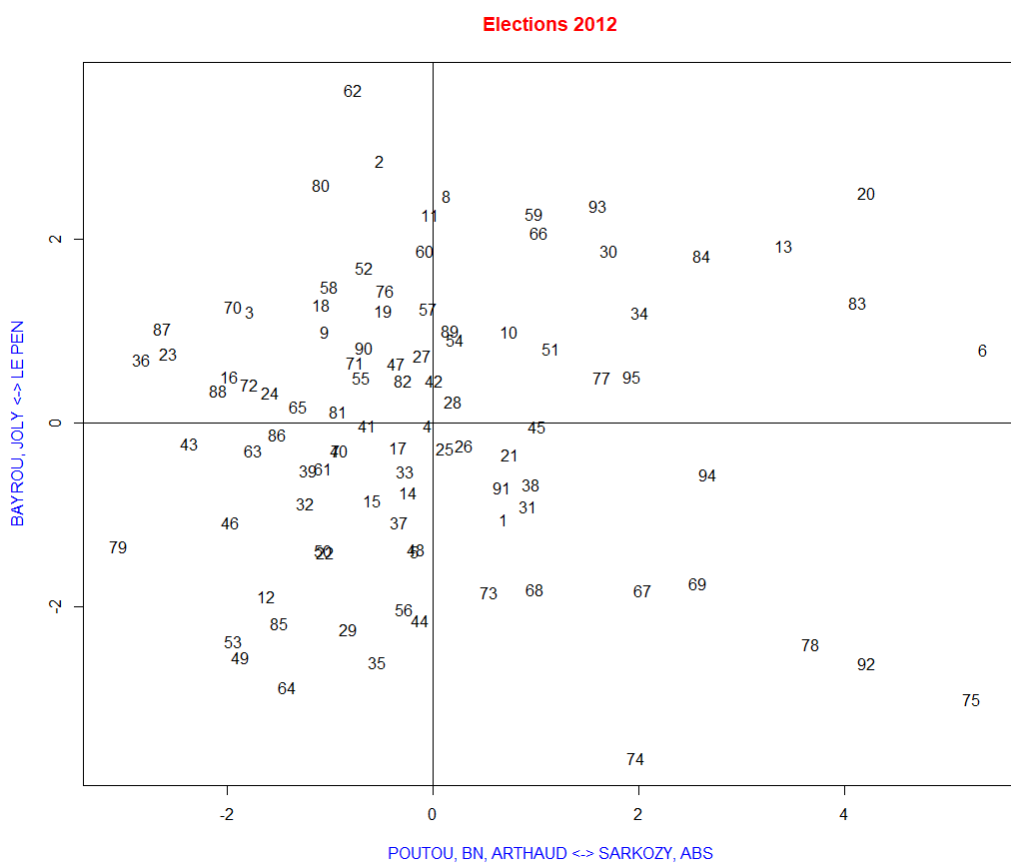
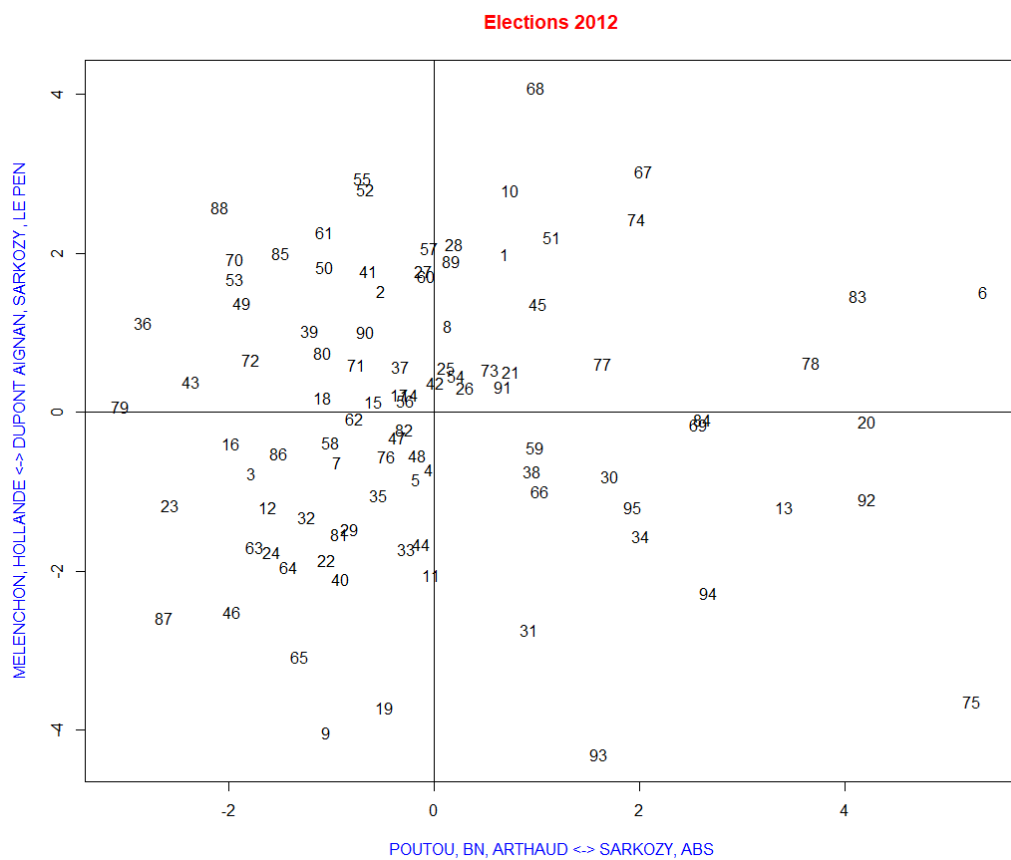
	[,1]		[,1]
PINT	0.43350058	OUVR	0.65244023
JEUN	0.38761995	CHOM	0.30003245
CPIS	0.32827862	JEUN	0.27110614
EMPL	0.28360863	EMPL	0.18726332
CHOM	0.05075403	AGRI	-0.01730830
OUVR	-0.04894830	VIEU	-0.04547124
ACCE	-0.29228908	PINT	-0.23926368
AGRI	-0.40230595	ACCE	-0.30457113
VIEU	-0.47050231	CPIS	-0.47260796
Comp1		Comp2	

