Latent Topic Modeling on Twitter Data

Method: CA

Correspondence Analysis (CA) is a multivariate graphical technique designed to explore relationships among categorical variables. The outcome from correspondence analysis is a graphical display of the rows and columns of a contingency table that is designed to permit visualization of the salient relationships among the variable responses in a low-dimensional space. Such a representation reveals a more global picture of the relationships among row-column pairs which would otherwise not be detected through a pairwise analysis.

Calculate CA:

- Step 1: Compute row and column averages
- Step 2: Compute the expected values
- Step 3: Compute the residuals
- Step 4: Plotting labels with similar residuals close together
- Step 5: Interpreting the relationship between row and column labels

How to Interpret Correspondence Analysis Plots

Correspondence analysis does not show us which rows have the highest numbers, nor which columns have the highest numbers. It instead shows us the relativities.

- The further things are from the origin, the more discriminating they are.
- Look at the length of the line connecting the row label to the origin. Longer lines indicate that the row label is highly associated with some of the column labels (i.e., it has at least one high residual).
- Look at the length of the label connecting the column label to the origin. Longer lines again indicate a high association between the column label and one or more row labels.
- Look at the angle formed between these two lines. Really small angles indicate association. 90 degree angles indicate no relationship. Angles near 180 degrees indicate negative associations.

