

3-Práctica de Análisis de Componentes Principales en R

Vamos a realizar un Análisis de Componentes Principales sobre la siguiente matriz de datos que corresponde a una tabla de 28 clases de sujetos, cuyas variables de base son: el sexo, el país, la actividad profesional y el estado civil, y por otro lado 10 clases de actividades relacionadas con el trabajo, transporte, hogar, cuidado de los hijos, viajes, aseo, comida, sueño, televisión y ocio, reagrupadas por la necesidad de comparar el tiempo de dedicación a ellas. Un caso de la tabla, contiene el número de horas que los sujetos de la clase i han dedicado por término medio a la actividad j durante el tiempo en que transcurre la encuesta.

I \ J	PROFESSION	TRANSPORT	MENAGE	ENFANTS	COURSES	TOILETTE	REPAS	SOMMEIL	TELEVISION	LOISIRS
HAUS	610	140	60	10	120	95	115	760	175	315
FAUS	475	90	250	30	140	120	100	775	115	305
FNAU	10	495	110	170	110	130	785	160	430	
HMUS	615	141	65	10	115	90	115	765	180	305
FMUS	179	29	421	87	161	112	119	776	143	373
HCUS	585	115	50	150	105	100	760	150	385	
FCUS	482	94	196	18	141	130	96	775	132	336
HAW	652	100	95	7	57	85	150	807	115	330
FAWE	510	70	307	30	80	95	142	815	87	262
FNAW	20	7	567	87	112	90	180	842	125	367
HMWE	655	97	97	10	52	85	152	807	122	320
FMWE	168	22	529	69	102	83	174	825	119	392
HCWE	642	105	72	62	77	140	812	100	387	
FCWE	389	34	262	14	92	97	147	848	84	392
HAYO	650	140	120	15	85	90	105	760	70	365
FAYO	560	105	375	45	90	90	95	745	60	235
HMYO	650	145	112	15	85	90	105	760	80	357
FNAY	10	10	710	55	145	85	130	815	60	380
FMYO	260	52	576	59	116	85	117	775	65	295
HCYO	615	125	95	115	90	85	760	40	475	
FCYO	433	89	318	23	112	96	102	774	45	409
HAES	650	142	122	22	76	94	100	764	96	334
FAES	578	106	338	42	106	94	92	752	64	228
FNAE	24	8	594	72	158	82	128	840	86	398
HMES	652	133	134	22	68	54	102	762	122	310
HCES	627	148	68	88	92	86	770	58	463	
FMES	434	77	431	60	117	88	105	770	73	229
FCES	433	88	296	21	128	102	94	798	58	379

Composition de l'ensemble I

HAUS hommes actifs des U.S.A
 FAUS femmes actives des U.S.A
 FNAU femmes non actives des U.S.A
 HMUS hommes mariés des U.S.A
 FMUS femmes mariées des U.S.A
 HCUS hommes célibataires des U.S.A
 HAW hommes actifs des pays de l'Ouest
 FAWE femmes actives des pays de l'Ouest
 FNAW femmes non actives des pays de l'Ouest
 HMWE hommes mariés des pays de l'Ouest
 HCWE hommes célibataires des pays de l'Ouest
 HAES hommes actifs des pays de l'Est
 FAES femmes actives des pays de l'Est
 FNAE femmes non actives des pays de l'Est
 HME hommes mariés des pays de l'Est
 HCM hommes célibataires des pays de l'Est
 HAYO hommes actifs de Yougoslavie
 FAYO femmes actives de Yougoslavie
 FNAY femmes non actives de Yougoslavie
 HMYO hommes mariés de Yougoslavie
 FMYO femmes mariées de Yougoslavie
 HCYO hommes célibataires de Yougoslavie
 FCUS femmes célibataires des U.S.A
 FCWE femmes célibataires des pays de l'Ouest
 FCES femmes célibataires des pays de l'Est
 FCYO femmes célibataires de Yougoslavie

Composition de l'ensemble J

PROF travail professionnel
 TRAN occupations dues ou liées au travail professionnel (transports...)
 MENA travail ménager
 ENFA occupations liées aux enfants
 COUR les courses
 TOIL la toilette, les soins personnels
 REPA les repas
 SOMM le sommeil
 TELE la télévision
 LOIS les autres loisirs

Los resultados generados en R, tienen que coincidir con los que aparecen en este [documento](#) donde se han utilizado los programas MVSP y Statgraphics.