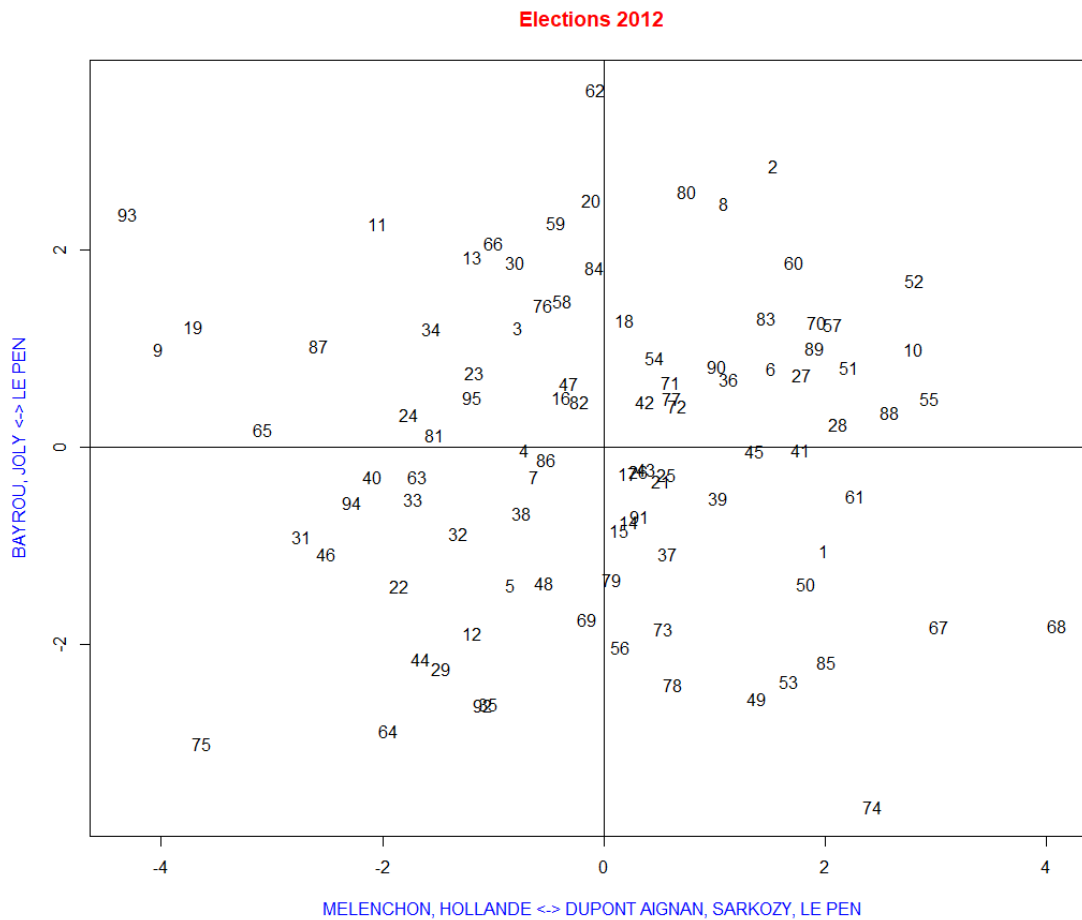


PC	-	+
1	VIEU, AGRI	PINT, JEUN
2	CPIS	OUVR

The first axis opposes old farmers and intermediate professions with children.
The other one confronts very qualified people and the working class.