Dataset

```
##                               9      10      11      12      13      14      15      16
## #actu                        33    1887    1719       0    2248    2178       0    2046
## #ada                       5442    8017   25570    8335    7913    4790    4459    5966
## #airdrop                  11441   36136   65027   47022   44009   28802   31422   20915
## #altcoin                   8576   27302   34043   33968   35554   23094   29489   21702
## #amazon                       0     985     706       0       0       0       0       0
## #bch                       2256    5532       0       0    5837    6713       0    4335
## #binanc                    2967   10488    9240   10857    8285    8518   11244    7510
## #bitcoin                  48217  203875  217191  222528  181728  169374  217601  146159
## #bitcoincash                805    3329    3176    3487    2468    2912    3852    7995
## #bittrex                      0       0       0       0       0       0       0    1327
## #blockchain               25360  104908  121667  126158  119212  101804  120474   82617
## #bounti                    5951   18956   32387   27493   29709   15770   22262   14486
## #btc                      28617   95589  119714   95818   91273   76517   91924   64283
## #bts                          0       0       0    9725       0       0       0    4577
## #busi                        29    1283    1041       0    1989       0       0    1566
## #cambridgeanalyt              0       0       0    5004    1658       0       0       0
## #cambridgeanalytica           0       0     780   13947    4700    4102    6515    1851
## #coin                       544    2564       0       0   12546    4176       0       0
```

```
## #coinbas                 674      0      0      0      0   1647   2644      0
## #congress                  0      0      0      0      0      0   2309      0
## #costarica                 0      0      0      0      0      0      0      0
## #crowdfund              1649      0      0      0      0      0   9194   4170
## #crowdsal                  0   4511      0   7858   4876   5252   9604   4020
## #crypto                23912  84945 101526  96566  88437  81127 102777  75307
## #cryptocurr            25722  97272 114420 117667 107539  95315 116701  86840
## #cryptonew                 0   2919   2865   8174   2009   6030   8484      0
## #cybersecur             2396   8491   9800  12639   9689  11301  15782   8265
## #dash                   2861   8558   9124   8832   6340   8412   4518   5950
## #data                      0      0      0   3958   2986   2558   3721   1867
## #date                      0      0      0      0      0      0      0      0
## #deletefacebook            0      0      0   5732   3050   1797   2762      0
## #digitalmarket             0    895    710      0      0      0      0   1356
## #digitizecoin              0      0      0      0      0      0   4733      0
## #earn                      0      0      0      0   8515      0      0      0
## #elsalvador                0      0      0      0      0      0      0      0
## #energytoken            5921   8852      0      0      0      0      0      0
## #eo                     4481   9439      0   4646   6158   4802      0   4102
## #erc20                  1385      0   5729   6245   7331   4942   4706   4441
## #escort                    0      0      0      0      0      0      0   5084
## #etc                    1643   6167      0      0      0      0      0      0
## #eth                   28904  90509 118505  96421 101394  82375  90647  65281
## #ether                  4201  17129  19586  20965  23653  24212  24726  14193
## #ethereum              37313 145661 163302 160486 153445 141294 157889 123366
## #f8                        0      0      0      0      0      0      0      0
## #facebook                949  50748  41961 130670  86932  76678 128772  63718
## #facebookdatabreach        0      0      0      0   1635      0   2683      0
## #facebookdataleak          0      0      0      0      0      0   2801      0
## #facebookg                 0      0      0   3196      0      0      0      0
## #faitsdiv                 33   1882   1717      0   2241   2173      0   2037
## #fintech                1109   4166   3392   3953   2660   2524   3768   1911
## #follow                   18      0      0      0      0      0      0      0
## #free                   2102   8614   2947      0  11960      0      0      0
## #freecoin                  0      0      0      0      0      0   9535      0
## #freetoken              1882   6550   7427   8803  18341  10097  11549   6243
## #game                      0      0      0      0   4687      0      0      0
## #gdpr                      0      0      0      0      0      0      0   1499
## #geoloc                    0      0      0   4655   8009   9285  10856   4415
## #girl                      0      0      0      0      0      0      0   5119
## #googl                    42   2779   2532   4691   5555   3372   4228   3154
## #grab                      0      0   9192      0      0      0      0      0
## #gto                    3015      0      0      0      0      0      0      0
## #guatemala                 0      0      0      0      0      0      0      0
## #hiphop                   21   1249    950      0      0      0      0      0
## #ico                   22618  85294 106509 107006  96788  85156  99988  71690
## #info                     35   1918   1747   2435   2295   2217      0   2101
## #instagram               153   7778   5601   8764   7736   7760   8403   7887
## #invest                 2549  10826   4243  10145   8789  10133  11408   6770
## #justic                   35   1962   1773   2452   2316   2263   2288   2205
## #linkedin                 23   1091    948      0      0      0      0   1384
## #litecoin               6944  24524  28035  22353  22159  18549  19239  13606
## #live                   1444      0      0      0   8888      0      0      0
## #ltc                   10626  24905  26691  24203  20939  17617  18332  18170
```

```
## #maga                      0      0      0      0      0      0   2999      0
## #mana                      0      0  14506      0      0      0      0      0
## #market                   36   2763   1954   3032   4668   2457   2865   2591
## #markzuckerberg            0      0      0   3952      0   1805   7903      0
## #média                    33   1917   1760      0   2271   2192      0   2047
## #mexico                    0      0      0      0      0      0      0      0
## #money                   759   3616   3129      0  11018   1775      0      0
## #music                    46   2458   2201   3045   2798   2846   3027   2820
## #neo                    6536  17747  12554  11168  10211   8381   7989   5928
## #new                     734  11244   6719   5867   6333  10280   5774   9363
## #nowplay                   0      0      0      0      0      0      0      0
## #np                        0      0      0      0      0      0      0      0
## #opirium                   0      0      0      0      0   4354   4372      0
## #panama                    0      0      0      0      0      0      0      0
## #pdata                     0      0      0      0      0   4269   4318      0
## #pinterest                 0    924    745      0      0      0      0      0
## #privaci                   0      0      0   5047   4843   3767   6267   3097
## #qanon                     0      0      0      0      0      0   2491      0
## #radiocapitol             33   1882   1717      0   2241   2173      0   2037
## #rippl                 10406  30151  21378  20985  19602  17416  19468  13612
## #rt                        0      0      0      0      0      0      0      0
## #smm                       0   1249    922      0      0   1509      0   1194
## #snapchat                 20   1406    984      0   1697   1602      0   1631
## #socialmedia              84   5468   4141   8751   6959   6267   8052   6012
## #socialmediamarket        20      0      0      0      0      0      0      0
## #soundcloud               31   1424   1162      0      0      0      0   1183
## #submityourmus            21   1158    885      0      0      0      0      0
## #tge                       0      0      0      0      0      0   5112   4757
## #tinder                    0      0      0      0      0      0      0      0
## #token                  6253  25055  27857  26829  41958  27994  27825  14562
## #tokensal               5635  21400  22542  21919  21075  22293  27843  27337
## #trade                  3952  12218  12189  10300   9258   9860  10287   8306
## #travel                    0      0      0      0      0      0      0      0
## #tron                   3465   7741      0   4996      0   4132   6167      0
## #trump                     0      0      0   3805      0      0      0      0
## #trx                    8392  19648  34732  21853  17709  13922  17372  13047
## #twitter                 160   8199   6384  11196   9690   8526   9834   8848
## #uniqu                    33   1887   1720   2527   2248   2251      0   2045
## #usa                      21      0      0      0      0      0      0      0
## #usd                       0      0      0      0   2241      0      0      0
## #verg                   2493   6675      0      0      0      0      0      0
## #video                     0      0      0      0      0      0      0      0
## #vip                       0      0      0      0      0      0      0      0
## #webradio                 33   1882   1718      0   2241   2173      0   2039
## #whatsapp                  0   1146    836      0      0      0      0      0
## #xem                       0      0      0      0      0      0      0      0
## #xlm                    5289  11806   5957   5749   5579   4759      0   3891
## #xmr                    1428      0      0      0      0      0      0      0
## #xrb                    3144   6450      0      0      0      0      0      0
## #xrp                   11169  33533  29413  25704  23416  20931  21598  17065
## #xvg                    6037  10978  33533  15046   9724   6645   8805   9520
## #youtub                   84   3921   2951   4276   3684   3824   4257   4265
## #zuckerberg                0      0      0   4287   1763   2614  18855   1838
## 000facebook                0      0      0   4391   2785   2602   3727   1675
```

```
## 000guarium        0       0       0       0       0       0       0    1311
## account           0       0       0    3637    1793    1493    2533       0
## ad               41    1610    1252    2824    2556    2127    2790    1640
## airdrop         4272    8952   17883   10533    7212    6779    7201    4515
## al                0       0       0       0       0       0    2312    1263
## analytica         0       0       0    5653    1681    1826    2917       0
## app               0       0       0       0       0       0       0       0
## bitcoin        2711   14780   14408   13655    7537    7178   11675    5826
## blockchain      679    3830    3165    9959    6873    5983    8528    5830
## btc            7909   28256   28966   32636   25442   21654   27668   20829
## busi             19     957     765       0       0       0       0       0
## buy               0       0    3049    3092    2252    1773    2703    2144
## call              0       0       0       0    2079       0       0       0
## cambridg          0       0       0    5210       0    1697    2915       0
## ce               25    1120    1013       0       0       0       0    1296
## ceo               0       0       0       0       0       0    2327       0
## chanc             0       0   10243       0       0       0       0       0
## check            23       0       0       0       0       0       0       0
## compani           0       0       0    2474       0       0       0       0
## con              24       0     727       0       0       0       0       0
## congress          0       0       0       0       0       0    2865       0
## crypto         1098   10822    5945   10172    8295    7665    9818    6544
## cryptocurr      956    5092    5437    5222    3318    3026    8716    2091
## data              0       0    1377   13700    8052    6269   11498    3051
## date              0       0       0       0       0       0       0       0
## dato              0       0       0    2483       0       0       0       0
## day               0     935       0       0       0       0       0       0
## de              113    6790    8049   24821   15463   13950   22702   12976
## delet             0       0       0    3964    1851       0       0       0
## di                0       0       0    3647       0       0       0       0
## earn           2223    5665       0       0       0       0       0       0
## el               28    1370    1071    4103    2548    2433    4281    2327
## en              120    5497    4486    9932    7427    7699    9991    7677
## eth            3241   11422   11191   13177    8228    6775    9134    6817
## exchang           0    3077       0    2945       0    1639    2622       0
## facebook         94    5427    4555   15673   10760    8853   15829    7125
## fb                0       0       0    2720       0       0    2346       0
## featur            0       0       0       0       0       0       0       0
## follow           38    1233    1023       0       0       0       0    1291
## free           5808   16399   25969   12939    5688    6081    4254    1327
## friend         1510       0   11701       0       0       0       0       0
## goal              0       0    9690       0       0       0       0       0
## hear              0       0       0       0       0       0    3143       0
## hour              0       0       0       0       0    1838    2616       0
## ico               0    7126    2803    8051       0    4069    8521    5162
## invest            0    2545       0       0       0       0       0       0
## join           6079   19880   19144   14644   12512   10303   11544    9214
## la               80    3471    2896    9927    6200    5685    7844    4939
## las              23       0       0       0       0       0       0       0
## le                0       0       0    2617    1695       0    2817    1396
## les              19       0       0       0       0       0       0       0
## link              0       0    8352    5435       0       0       0       0
## live             18     917     808       0       0       0       0       0
## los               0       0       0       0       0    1652       0       0
```

```
## mani               0      0  10111      0      0      0      0      0
## mark               0      0      0   2944      0      0   6420      0
## market           822   4974   4242   4148   3030   2923   3997   1837
## media             33   1383   1208   3226   2058   1885   3156   1705
## million            0      0      0      0      0   1853      0      0
## mine               0   2674   2724      0      0      0      0      0
## moment            26   1072    964      0      0      0      0   1193
## news               0   1296    827      0   1615   1580      0      0
## offer              0      0   5691      0      0      0      0      0
## page              66   2644   2094   3646   2885   2674   3505   2364
## para              20   1126    805      0   1709   1636      0   1655
## peopl             18      0  10731   3429   1921   2004   3763      0
## person             0      0      0   2847      0      0      0      0
## platform           0   4424      0   4653   4636   4337   4483   3521
## por               19      0      0      0      0      0      0      0
## post              32   1751   1211   2450   2007   1685   2311   1629
## price           1243  10972   6949   7200   9158   4847   7262   3282
## privaci            0      0      0   2567   2799   2136   4267   1673
## project         2154  11358  21611  14398  12914  12225  13507   9354
## question           0      0      0      0      0      0   3826      0
## radiocapitol      25    997    922      0      0      0      0      0
## reach              0      0   9778      0      0      0      0      0
## refer              0      0   5695      0      0      0      0      0
## regist             0      0  13344   4883      0      0      0      0
## scandal            0      0      0   3077   1805   1632      0      0
## secur            564      0      0      0      0      0      0      0
## sell               0      0      0      0      0      0      0   1423
## senat              0      0      0      0      0      0   3569      0
## share              0      0  14946   6956      0   1833   2849      0
## social            60   2131   1766   5031   3234   2631   4526   2540
## start              0   2745   7559      0      0      0      0   1323
## su                 0      0      0      0      0      0      0   1254
## sur                0    914      0      0      0      0      0      0
## telegram         557      0      0      0      0      0      0      0
## time              28      0   7462   7755   1627      0   2645      0
## tip               19      0      0      0      0      0      0      0
## token           5349  17632  45257  23837  16045  13554  16261   9327
## trade            730   3604   3056   2933      0   1966      0   1375
## user               0      0      0   4479   2942   3965   5084   2144
## video             18   1236    766      0      0      0      0      0
## world              0      0      0   3240      0      0      0      0
## zuckerberg         0      0      0   4690   1625   2486  11162   1224
##                   17     18
## #actu           2078   1070
## #ada            5662   3024
## #airdrop       25835  12552
## #altcoin       22645  11037
## #amazon         1223      0
## #bch            8765   3517
## #binanc        11870   5286
## #bitcoin      158495  75997
## #bitcoincash   11788   7675
## #bittrex           0      0
## #blockchain    99271  49005
```

```
## #bounti                12209   5916
## #btc                   76877  35862
## #bts                        0      0
## #busi                   1457    712
## #cambridgeanalyt            0      0
## #cambridgeanalytica     1307    826
## #coin                       0      0
## #coinbas                    0      0
## #congress                   0      0
## #costarica                  0   1258
## #crowdfund              4572      0
## #crowdsal               4487      0
## #crypto                 87376  42214
## #cryptocurr             91921  43949
## #cryptonew              1773      0
## #cybersecur             4301      0
## #dash                   7772   2968
## #data                   1233      0
## #date                       0    832
## #deletefacebook             0      0
## #digitalmarket          1218      0
## #digitizecoin               0      0
## #earn                       0      0
## #elsalvador                 0   5021
## #energytoken                0      0
## #eo                     10170   5725
## #erc20                  5897   3412
## #escort                 2142   5796
## #etc                        0      0
## #eth                    77083  37647
## #ether                  14613   7550
## #ethereum              128290  63917
## #f8                         0   1318
## #facebook               57189  32773
## #facebookdatabreach         0      0
## #facebookdataleak           0      0
## #facebookg                  0      0
## #faitsdiv               2069   1067
## #fintech                6752   1578
## #follow                     0      0
## #free                       0      0
## #freecoin                   0      0
## #freetoken              13292   5198
## #game                       0      0
## #gdpr                       0      0
## #geoloc                 4390      0
## #girl                       0   1818
## #googl                  3154   1144
## #grab                       0      0
## #gto                        0      0
## #guatemala                  0   5024
## #hiphop                 1102      0
## #ico                    66002  30532
## #info                   2118   1077
```

6

```
## #instagram            7987  3791
## #invest               7421  1640
## #justic               2266  1125
## #linkedin             1390     0
## #litecoin            16692  8097
## #live                   0     0
## #ltc                 19869  9654
## #maga                   0     0
## #mana                   0     0
## #market               2902  1449
## #markzuckerberg         0     0
## #média                2093  1075
## #mexico               2147  5094
## #money                  0     0
## #music                2985  1497
## #neo                 11323  4541
## #new                 12422  7881
## #nowplay                0  1820
## #np                   6086  5036
## #opirium                0     0
## #panama                 0  4941
## #pdata                  0     0
## #pinterest              0     0
## #privaci              1785  1170
## #qanon                  0     0
## #radiocapitol         2069  1065
## #rippl               19950  9200
## #rt                     0  4098
## #smm                    0     0
## #snapchat             1688   725
## #socialmedia          5996  3210
## #socialmediamarket    1045     0
## #soundcloud           1213     0
## #submityourmus          0     0
## #tge                  5659  2672
## #tinder                 0   767
## #token               14649  7684
## #tokensal            22074  9379
## #trade                9931  4516
## #travel               2145  1876
## #tron                 6643  2890
## #trump                  0     0
## #trx                 18464  9152
## #twitter              8827  3895
## #uniqu                2073  1067
## #usa                  2307  5215
## #usd                    0     0
## #verg                   0     0
## #video                6392  1499
## #vip                    0  5005
## #webradio             2069  1067
## #whatsapp               0  1342
## #xem                  3921     0
## #xlm                  5308  2706
```

```
## #xmr            0      0
## #xrb            0      0
## #xrp        26585  12577
## #xvg         5656   3131
## #youtub      4256   2146
## #zuckerberg     0    712
## 000facebook   1191   1052
## 000guarium       0      0
## account          0      0
## ad            1670    772
## airdrop       6496   2585
## al               0      0
## analytica        0      0
## app              0    820
## bitcoin       8137   3793
## blockchain    7076   1368
## btc          27933  14644
## busi             0      0
## buy           2452   1038
## call             0      0
## cambridg         0      0
## ce            1241    669
## ceo              0      0
## chanc            0      0
## check            0      0
## compani          0      0
## con           1020      0
## congress         0      0
## crypto        7519   1661
## cryptocurr    2740   1309
## data          1886   1282
## date             0   1409
## dato             0      0
## day              0      0
## de           11409  11511
## delet            0      0
## di               0      0
## earn             0      0
## el            1834   1198
## en            6994   3685
## eth           8523   4759
## exchang          0      0
## facebook      5951   3817
## fb               0      0
## featur           0    815
## follow        1173    675
## free          1846      0
## friend           0      0
## goal             0      0
## hear             0      0
## hour             0      0
## ico              0      0
## invest           0      0
## join          8760   2836
```

```
## la                    4419  2675
## las                       0     0
## le                     1059   834
## les                       0   725
## link                      0     0
## live                      0     0
## los                       0     0
## mani                      0     0
## mark                      0     0
## market                 4216  1311
## media                  1494   672
## million                   0     0
## mine                      0     0
## moment                 1192     0
## news                      0   703
## offer                     0     0
## page                   2321  1154
## para                   1425  1028
## peopl                     0     0
## person                    0     0
## platform                  0     0
## por                       0     0
## post                   1722   898
## price                  4641  1921
## privaci                   0   780
## project                8053  3245
## question                  0     0
## radiocapitol           1091     0
## reach                     0     0
## refer                     0     0
## regist                    0     0
## scandal                   0     0
## secur                     0     0
## sell                      0     0
## senat                     0     0
## share                     0     0
## social                 2228  1072
## start                     0     0
## su                        0     0
## sur                       0     0
## telegram                  0     0
## time                      0     0
## tip                       0     0
## token                 13797  4653
## trade                  1859     0
## user                   1281   895
## video                  1042     0
## world                     0     0
## zuckerberg                0   763
```

- Research Question

    - Do we see new words appearing on a particular week

Analysis

Heatmap
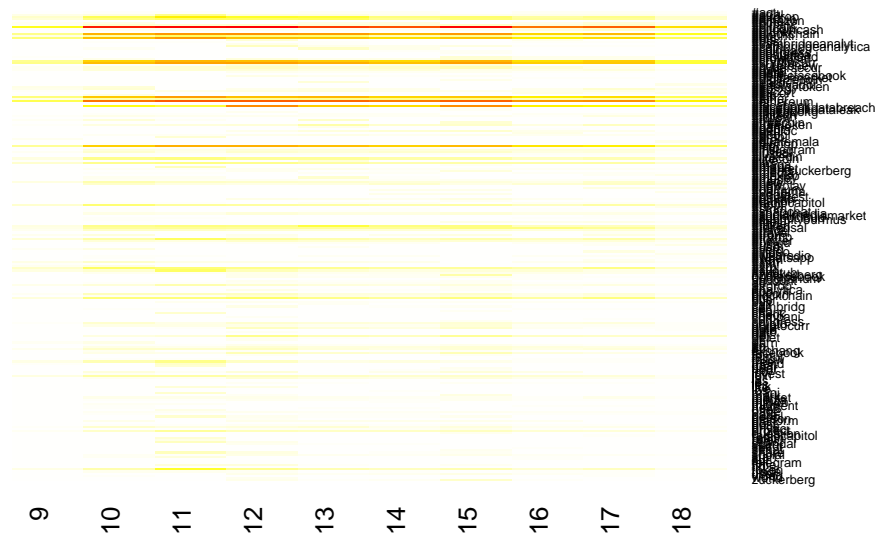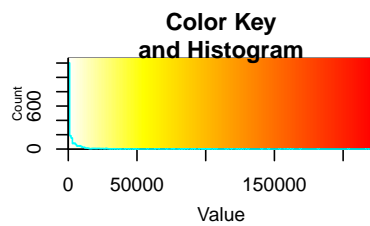
Scree Plot

Gives amount of information explained by corresponding component. Gives an intuition to decide which components best represent data in order to answer the research question.

P.S. The most contribution component may not always be most useful for a given research question.

```
PTCA4CATA::PlotScree(ev = resCA.sym$ExPosition.Data$eigs,
                     #p.ev = we_data_inf$Inference.Data$components$p.vals,
                     title = 'SCREE Plot',
                     plotKaiser = TRUE
)
```

SCREE Plot
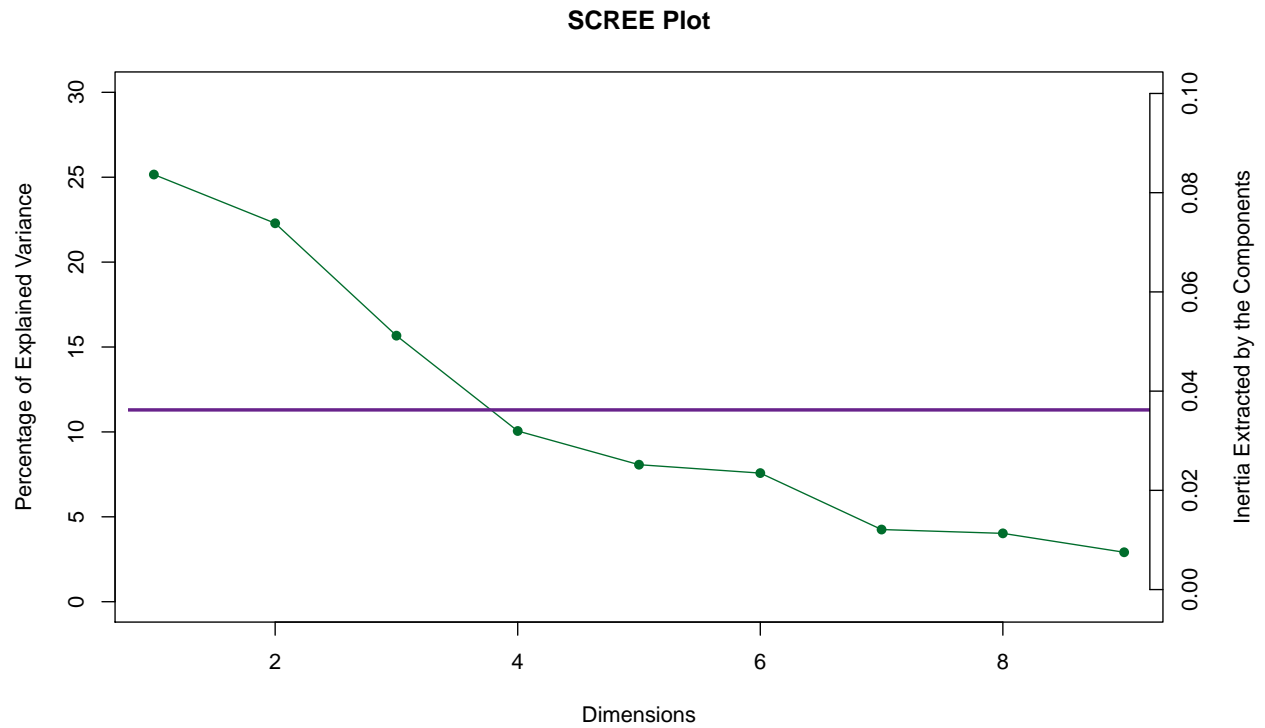
Factor Scores

Asymmetric Plot

```
#### Asymmetric Plot

map.IJ.asym <- asymMap$baseMap + asymMap$J_labels +
  asymMap$J_points + labels4CA #+ legend$zeMap_dots + legend$zeMap_text
print(map.IJ.asym)
```
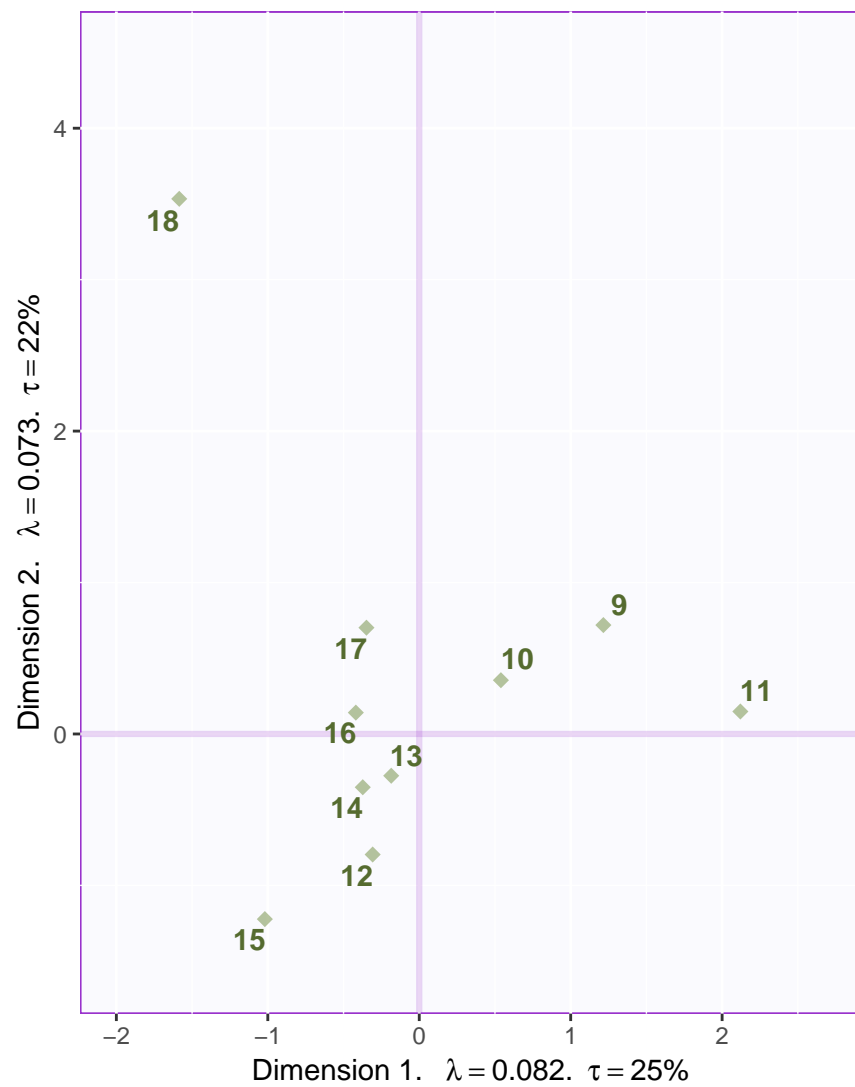
Asymmetric Plot

```
map.IJ.asym <- asymMap$baseMap + asymMap$I_labels +
  asymMap$I_points + labels4CA #+ legend$zeMap_dots + legend$zeMap_text
print(map.IJ.asym)
```
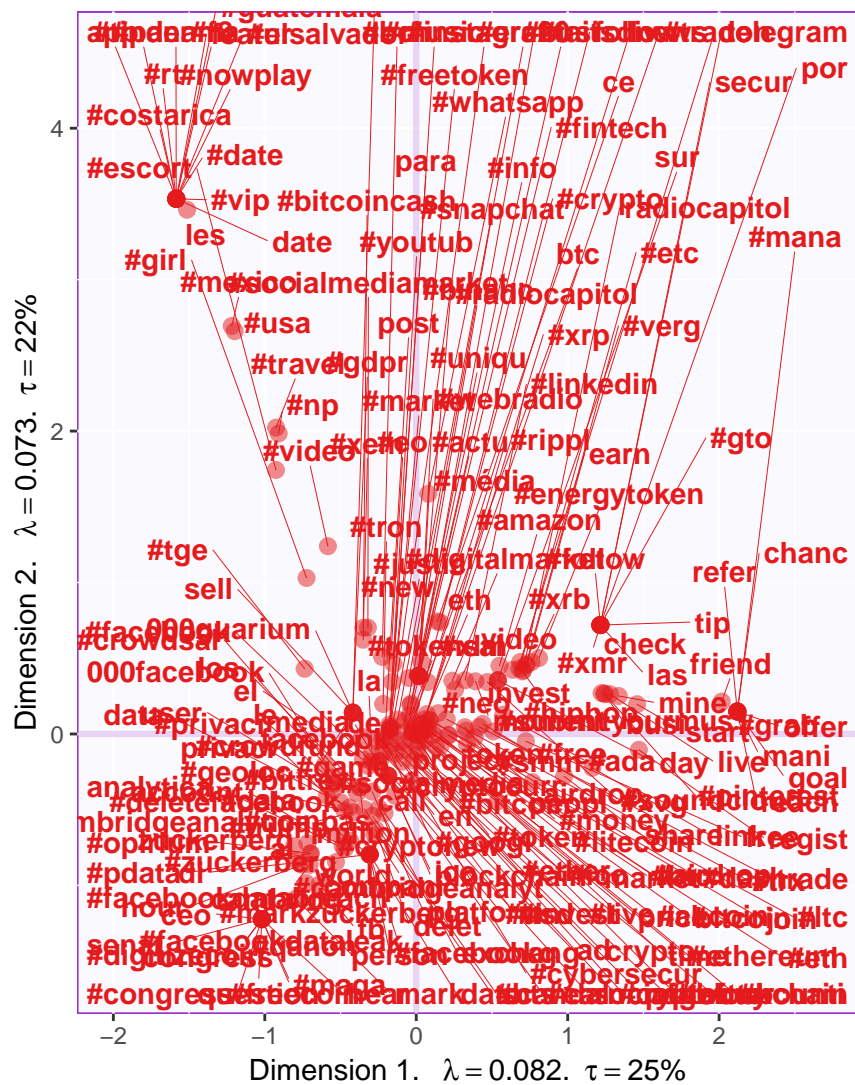
```
#### Asymmetric Plot

map.IJ.asym <- asymMap$baseMap + asymMap$I_labels +
  asymMap$I_points + asymMap$J_labels +
  asymMap$J_points + labels4CA #+ legend$zeMap_dots + legend$zeMap_text
print(map.IJ.asym)
```
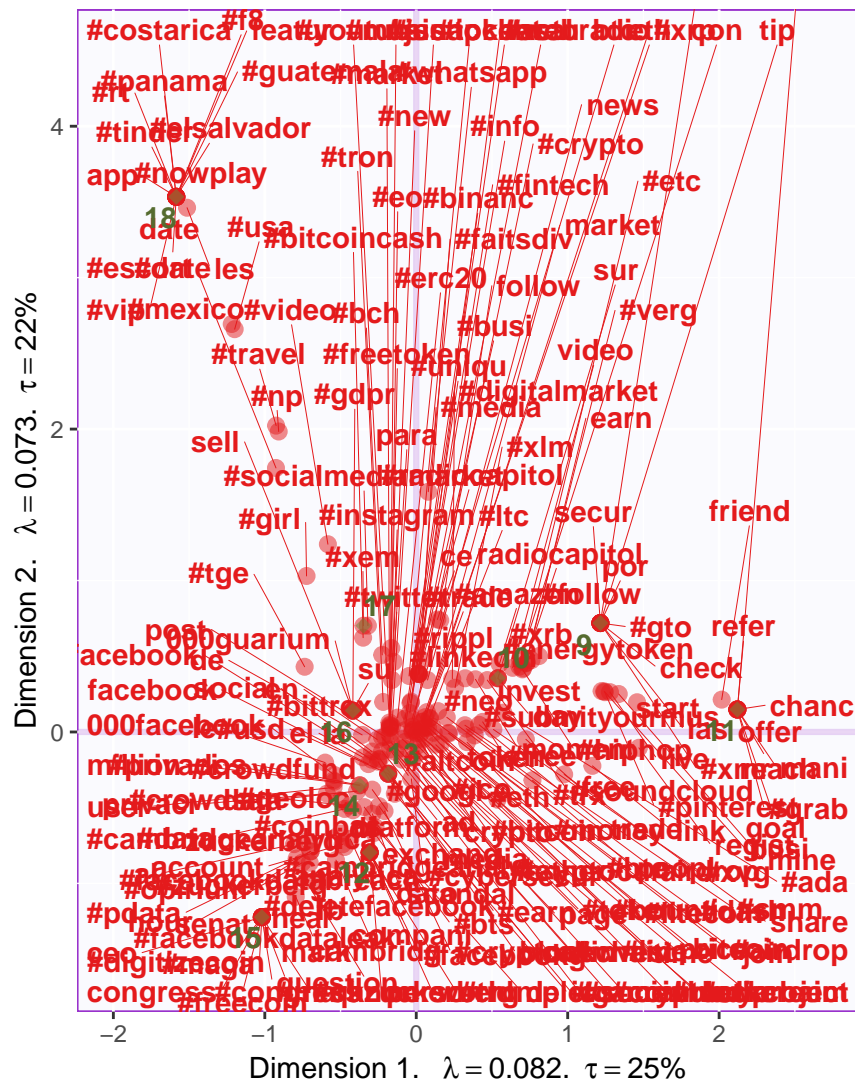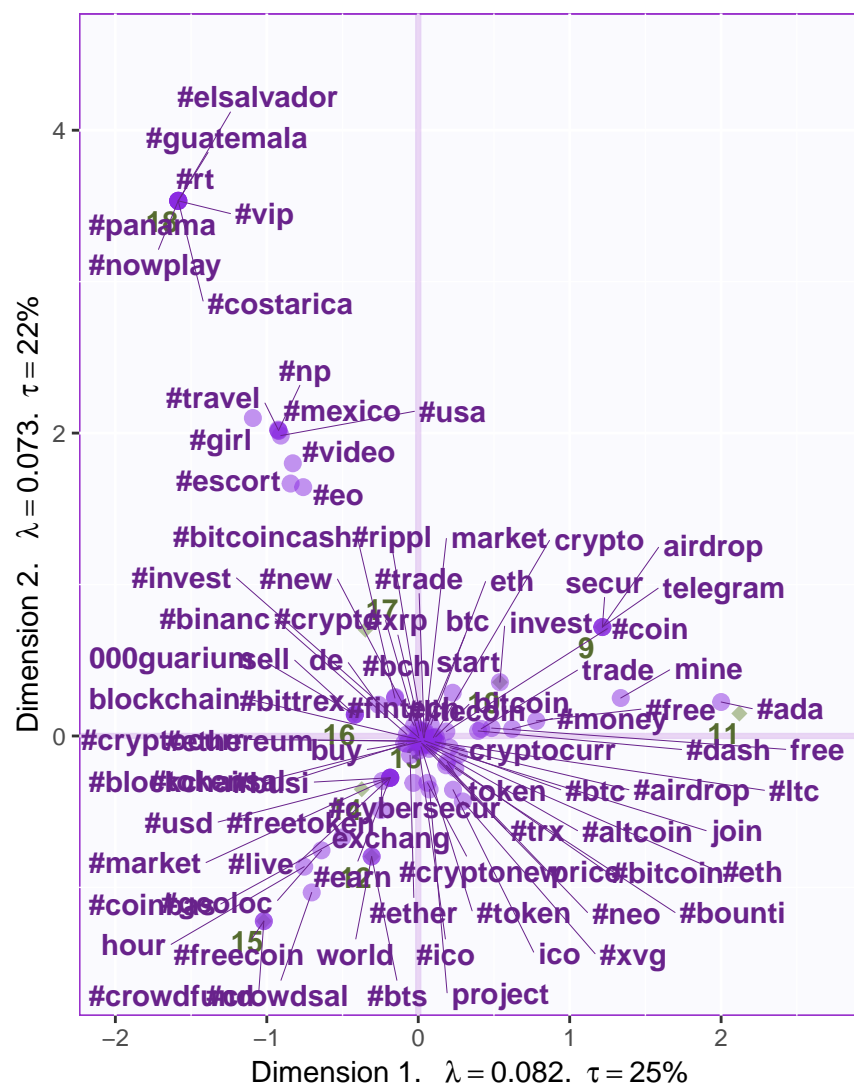
```
tweets_eth_supp <- supplementaryRows(tweets_eth,resCA.asym)
asymMap_supp  <- createFactorMapIJ(tweets_eth_supp$fii,Fj,
                            #col.points.i = color4Authors,
                            #col.labels.i = color4Authors
                            )

map.IJ.asym <- asymMap$baseMap + #asymMap$I_labels +
  #asymMap$I_points +
  asymMap$J_labels +
  asymMap$J_points + labels4CA + #+ legend$zeMap_dots + legend$zeMap_text
  asymMap_supp$I_points + asymMap_supp$I_labels

print(map.IJ.asym)
```
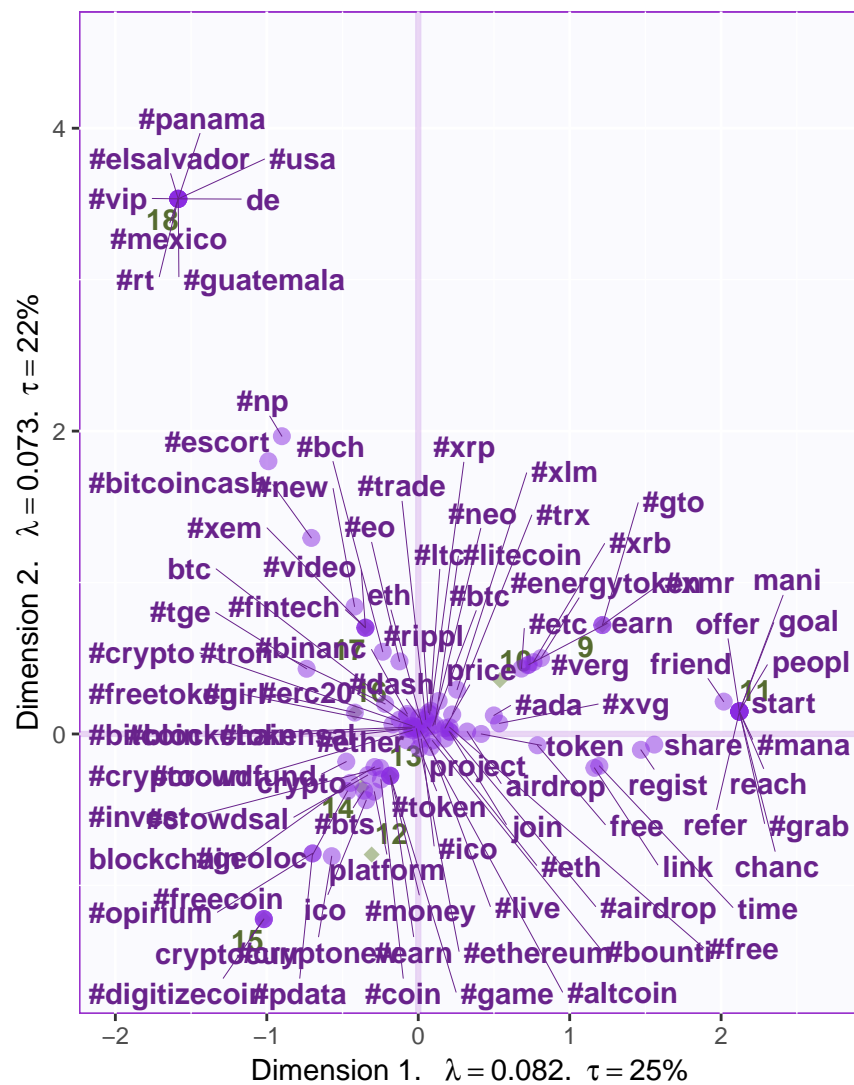
```
tweets_facebook_supp <- supplementaryRows(tweets_facebook,resCA.asym)
asymMap_supp  <- createFactorMapIJ(tweets_facebook_supp$fii,Fj,
                            #col.points.i = color4Authors,
                            #col.labels.i = color4Authors
                            )

map.IJ.asym <- asymMap$baseMap + #asymMap$I_labels +
  #asymMap$I_points +
  asymMap$J_labels +
  asymMap$J_points + labels4CA + #+ legend$zeMap_dots + legend$zeMap_text
  asymMap_supp$I_points + asymMap_supp$I_labels

print(map.IJ.asym)
```

Dimension 2. $\lambda = 0.073$. $\tau = 22\%$

Dimension 1. $\lambda = 0.082$. $\tau = 25\%$
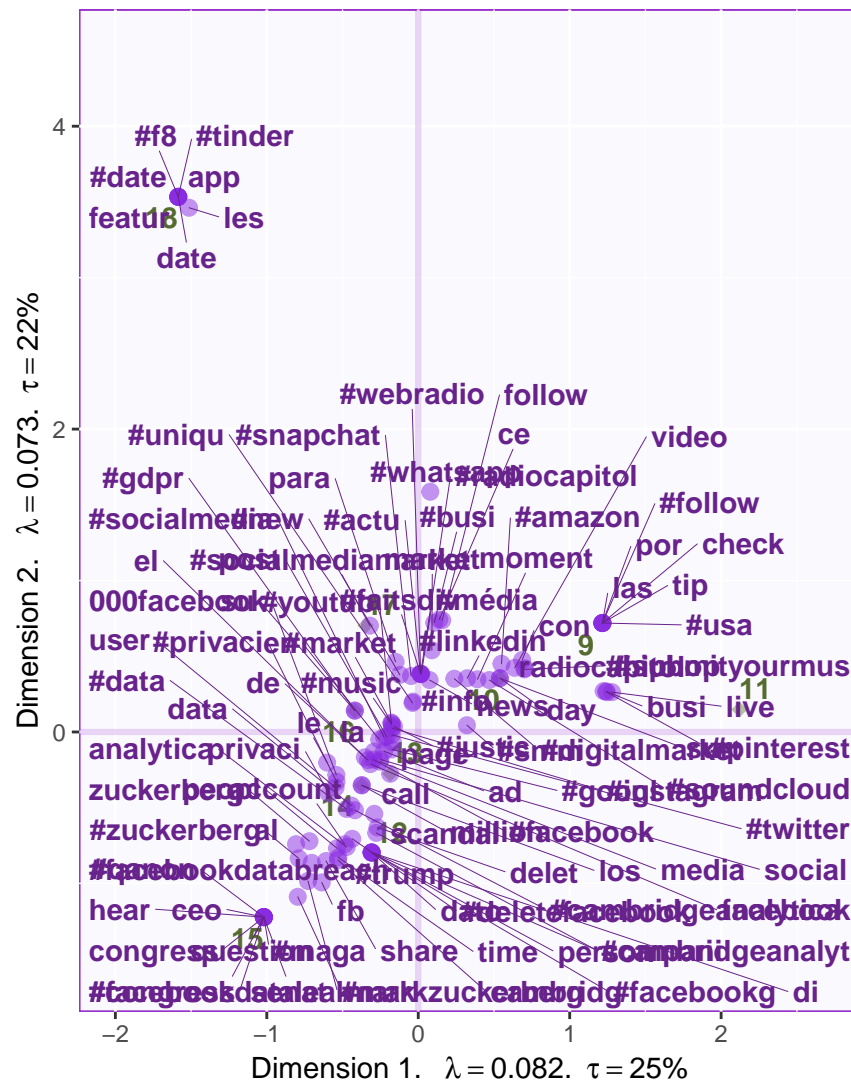
```
tweets_bitcoin_supp <- supplementaryRows(tweets_bitcoin,resCA.asym)
asymMap_supp  <- createFactorMapIJ(tweets_bitcoin_supp$fii,Fj,
                         #col.points.i = color4Authors,
                         #col.labels.i = color4Authors
                         )

map.IJ.asym <- asymMap$baseMap + #asymMap$I_labels +
  #asymMap$I_points +
  asymMap$J_labels +
  asymMap$J_points + labels4CA + #+ legend$zeMap_dots + legend$zeMap_text
  asymMap_supp$I_points + asymMap_supp$I_labels

print(map.IJ.asym)
```

Symmetric Plot

The scatter plot axes:
- Dimension 2. λ = 0.073. τ = 22%
- Dimension 1. λ = 0.082. τ = 25%
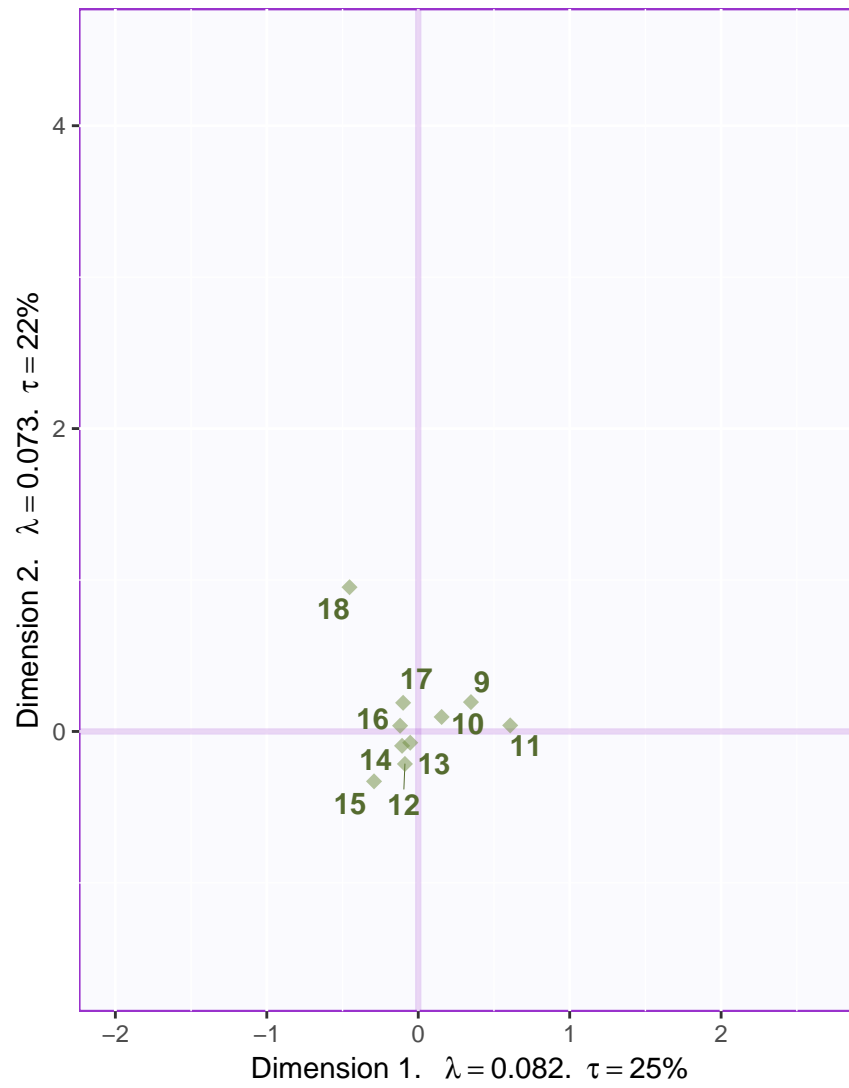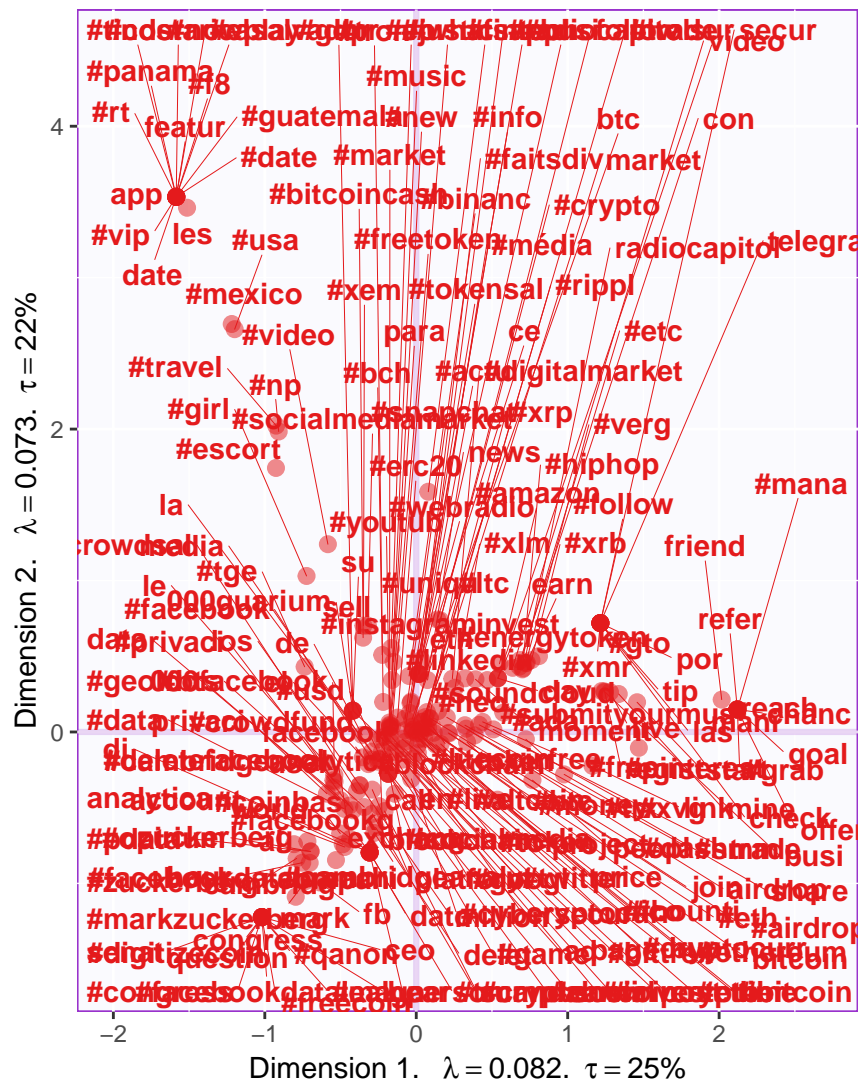
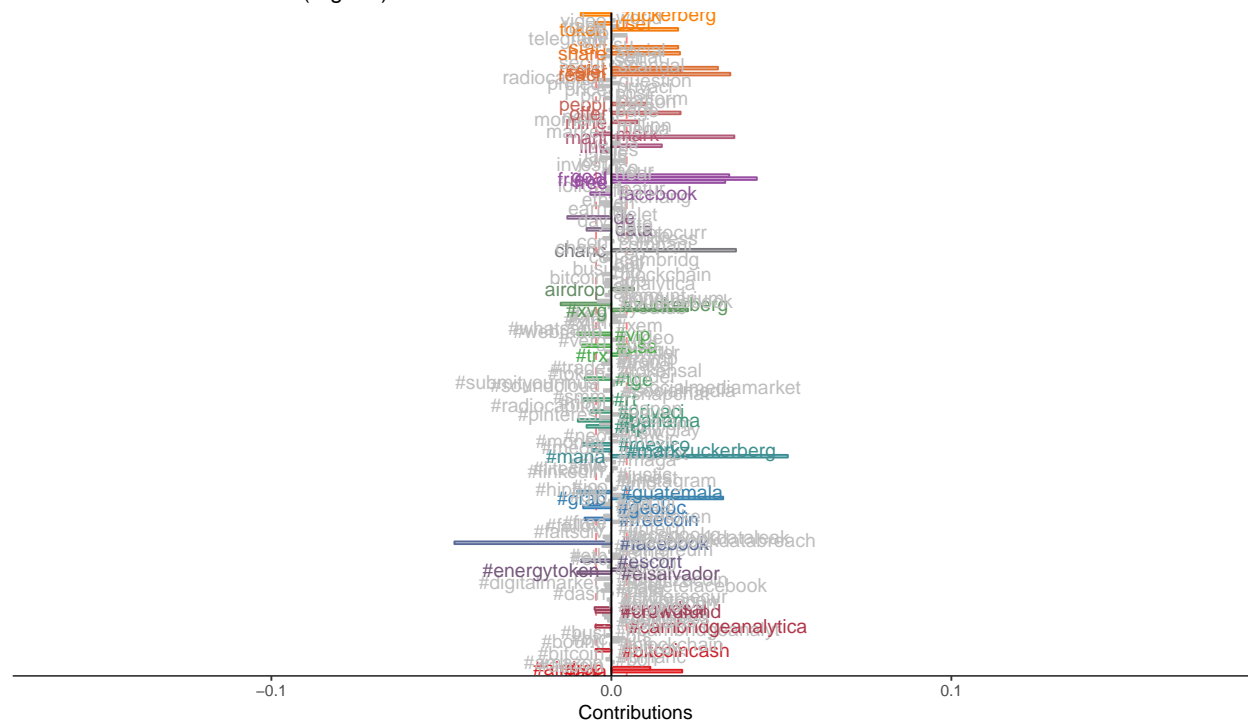## Most Contributing Variables

```r
PTCA4CATA::PrettyBarPlot2(ctr.I[,1],
                    threshold = 1 / NROW(ctr.I),
                    font.size = 4,
                    color4bar = gplots::col2hex(color4I),
                    color4ns = 'grey',
                    main = 'Observations: Contributions (Signed)',
                    ylab = 'Contributions', ylim = c(1.2*min(ctr.I),
                     1.2*max(ctr.I) ),
                    horizontal = FALSE )
```

Observations: Contributions (Signed)

Contributions

```
PTCA4CATA::PrettyBarPlot2(ctr.J[,1],
                  threshold = 1 / NROW(ctr.J),
                  font.size = 4,
                  color4bar = gplots::col2hex(color4J),
                  color4ns = 'grey',
                  main = 'Observations: Contributions (Signed)',
                  ylab = 'Contributions', ylim = c(1.2*min(ctr.J),
                   1.2*max(ctr.J) ),
                  horizontal = FALSE )
```

Observations: Contributions (Signed)