La interpretación de los resultados, tendrá como base, las conclusiones obtenidas en el documento anterior, y la representación gráfica y las salidas, deberán coincidir con las que se relacionan a continuación.

Pasos a realizar en la práctica

1. Leemos los datos del fichero tiempos.txt

> X

	Prof	Tran	Mena	Enfa	Cour	Toil	Repa	Somm	Tele	Lois
HAUS	610	140	60	10	120	95	115	760	175	315
FAUS	475	90	250	30	140	120	100	775	115	305
FNAU	10	0	495	110	170	110	130	785	160	430
HMUS	615	140	65	10	115	90	115	765	180	305
FMUS	179	29	421	87	161	112	119	776	143	373
HCUS	585	115	50	0	150	105	100	760	150	385
FCUS	482	94	196	18	141	130	96	775	132	336
Hawe	653	100	95	7	57	85	150	808	115	330
FAWE	511	70	307	30	80	95	142	816	87	262
FNAW	20	7	568	87	112	90	180	843	125	368
HMWE	656	97	97	10	52	85	152	808	122	321
FMWE	168	22	528	69	102	83	174	824	119	311
HCWE	643	105	72	0	62	77	140	813	100	388
FCWE	429	34	262	14	92	97	147	849	84	392
HAYO	650	140	120	15	85	90	105	760	70	365
FAYO	560	105	375	45	90	90	95	745	60	235
FNAY	10	10	710	55	145	85	130	815	60	380
HMYO	650	145	112	15	85	90	105	760	80	358
FMYO	260	52	576	59	116	85	117	775	65	295
HCOYO	615	125	95	0	115	90	85	760	40	475
FCYO	433	89	318	23	112	96	102	774	45	408
HAES	650	142	122	22	76	94	100	764	96	334
FAES	578	106	338	42	106	94	92	752	64	228
FNAE	24	8	594	72	158	92	128	840	86	398
HMES	652	133	134	22	68	94	102	763	122	310
FMES	436	79	433	60	119	90	107	772	73	231
HCES	627	148	68	0	88	92	86	770	58	463
FCES	434	86	297	21	129	102	94	799	58	380

2. Realizamos un ACP normalizado

> X_pca

Standard deviations:

```
[1] 2.142118e+00 1.455968e+00 1.149338e+00 1.093277e+00 6.844052e-01
[6] 4.461473e-01 2.163636e-01 1.925230e-01 1.546575e-01 1.333379e-16
```

Rotation:

	PC1	PC2	PC3	PC4	PC5	PC6
Prof	-0.45617162	0.08313782	0.073587007	0.06123280	-0.140328264	0.04064934
Tran	-0.45738827	-0.03991548	0.007303258	0.04166767	0.162269266	-0.01895219
Mena	0.42009993	-0.01555795	-0.315341555	0.19589470	-0.006074950	-0.09766395
Enfa	0.40712005	-0.12264860	-0.072851719	0.26932467	0.277549704	0.57174504
Cour	0.26310001	-0.52241218	0.003967461	-0.11071136	0.124557933	-0.61031345
Toil	0.03711770	-0.56189036	0.262902171	-0.05812977	-0.655263317	0.36246486
Repa	0.27465298	0.45973933	0.370916117	0.01293150	-0.003644108	0.11412606
Somm	0.30072032	0.39101336	0.166054341	-0.28583091	-0.457422601	-0.24393929
Tele	0.04642008	-0.13262215	0.809201165	0.13834203	0.351950788	-0.09820510
Lois	0.04303032	-0.07572669	-0.026292895	-0.87576408	0.314488720	0.27480748

	PC7	PC8	PC9	PC10
Prof	-0.06675463	0.489097798	-0.09531879	-0.70832772
Tran	0.30461479	-0.420263064	0.68469116	-0.15003163
Mena	-0.06475390	-0.513338595	-0.15232809	-0.62045982
Enfa	0.36483611	0.369269960	0.24275152	-0.09511692
Cour	-0.12200791	0.337151011	0.34452689	-0.10167821
Toil	-0.10567047	-0.168510499	0.09379873	-0.03597011
Repa	-0.59004121	0.002283305	0.45589656	-0.08016202
Somm	0.59344728	0.080942595	0.10625604	-0.09294598
Tele	0.19317992	-0.174400503	-0.29986126	-0.12307359
Lois	-0.04190751	-0.072432310	-0.05860395	-0.19975088

>

Importance of components:

	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Standard deviation	2.1421	1.4560	1.1493	1.0933	0.68441	0.4461	0.21636
Proportion of Variance	0.4589	0.2120	0.1321	0.1195	0.04684	0.0199	0.00468
Cumulative Proportion	0.4589	0.6708	0.8030	0.9225	0.96932	0.9892	0.99390

	PC8	PC9	PC10
Standard deviation	0.19252	0.15466	1.333e-16

```
Proportion of Variance 0.00371 0.00239 0.000e+00
Cumulative Proportion 0.99761 1.00000 1.000e+00
```

Recordemos que los valores de las desviaciones típicas de la función prcomp al cuadrado coinciden con los autovalores de $X'X$ que en este caso es la matriz de correlaciones.

3. Calculamos la matriz de correlaciones y su DVS

```
>
      Prof      Tran      Mena      Enfa      Cour      Toil
Prof 1.00000000 0.93318819 -0.90756704 -0.8697945 -0.65793062 -0.11235558
Tran 0.93318819 1.00000000 -0.86919178 -0.8090113 -0.50304656 -0.07923623
Mena -0.90756704 -0.86919178 1.00000000 0.8613371 0.50104152 -0.03503879
Enfa -0.86979452 -0.80901128 0.86133708 1.00000000 0.54257959 0.12391153
Cour -0.65793062 -0.50304656 0.50104152 0.5425796 1.00000000 0.59314377
Toil -0.11235558 -0.07923623 -0.03503879 0.1239115 0.59314377 1.00000000
Repa -0.45487438 -0.61281159 0.36068115 0.3671424 -0.18423567 -0.35962911
Somm -0.53787631 -0.70177756 0.43302307 0.2767637 -0.02982977 -0.21740108
Tele -0.05876609 -0.04382592 -0.20609760 0.1216116 0.21555690 0.32163961
Lois -0.18956667 -0.10533627 -0.11317381 -0.1092004 0.23537821 0.07307349
      Repa      Somm      Tele      Lois
Prof -0.45487438 -0.53787631 -0.05876609 -0.18956667
Tran -0.61281159 -0.70177756 -0.04382592 -0.10533627
Mena 0.36068115 0.43302307 -0.20609760 -0.11317381
Enfa 0.36714243 0.27676375 0.12161155 -0.10920043
Cour -0.18423567 -0.02982977 0.21555690 0.23537821
Toil -0.35962911 -0.21740108 0.32163961 0.07307349
Repa 1.00000000 0.81702405 0.31642471 -0.03977134
Somm 0.81702405 1.00000000 0.01780528 0.20778151
Tele 0.31642471 0.01780528 1.00000000 -0.09547759
Lois -0.03977134 0.20778151 -0.09547759 1.00000000
```

```
>
$d
[1] 4.588669e+00 2.119843e+00 1.320978e+00 1.195255e+00 4.684105e-01
[6] 1.990474e-01 4.681319e-02 3.706510e-02 2.391893e-02 2.383231e-16
```

```
$u
      [,1]      [,2]      [,3]      [,4]      [,5]      [,6]
[1,] -0.45617162 0.08313782 0.073587007 0.06123280 -0.140328264 0.04064934
[2,] -0.45738827 -0.03991548 0.007303258 0.04166767 0.162269266 -0.01895219
[3,] 0.42009993 -0.01555795 -0.315341555 0.19589470 -0.006074950 -0.09766395
[4,] 0.40712005 -0.12264860 -0.072851719 0.26932467 0.277549704 0.57174504
[5,] 0.26310001 -0.52241218 0.003967461 -0.11071136 0.124557933 -0.61031345
[6,] 0.03711770 -0.56189036 0.262902171 -0.05812977 -0.655263317 0.36246486
[7,] 0.27465298 0.45973933 0.370916117 0.01293150 -0.003644108 0.11412606
[8,] 0.30072032 0.39101336 0.166054341 -0.28583091 -0.457422601 -0.24393929
[9,] 0.04642008 -0.13262215 0.809201165 0.13834203 0.351950788 -0.09820510
[10,] 0.04303032 -0.07572669 -0.026292895 -0.87576408 0.314488720 0.27480748
      [,7]      [,8]      [,9]      [,10]
[1,] 0.06675463 -0.489097798 -0.09531879 0.70832772
[2,] -0.30461479 0.420263064 0.68469116 0.15003163
[3,] 0.06475390 0.513338595 -0.15232809 0.62045982
[4,] -0.36483611 -0.369269960 0.24275152 0.09511692
[5,] 0.12200791 -0.337151011 0.34452689 0.10167821
[6,] 0.10567047 0.168510499 0.09379873 0.03597011
[7,] 0.59004121 -0.002283305 0.45589656 0.08016202
[8,] -0.59344728 -0.080942595 0.10625604 0.09294598
[9,] -0.19317992 0.174400503 -0.29986126 0.12307359
[10,] 0.04190751 0.072432310 -0.05860395 0.19975088
```

```
$v
      [,1]      [,2]      [,3]      [,4]      [,5]      [,6]
[1,] -0.45617162 0.08313782 0.073587007 0.06123280 -0.140328264 0.04064934
[2,] -0.45738827 -0.03991548 0.007303258 0.04166767 0.162269266 -0.01895219
[3,] 0.42009993 -0.01555795 -0.315341555 0.19589470 -0.006074950 -0.09766395
[4,] 0.40712005 -0.12264860 -0.072851719 0.26932467 0.277549704 0.57174504
[5,] 0.26310001 -0.52241218 0.003967461 -0.11071136 0.124557933 -0.61031345
[6,] 0.03711770 -0.56189036 0.262902171 -0.05812977 -0.655263317 0.36246486
[7,] 0.27465298 0.45973933 0.370916117 0.01293150 -0.003644108 0.11412606
[8,] 0.30072032 0.39101336 0.166054341 -0.28583091 -0.457422601 -0.24393929
[9,] 0.04642008 -0.13262215 0.809201165 0.13834203 0.351950788 -0.09820510
[10,] 0.04303032 -0.07572669 -0.026292895 -0.87576408 0.314488720 0.27480748
      [,7]      [,8]      [,9]      [,10]
[1,] 0.06675463 -0.489097798 -0.09531879 0.70832772
```

```
[2,] -0.30461479  0.420263064  0.68469116  0.15003163
[3,]  0.06475390  0.513338595 -0.15232809  0.62045982
[4,] -0.36483611 -0.369269960  0.24275152  0.09511692
[5,]  0.12200791 -0.337151011  0.34452689  0.10167821
[6,]  0.10567047  0.168510499  0.09379873  0.03597011
[7,]  0.59004121 -0.002283305  0.45589656  0.08016202
[8,] -0.59344728 -0.080942595  0.10625604  0.09294598
[9,] -0.19317992  0.174400503 -0.29986126  0.12307359
[10,] 0.04190751  0.072432310 -0.05860395  0.19975088
```

4. Vamos a calcular las coordenadas de los individuos respecto a las 2 primeras componentes principales

```
>
      HAUS      FAUS      FNAU      HMUS      FMUS      HCUS
-1.74099274 -0.16849652  3.98035737 -1.74731129  2.56714870 -1.47570860
      FCUS      HAWF      FAWF      FNAW      HMWE      FMWE
-0.45685884 -1.15514555  0.30638201  4.24547729 -1.10510106  3.07485416
      HCWE      FCWE      HAYO      FAYO      FNAY      HMYO
-1.34534413  1.07930555 -2.12372623 -0.98667473  3.47369092 -2.18117628
      FMYO      HCYO      FCYO      HAES      FAES      FNAE
 1.51222354 -2.09679572 -0.32976004 -2.10812096 -0.96991815  3.84808240
      HMES      FMES      HCES      FCES
-2.03995477  0.48158804 -2.48386893 -0.05415543
```

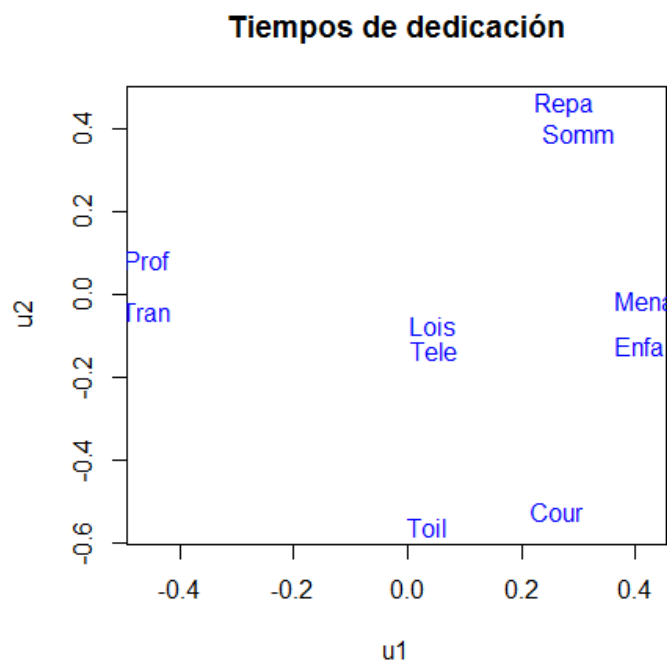
```
>
      HAUS      FAUS      FNAU      HMUS      FMUS      HCUS
-0.67369138 -2.17540053 -2.23666260 -0.28739807 -2.24412034 -1.85764467
      FCUS      HAWF      FAWF      FNAW      HMWE      FMWE
-2.79304864  2.32501506  1.46833416  1.60314689  2.41951762  1.95308508
      HCWE      FCWE      HAYO      FAYO      FNAY      HMYO
 2.52562459  1.62531992  0.23670324 -0.17682317  0.37028404  0.20781022
      FMYO      HCYO      FCYO      HAES      FAES      FNAE
 0.21218039 -0.57015743 -0.41069745  0.06817319 -0.57488313 -0.04855701
      HMES      FMES      HCES      FCES
 0.16740958 -0.20029767 -0.14416915 -0.78905275
```

5. Coordenadas de las variables

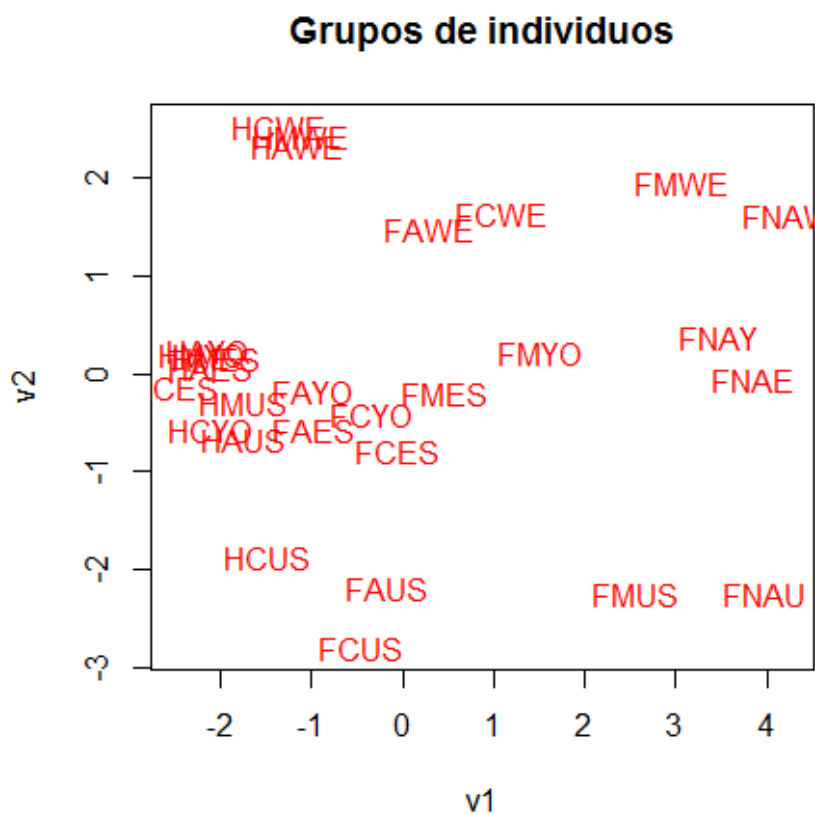
```
[1] -0.45617162 -0.45738827  0.42009993  0.40712005  0.26310001  0.03711770
[7]  0.27465298  0.30072032  0.04642008  0.04303032

[1]  0.08313782 -0.03991548 -0.01555795 -0.12264860 -0.52241218 -0.56189036
[7]  0.45973933  0.39101336 -0.13262215 -0.07572669
```

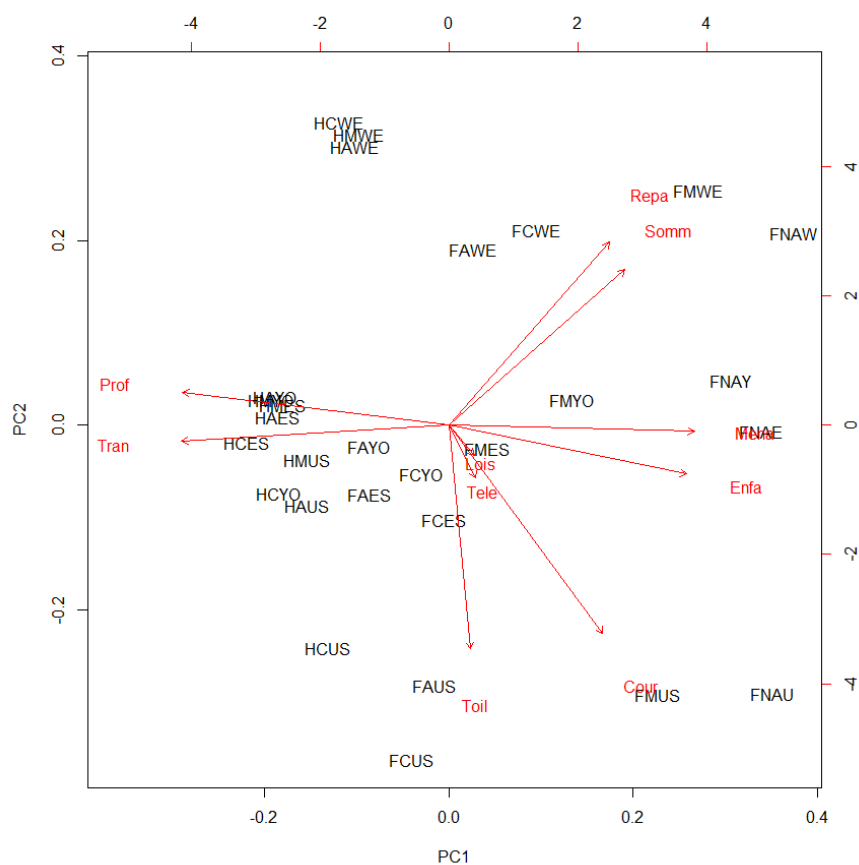
6. Realizamos la representación gráfica



7. Representación gráfica de los individuos



8. Representación Biplot



9. Resultados y conclusiones