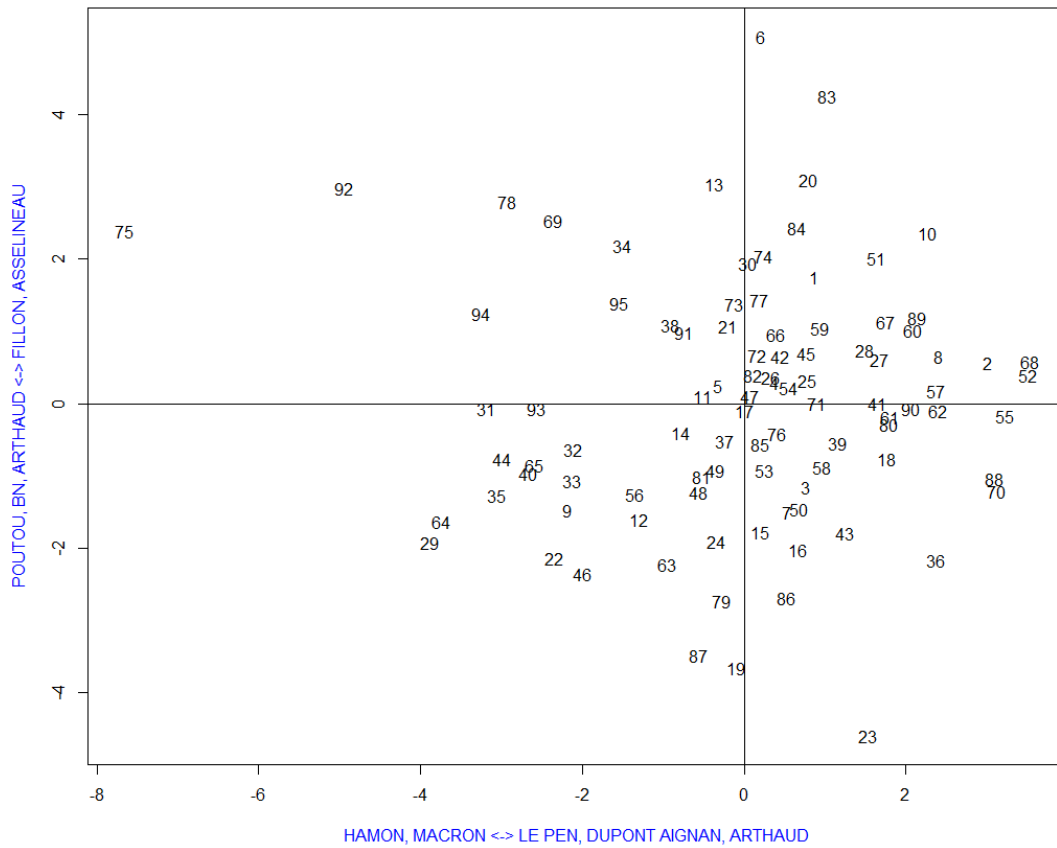
Graphs



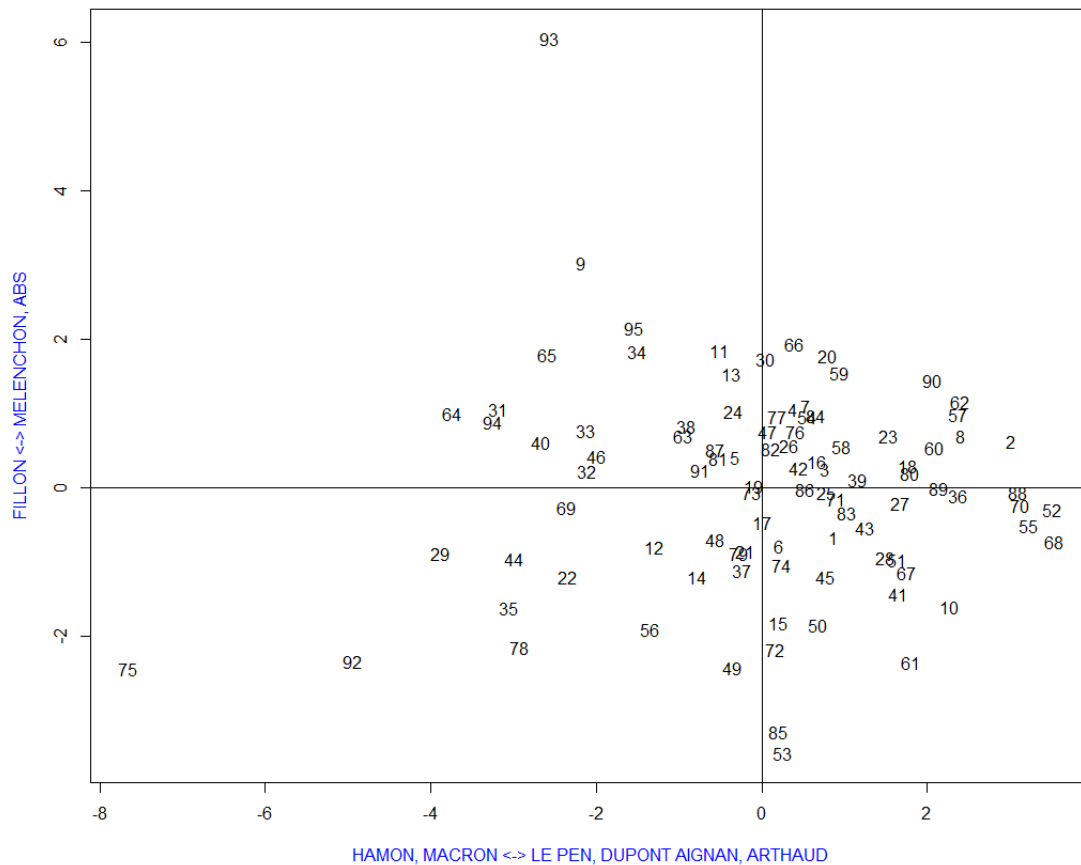


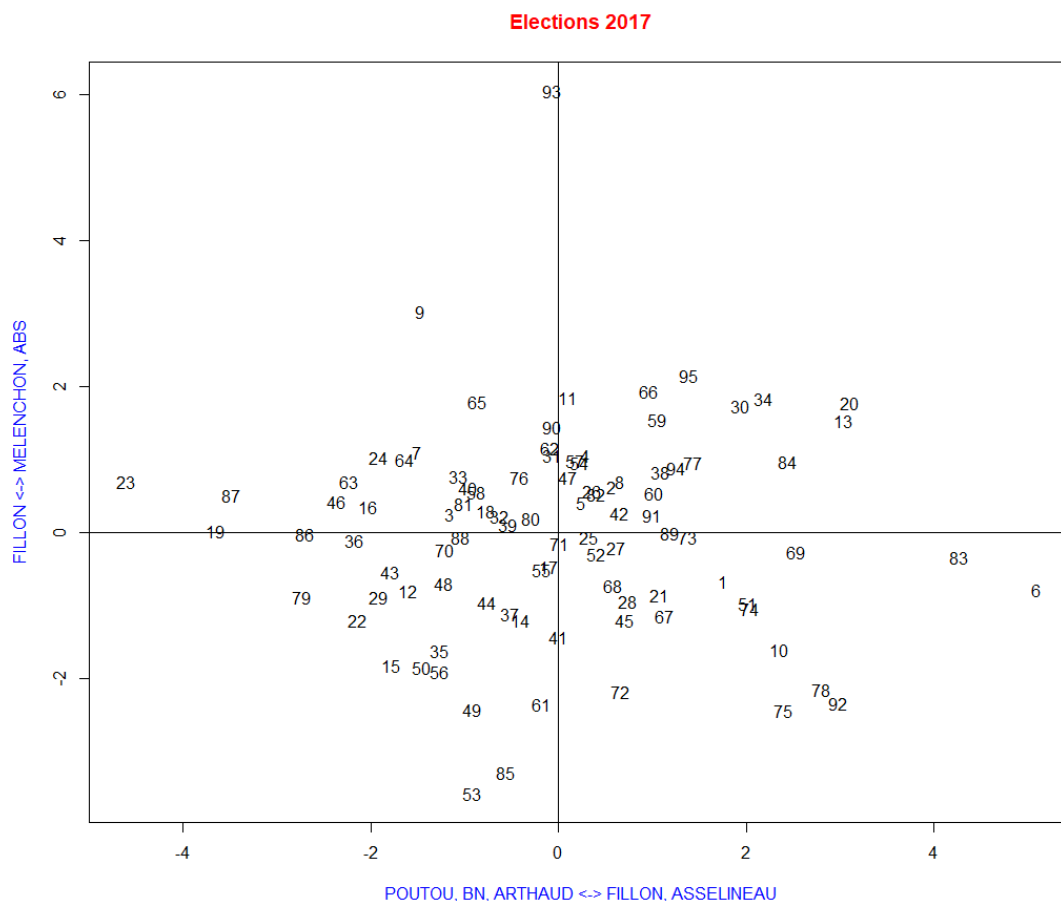
From these graphs, we can make some conclusions. On the first axis, we remark that departments **79**, **36**, **87**, **23** and **43** vote for far-left workers parties as opposed to departments **6**, **75**, **92**, **20**, **83**, **78** and **13** that vote for Sarkozy and have a high rate of abstention. On the second axis, we can see the classic left-right opposition, respectively departments **93**, **9**, **19**, **75**, **65** and departments **68**, **67**, **55**, **52** and **10**. Finally, the third axis confronts departments voting for center candidates: **74**, **75**, **64**, **92**, **35**, **49** and the ones voting for Le Pen: **62**, **2**, **80**, **20** and **8**.

Elections 2017

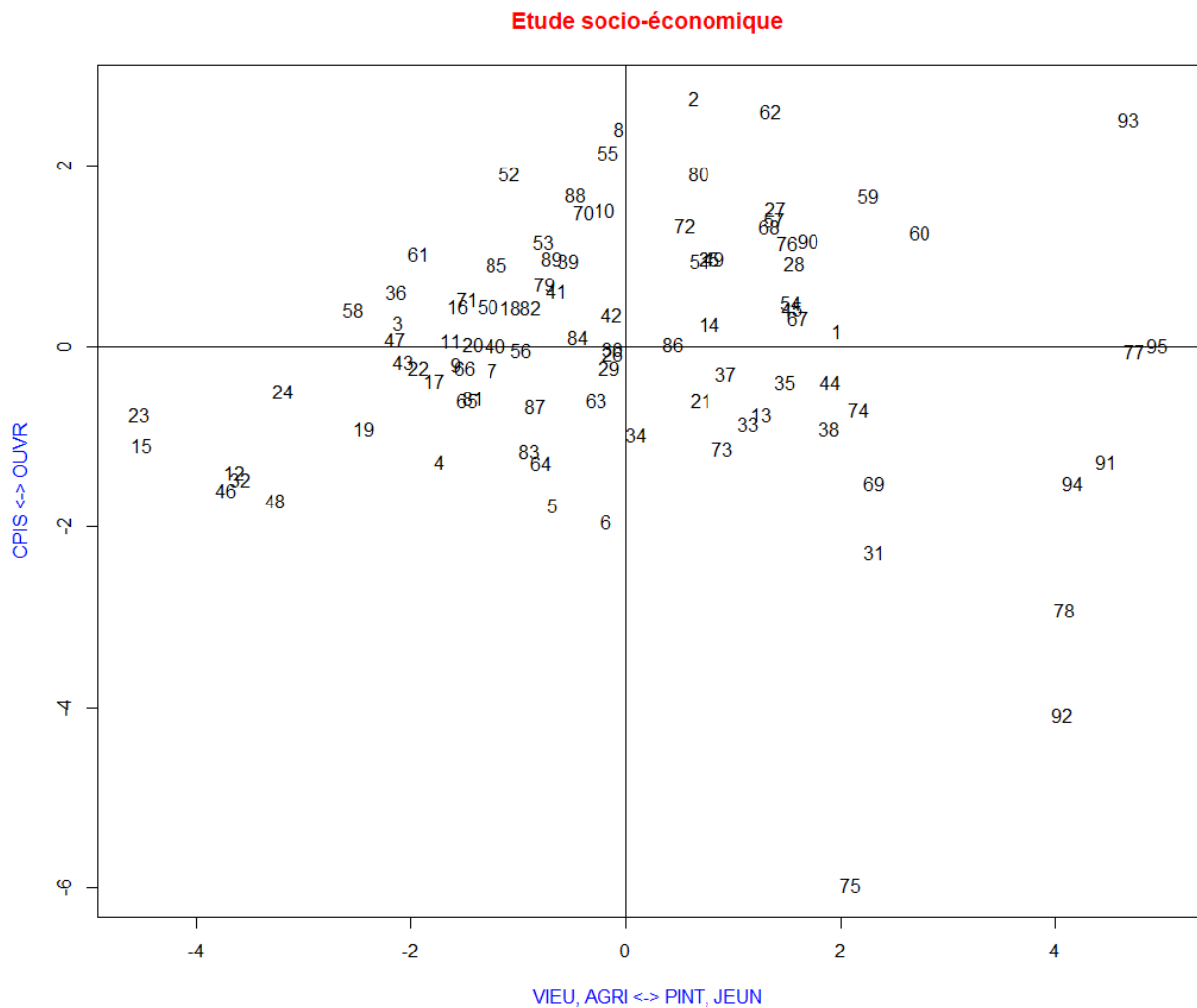


Elections 2017





For the 2017 presidential elections, axis are a bit different from the 2012 one. But we still have some similarities. The first axis (that looks like the second one of the 2012 elections) contrasts between departments voting for center-left parties: **75**, **92**, **29**, **64** and others voting for extreme parties: **68**, **52**, **55**, **70**, **88** and **2**. The second axis, which can be assimilated to the first one of the 2012 elections, opposes far-left workers parties: **23**, **19**, **87**, **79** and **86** to right parties: **6**, **83**, **20**, **13**, **92** and **78**. The last one confronts departments voting for Fillon: **53**, **85**, **75**, **49**, **61**, **92**, **72**, **78** and those voting for Mélenchon and having a high rate of abstention: **93**, **9**, **95** and **66**.



Now, let's look at the socio-professional analysis. The first axis reflects the activity of the departments. It opposes departments with a high proportion of old farmers: 23, 15, 46, 12, 32, 48 and 24 and those having a high rate of intermediate professions with children: 95, 77, 93, 91, 94, 78 and 92. The other one represents the qualification of the population, confronting very qualified people: 75, 92, 78, 31 and 6 with the working class: 2, 62, 93, 8, 55, 52 and 80.

Conclusion

From these, we can make categories of departments:

- Departments voting for far-left workers parties: 79, 36, 87, 23, 43, 19 and 86
- Departments voting for right parties: 6, 20, 83, 78, 13, 53, 85, 61 and 72
- Departments voting for left to far-left parties: 93, 9, 65, 95 and 66
- Departments voting for far-right parties: 68, 67, 55, 52, 10, 62, 2, 80, 8, 70 and 88
- Departments voting for center parties: 74, 64, 35, 49 and 29
- Special departments: 75 and 92

As departments 75 and 92 are cosmopolitan, they have not a clear orientation. They vote for right, left and center parties.

From these categories, we can color them on a France map:

