

Data Modeling

Contents

Overview	1
Model - Overall Data	2
Model - Split by Televote	18
Model - Split by Jury	33

Overview

A stratified analysis method will be implemented 1. Test Overall Data Iteratively create model step wise, 2. Split and Test Data by Voting Method Can't stratify the data by each country due to a lack of data Need a minimum of 10/20 observations per covariate for regression analysis Split data by voting method, research televote shows more bias than the jury NOTE forward and step wise fitting will be utilized using AIC to determine model of best fit

NOTE: the models will be evaluated using the car package MLR requires the residuals to be $\sim \text{IID } N(0, \sigma^2)$ the residuals will be standardized for the assessment Normality Assumptions will be accessed using: (i) Normality tests from the nortest package (ii) Visualizations such as histograms, QQ-plots, Residual Plots and Add Variable Plots Constant Variance will be accessed using: (i) non-constant variance test Multi-collinearity will be accessed using: (i) variance inflation factors Outliers will be accessed using: (i) Cooks Distance

```
# load the relevant libraries
library(rmarkdown)
library(knitr)
library(car)
```

```
## Loading required package: carData
```

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following object is masked from 'package:car':
##
##      recode
```

```
## The following objects are masked from 'package:stats':
##
##      filter, lag
```

```
## The following objects are masked from 'package:base':
##
## intersect, setdiff, setequal, union
```

```
# load custom functions
source('scripts/utilities/step_lm_model.R')
```

```
##-- Data --#
```

```
# load in the historic voting data for deriving the voting blocs
processed_data <- read.csv(file = "./data/processed_data.csv", header = T)
# split the televote data
televote_data <- processed_data %>% filter(Voting_Method_J == 0)
# split out the jury vote data
jury_data <- processed_data %>% filter(Voting_Method_J == 1)

# define the competition factors
competition_factors <- extract_preds_by_cats(cat = 'competition')
# define the performance factors
performance_factors <- extract_preds_by_cats(cat = 'performance')
# define the external factors
external_factors <- extract_preds_by_cats(cat = 'external')
```

Model - Overall Data

iteratively create my own mode; continuously noting the magnitude and significance of the predictors. Fit the variables in groups/blocs; performance, competition and external variables. Fit each variable block independently. Then fit the all the best variables. Incorporate interaction and squared terms. Compare my final model with the baseline mode; making notes of any differences/similarities

```
# fit step wise linear model
overall_competition_model <- step_lm_model(dataset = processed_data, pred_cols = competition_factors)
```

```
## Start: AIC=1596.4
## Points ~ 1
##
##           Df Sum of Sq  RSS    AIC
## + Average_Points  1    384.92 7037.8 1563.4
## + OOA              1     68.14 7354.6 1592.3
## <none>              7422.7 1596.4
## + Host_Nation_y    1     15.42 7407.3 1597.0
## + Voting_Method_J  1      1.23 7421.5 1598.3
## + Round_f          1      0.25 7422.5 1598.4
## + Round_sf1        1      0.19 7422.5 1598.4
##
## Step: AIC=1563.36
## Points ~ Average_Points
##
##           Df Sum of Sq  RSS    AIC
## + OOA              1     57.05 6980.7 1560.0
## <none>              7037.8 1563.4
## + Round_f          1      1.92 7035.9 1565.2
```

```
## + Round_sf1      1      0.89 7036.9 1565.3
## + Voting_Method_J 1      0.69 7037.1 1565.3
## + Host_Nation_y  1      0.41 7037.4 1565.3
## - Average_Points 1    384.92 7422.7 1596.4
##
## Step:  AIC=1560
## Points ~ Average_Points + 00A
##
##              Df Sum of Sq    RSS    AIC
## <none>                6980.7 1560.0
## + Host_Nation_y      1      2.79 6977.9 1561.7
## + Round_f            1      2.47 6978.3 1561.8
## + Voting_Method_J    1      1.65 6979.1 1561.8
## + Round_sf1          1      0.71 6980.0 1561.9
## - 00A                1     57.05 7037.8 1563.4
## - Average_Points     1    373.83 7354.6 1592.3
```

```
# extract out significant predictors
overall_sign_competition_factors <- overall_competition_model$sign_factors
```

```
# fit step wise linear model
overall_performance_model <- step_lm_model(dataset = processed_data, pred_cols = performance_factors)
```

```
## Start:  AIC=1596.4
## Points ~ 1
##
##              Df Sum of Sq    RSS    AIC
## + speechiness      1    261.406 7161.3 1574.8
## + acousticness     1    216.707 7206.0 1578.9
## + liveness         1    156.211 7266.5 1584.4
## + danceability     1    142.027 7280.7 1585.7
## + key_2            1     96.926 7325.8 1589.8
## + TC_PerfType_Group 1     81.654 7341.0 1591.1
## + key_6            1     61.107 7361.6 1593.0
## + TC_PerfType_Solo  1     55.383 7367.3 1593.5
## + time_signature_4  1     54.833 7367.9 1593.5
## + valence          1     47.386 7375.3 1594.2
## + key_8            1     35.450 7387.3 1595.2
## + TC_SingerGender_Male 1     33.874 7388.8 1595.4
## + loudiness        1     26.977 7395.7 1596.0
## + mode_1           1     25.286 7397.4 1596.2
## + TC_SingerGender_Female 1     24.834 7397.9 1596.2
## + TC_PerfType_Mixed 1     23.234 7399.5 1596.3
## + TC_SONGLANG_Bosnian 1     23.234 7399.5 1596.3
## <none>                7422.7 1596.4
## + ComSONGLAN        1      8.164 7414.5 1597.7
## + duration_ms       1      4.896 7417.8 1598.0
## + tempo             1      1.944 7420.8 1598.2
## + key_0             1      1.885 7420.8 1598.2
## + energy            1      1.783 7420.9 1598.2
## + FC_SONGLANG_English 1      0.749 7422.0 1598.3
## + instrumentalness  1      0.002 7422.7 1598.4
##
```

```

## Step: AIC=1574.8
## Points ~ speechiness
##
##
## Df Sum of Sq RSS AIC
## + acousticness 1 310.173 6851.1 1547.7
## + TC_PerfType_Solo 1 114.035 7047.3 1566.2
## + TC_PerfType_Group 1 81.777 7079.5 1569.2
## + liveness 1 73.638 7087.7 1570.0
## + key_2 1 62.090 7099.2 1571.1
## + danceability 1 54.252 7107.0 1571.8
## + key_6 1 45.114 7116.2 1572.7
## + key_0 1 34.936 7126.4 1573.6
## + key_8 1 31.708 7129.6 1573.9
## + time_signature_4 1 28.732 7132.6 1574.2
## <none> 7161.3 1574.8
## + mode_1 1 13.958 7147.3 1575.5
## + tempo 1 13.161 7148.1 1575.6
## + TC_PerfType_Mixed 1 10.154 7151.1 1575.9
## + TC_SONGLANG_Bosnian 1 10.154 7151.1 1575.9
## + instrumentalness 1 9.722 7151.6 1575.9
## + ComSONGLAN 1 9.635 7151.7 1575.9
## + loudiness 1 6.066 7155.2 1576.2
## + energy 1 5.125 7156.2 1576.3
## + valence 1 4.452 7156.8 1576.4
## + FC_SONGLANG_English 1 0.590 7160.7 1576.8
## + TC_SingerGender_Female 1 0.215 7161.1 1576.8
## + duration_ms 1 0.027 7161.3 1576.8
## + TC_SingerGender_Male 1 0.002 7161.3 1576.8
## - speechiness 1 261.406 7422.7 1596.4
##
## Step: AIC=1547.67
## Points ~ speechiness + acousticness
##
##
## Df Sum of Sq RSS AIC
## + key_0 1 102.93 6748.2 1539.7
## + TC_PerfType_Solo 1 63.21 6787.9 1543.6
## + liveness 1 39.50 6811.6 1545.9
## + ComSONGLAN 1 38.20 6812.9 1546.0
## + TC_PerfType_Group 1 34.33 6816.8 1546.4
## + tempo 1 30.48 6820.6 1546.7
## + key_2 1 28.27 6822.8 1547.0
## + instrumentalness 1 26.57 6824.6 1547.1
## + TC_PerfType_Mixed 1 24.16 6827.0 1547.3
## + TC_SONGLANG_Bosnian 1 24.16 6827.0 1547.3
## <none> 6851.1 1547.7
## + key_8 1 17.83 6833.3 1548.0
## + key_6 1 17.67 6833.5 1548.0
## + duration_ms 1 17.33 6833.8 1548.0
## + mode_1 1 14.83 6836.3 1548.2
## + valence 1 11.70 6839.4 1548.5
## + loudiness 1 11.35 6839.8 1548.6
## + energy 1 5.18 6845.9 1549.2
## + time_signature_4 1 2.81 6848.3 1549.4
## + FC_SONGLANG_English 1 0.70 6850.4 1549.6

```

```

## + danceability          1      0.30 6850.8 1549.6
## + TC_SingerGender_Male  1      0.24 6850.9 1549.7
## + TC_SingerGender_Female 1      0.09 6851.0 1549.7
## - acousticness          1    310.17 7161.3 1574.8
## - speechiness           1    354.87 7206.0 1578.9
##
## Step: AIC=1539.71
## Points ~ speechiness + acousticness + key_0
##
##              Df Sum of Sq    RSS    AIC
## + TC_PerfType_Solo      1     52.97 6695.2 1536.5
## + TC_PerfType_Mixed      1     41.05 6707.1 1537.7
## + TC_SONGLANG_Bosnian    1     41.05 6707.1 1537.7
## + ComSONGLAN             1     40.22 6708.0 1537.8
## + instrumentalness       1     25.54 6722.6 1539.2
## + liveness               1     24.95 6723.2 1539.3
## + TC_PerfType_Group      1     22.35 6725.8 1539.5
## <none>                   6748.2 1539.7
## + key_2                  1     17.24 6731.0 1540.0
## + key_8                  1     13.46 6734.7 1540.4
## + key_6                  1      9.88 6738.3 1540.7
## + duration_ms            1      7.52 6740.7 1541.0
## + energy                 1      6.75 6741.4 1541.0
## + valence                1      6.20 6742.0 1541.1
## + danceability           1      3.75 6744.4 1541.3
## + loudiness              1      3.32 6744.9 1541.4
## + mode_1                 1      2.65 6745.5 1541.5
## + tempo                  1      2.56 6745.6 1541.5
## + TC_SingerGender_Female 1      2.20 6746.0 1541.5
## + FC_SONGLANG_English    1      0.94 6747.3 1541.6
## + TC_SingerGender_Male   1      0.23 6748.0 1541.7
## + time_signature_4       1      0.00 6748.2 1541.7
## - key_0                  1    102.93 6851.1 1547.7
## - acousticness           1    378.17 7126.4 1573.6
## - speechiness            1    442.26 7190.5 1579.5
##
## Step: AIC=1536.52
## Points ~ speechiness + acousticness + key_0 + TC_PerfType_Solo
##
##              Df Sum of Sq    RSS    AIC
## + ComSONGLAN             1     41.52 6653.7 1534.4
## + liveness               1     35.33 6659.9 1535.0
## + instrumentalness       1     32.42 6662.8 1535.3
## <none>                   6695.2 1536.5
## + key_2                  1     19.81 6675.4 1536.6
## + TC_PerfType_Mixed      1     16.51 6678.7 1536.9
## + TC_SONGLANG_Bosnian    1     16.51 6678.7 1536.9
## + energy                 1     14.16 6681.1 1537.1
## + key_6                  1     12.57 6682.6 1537.3
## + TC_PerfType_Group      1      7.57 6687.6 1537.8
## + loudiness              1      5.14 6690.1 1538.0
## + duration_ms            1      4.15 6691.1 1538.1
## + TC_SingerGender_Male   1      2.32 6692.9 1538.3
## + valence                1      2.15 6693.1 1538.3

```

```

## + mode_1          1      2.05 6693.2 1538.3
## + key_8           1      1.09 6694.1 1538.4
## + TC_SingerGender_Female 1      0.76 6694.5 1538.5
## + tempo           1      0.69 6694.5 1538.5
## + FC_SONGLANG_English 1      0.56 6694.7 1538.5
## + time_signature_4 1      0.33 6694.9 1538.5
## + danceability    1      0.30 6694.9 1538.5
## - TC_PerfType_Solo 1     52.97 6748.2 1539.7
## - key_0           1     92.70 6787.9 1543.6
## - acousticness    1    320.65 7015.9 1565.3
## - speechiness     1    476.23 7171.5 1579.7
##
## Step:  AIC=1534.43
## Points ~ speechiness + acousticness + key_0 + TC_PerfType_Solo +
##      ComSONGLAN
##
##              Df Sum of Sq    RSS    AIC
## + FC_SONGLANG_English 1     29.97 6623.7 1533.5
## + instrumentalness     1     25.98 6627.7 1533.9
## <none>                  6653.7 1534.4
## + liveness             1     19.82 6633.9 1534.5
## + key_2                 1     18.65 6635.1 1534.6
## + key_6                 1     13.78 6639.9 1535.1
## + loudiness            1     11.35 6642.4 1535.3
## + TC_PerfType_Mixed    1     10.11 6643.6 1535.4
## + TC_SONGLANG_Bosnian  1     10.11 6643.6 1535.4
## + duration_ms          1      9.92 6643.8 1535.5
## + energy               1      8.72 6645.0 1535.6
## + TC_PerfType_Group    1      5.39 6648.3 1535.9
## + mode_1               1      5.11 6648.6 1535.9
## + key_8                 1      1.73 6652.0 1536.3
## + valence              1      1.58 6652.1 1536.3
## + danceability         1      1.10 6652.6 1536.3
## + time_signature_4     1      0.53 6653.2 1536.4
## + TC_SingerGender_Female 1      0.12 6653.6 1536.4
## + TC_SingerGender_Male 1      0.02 6653.7 1536.4
## + tempo                1      0.00 6653.7 1536.4
## - ComSONGLAN           1     41.52 6695.2 1536.5
## - TC_PerfType_Solo     1     54.27 6708.0 1537.8
## - key_0                 1     94.53 6748.2 1541.7
## - acousticness         1    350.48 7004.2 1566.2
## - speechiness          1    488.63 7142.3 1579.1
##
## Step:  AIC=1533.46
## Points ~ speechiness + acousticness + key_0 + TC_PerfType_Solo +
##      ComSONGLAN + FC_SONGLANG_English
##
##              Df Sum of Sq    RSS    AIC
## + instrumentalness     1     21.50 6602.2 1533.3
## + key_2                 1     20.40 6603.3 1533.4
## <none>                  6623.7 1533.5
## + loudiness            1     17.01 6606.7 1533.8
## + key_6                 1     14.10 6609.6 1534.1
## + duration_ms          1     13.05 6610.7 1534.2

```

```

## + liveness          1      12.85 6610.9 1534.2
## - FC_SONGLANG_English 1      29.97 6653.7 1534.4
## + mode_1            1       7.84 6615.9 1534.7
## + TC_PerfType_Mixed  1       7.80 6615.9 1534.7
## + TC_SONGLANG_Bosnian 1       7.80 6615.9 1534.7
## + energy            1       5.87 6617.9 1534.9
## + TC_PerfType_Group  1       4.06 6619.7 1535.1
## + danceability       1       2.81 6620.9 1535.2
## + key_8              1       1.63 6622.1 1535.3
## + TC_SingerGender_Female 1     1.21 6622.5 1535.3
## + valence            1       0.94 6622.8 1535.4
## + time_signature_4    1       0.66 6623.1 1535.4
## + TC_SingerGender_Male 1     0.45 6623.3 1535.4
## + tempo              1       0.35 6623.4 1535.4
## - TC_PerfType_Solo    1     52.05 6675.8 1536.6
## - ComSONGLAN          1     70.93 6694.7 1538.5
## - key_0              1     97.56 6721.3 1541.1
## - acousticness        1    371.40 6995.1 1567.4
## - speechiness         1    494.90 7118.6 1578.9
##
## Step: AIC=1533.32
## Points ~ speechiness + acousticness + key_0 + TC_PerfType_Solo +
##          ComSONGLAN + FC_SONGLANG_English + instrumentalness
##
##              Df Sum of Sq    RSS    AIC
## + key_2          1     20.23 6582.0 1533.3
## <none>              6602.2 1533.3
## - instrumentalness 1     21.50 6623.7 1533.5
## + loudiness        1     16.26 6586.0 1533.7
## - FC_SONGLANG_English 1     25.50 6627.7 1533.9
## + key_6            1     14.52 6587.7 1533.9
## + TC_PerfType_Mixed 1     12.25 6590.0 1534.1
## + TC_SONGLANG_Bosnian 1     12.25 6590.0 1534.1
## + duration_ms       1     10.90 6591.3 1534.2
## + danceability       1       7.84 6594.4 1534.5
## + mode_1            1       7.82 6594.4 1534.5
## + liveness          1       6.08 6596.1 1534.7
## + TC_PerfType_Group  1       5.90 6596.3 1534.7
## + energy            1       4.45 6597.8 1534.9
## + TC_SingerGender_Female 1     3.87 6598.4 1534.9
## + TC_SingerGender_Male 1     2.06 6600.2 1535.1
## + key_8              1     1.34 6600.9 1535.2
## + time_signature_4    1     0.63 6601.6 1535.3
## + valence            1     0.29 6601.9 1535.3
## + tempo              1     0.07 6602.2 1535.3
## - TC_PerfType_Solo    1     57.60 6659.8 1537.0
## - ComSONGLAN          1     60.13 6662.4 1537.3
## - key_0              1     95.72 6697.9 1540.8
## - acousticness        1    381.50 6983.7 1568.3
## - speechiness         1    516.40 7118.6 1580.9
##
## Step: AIC=1533.3
## Points ~ speechiness + acousticness + key_0 + TC_PerfType_Solo +
##          ComSONGLAN + FC_SONGLANG_English + instrumentalness + key_2

```

```
##
##           Df Sum of Sq   RSS   AIC
## <none>                6582.0 1533.3
## - key_2              1    20.23 6602.2 1533.3
## - instrumentalness   1    21.34 6603.3 1533.4
## + key_6              1    16.96 6565.0 1533.6
## + loudiness          1    14.82 6567.2 1533.8
## - FC_SONGLANG_English 1    27.12 6609.1 1534.0
## + TC_PerfType_Mixed   1     9.06 6572.9 1534.4
## + TC_SONGLANG_Bosnian 1     9.06 6572.9 1534.4
## + duration_ms        1     8.15 6573.8 1534.5
## + liveness           1     7.83 6574.2 1534.5
## + danceability        1     7.44 6574.5 1534.6
## + mode_1             1     5.62 6576.4 1534.7
## + energy              1     5.19 6576.8 1534.8
## + TC_PerfType_Group   1     4.51 6577.5 1534.8
## + TC_SingerGender_Female 1     1.84 6580.2 1535.1
## + time_signature_4    1     1.57 6580.4 1535.1
## + key_8              1     1.54 6580.5 1535.2
## + TC_SingerGender_Male 1     0.79 6581.2 1535.2
## + tempo               1     0.54 6581.5 1535.2
## + valence             1     0.25 6581.7 1535.3
## - TC_PerfType_Solo    1    60.19 6642.2 1537.3
## - ComSONGLAN          1    60.42 6642.4 1537.3
## - key_0              1    84.20 6666.2 1539.7
## - acousticness        1   341.25 6923.2 1564.6
## - speechiness         1   468.40 7050.4 1576.5
```

```
# extract out significant predictors
```

```
overall_sign_performance_factors <- overall_performance_model$sign_factors
```

```
# fit step wise linear model
```

```
overall_external_model <- step_lm_model(dataset = processed_data, pred_cols = external_factors)
```

```
## Start:  AIC=1596.4
```

```
## Points ~ 1
```

```
##
##           Df Sum of Sq   RSS   AIC
## + METRIC_Citizens    1   263.517 7159.2 1574.6
## + FC_NonCitizens     1   177.512 7245.2 1582.5
## + FC_NonCOB          1   168.440 7254.3 1583.3
## + ComLANGFAM_y       1   153.917 7268.8 1584.6
## + CAP_DIST_km        1   128.658 7294.0 1586.9
## + Neighbours_y       1    73.052 7349.6 1591.9
## + TC_NumNeigh        1    54.682 7368.0 1593.5
## + TC_LANGFAM_Armenian 1    23.076 7399.6 1596.3
## <none>                7422.7 1596.4
## + VBlocs1_TC_1       1    20.184 7402.5 1596.6
## + ComVBlocs1_y       1     5.348 7417.4 1597.9
## + VBlocs1_TC_8       1     4.239 7418.5 1598.0
## + FC_LANGFAM_Baltic  1     3.630 7419.1 1598.1
## + ComVBlocs2_y       1     3.626 7419.1 1598.1
## + TC_LANGFAM_Baltic  1     1.688 7421.0 1598.2
```



```

## + VBlocs1_TC_13      1      1.458 7421.2 1598.3
## + VBlocs1_FC_1       1      0.906 7421.8 1598.3
## + VBlocs2_TC_1       1      0.257 7422.4 1598.4
## + VBlocs2_FC_1       1      0.176 7422.5 1598.4
## + VBlocs1_TC_9       1      0.087 7422.6 1598.4
##
## Step:  AIC=1574.61
## Points ~ METRIC_Citizens
##
##              Df Sum of Sq  RSS    AIC
## + CAP_DIST_km      1   175.483 6983.7 1560.3
## + ComLANGFAM_y      1   143.563 7015.6 1563.3
## + FC_NonCOB         1    37.343 7121.8 1573.2
## + FC_NonCitizens    1    35.608 7123.6 1573.3
## + VBlocs1_TC_1      1    22.943 7136.2 1574.5
## + VBlocs1_TC_8      1    22.136 7137.0 1574.6
## <none>              7159.2 1574.6
## + TC_LANGFAM_Armenian 1    13.359 7145.8 1575.4
## + VBlocs1_TC_13     1    10.880 7148.3 1575.6
## + Neighbours_y      1     6.862 7152.3 1576.0
## + ComVBlocs1_y       1     3.785 7155.4 1576.3
## + ComVBlocs2_y       1     3.210 7156.0 1576.3
## + TC_NumNeigh       1     2.464 7156.7 1576.4
## + TC_LANGFAM_Baltic  1     1.759 7157.4 1576.5
## + FC_LANGFAM_Baltic  1     1.569 7157.6 1576.5
## + VBlocs2_FC_1      1     0.589 7158.6 1576.6
## + VBlocs2_TC_1      1     0.241 7158.9 1576.6
## + VBlocs1_FC_1      1     0.197 7159.0 1576.6
## + VBlocs1_TC_9      1     0.026 7159.2 1576.6
## - METRIC_Citizens    1   263.517 7422.7 1596.4
##
## Step:  AIC=1560.28
## Points ~ METRIC_Citizens + CAP_DIST_km
##
##              Df Sum of Sq  RSS    AIC
## + ComLANGFAM_y      1   119.577 6864.1 1550.9
## + FC_NonCOB         1    62.587 6921.1 1556.4
## + FC_NonCitizens    1    59.150 6924.5 1556.7
## + TC_NumNeigh       1    48.439 6935.3 1557.7
## <none>              6983.7 1560.3
## + VBlocs1_TC_8      1    18.856 6964.8 1560.5
## + ComVBlocs1_y       1    15.902 6967.8 1560.8
## + Neighbours_y      1    13.840 6969.9 1561.0
## + VBlocs2_TC_1      1    12.772 6970.9 1561.1
## + TC_LANGFAM_Armenian 1    11.340 6972.4 1561.2
## + TC_LANGFAM_Baltic  1     9.263 6974.4 1561.4
## + VBlocs1_TC_13     1     9.133 6974.6 1561.4
## + VBlocs1_TC_1      1     3.054 6980.6 1562.0
## + FC_LANGFAM_Baltic  1     2.780 6980.9 1562.0
## + VBlocs1_FC_1      1     1.468 6982.2 1562.1
## + VBlocs2_FC_1      1     0.509 6983.2 1562.2
## + ComVBlocs2_y       1     0.431 6983.3 1562.2
## + VBlocs1_TC_9      1     0.191 6983.5 1562.3
## - CAP_DIST_km      1   175.483 7159.2 1574.6

```

```

## - METRIC_Citizens      1    310.343 7294.0 1586.9
##
## Step:  AIC=1550.92
## Points ~ METRIC_Citizens + CAP_DIST_km + ComLANGFAM_y
##
##              Df Sum of Sq    RSS    AIC
## + FC_NonCOB      1      66.267 6797.9 1546.5
## + FC_NonCitizens  1      64.223 6799.9 1546.7
## + TC_NumNeigh     1      57.332 6806.8 1547.4
## + VBlocs2_TC_1    1      33.816 6830.3 1549.7
## + ComVBlocs1_y    1      27.060 6837.1 1550.3
## + VBlocs1_TC_8    1      25.404 6838.7 1550.5
## <none>                        6864.1 1550.9
## + VBlocs1_TC_13   1      16.527 6847.6 1551.3
## + Neighbours_y    1       8.465 6855.7 1552.1
## + TC_LANGFAM_Armenian 1       4.261 6859.9 1552.5
## + TC_LANGFAM_Baltic 1       4.041 6860.1 1552.5
## + VBlocs2_FC_1    1       3.238 6860.9 1552.6
## + ComVBlocs2_y    1       0.790 6863.3 1552.8
## + VBlocs1_FC_1    1       0.165 6864.0 1552.9
## + FC_LANGFAM_Baltic 1       0.108 6864.0 1552.9
## + VBlocs1_TC_1    1       0.064 6864.1 1552.9
## + VBlocs1_TC_9    1       0.006 6864.1 1552.9
## - ComLANGFAM_y    1    119.577 6983.7 1560.3
## - CAP_DIST_km     1    151.497 7015.6 1563.3
## - METRIC_Citizens  1    296.425 7160.5 1576.7
##
## Step:  AIC=1546.53
## Points ~ METRIC_Citizens + CAP_DIST_km + ComLANGFAM_y + FC_NonCOB
##
##              Df Sum of Sq    RSS    AIC
## + TC_NumNeigh      1     50.294 6747.6 1543.7
## + VBlocs2_TC_1      1     41.209 6756.6 1544.5
## + VBlocs1_TC_13     1     40.979 6756.9 1544.6
## + ComVBlocs1_y      1     33.968 6763.9 1545.2
## <none>                        6797.9 1546.5
## + VBlocs1_TC_8      1     19.878 6778.0 1546.6
## + FC_NonCitizens    1       7.441 6790.4 1547.8
## + TC_LANGFAM_Armenian 1       2.640 6795.2 1548.3
## + TC_LANGFAM_Baltic 1       2.471 6795.4 1548.3
## + VBlocs2_FC_1      1       1.222 6796.6 1548.4
## + Neighbours_y      1       1.159 6796.7 1548.4
## + VBlocs1_TC_1      1       0.214 6797.6 1548.5
## + VBlocs1_FC_1      1       0.200 6797.7 1548.5
## + VBlocs1_TC_9      1       0.030 6797.8 1548.5
## + FC_LANGFAM_Baltic 1       0.023 6797.8 1548.5
## + ComVBlocs2_y      1       0.020 6797.8 1548.5
## - FC_NonCOB         1      66.267 6864.1 1550.9
## - ComLANGFAM_y      1    123.257 6921.1 1556.4
## - METRIC_Citizens   1    134.248 6932.1 1557.4
## - CAP_DIST_km       1    175.663 6973.5 1561.3
##
## Step:  AIC=1543.65
## Points ~ METRIC_Citizens + CAP_DIST_km + ComLANGFAM_y + FC_NonCOB +

```

```

##      TC_NumNeigh
##
##
##      Df Sum of Sq    RSS    AIC
## + VBlocs1_TC_13      1    45.258 6702.3 1541.2
## + VBlocs2_TC_1       1    36.969 6710.6 1542.0
## + ComVBlocs1_y       1    25.211 6722.4 1543.2
## <none>                                6747.6 1543.7
## + VBlocs1_TC_8       1    13.411 6734.2 1544.3
## + TC_LANGFAM_Baltic   1     6.523 6741.0 1545.0
## + FC_NonCitizens     1     5.748 6741.8 1545.1
## + VBlocs2_FC_1       1     1.185 6746.4 1545.5
## + VBlocs1_TC_1       1     0.675 6746.9 1545.6
## + TC_LANGFAM_Armenian 1     0.637 6746.9 1545.6
## + VBlocs1_FC_1       1     0.342 6747.2 1545.6
## + FC_LANGFAM_Baltic   1     0.243 6747.3 1545.6
## + Neighbours_y       1     0.172 6747.4 1545.6
## + ComVBlocs2_y       1     0.029 6747.5 1545.6
## + VBlocs1_TC_9       1     0.016 6747.5 1545.7
## - TC_NumNeigh        1    50.294 6797.9 1546.5
## - FC_NonCOB          1    59.228 6806.8 1547.4
## - METRIC_Citizens    1    80.630 6828.2 1549.5
## - ComLANGFAM_y       1   131.499 6879.1 1554.3
## - CAP_DIST_km        1   222.378 6969.9 1563.0
##
## Step:  AIC=1541.22
## Points ~ METRIC_Citizens + CAP_DIST_km + ComLANGFAM_y + FC_NonCOB +
##      TC_NumNeigh + VBlocs1_TC_13
##
##
##      Df Sum of Sq    RSS    AIC
## + VBlocs2_TC_1       1    35.188 6667.1 1539.8
## + ComVBlocs1_y       1    28.697 6673.6 1540.4
## <none>                                6702.3 1541.2
## + FC_NonCitizens     1    14.241 6688.1 1541.8
## + VBlocs1_TC_8       1    13.787 6688.5 1541.9
## + TC_LANGFAM_Baltic   1     6.447 6695.9 1542.6
## + VBlocs2_FC_1       1     1.507 6700.8 1543.1
## + Neighbours_y       1     0.632 6701.7 1543.2
## + VBlocs1_FC_1       1     0.582 6701.7 1543.2
## + TC_LANGFAM_Armenian 1     0.366 6701.9 1543.2
## + FC_LANGFAM_Baltic   1     0.221 6702.1 1543.2
## + VBlocs1_TC_1       1     0.111 6702.2 1543.2
## + VBlocs1_TC_9       1     0.056 6702.2 1543.2
## + ComVBlocs2_y       1     0.019 6702.3 1543.2
## - VBlocs1_TC_13      1    45.258 6747.6 1543.7
## - TC_NumNeigh        1    54.573 6756.9 1544.6
## - METRIC_Citizens    1    77.782 6780.1 1546.8
## - FC_NonCOB          1    84.048 6786.4 1547.4
## - ComLANGFAM_y       1   146.646 6849.0 1553.5
## - CAP_DIST_km        1   226.507 6928.8 1561.1
##
## Step:  AIC=1539.76
## Points ~ METRIC_Citizens + CAP_DIST_km + ComLANGFAM_y + FC_NonCOB +
##      TC_NumNeigh + VBlocs1_TC_13 + VBlocs2_TC_1
##

```

	Df	Sum of Sq	RSS	AIC
## <none>			6667.1	1539.8
## + VBlocs1_TC_1	1	16.273	6650.8	1540.2
## + FC_NonCitizens	1	16.099	6651.0	1540.2
## + ComVBlocs1_y	1	14.420	6652.7	1540.3
## + VBlocs1_TC_8	1	11.381	6655.7	1540.6
## - VBlocs2_TC_1	1	35.188	6702.3	1541.2
## + TC_LANGFAM_Armenian	1	4.060	6663.1	1541.3
## + Neighbours_y	1	1.079	6666.0	1541.7
## + VBlocs2_FC_1	1	1.055	6666.1	1541.7
## + VBlocs1_FC_1	1	0.859	6666.3	1541.7
## + TC_LANGFAM_Baltic	1	0.692	6666.4	1541.7
## + FC_LANGFAM_Baltic	1	0.578	6666.5	1541.7
## + VBlocs1_TC_9	1	0.039	6667.1	1541.8
## + ComVBlocs2_y	1	0.020	6667.1	1541.8
## - VBlocs1_TC_13	1	43.477	6710.6	1542.0
## - TC_NumNeigh	1	50.164	6717.3	1542.7
## - METRIC_Citizens	1	77.673	6744.8	1545.4
## - FC_NonCOB	1	91.088	6758.2	1546.7
## - ComLANGFAM_y	1	169.508	6836.6	1554.3
## - CAP_DIST_km	1	253.009	6920.1	1562.3

```
# extract out significant predictors
```

```
overall_sign_external_factors <- overall_external_model$sign_factors
```

```
# define the significant factors
```

```
overall_all_factors <- c(overall_sign_competition_factors, overall_sign_performance_factors, overall_si
```

```
# fit step wise linear model
```

```
overall_all_model <- step_lm_model(dataset = processed_data, pred_cols = overall_all_factors)
```

```
## Start: AIC=1596.4
```

```
## Points ~ 1
```

	Df	Sum of Sq	RSS	AIC
## + Average_Points	1	384.92	7037.8	1563.4
## + METRIC_Citizens	1	263.52	7159.2	1574.6
## + speechiness	1	261.41	7161.3	1574.8
## + acousticness	1	216.71	7206.0	1578.9
## + FC_NonCOB	1	168.44	7254.3	1583.3
## + ComLANGFAM_y	1	153.92	7268.8	1584.6
## + CAP_DIST_km	1	128.66	7294.0	1586.9
## + OOA	1	68.14	7354.6	1592.3
## + TC_PerfType_Solo	1	55.38	7367.3	1593.5
## + TC_NumNeigh	1	54.68	7368.0	1593.5
## <none>			7422.7	1596.4
## + ComSONGLAN	1	8.16	7414.5	1597.7
## + key_0	1	1.88	7420.8	1598.2
## + VBlocs1_TC_13	1	1.46	7421.2	1598.3

```
## Step: AIC=1563.36
```

```
## Points ~ Average_Points
```

	Df	Sum of Sq	RSS	AIC
--	----	-----------	-----	-----

```

## + acousticness      1      180.04 6857.7 1548.3
## + speechiness       1      173.95 6863.8 1548.9
## + METRIC_Citizens   1      169.72 6868.1 1549.3
## + FC_NonCOB         1      106.08 6931.7 1555.4
## + CAP_DIST_km       1      104.68 6933.1 1555.5
## + ComLANGFAM_y      1       61.60 6976.2 1559.6
## + TC_PerfType_Solo  1       61.13 6976.7 1559.6
## + TC_NumNeigh       1       58.82 6979.0 1559.8
## + OOA               1       57.05 6980.7 1560.0
## <none>              1       7037.8 1563.4
## + key_0             1        7.24 7030.5 1564.7
## + ComSONGLAN        1        2.02 7035.8 1565.2
## + VBlocs1_TC_13     1        1.85 7035.9 1565.2
## - Average_Points    1      384.92 7422.7 1596.4
##
## Step:  AIC=1548.3
## Points ~ Average_Points + acousticness
##
##           Df Sum of Sq  RSS    AIC
## + speechiness      1    250.43 6607.3 1525.8
## + METRIC_Citizens  1    158.77 6699.0 1534.9
## + FC_NonCOB        1    108.71 6749.0 1539.8
## + CAP_DIST_km      1     97.59 6760.1 1540.9
## + OOA              1     64.81 6792.9 1544.1
## + TC_NumNeigh      1     49.58 6808.2 1545.5
## + ComLANGFAM_y     1     42.01 6815.7 1546.3
## + TC_PerfType_Solo 1     29.01 6828.7 1547.5
## + key_0            1     24.99 6832.7 1547.9
## <none>             1    6857.7 1548.3
## + ComSONGLAN       1     14.20 6843.5 1548.9
## + VBlocs1_TC_13    1      2.61 6855.1 1550.0
## - acousticness     1    180.04 7037.8 1563.4
## - Average_Points   1    348.25 7206.0 1578.9
##
## Step:  AIC=1525.83
## Points ~ Average_Points + acousticness + speechiness
##
##           Df Sum of Sq  RSS    AIC
## + METRIC_Citizens  1    182.747 6424.6 1509.4
## + FC_NonCOB        1    128.032 6479.3 1515.0
## + key_0            1    104.023 6503.3 1517.4
## + TC_NumNeigh      1     68.424 6538.9 1521.0
## + TC_PerfType_Solo 1     64.249 6543.1 1521.4
## + CAP_DIST_km      1     38.649 6568.7 1524.0
## + ComSONGLAN       1     22.267 6585.0 1525.6
## + ComLANGFAM_y     1     20.801 6586.5 1525.8
## + OOA              1     20.446 6586.9 1525.8
## <none>             1    6607.3 1525.8
## + VBlocs1_TC_13    1      1.615 6605.7 1527.7
## - Average_Points    1    243.808 6851.1 1547.7
## - speechiness       1    250.425 6857.7 1548.3
## - acousticness     1    256.515 6863.8 1548.9
##
## Step:  AIC=1509.37

```

```

## Points ~ Average_Points + acousticness + speechiness + METRIC_Citizens
##
##
##      Df Sum of Sq  RSS   AIC
## + TC_PerfType_Solo  1    63.390 6361.2 1504.8
## + CAP_DIST_km      1    61.215 6363.4 1505.1
## + key_0             1    58.181 6366.4 1505.4
## + FC_NonCOB        1    34.023 6390.5 1507.9
## + ComLANGFAM_y     1    22.486 6402.1 1509.1
## + ComSONGLAN       1    20.464 6404.1 1509.3
## + OOA              1    19.763 6404.8 1509.3
## <none>              6424.6 1509.4
## + TC_NumNeigh      1    12.383 6412.2 1510.1
## + VBlocs1_TC_13    1     9.008 6415.6 1510.5
## - Average_Points   1   167.840 6592.4 1524.3
## - METRIC_Citizens  1   182.747 6607.3 1525.8
## - acousticness     1   247.038 6671.6 1532.2
## - speechiness      1   274.401 6699.0 1534.9
##
## Step:  AIC=1504.85
## Points ~ Average_Points + acousticness + speechiness + METRIC_Citizens +
##      TC_PerfType_Solo
##
##      Df Sum of Sq  RSS   AIC
## + key_0      1    50.397 6310.8 1501.6
## + CAP_DIST_km 1    47.890 6313.3 1501.9
## + FC_NonCOB   1    37.645 6323.5 1502.9
## + OOA         1    30.135 6331.0 1503.7
## + ComLANGFAM_y 1    22.218 6339.0 1504.5
## + ComSONGLAN  1    21.533 6339.6 1504.6
## <none>        6361.2 1504.8
## + VBlocs1_TC_13 1     9.293 6351.9 1505.9
## + TC_NumNeigh  1     2.415 6358.8 1506.6
## - TC_PerfType_Solo 1    63.390 6424.6 1509.4
## - Average_Points 1   168.832 6530.0 1520.1
## - METRIC_Citizens 1   181.888 6543.1 1521.4
## - acousticness   1   202.709 6563.9 1523.5
## - speechiness    1   310.506 6671.7 1534.2
##
## Step:  AIC=1501.61
## Points ~ Average_Points + acousticness + speechiness + METRIC_Citizens +
##      TC_PerfType_Solo + key_0
##
##      Df Sum of Sq  RSS   AIC
## + CAP_DIST_km  1    51.26 6259.5 1498.2
## + OOA          1    50.24 6260.5 1498.3
## + FC_NonCOB    1    34.25 6276.5 1500.0
## + ComSONGLAN   1    22.74 6288.0 1501.2
## + ComLANGFAM_y 1    22.53 6288.2 1501.3
## <none>          6310.8 1501.6
## + VBlocs1_TC_13 1     7.29 6303.5 1502.8
## + TC_NumNeigh  1     0.25 6310.5 1503.6
## - key_0        1    50.40 6361.2 1504.8
## - TC_PerfType_Solo 1    55.61 6366.4 1505.4
## - METRIC_Citizens 1   138.63 6449.4 1513.9

```

```

## - Average_Points      1      176.00 6486.8 1517.7
## - acousticness        1      241.10 6551.9 1524.3
## - speechiness         1      357.50 6668.3 1535.9
##
## Step:  AIC=1498.25
## Points ~ Average_Points + acousticness + speechiness + METRIC_Citizens +
##      TC_PerfType_Solo + key_0 + CAP_DIST_km
##
##           Df Sum of Sq    RSS    AIC
## + OOA           1      51.774 6207.7 1494.8
## + FC_NonCOB      1      46.544 6213.0 1495.3
## + ComLANGFAM_y    1      20.330 6239.2 1498.1
## <none>                6259.5 1498.2
## + ComSONGLAN      1      13.532 6246.0 1498.8
## + TC_NumNeigh     1       7.595 6251.9 1499.5
## + VBlocs1_TC_13   1       6.546 6253.0 1499.6
## - TC_PerfType_Solo 1      42.637 6302.2 1500.7
## - CAP_DIST_km      1      51.257 6310.8 1501.6
## - key_0            1      53.764 6313.3 1501.9
## - METRIC_Citizens  1     155.634 6415.2 1512.4
## - Average_Points   1     169.640 6429.2 1513.8
## - acousticness     1     230.706 6490.2 1520.1
## - speechiness      1     278.155 6537.7 1524.9
##
## Step:  AIC=1494.78
## Points ~ Average_Points + acousticness + speechiness + METRIC_Citizens +
##      TC_PerfType_Solo + key_0 + CAP_DIST_km + OOA
##
##           Df Sum of Sq    RSS    AIC
## + FC_NonCOB      1      49.714 6158.0 1491.5
## + ComSONGLAN      1      29.710 6178.0 1493.6
## + ComLANGFAM_y    1      25.515 6182.2 1494.1
## <none>                6207.7 1494.8
## + VBlocs1_TC_13   1       5.402 6202.3 1496.2
## + TC_NumNeigh     1       3.345 6204.4 1496.4
## - OOA             1      51.774 6259.5 1498.2
## - CAP_DIST_km     1      52.789 6260.5 1498.3
## - TC_PerfType_Solo 1      53.158 6260.9 1498.4
## - key_0            1      74.807 6282.6 1500.7
## - METRIC_Citizens  1     147.089 6354.8 1508.2
## - Average_Points   1     171.863 6379.6 1510.8
## - acousticness     1     235.949 6443.7 1517.3
## - speechiness      1     237.431 6445.2 1517.5
##
## Step:  AIC=1491.49
## Points ~ Average_Points + acousticness + speechiness + METRIC_Citizens +
##      TC_PerfType_Solo + key_0 + CAP_DIST_km + OOA + FC_NonCOB
##
##           Df Sum of Sq    RSS    AIC
## + ComSONGLAN      1      43.476 6114.6 1488.8
## + ComLANGFAM_y    1      28.636 6129.4 1490.4
## <none>                6158.0 1491.5
## + VBlocs1_TC_13   1      18.615 6139.4 1491.5
## + TC_NumNeigh     1       1.670 6156.4 1493.3

```

```

## - FC_NonCOB      1      49.714 6207.7 1494.8
## - OOA            1      54.944 6213.0 1495.3
## - TC_PerfType_Solo 1      56.024 6214.1 1495.5
## - METRIC_Citizens 1      62.476 6220.5 1496.1
## - CAP_DIST_km     1      65.764 6223.8 1496.5
## - key_0           1      71.189 6229.2 1497.0
## - Average_Points  1     155.891 6313.9 1505.9
## - speechiness     1     235.242 6393.3 1514.2
## - acousticness    1     238.221 6396.3 1514.5
##
## Step: AIC=1488.83
## Points ~ Average_Points + acousticness + speechiness + METRIC_Citizens +
## TC_PerfType_Solo + key_0 + CAP_DIST_km + OOA + FC_NonCOB +
## ComSONGLAN
##
##           Df Sum of Sq    RSS    AIC
## + ComLANGFAM_y      1      26.748 6087.8 1487.9
## + VBlocs1_TC_13     1      19.125 6095.4 1488.8
## <none>                6114.6 1488.8
## + TC_NumNeigh       1       5.933 6108.6 1490.2
## - ComSONGLAN        1      43.476 6158.0 1491.5
## - CAP_DIST_km       1      50.384 6164.9 1492.2
## - METRIC_Citizens   1      51.040 6165.6 1492.3
## - TC_PerfType_Solo  1      62.315 6176.9 1493.5
## - FC_NonCOB         1      63.479 6178.0 1493.6
## - OOA               1      76.503 6191.1 1495.0
## - key_0             1      77.382 6191.9 1495.1
## - Average_Points    1     138.629 6253.2 1501.6
## - speechiness       1     247.669 6362.2 1513.0
## - acousticness      1     269.861 6384.4 1515.2
##
## Step: AIC=1487.94
## Points ~ Average_Points + acousticness + speechiness + METRIC_Citizens +
## TC_PerfType_Solo + key_0 + CAP_DIST_km + OOA + FC_NonCOB +
## ComSONGLAN + ComLANGFAM_y
##
##           Df Sum of Sq    RSS    AIC
## + VBlocs1_TC_13     1      24.902 6062.9 1487.2
## <none>                6087.8 1487.9
## - ComLANGFAM_y      1      26.748 6114.6 1488.8
## + TC_NumNeigh       1       6.983 6080.8 1489.2
## - ComSONGLAN        1      41.588 6129.4 1490.4
## - CAP_DIST_km       1      48.697 6136.5 1491.2
## - METRIC_Citizens   1      50.267 6138.1 1491.3
## - TC_PerfType_Solo  1      62.953 6150.8 1492.7
## - FC_NonCOB         1      66.498 6154.3 1493.1
## - key_0             1      78.800 6166.6 1494.4
## - OOA               1      82.277 6170.1 1494.8
## - Average_Points    1     108.150 6196.0 1497.5
## - speechiness       1     225.819 6313.6 1509.9
## - acousticness      1     246.433 6334.2 1512.0
##
## Step: AIC=1487.25
## Points ~ Average_Points + acousticness + speechiness + METRIC_Citizens +

```



```
## TC_PerfType_Solo + key_0 + CAP_DIST_km + OOA + FC_NonCOB +
## ComSONGLAN + ComLANGFAM_y + VBlocs1_TC_13
##
##           Df Sum of Sq    RSS    AIC
## <none>                6062.9 1487.2
## - VBlocs1_TC_13      1    24.902 6087.8 1487.9
## + TC_NumNeigh        1     8.856 6054.1 1488.3
## - ComLANGFAM_y       1    32.524 6095.4 1488.8
## - ComSONGLAN         1    41.961 6104.9 1489.8
## - CAP_DIST_km        1    49.385 6112.3 1490.6
## - METRIC_Citizens    1    50.686 6113.6 1490.7
## - TC_PerfType_Solo   1    64.312 6127.2 1492.2
## - key_0              1    72.939 6135.8 1493.1
## - OOA                1    80.888 6143.8 1494.0
## - FC_NonCOB          1    84.356 6147.3 1494.3
## - Average_Points     1   101.485 6164.4 1496.2
## - speechiness        1   220.741 6283.7 1508.8
## - acousticness       1   244.867 6307.8 1511.3
```

```
# extract out significant predictors
```

```
overall_sign_all_factors <- overall_all_model$sign_factors
```

```
# create a model formula
```

```
overall_final_model_form <- as.formula(paste('Points ~', paste(overall_sign_all_factors, collapse = ' +
```

```
# create the maximum model
```

```
overall_final_model <- lm(overall_final_model_form, data = processed_data)
```

```
# get model summary
```

```
summary(overall_final_model)
```

```
##
## Call:
## lm(formula = overall_final_model_form, data = processed_data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -9.5505 -2.3301 -0.2858  2.1846  7.8517
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    3.7244     0.6169   6.037 2.64e-09 ***
## Average_Points  0.4798     0.1253   3.830 0.000141 ***
## acousticness    0.6959     0.1302   5.344 1.26e-07 ***
## speechiness     0.6973     0.1362   5.119 4.05e-07 ***
## METRIC_Citizens 0.3251     0.1399   2.324 0.020438 *
## TC_PerfType_Solo 1.4412     0.5613   2.568 0.010457 *
## key_0           1.2923     0.4516   2.861 0.004353 **
## CAP_DIST_km     0.2956     0.1280   2.309 0.021260 *
## OOA             1.2837     0.4512   2.845 0.004579 **
## FC_NonCOB       0.3604     0.1391   2.592 0.009766 **
## ComSONGLAN      0.2760     0.1287   2.145 0.032338 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Residual standard error: 3.074 on 647 degrees of freedom
## Multiple R-squared: 0.1762, Adjusted R-squared: 0.1635
## F-statistic: 13.84 on 10 and 647 DF, p-value: < 2.2e-16
```

```
# get anova results
anova(overall_final_model)
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Average_Points	1	384.91812	384.918123	40.729348	0.0000000
acousticness	1	180.04330	180.043297	19.050924	0.0000148
speechiness	1	250.42520	250.425204	26.498246	0.0000004
METRIC_Citizens	1	182.74659	182.746587	19.336968	0.0000128
TC_PerfType_Solo	1	63.39027	63.390273	6.707516	0.0098168
key_0	1	50.39742	50.397418	5.332703	0.0212430
CAP_DIST_km	1	51.25695	51.256945	5.423652	0.0201728
OOA	1	51.77395	51.773950	5.478358	0.0195562
FC_NonCOB	1	49.71358	49.713581	5.260344	0.0221364
ComSONGLAN	1	43.47561	43.475609	4.600285	0.0323384
Residuals	647	6114.55962	9.450633	NA	NA

```
# check variance inflation factors
vif(overall_final_model)
```

```
## Average_Points acousticness speechiness METRIC_Citizens
## 1.091139 1.179141 1.289927 1.360161
## TC_PerfType_Solo key_0 CAP_DIST_km OOA
## 1.104542 1.246838 1.139690 1.188927
## FC_NonCOB ComSONGLAN
## 1.344230 1.150996
```

```
# write the model to disk
saveRDS(object = overall_final_model, file = './models/overall_final_model.RDS')
```

Model - Split by Televote

Consider how the televoting data differs from the jury data with regards to: performance features competition features external features

```
# fit step wise linear model
televote_competition_model <- step_lm_model(dataset = televote_data, pred_cols = competition_factors)
```

```
## Start: AIC=793.79
## Points ~ 1
##
## Df Sum of Sq RSS AIC
## + Average_Points 1 349.05 3333.4 763.23
## + OOA 1 61.86 3620.6 790.25
## <none> 3682.5 793.79
## + Round_f 1 0.64 3681.8 795.73
```

```
## + Round_sf1      1      0.04 3682.4 795.79
## + Host_Nation_y  1      0.03 3682.4 795.79
##
## Step: AIC=763.23
## Points ~ Average_Points
##
##           Df Sum of Sq   RSS   AIC
## + 00A      1     64.40 3269.0 758.85
## <none>                      3333.4 763.23
## + Host_Nation_y  1      7.19 3326.2 764.52
## + Round_f       1      2.11 3331.3 765.02
## + Round_sf1     1      1.48 3331.9 765.08
## - Average_Points 1     349.05 3682.5 793.79
##
## Step: AIC=758.85
## Points ~ Average_Points + 00A
##
##           Df Sum of Sq   RSS   AIC
## <none>                      3269.0 758.85
## + Round_f       1      5.34 3263.7 760.31
## + Round_sf1     1      2.64 3266.4 760.58
## + Host_Nation_y  1      1.93 3267.1 760.65
## - 00A           1     64.40 3333.4 763.23
## - Average_Points 1     351.59 3620.6 790.25
```

```
# extract out significant predictors
```

```
televote_sign_competition_factors <- televote_competition_model$sign_factors
```

```
# fit step wise linear model
```

```
televote_performance_model <- step_lm_model(dataset = televote_data, pred_cols = performance_factors)
```

```
## Start: AIC=793.79
## Points ~ 1
##
##           Df Sum of Sq   RSS   AIC
## + acousticness      1    135.020 3547.4 783.58
## + speechiness       1    112.506 3570.0 785.64
## + danceability      1     87.310 3595.2 787.94
## + mode_1            1     76.651 3605.8 788.91
## + time_signature_4   1     59.993 3622.5 790.42
## + TC_PerfType_Mixed  1     52.598 3629.9 791.09
## + TC_SONGLANG_Bosnian 1     52.598 3629.9 791.09
## + key_6             1     49.747 3632.7 791.34
## + TC_PerfType_Group  1     49.458 3633.0 791.37
## + valence           1     44.790 3637.7 791.79
## + key_2             1     40.141 3642.3 792.21
## + key_8             1     36.907 3645.6 792.50
## + key_0             1     31.319 3651.1 793.00
## <none>                      3682.5 793.79
## + duration_ms       1     21.050 3661.4 793.92
## + tempo             1     20.460 3662.0 793.97
## + liveness          1     17.840 3664.6 794.20
## + TC_PerfType_Solo   1     13.612 3668.9 794.58
```

```

## + instrumentalness      1      8.295 3674.2 795.05
## + TC_SingerGender_Female 1      6.580 3675.9 795.21
## + ComSONGLAN            1      3.439 3679.0 795.48
## + energy                1      1.916 3680.5 795.62
## + TC_SingerGender_Male  1      0.915 3681.5 795.71
## + loudiness             1      0.705 3681.8 795.73
## + FC_SONGLANG_English   1      0.114 3682.4 795.78
##
## Step: AIC=783.58
## Points ~ acousticness
##
##              Df Sum of Sq    RSS    AIC
## + speechiness      1  124.531 3422.9 773.89
## + mode_1           1   89.473 3458.0 777.22
## + key_0            1   65.952 3481.5 779.44
## + TC_PerfType_Mixed 1   51.230 3496.2 780.82
## + TC_SONGLANG_Bosnian 1   51.230 3496.2 780.82
## + tempo            1   48.526 3498.9 781.07
## + time_signature_4  1   37.241 3510.2 782.12
## + danceability      1   27.271 3520.2 783.05
## + key_6             1   26.684 3520.8 783.11
## + ComSONGLAN        1   23.107 3524.3 783.44
## + liveness          1   22.938 3524.5 783.45
## + key_8             1   22.564 3524.9 783.49
## + key_2             1   22.526 3524.9 783.49
## <none>                3547.4 783.58
## + TC_SingerGender_Female 1   20.387 3527.1 783.69
## + TC_PerfType_Group  1   19.927 3527.5 783.73
## + valence           1   19.762 3527.7 783.75
## + TC_SingerGender_Male 1    8.422 3539.0 784.80
## + energy            1    3.542 3543.9 785.25
## + duration_ms       1    2.528 3544.9 785.34
## + TC_PerfType_Solo   1    1.513 3545.9 785.44
## + instrumentalness   1    1.242 3546.2 785.46
## + FC_SONGLANG_English 1    0.156 3547.3 785.56
## + loudiness          1    0.052 3547.4 785.57
## - acousticness       1  135.020 3682.5 793.79
##
## Step: AIC=773.89
## Points ~ acousticness + speechiness
##
##              Df Sum of Sq    RSS    AIC
## + key_0          1  171.656 3251.3 759.07
## + tempo          1  137.558 3285.4 762.48
## + mode_1         1   87.801 3335.1 767.39
## + TC_SingerGender_Male 1   63.307 3359.6 769.79
## + TC_SingerGender_Female 1   60.154 3362.8 770.09
## + ComSONGLAN     1   25.687 3397.2 773.43
## + time_signature_4 1   24.741 3398.2 773.52
## <none>            3422.9 773.89
## + key_8          1   18.817 3404.1 774.09
## + key_6          1   17.814 3405.1 774.18
## + TC_PerfType_Group 1   17.605 3405.3 774.20
## + TC_PerfType_Solo 1   16.291 3406.6 774.33

```

```

## + key_2          1    10.335 3412.6 774.90
## + danceability   1     8.233 3414.7 775.10
## + liveness       1     7.041 3415.9 775.22
## + loudness       1     2.619 3420.3 775.64
## + valence        1     1.545 3421.4 775.74
## + instrumentalness 1     0.817 3422.1 775.81
## + TC_PerfType_Mixed 1     0.677 3422.2 775.83
## + TC_SONGLANG_Bosnian 1     0.677 3422.2 775.83
## + duration_ms    1     0.352 3422.6 775.86
## + FC_SONGLANG_English 1     0.242 3422.7 775.87
## + energy         1     0.004 3422.9 775.89
## - speechiness    1    124.531 3547.4 783.58
## - acousticness   1    147.045 3570.0 785.64
##
## Step: AIC=759.07
## Points ~ acousticness + speechiness + key_0
##
##              Df Sum of Sq    RSS    AIC
## + mode_1      1    45.533 3205.7 756.45
## + danceability 1    35.816 3215.4 757.44
## + TC_SingerGender_Male 1    35.746 3215.5 757.45
## + TC_SingerGender_Female 1    28.450 3222.8 758.19
## + tempo       1    24.127 3227.1 758.63
## <none>                3251.3 759.07
## + ComSONGLAN      1    19.258 3232.0 759.12
## + time_signature_4 1    10.410 3240.8 760.02
## + loudness       1    10.355 3240.9 760.02
## + key_8          1     9.879 3241.4 760.07
## + TC_PerfType_Solo 1     9.866 3241.4 760.07
## + valence        1     8.247 3243.0 760.24
## + key_6          1     5.429 3245.8 760.52
## + TC_PerfType_Mixed 1     4.852 3246.4 760.58
## + TC_SONGLANG_Bosnian 1     4.852 3246.4 760.58
## + TC_PerfType_Group 1     4.467 3246.8 760.62
## + duration_ms    1     4.212 3247.0 760.64
## + energy         1     2.613 3248.6 760.80
## + key_2          1     1.781 3249.5 760.89
## + instrumentalness 1     0.601 3250.7 761.01
## + liveness       1     0.387 3250.9 761.03
## + FC_SONGLANG_English 1     0.353 3250.9 761.03
## - key_0          1    171.656 3422.9 773.89
## - acousticness   1    220.612 3471.9 778.53
## - speechiness    1    230.234 3481.5 779.44
##
## Step: AIC=756.45
## Points ~ acousticness + speechiness + key_0 + mode_1
##
##              Df Sum of Sq    RSS    AIC
## + ComSONGLAN      1    28.170 3177.6 755.57
## + TC_SingerGender_Male 1    20.426 3185.3 756.36
## <none>                3205.7 756.45
## + key_8          1    17.123 3188.6 756.70
## + tempo         1    16.025 3189.7 756.82
## + TC_SingerGender_Female 1    14.537 3191.2 756.97

```

```

## + energy          1      13.957 3191.8 757.03
## + danceability    1      13.878 3191.8 757.04
## + TC_PerfType_Solo 1       8.646 3197.1 757.57
## + loudiness       1       8.540 3197.2 757.58
## + TC_PerfType_Mixed 1      7.836 3197.9 757.65
## + TC_SONGLANG_Bosnian 1     7.836 3197.9 757.65
## + time_signature_4 1      5.443 3200.3 757.90
## + duration_ms     1      4.643 3201.1 757.98
## + TC_PerfType_Group 1      2.403 3203.3 758.21
## + valence         1      2.189 3203.5 758.23
## + instrumentalness 1      1.927 3203.8 758.26
## + key_6           1      1.490 3204.2 758.30
## + liveness        1      0.524 3205.2 758.40
## + FC_SONGLANG_English 1     0.373 3205.4 758.42
## + key_2           1      0.267 3205.5 758.43
## - mode_1          1     45.533 3251.3 759.07
## - key_0           1    129.388 3335.1 767.39
## - speechiness     1    211.218 3416.9 775.32
## - acousticness    1    222.176 3427.9 776.37
##
## Step: AIC=755.57
## Points ~ acousticness + speechiness + key_0 + mode_1 + ComSONGLAN
##
##              Df Sum of Sq    RSS    AIC
## + key_8        1     21.254 3156.3 755.37
## <none>                3177.6 755.57
## + FC_SONGLANG_English 1     16.849 3160.7 755.83
## + danceability    1     12.619 3164.9 756.27
## - ComSONGLAN      1     28.170 3205.7 756.45
## + TC_SingerGender_Male 1      9.553 3168.0 756.58
## + tempo           1      8.665 3168.9 756.67
## + TC_PerfType_Solo 1      8.179 3169.4 756.72
## + energy          1      6.917 3170.6 756.85
## + TC_SingerGender_Female 1     6.651 3170.9 756.88
## + time_signature_4 1      4.587 3173.0 757.10
## + loudiness       1      4.396 3173.2 757.11
## + TC_PerfType_Group 1      3.330 3174.2 757.22
## + TC_PerfType_Mixed 1      3.327 3174.2 757.22
## + TC_SONGLANG_Bosnian 1      3.327 3174.2 757.22
## + valence         1      2.925 3174.6 757.27
## + duration_ms     1      2.111 3175.4 757.35
## + key_6           1      1.399 3176.2 757.42
## + instrumentalness 1      0.899 3176.7 757.48
## + liveness        1      0.720 3176.8 757.49
## + key_2           1      0.065 3177.5 757.56
## - mode_1          1     54.445 3232.0 759.12
## - key_0           1    119.233 3296.8 765.61
## - speechiness     1    209.860 3387.4 774.48
## - acousticness    1    247.219 3424.8 778.07
##
## Step: AIC=755.37
## Points ~ acousticness + speechiness + key_0 + mode_1 + ComSONGLAN +
##           key_8
##

```

	Df	Sum of Sq	RSS	AIC
## <none>			3156.3	755.37
## - key_8	1	21.254	3177.6	755.57
## + FC_SONGLANG_English	1	16.433	3139.9	755.67
## + danceability	1	14.951	3141.3	755.82
## + TC_SingerGender_Male	1	11.111	3145.2	756.22
## + TC_SingerGender_Female	1	8.085	3148.2	756.53
## + tempo	1	6.710	3149.6	756.68
## - ComSONGLAN	1	32.301	3188.6	756.70
## + loudiness	1	6.143	3150.2	756.74
## + energy	1	6.059	3150.2	756.74
## + time_signature_4	1	5.249	3151.1	756.83
## + duration_ms	1	3.450	3152.9	757.02
## + valence	1	3.327	3153.0	757.03
## + TC_PerfType_Mixed	1	2.728	3153.6	757.09
## + TC_SONGLANG_Bosnian	1	2.728	3153.6	757.09
## + key_6	1	1.839	3154.5	757.18
## + instrumentalness	1	1.058	3155.2	757.26
## + TC_PerfType_Group	1	0.566	3155.7	757.31
## + TC_PerfType_Solo	1	0.509	3155.8	757.32
## + key_2	1	0.166	3156.1	757.36
## + liveness	1	0.009	3156.3	757.37
## - mode_1	1	63.867	3220.2	759.92
## - key_0	1	104.910	3261.2	764.07
## - speechiness	1	197.647	3353.9	773.23
## - acousticness	1	227.692	3384.0	776.15

```
# extract out significant predictors
```

```
televote_sign_performance_factors <- televote_performance_model$sign_factors
```

```
# fit step wise linear model
```

```
televote_external_model <- step_lm_model(dataset = televote_data, pred_cols = external_factors)
```

```
## Start: AIC=793.79
```

```
## Points ~ 1
```

	Df	Sum of Sq	RSS	AIC
## + METRIC_Citizens	1	512.72	3169.7	746.76
## + TC_NumNeigh	1	306.60	3375.9	767.36
## + FC_NonCitizens	1	304.54	3377.9	767.56
## + FC_NonCOB	1	272.48	3410.0	770.65
## + Neighbours_y	1	127.69	3554.8	784.25
## + ComLANGFAM_y	1	61.32	3621.1	790.30
## + VBlocs1_TC_8	1	37.37	3645.1	792.45
## <none>			3682.5	793.79
## + TC_LANGFAM_Baltic	1	20.21	3662.3	793.99
## + ComVBlocs1_y	1	8.30	3674.2	795.05
## + VBlocs1_TC_1	1	4.72	3677.7	795.37
## + FC_LANGFAM_Baltic	1	4.40	3678.1	795.40
## + TC_LANGFAM_Armenian	1	3.54	3678.9	795.48
## + VBlocs2_TC_1	1	3.07	3679.4	795.52
## + VBlocs1_FC_1	1	1.75	3680.7	795.64
## + VBlocs1_TC_13	1	1.62	3680.8	795.65

```

## + VBlocs2_FC_1      1      0.09 3682.4 795.78
## + VBlocs1_TC_9      1      0.04 3682.4 795.79
## + ComVBlocs2_y      1      0.02 3682.4 795.79
## + CAP_DIST_km       1      0.01 3682.5 795.79
##
## Step:  AIC=746.76
## Points ~ METRIC_Citizens
##
##              Df Sum of Sq  RSS    AIC
## + TC_NumNeigh      1    100.50 3069.2 738.23
## + ComLANGFAM_y      1     59.90 3109.8 742.52
## + FC_NonCitizens    1     58.86 3110.9 742.63
## + FC_NonCOB         1     47.19 3122.6 743.86
## + VBlocs1_TC_13     1     21.13 3148.6 746.58
## + TC_LANGFAM_Baltic 1     19.96 3149.8 746.70
## <none>                3169.7 746.76
## + Neighbours_y      1     10.52 3159.2 747.68
## + CAP_DIST_km       1      5.92 3163.8 748.15
## + ComVBlocs1_y      1      5.89 3163.9 748.15
## + VBlocs1_TC_8      1      5.42 3164.3 748.20
## + VBlocs1_TC_1      1      1.87 3167.9 748.57
## + FC_LANGFAM_Baltic 1      1.41 3168.3 748.62
## + VBlocs2_TC_1      1      0.88 3168.9 748.67
## + VBlocs2_FC_1      1      0.67 3169.1 748.69
## + VBlocs1_FC_1      1      0.60 3169.1 748.70
## + VBlocs1_TC_9      1      0.09 3169.7 748.75
## + ComVBlocs2_y      1      0.01 3169.7 748.76
## + TC_LANGFAM_Armenian 1      0.01 3169.7 748.76
## - METRIC_Citizens    1    512.72 3682.5 793.79
##
## Step:  AIC=738.23
## Points ~ METRIC_Citizens + TC_NumNeigh
##
##              Df Sum of Sq  RSS    AIC
## + ComLANGFAM_y      1    82.884 2986.4 731.27
## + CAP_DIST_km       1    49.567 3019.7 734.90
## + FC_NonCitizens    1    41.194 3028.0 735.81
## + FC_NonCOB         1    33.089 3036.2 736.68
## + VBlocs1_TC_13     1    28.713 3040.5 737.15
## <none>                3069.2 738.23
## + TC_LANGFAM_Baltic 1    18.437 3050.8 738.26
## + VBlocs1_TC_8      1    11.720 3057.5 738.98
## + Neighbours_y      1      4.231 3065.0 739.78
## + VBlocs1_TC_1      1      3.403 3065.8 739.86
## + VBlocs2_TC_1      1      2.060 3067.2 740.01
## + TC_LANGFAM_Armenian 1      1.210 3068.0 740.10
## + FC_LANGFAM_Baltic 1      1.197 3068.0 740.10
## + ComVBlocs1_y      1      0.604 3068.6 740.16
## + VBlocs2_FC_1      1      0.097 3069.1 740.22
## + VBlocs1_TC_9      1      0.081 3069.2 740.22
## + ComVBlocs2_y      1      0.005 3069.2 740.23
## + VBlocs1_FC_1      1      0.001 3069.2 740.23
## - TC_NumNeigh      1   100.500 3169.7 746.76
## - METRIC_Citizens    1   306.623 3375.9 767.36

```



```

##
## Step: AIC=731.27
## Points ~ METRIC_Citizens + TC_NumNeigh + ComLANGFAM_y
##
##          Df Sum of Sq    RSS    AIC
## + CAP_DIST_km      1    45.785 2940.6 728.22
## + VBlocs1_TC_13     1    44.631 2941.7 728.35
## + FC_NonCitizens    1    43.040 2943.3 728.53
## + FC_NonCOB         1    34.261 2952.1 729.50
## + TC_LANGFAM_Baltic 1    24.845 2961.5 730.54
## <none>                2986.4 731.27
## + VBlocs1_TC_8      1     7.452 2978.9 732.46
## + TC_LANGFAM_Armenian 1     5.934 2980.4 732.62
## + FC_LANGFAM_Baltic 1     4.746 2981.6 732.75
## + ComVBlocs1_y      1     2.034 2984.3 733.05
## + Neighbours_y      1     1.595 2984.8 733.10
## + VBlocs2_FC_1      1     1.483 2984.9 733.11
## + VBlocs1_TC_1      1     1.059 2985.3 733.16
## + VBlocs1_TC_9      1     0.623 2985.7 733.21
## + VBlocs1_FC_1      1     0.368 2986.0 733.23
## + ComVBlocs2_y      1     0.042 2986.3 733.27
## + VBlocs2_TC_1      1     0.023 2986.3 733.27
## - ComLANGFAM_y      1    82.884 3069.2 738.23
## - TC_NumNeigh       1   123.479 3109.8 742.52
## - METRIC_Citizens   1   289.998 3276.4 759.58
##
## Step: AIC=728.22
## Points ~ METRIC_Citizens + TC_NumNeigh + ComLANGFAM_y + CAP_DIST_km
##
##          Df Sum of Sq    RSS    AIC
## + FC_NonCitizens    1    53.024 2887.5 724.27
## + FC_NonCOB         1    44.222 2896.4 725.27
## + VBlocs1_TC_13     1    44.059 2896.5 725.29
## <none>                2940.6 728.22
## + TC_LANGFAM_Baltic 1    16.818 2923.8 728.35
## + VBlocs1_TC_8      1    10.515 2930.1 729.05
## + TC_LANGFAM_Armenian 1     8.784 2931.8 729.24
## + ComVBlocs1_y      1     4.267 2936.3 729.75
## + Neighbours_y      1     2.667 2937.9 729.93
## + VBlocs2_FC_1      1     1.349 2939.2 730.07
## + VBlocs2_TC_1      1     0.914 2939.7 730.12
## + ComVBlocs2_y      1     0.730 2939.8 730.14
## + FC_LANGFAM_Baltic 1     0.338 2940.2 730.19
## + VBlocs1_FC_1      1     0.106 2940.5 730.21
## + VBlocs1_TC_9      1     0.094 2940.5 730.21
## + VBlocs1_TC_1      1     0.026 2940.5 730.22
## - CAP_DIST_km       1    45.785 2986.4 731.27
## - ComLANGFAM_y      1    79.102 3019.7 734.90
## - TC_NumNeigh       1   165.932 3106.5 744.17
## - METRIC_Citizens   1   279.769 3220.3 755.94
##
## Step: AIC=724.27
## Points ~ METRIC_Citizens + TC_NumNeigh + ComLANGFAM_y + CAP_DIST_km +
##          FC_NonCitizens

```

```

##
##              Df Sum of Sq    RSS    AIC
## + VBlocs1_TC_13      1   112.396 2775.2 713.29
## + TC_LANGFAM_Baltic   1    19.168 2868.4 724.09
## <none>                  2887.6 724.27
## + VBlocs1_TC_8       1    12.139 2875.4 724.89
## + TC_LANGFAM_Armenian 1    10.817 2876.7 725.05
## + ComVBlocs1_y       1     8.975 2878.6 725.25
## + FC_LANGFAM_Baltic   1     2.851 2884.7 725.95
## + VBlocs2_TC_1       1     2.799 2884.8 725.96
## + VBlocs1_FC_1       1     2.289 2885.3 726.01
## + ComVBlocs2_y       1     1.535 2886.0 726.10
## + FC_NonCOB          1     1.185 2886.4 726.14
## + VBlocs2_FC_1       1     0.847 2886.7 726.18
## + VBlocs1_TC_9       1     0.403 2887.2 726.23
## + Neighbours_y       1     0.296 2887.2 726.24
## + VBlocs1_TC_1       1     0.250 2887.3 726.24
## - FC_NonCitizens     1    53.024 2940.6 728.22
## - CAP_DIST_km        1    55.769 2943.3 728.53
## - ComLANGFAM_y       1    80.719 2968.3 731.29
## - METRIC_Citizens    1   146.922 3034.5 738.50
## - TC_NumNeigh        1   150.586 3038.1 738.90
##
## Step:  AIC=713.29
## Points ~ METRIC_Citizens + TC_NumNeigh + ComLANGFAM_y + CAP_DIST_km +
##          FC_NonCitizens + VBlocs1_TC_13
##
##              Df Sum of Sq    RSS    AIC
## + TC_LANGFAM_Baltic   1    19.378 2755.8 713.00
## <none>                  2775.2 713.29
## + ComVBlocs1_y       1    16.259 2758.9 713.37
## + TC_LANGFAM_Armenian 1    14.356 2760.8 713.59
## + VBlocs1_TC_8       1    10.598 2764.6 714.04
## + VBlocs1_FC_1       1     5.417 2769.7 714.65
## + FC_LANGFAM_Baltic   1     4.966 2770.2 714.70
## + FC_NonCOB          1     2.634 2772.5 714.98
## + VBlocs1_TC_1       1     2.535 2772.6 714.99
## + Neighbours_y       1     2.393 2772.8 715.01
## + VBlocs2_FC_1       1     2.037 2773.1 715.05
## + VBlocs2_TC_1       1     1.802 2773.3 715.08
## + VBlocs1_TC_9       1     1.189 2774.0 715.15
## + ComVBlocs2_y       1     1.045 2774.1 715.17
## - CAP_DIST_km        1    62.021 2837.2 718.52
## - ComLANGFAM_y       1   111.061 2886.2 724.12
## - VBlocs1_TC_13      1   112.396 2887.6 724.27
## - FC_NonCitizens     1   121.361 2896.5 725.29
## - METRIC_Citizens    1   124.396 2899.6 725.63
## - TC_NumNeigh        1   164.723 2939.9 730.15
##
## Step:  AIC=713
## Points ~ METRIC_Citizens + TC_NumNeigh + ComLANGFAM_y + CAP_DIST_km +
##          FC_NonCitizens + VBlocs1_TC_13 + TC_LANGFAM_Baltic
##
##              Df Sum of Sq    RSS    AIC

```

```
## <none> 2755.8 713.00
## + TC_LANGFAM_Armenian 1 16.517 2739.3 713.03
## - TC_LANGFAM_Baltic 1 19.378 2775.2 713.29
## + ComVBlocs1_y 1 11.563 2744.2 713.62
## + VBlocs1_TC_8 1 10.597 2745.2 713.74
## + VBlocs2_TC_1 1 6.512 2749.3 714.22
## + VBlocs1_FC_1 1 5.007 2750.8 714.40
## + FC_LANGFAM_Baltic 1 4.762 2751.0 714.43
## + FC_NonCOB 1 3.352 2752.4 714.60
## + VBlocs2_FC_1 1 2.663 2753.1 714.68
## + Neighbours_y 1 1.374 2754.4 714.84
## + ComVBlocs2_y 1 1.279 2754.5 714.85
## + VBlocs1_TC_9 1 1.033 2754.7 714.88
## + VBlocs1_TC_1 1 0.165 2755.6 714.98
## - CAP_DIST_km 1 52.227 2808.0 717.14
## - VBlocs1_TC_13 1 112.606 2868.4 724.09
## - ComLANGFAM_y 1 117.798 2873.6 724.69
## - METRIC_Citizens 1 123.462 2879.2 725.33
## - FC_NonCitizens 1 124.645 2880.4 725.46
## - TC_NumNeigh 1 156.923 2912.7 729.11
```

```
# extract out significant predictors
```

```
televote_sign_external_factors <- televote_external_model$sign_factors
```

```
# define the significant factors
```

```
televote_all_factors <- c(televote_sign_competition_factors, televote_sign_performance_factors, televote_sign_external_factors)
```

```
# fit step wise linear model
```

```
televote_all_model <- step_lm_model(dataset = televote_data, pred_cols = televote_all_factors)
```

```
## Start: AIC=793.79
```

```
## Points ~ 1
```

```
##
```

	Df	Sum of Sq	RSS	AIC
## + METRIC_Citizens	1	512.72	3169.7	746.76
## + Average_Points	1	349.05	3333.4	763.23
## + TC_NumNeigh	1	306.60	3375.9	767.36
## + FC_NonCitizens	1	304.54	3377.9	767.56
## + acousticness	1	135.02	3547.4	783.58
## + speechiness	1	112.51	3570.0	785.64
## + mode_1	1	76.65	3605.8	788.91
## + OOA	1	61.86	3620.6	790.25
## + ComLANGFAM_y	1	61.32	3621.1	790.30
## + key_0	1	31.32	3651.1	793.00
## <none>			3682.5	793.79
## + VBlocs1_TC_13	1	1.62	3680.8	795.65
## + CAP_DIST_km	1	0.01	3682.5	795.79

```
##
```

```
## Step: AIC=746.76
```

```
## Points ~ METRIC_Citizens
```

```
##
```

	Df	Sum of Sq	RSS	AIC
## + Average_Points	1	236.58	2933.2	723.40
## + speechiness	1	139.46	3030.3	734.05

```

## + acousticness      1    112.12 3057.6 736.99
## + TC_NumNeigh       1    100.50 3069.2 738.23
## + OOA               1     67.89 3101.9 741.68
## + ComLANGFAM_y      1     59.90 3109.8 742.52
## + FC_NonCitizens    1     58.86 3110.9 742.63
## + mode_1           1     53.26 3116.5 743.22
## + VBlocs1_TC_13     1     21.13 3148.6 746.58
## <none>              3169.7 746.76
## + CAP_DIST_km       1      5.92 3163.8 748.15
## + key_0             1      1.88 3167.9 748.57
## - METRIC_Citizens   1    512.72 3682.5 793.79
##
## Step:  AIC=723.4
## Points ~ METRIC_Citizens + Average_Points
##
##           Df Sum of Sq  RSS    AIC
## + TC_NumNeigh      1    140.97 2792.2 709.29
## + acousticness     1    104.56 2828.6 713.53
## + speechiness      1     86.61 2846.6 715.60
## + OOA              1     69.43 2863.7 717.56
## + FC_NonCitizens   1     54.80 2878.4 719.23
## + mode_1           1     46.38 2886.8 720.19
## + ComLANGFAM_y     1     21.42 2911.7 723.00
## + VBlocs1_TC_13    1     18.46 2914.7 723.33
## <none>             2933.2 723.40
## + key_0            1     17.70 2915.5 723.42
## + CAP_DIST_km      1      2.01 2931.2 725.17
## - Average_Points   1    236.58 3169.7 746.76
## - METRIC_Citizens  1    400.26 3333.4 763.23
##
## Step:  AIC=709.29
## Points ~ METRIC_Citizens + Average_Points + TC_NumNeigh
##
##           Df Sum of Sq  RSS    AIC
## + speechiness      1    122.532 2669.7 696.62
## + acousticness     1     74.255 2717.9 702.48
## + OOA              1     61.816 2730.4 703.97
## + CAP_DIST_km      1     44.535 2747.7 706.03
## + mode_1           1     39.264 2752.9 706.66
## + ComLANGFAM_y     1     35.281 2756.9 707.13
## + FC_NonCitizens   1     34.464 2757.7 707.23
## + VBlocs1_TC_13    1     26.775 2765.4 708.14
## <none>             2792.2 709.29
## + key_0            1      0.359 2791.8 711.25
## - TC_NumNeigh      1    140.969 2933.2 723.40
## - METRIC_Citizens  1    199.772 2992.0 729.89
## - Average_Points   1    277.052 3069.2 738.23
##
## Step:  AIC=696.62
## Points ~ METRIC_Citizens + Average_Points + TC_NumNeigh + speechiness
##
##           Df Sum of Sq  RSS    AIC
## + acousticness     1     80.101 2589.6 688.66
## + FC_NonCitizens   1     41.625 2628.0 693.48

```

```

## + mode_1      1      37.157 2632.5 694.03
## + ComLANGFAM_y 1      29.676 2640.0 694.96
## + VBlocs1_TC_13 1      25.151 2644.5 695.52
## + OOA         1      21.189 2648.5 696.01
## + CAP_DIST_km 1      20.869 2648.8 696.05
## + key_0       1      16.681 2653.0 696.57
## <none>                2669.7 696.62
## - speechiness 1     122.532 2792.2 709.29
## - TC_NumNeigh 1     176.893 2846.6 715.60
## - METRIC_Citizens 1    206.591 2876.2 718.99
## - Average_Points 1    216.229 2885.9 720.08
##
## Step:  AIC=688.66
## Points ~ METRIC_Citizens + Average_Points + TC_NumNeigh + speechiness +
##          acoustictness
##
##              Df Sum of Sq    RSS    AIC
## + key_0      1      49.832 2539.7 684.30
## + mode_1     1      45.432 2544.1 684.87
## + FC_NonCitizens 1      42.783 2546.8 685.21
## + VBlocs1_TC_13 1      26.291 2563.3 687.32
## + ComLANGFAM_y 1      18.036 2571.5 688.37
## <none>                2589.6 688.66
## + CAP_DIST_km 1      12.950 2576.6 689.02
## + OOA         1      11.550 2578.0 689.19
## - acoustictness 1      80.101 2669.7 696.62
## - speechiness  1     128.378 2717.9 702.48
## - TC_NumNeigh  1     142.623 2732.2 704.19
## - Average_Points 1     204.218 2793.8 711.48
## - METRIC_Citizens 1     210.482 2800.0 712.21
##
## Step:  AIC=684.3
## Points ~ METRIC_Citizens + Average_Points + TC_NumNeigh + speechiness +
##          acoustictness + key_0
##
##              Df Sum of Sq    RSS    AIC
## + FC_NonCitizens 1      33.525 2506.2 681.96
## + OOA             1      31.904 2507.8 682.17
## + mode_1         1      29.495 2510.2 682.48
## + VBlocs1_TC_13  1      19.808 2519.9 683.74
## + ComLANGFAM_y   1      16.007 2523.7 684.23
## <none>                2539.7 684.30
## + CAP_DIST_km    1       8.134 2531.6 685.25
## - key_0          1      49.832 2589.6 688.66
## - TC_NumNeigh    1      80.966 2620.7 692.56
## - acoustictness  1     113.253 2653.0 696.57
## - speechiness    1     168.714 2708.4 703.33
## - METRIC_Citizens 1     190.501 2730.2 705.95
## - Average_Points 1     222.915 2762.6 709.81
##
## Step:  AIC=681.96
## Points ~ METRIC_Citizens + Average_Points + TC_NumNeigh + speechiness +
##          acoustictness + key_0 + FC_NonCitizens
##

```

```

##              Df Sum of Sq    RSS    AIC
## + VBlocs1_TC_13      1    57.914 2448.3 676.31
## + OOA                 1    35.065 2471.1 679.35
## + mode_1              1    22.735 2483.5 680.98
## + ComLANGFAM_y        1    17.105 2489.1 681.72
## <none>                2506.2 681.96
## + CAP_DIST_km         1    12.186 2494.0 682.36
## - FC_NonCitizens      1    33.525 2539.7 684.30
## - key_0                1    40.574 2546.8 685.21
## - TC_NumNeigh         1    71.954 2578.2 689.21
## - METRIC_Citizens     1   107.551 2613.8 693.70
## - acousticness        1   110.281 2616.5 694.04
## - speechiness         1   170.781 2677.0 701.51
## - Average_Points      1   213.316 2719.5 706.67
##
## Step:  AIC=676.31
## Points ~ METRIC_Citizens + Average_Points + TC_NumNeigh + speechiness +
##          acousticness + key_0 + FC_NonCitizens + VBlocs1_TC_13
##
##              Df Sum of Sq    RSS    AIC
## + ComLANGFAM_y        1    30.752 2417.5 674.18
## + OOA                 1    29.630 2418.7 674.33
## + CAP_DIST_km         1    15.746 2432.5 676.20
## <none>                2448.3 676.31
## + mode_1              1    14.048 2434.2 676.43
## - key_0                1    25.794 2474.1 677.74
## - VBlocs1_TC_13       1    57.914 2506.2 681.96
## - FC_NonCitizens      1    71.631 2519.9 683.74
## - TC_NumNeigh         1    80.564 2528.8 684.90
## - METRIC_Citizens     1    97.217 2545.5 687.04
## - acousticness        1   105.379 2553.7 688.09
## - speechiness         1   161.982 2610.3 695.26
## - Average_Points      1   202.845 2651.1 700.34
##
## Step:  AIC=674.18
## Points ~ METRIC_Citizens + Average_Points + TC_NumNeigh + speechiness +
##          acousticness + key_0 + FC_NonCitizens + VBlocs1_TC_13 + ComLANGFAM_y
##
##              Df Sum of Sq    RSS    AIC
## + OOA                 1    33.018 2384.5 671.68
## + CAP_DIST_km         1    16.397 2401.1 673.95
## <none>                2417.5 674.18
## + mode_1              1     9.665 2407.9 674.87
## - key_0                1    22.125 2439.7 675.16
## - ComLANGFAM_y        1    30.752 2448.3 676.31
## - VBlocs1_TC_13       1    71.560 2489.1 681.72
## - FC_NonCitizens      1    80.186 2497.7 682.85
## - acousticness        1    86.725 2504.3 683.70
## - TC_NumNeigh         1    92.989 2510.5 684.52
## - METRIC_Citizens     1    93.517 2511.1 684.59
## - speechiness         1   152.070 2569.6 692.13
## - Average_Points      1   165.504 2583.0 693.83
##
## Step:  AIC=671.68

```

```

## Points ~ METRIC_Citizens + Average_Points + TC_NumNeigh + speechiness +
##      acoustictness + key_0 + FC_NonCitizens + VBlocs1_TC_13 + ComLANGFAM_y +
##      OOA
##
##
##      Df Sum of Sq    RSS    AIC
## + CAP_DIST_km      1    18.176 2366.3 671.18
## <none>                2384.5 671.68
## + mode_1            1    10.612 2373.9 672.22
## - OOA                1    33.018 2417.5 674.18
## - ComLANGFAM_y       1    34.140 2418.7 674.33
## - key_0              1    37.646 2422.2 674.80
## - VBlocs1_TC_13      1    66.184 2450.7 678.63
## - TC_NumNeigh        1    73.687 2458.2 679.63
## - acoustictness      1    80.420 2464.9 680.53
## - FC_NonCitizens     1    82.196 2466.7 680.76
## - METRIC_Citizens    1    91.235 2475.8 681.96
## - speechiness        1   113.129 2497.7 684.84
## - Average_Points     1   176.540 2561.1 693.04
##
## Step:  AIC=671.18
## Points ~ METRIC_Citizens + Average_Points + TC_NumNeigh + speechiness +
##      acoustictness + key_0 + FC_NonCitizens + VBlocs1_TC_13 + ComLANGFAM_y +
##      OOA + CAP_DIST_km
##
##
##      Df Sum of Sq    RSS    AIC
## + mode_1            1    22.313 2344.0 670.08
## <none>                2366.3 671.18
## - CAP_DIST_km       1    18.176 2384.5 671.68
## - key_0              1    31.491 2397.8 673.50
## - OOA                1    34.797 2401.1 673.95
## - ComLANGFAM_y       1    34.958 2401.3 673.97
## - acoustictness      1    68.072 2434.4 678.45
## - VBlocs1_TC_13      1    70.247 2436.6 678.74
## - METRIC_Citizens    1    84.145 2450.5 680.60
## - speechiness        1    87.690 2454.0 681.08
## - FC_NonCitizens     1    90.747 2457.1 681.48
## - TC_NumNeigh        1    91.493 2457.8 681.58
## - Average_Points     1   175.992 2542.3 692.64
##
## Step:  AIC=670.08
## Points ~ METRIC_Citizens + Average_Points + TC_NumNeigh + speechiness +
##      acoustictness + key_0 + FC_NonCitizens + VBlocs1_TC_13 + ComLANGFAM_y +
##      OOA + CAP_DIST_km + mode_1
##
##
##      Df Sum of Sq    RSS    AIC
## <none>                2344.0 670.08
## - key_0              1    21.486 2365.5 671.06
## - mode_1              1    22.313 2366.3 671.18
## - ComLANGFAM_y       1    28.227 2372.3 672.00
## - CAP_DIST_km        1    29.877 2373.9 672.22
## - OOA                1    36.905 2380.9 673.19
## - VBlocs1_TC_13      1    57.628 2401.7 676.02
## - acoustictness      1    67.097 2411.1 677.31
## - speechiness        1    73.839 2417.9 678.22

```

```
## - FC_NonCitizens      1      76.003 2420.0 678.52
## - METRIC_Citizens     1      85.869 2429.9 679.85
## - TC_NumNeigh         1     100.591 2444.6 681.82
## - Average_Points      1     173.070 2517.1 691.37
```

```
# extract out significant predictors
```

```
televote_sign_all_factors <- televote_all_model$sign_factors
```

```
# create a model formula
```

```
televote_final_model_form <- as.formula(paste('Points ~', paste(televote_sign_all_factors, collapse = ' ')))
```

```
# create the maximum model
```

```
televote_final_model <- lm(televote_final_model_form, data = televote_data)
```

```
# get model summary
```

```
summary(televote_final_model)
```

```
##
```

```
## Call:
```

```
## lm(formula = televote_final_model_form, data = televote_data)
```

```
##
```

```
## Residuals:
```

```
##      Min       1Q   Median       3Q      Max
```

```
## -7.3561 -1.9688 -0.0461  1.7443  6.7011
```

```
##
```

```
## Coefficients:
```

```
##              Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)      5.1314      0.3466  14.806 < 2e-16 ***
```

```
## METRIC_Citizens  0.5344      0.1555   3.436 0.000668 ***
```

```
## Average_Points   0.8126      0.1607   5.057 7.22e-07 ***
```

```
## TC_NumNeigh      0.7464      0.1742   4.286 2.42e-05 ***
```

```
## speechiness      0.5175      0.1656   3.125 0.001943 **
```

```
## acousticness     0.4804      0.1681   2.858 0.004550 **
```

```
## FC_NonCitizens   0.6452      0.1767   3.652 0.000304 ***
```

```
## VBlocs1_TC_13    -6.8165     2.1841  -3.121 0.001968 **
```

```
## OOA              0.8913      0.6028   1.479 0.140203
```

```
## CAP_DIST_km      0.3029      0.1726   1.755 0.080254 .
```

```
## ---
```

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

```
##
```

```
## Residual standard error: 2.772 on 317 degrees of freedom
```

```
## Multiple R-squared:  0.3384, Adjusted R-squared:  0.3196
```

```
## F-statistic: 18.02 on 9 and 317 DF,  p-value: < 2.2e-16
```

```
# get anova results
```

```
anova(televote_final_model)
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
METRIC_Citizens	1	512.72219	512.722191	66.714609	0.0000000
Average_Points	1	236.58279	236.582791	30.783782	0.0000001
TC_NumNeigh	1	140.96861	140.968606	18.342614	0.0000245
speechiness	1	122.53173	122.531730	15.943637	0.0000812
acousticness	1	80.10124	80.101239	10.422648	0.0013751

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
FC_NonCitizens	1	42.78307	42.783069	5.566866	0.0189095
VBlocs1_TC_13	1	72.69433	72.694333	9.458873	0.0022842
OOA	1	14.17237	14.172369	1.844086	0.1754385
CAP_DIST_km	1	23.66646	23.666463	3.079443	0.0802537
Residuals	317	2436.24204	7.685306	NA	NA

```
# check variance inflation factors
vif(televote_final_model)
```

```
## METRIC_Citizens Average_Points TC_NumNeigh speechiness acoustiness
##      1.440215      1.072688      1.440252      1.231842      1.059780
## FC_NonCitizens VBlocs1_TC_13      OOA CAP_DIST_km
##      1.599009      1.233766      1.147115      1.291723
```

```
# write the model to disk
saveRDS(object = televote_final_model, file = './models/televote_final_model.RDS')
```

Model - Split by Jury

```
# fit step wise linear model
jury_competition_model <- step_lm_model(dataset = jury_data, pred_cols = competition_factors)
```

```
## Start: AIC=804.5
## Points ~ 1
##
##           Df Sum of Sq  RSS   AIC
## + Average_Points  1    83.411 3655.6 799.03
## + Host_Nation_y    1    34.282 3704.7 803.45
## <none>                3739.0 804.50
## + OOA              1    15.855 3723.2 805.09
## + Round_sf1        1     0.165 3738.8 806.48
## + Round_f          1     0.008 3739.0 806.49
##
## Step: AIC=799.03
## Points ~ Average_Points
##
##           Df Sum of Sq  RSS   AIC
## <none>                3655.6 799.03
## + Host_Nation_y    1    18.082 3637.5 799.39
## + OOA              1    11.609 3644.0 799.97
## + Round_f          1     0.582 3655.0 800.98
## + Round_sf1        1     0.033 3655.6 801.02
## - Average_Points  1    83.411 3739.0 804.50
```

```
# extract out significant predictors
jury_sign_competition_factors <- jury_competition_model$sign_factors
```

```
# fit step wise linear model
jury_performance_model <- step_lm_model(dataset = jury_data, pred_cols = performance_factors)
```

```
## Start:  AIC=804.5
## Points ~ 1
##
##           Df Sum of Sq  RSS   AIC
## + liveness      1   157.566 3581.4 792.24
## + speechiness    1   150.596 3588.4 792.89
## + TC_SingerGender_Female  1    95.380 3643.6 797.94
## + acousticness   1    87.688 3651.3 798.64
## + TC_SingerGender_Male    1    87.443 3651.6 798.66
## + loudiness      1    62.366 3676.6 800.93
## + key_2          1    59.021 3680.0 801.23
## + danceability    1    57.438 3681.6 801.37
## + TC_PerfType_Solo      1    56.337 3682.7 801.47
## + TC_PerfType_Group     1    34.778 3704.2 803.40
## + key_0           1    24.666 3714.3 804.30
## <none>                        3739.0 804.50
## + TC_PerfType_Mixed      1    14.558 3724.5 805.20
## + TC_SONGLANG_Bosnian    1    14.558 3724.5 805.20
## + time_signature_4       1    14.250 3724.8 805.23
## + key_6             1    13.260 3725.7 805.32
## + energy            1     9.535 3729.5 805.65
## + valence           1     9.268 3729.7 805.67
## + instrumentalness      1     6.390 3732.6 805.93
## + tempo             1     5.637 3733.4 806.00
## + ComSONGLAN          1     5.288 3733.7 806.03
## + mode_1            1     2.910 3736.1 806.24
## + duration_ms        1     2.567 3736.4 806.27
## + FC_SONGLANG_English    1     0.793 3738.2 806.43
##
## Step:  AIC=792.24
## Points ~ liveness
##
##           Df Sum of Sq  RSS   AIC
## + TC_SingerGender_Female  1   145.455 3436.0 780.52
## + TC_SingerGender_Male    1   134.091 3447.4 781.61
## + speechiness             1    76.836 3504.6 787.07
## + TC_PerfType_Solo        1    73.100 3508.3 787.42
## + key_2                   1    59.778 3521.7 788.67
## + TC_PerfType_Group       1    53.140 3528.3 789.30
## + acousticness            1    52.630 3528.8 789.34
## + loudiness               1    45.141 3536.3 790.05
## + tempo                   1    41.452 3540.0 790.39
## <none>                     3581.4 792.24
## + key_6                   1    18.586 3562.9 792.52
## + TC_PerfType_Mixed       1    18.403 3563.0 792.54
## + TC_SONGLANG_Bosnian     1    18.403 3563.0 792.54
## + danceability            1    15.762 3565.7 792.78
## + duration_ms             1    11.130 3570.3 793.21
## + key_0                   1    10.561 3570.9 793.27
## + mode_1                  1     3.060 3578.4 793.96
```

```

## + valence          1      2.424 3579.0 794.02
## + FC_SONGLANG_English 1      1.628 3579.8 794.09
## + instrumentalness  1      0.900 3580.5 794.16
## + time_signature_4  1      0.307 3581.1 794.22
## + ComSONGLAN        1      0.149 3581.3 794.23
## + energy            1      0.030 3581.4 794.24
## - liveness          1    157.566 3739.0 804.50
##
## Step:  AIC=780.52
## Points ~ liveness + TC_SingerGender_Female
##
##           Df Sum of Sq    RSS    AIC
## + acousticness      1     93.868 3342.1 773.35
## + key_2              1     37.616 3398.4 778.88
## + TC_PerfType_Solo   1     37.585 3398.4 778.88
## + key_6              1     32.373 3403.6 779.39
## + TC_PerfType_Group  1     29.747 3406.2 779.64
## + duration_ms        1     28.986 3407.0 779.72
## + loudness           1     22.426 3413.6 780.35
## <none>                3436.0 780.52
## + tempo              1     20.503 3415.5 780.54
## + speechiness        1     18.703 3417.3 780.71
## + TC_PerfType_Mixed  1     13.195 3422.8 781.25
## + TC_SONGLANG_Bosnian 1     13.195 3422.8 781.25
## + TC_SingerGender_Male 1     13.195 3422.8 781.25
## + instrumentalness   1     12.016 3424.0 781.36
## + danceability       1      7.964 3428.0 781.75
## + key_0              1      6.956 3429.0 781.85
## + mode_1             1      5.040 3430.9 782.03
## + ComSONGLAN         1      2.658 3433.3 782.26
## + time_signature_4    1      2.432 3433.6 782.29
## + FC_SONGLANG_English 1      1.040 3434.9 782.42
## + valence            1      0.912 3435.1 782.43
## + energy             1      0.259 3435.7 782.50
## - TC_SingerGender_Female 1    145.455 3581.4 792.24
## - liveness           1    207.642 3643.6 797.94
##
## Step:  AIC=773.35
## Points ~ liveness + TC_SingerGender_Female + acousticness
##
##           Df Sum of Sq    RSS    AIC
## + speechiness      1     59.523 3282.6 769.40
## + duration_ms       1     53.809 3288.3 769.98
## + loudness          1     31.557 3310.6 772.21
## + key_6             1     23.664 3318.5 773.00
## + key_2             1     22.952 3319.2 773.07
## <none>              3342.1 773.35
## + instrumentalness  1     18.463 3323.7 773.52
## + TC_PerfType_Solo  1     15.986 3326.1 773.77
## + tempo             1     14.171 3327.9 773.95
## + TC_PerfType_Group 1     13.083 3329.0 774.05
## + TC_PerfType_Mixed 1     12.315 3329.8 774.13
## + TC_SingerGender_Male 1     12.315 3329.8 774.13
## + TC_SONGLANG_Bosnian 1     12.315 3329.8 774.13

```

```

## + valence          1    10.185 3331.9 774.34
## + ComSONGLAN       1     9.555 3332.6 774.40
## + energy           1     9.393 3332.7 774.42
## + mode_1           1     7.459 3334.7 774.61
## + key_0            1     1.832 3340.3 775.17
## + FC_SONGLANG_English 1     0.947 3341.2 775.26
## + danceability      1     0.225 3341.9 775.33
## + time_signature_4  1     0.068 3342.1 775.35
## - acousticness      1    93.868 3436.0 780.52
## - liveness          1   164.643 3506.8 787.27
## - TC_SingerGender_Female 1  186.694 3528.8 789.34
##
## Step:  AIC=769.4
## Points ~ liveness + TC_SingerGender_Female + acousticness + speechiness
##
##              Df Sum of Sq    RSS    AIC
## + duration_ms      1    57.558 3225.0 765.55
## + TC_PerfType_Mixed 1    48.351 3234.2 766.49
## + TC_SONGLANG_Bosnian 1    48.351 3234.2 766.49
## + TC_SingerGender_Male 1    48.351 3234.2 766.49
## + valence          1    45.220 3237.4 766.81
## + instrumentalness  1    41.287 3241.3 767.21
## + TC_PerfType_Solo  1    25.675 3256.9 768.80
## + loudness          1    22.097 3260.5 769.17
## <none>              3282.6 769.40
## + key_2             1    14.509 3268.1 769.94
## + ComSONGLAN        1    13.871 3268.7 770.00
## + tempo             1    13.500 3269.1 770.04
## + key_6             1    12.488 3270.1 770.14
## + TC_PerfType_Group 1    12.242 3270.4 770.17
## + danceability      1    11.790 3270.8 770.21
## + energy            1     4.861 3277.7 770.91
## + time_signature_4  1     1.455 3281.1 771.26
## + FC_SONGLANG_English 1     0.557 3282.0 771.35
## + mode_1            1     0.036 3282.6 771.40
## + key_0             1     0.001 3282.6 771.40
## - speechiness       1    59.523 3342.1 773.35
## - liveness          1    65.235 3347.8 773.92
## - TC_SingerGender_Female 1    99.208 3381.8 777.26
## - acousticness      1   134.688 3417.3 780.71
##
## Step:  AIC=765.55
## Points ~ liveness + TC_SingerGender_Female + acousticness + speechiness +
##          duration_ms
##
##              Df Sum of Sq    RSS    AIC
## + TC_PerfType_Mixed 1    47.240 3177.8 762.66
## + TC_SONGLANG_Bosnian 1    47.240 3177.8 762.66
## + TC_SingerGender_Male 1    47.240 3177.8 762.66
## + instrumentalness  1    39.551 3185.5 763.46
## + ComSONGLAN        1    31.381 3193.7 764.31
## <none>              3225.0 765.55
## + TC_PerfType_Solo  1    15.442 3209.6 765.96
## + tempo             1    11.407 3213.6 766.38

```

```

## + valence          1      9.791 3215.2 766.54
## + TC_PerfType_Group 1      9.693 3215.3 766.55
## + key_2            1      9.525 3215.5 766.57
## + key_6            1      8.829 3216.2 766.64
## + loudiness        1      7.999 3217.0 766.73
## + danceability     1      6.330 3218.7 766.90
## + time_signature_4 1      6.143 3218.9 766.92
## + mode_1           1      4.382 3220.7 767.10
## + energy           1      3.590 3221.4 767.18
## + FC_SONGLANG_English 1      0.154 3224.9 767.53
## + key_0            1      0.049 3225.0 767.54
## - duration_ms      1     57.558 3282.6 769.40
## - speechiness      1     63.272 3288.3 769.98
## - liveness         1     78.400 3303.4 771.50
## - TC_SingerGender_Female 1    123.860 3348.9 776.02
## - acousticness     1    164.546 3389.6 780.02
##
## Step: AIC=762.66
## Points ~ liveness + TC_SingerGender_Female + acousticness + speechiness +
##          duration_ms + TC_PerfType_Mixed
##
##          Df Sum of Sq    RSS    AIC
## + instrumentalness  1    49.349 3128.5 759.48
## + danceability      1    27.767 3150.0 761.76
## + ComSONGLAN        1    25.282 3152.5 762.02
## + valence           1    22.453 3155.3 762.32
## + tempo             1    19.395 3158.4 762.64
## <none>                3177.8 762.66
## + TC_PerfType_Group  1    10.619 3167.2 763.56
## + time_signature_4   1     9.493 3168.3 763.67
## + key_2              1     8.096 3169.7 763.82
## + key_6              1     6.200 3171.6 764.02
## + loudiness         1     5.995 3171.8 764.04
## + TC_PerfType_Solo   1     5.510 3172.3 764.09
## + energy            1     2.160 3175.6 764.44
## + mode_1            1     2.035 3175.8 764.45
## + key_0             1     0.032 3177.8 764.66
## + FC_SONGLANG_English 1     0.024 3177.8 764.66
## - TC_PerfType_Mixed  1    47.240 3225.0 765.55
## - duration_ms       1    56.447 3234.2 766.49
## - liveness          1    59.420 3237.2 766.80
## - TC_SingerGender_Female 1    90.927 3268.7 770.00
## - speechiness       1    99.298 3277.1 770.85
## - acousticness      1   182.322 3360.1 779.13
##
## Step: AIC=759.48
## Points ~ liveness + TC_SingerGender_Female + acousticness + speechiness +
##          duration_ms + TC_PerfType_Mixed + instrumentalness
##
##          Df Sum of Sq    RSS    AIC
## + ComSONGLAN        1    22.014 3106.4 759.15
## <none>                3128.5 759.48
## + danceability      1    15.667 3112.8 759.82
## + valence           1    14.233 3114.2 759.97

```

```

## + tempo 1 13.563 3114.9 760.05
## + TC_PerfType_Group 1 9.443 3119.0 760.48
## + time_signature_4 1 6.503 3121.9 760.80
## + key_2 1 6.331 3122.1 760.81
## + key_6 1 5.711 3122.7 760.88
## + loudiness 1 5.443 3123.0 760.91
## + TC_PerfType_Solo 1 5.098 3123.4 760.94
## + energy 1 2.779 3125.7 761.19
## - liveness 1 35.602 3164.1 761.23
## + mode_1 1 1.494 3127.0 761.33
## + key_0 1 0.003 3128.4 761.48
## + FC_SONGLANG_English 1 0.001 3128.4 761.48
## - instrumentalness 1 49.349 3177.8 762.66
## - duration_ms 1 54.405 3182.9 763.19
## - TC_PerfType_Mixed 1 57.038 3185.5 763.46
## - TC_SingerGender_Female 1 102.782 3231.2 768.18
## - speechiness 1 131.833 3260.3 771.15
## - acousticness 1 209.626 3338.1 778.95
##
## Step: AIC=759.15
## Points ~ liveness + TC_SingerGender_Female + acousticness + speechiness +
## duration_ms + TC_PerfType_Mixed + instrumentalness + ComSONGLAN
##
## Df Sum of Sq RSS AIC
## <none> 3106.4 759.15
## + FC_SONGLANG_English 1 16.601 3089.8 759.37
## - ComSONGLAN 1 22.014 3128.5 759.48
## + tempo 1 13.056 3093.4 759.75
## + danceability 1 9.487 3096.9 760.13
## - liveness 1 28.368 3134.8 760.16
## + loudiness 1 9.272 3097.2 760.16
## + TC_PerfType_Group 1 8.818 3097.6 760.21
## + valence 1 7.668 3098.8 760.33
## + mode_1 1 6.654 3099.8 760.44
## + key_6 1 6.615 3099.8 760.44
## + key_2 1 5.332 3101.1 760.58
## + TC_PerfType_Solo 1 4.719 3101.7 760.64
## + time_signature_4 1 4.084 3102.4 760.71
## + energy 1 3.346 3103.1 760.79
## + key_0 1 0.168 3106.3 761.13
## - instrumentalness 1 46.082 3152.5 762.02
## - TC_PerfType_Mixed 1 50.344 3156.8 762.47
## - duration_ms 1 68.221 3174.7 764.34
## - TC_SingerGender_Female 1 114.605 3221.0 769.14
## - speechiness 1 135.602 3242.0 771.29
## - acousticness 1 228.121 3334.6 780.60

```

```
# extract out significant predictors
```

```
jury_sign_performance_factors <- jury_performance_model$sign_factors
```

```
# fit step wise linear model
```

```
jury_external_model <- step_lm_model(dataset = jury_data, pred_cols = external_factors)
```

```
## Start: AIC=804.5
```

```

## Points ~ 1
##
##
##      Df Sum of Sq  RSS   AIC
## + CAP_DIST_km      1  265.405 3473.6 782.12
## + ComLANGFAM_y      1   94.325 3644.7 798.04
## + TC_NumNeigh      1   82.439 3656.6 799.12
## + VBlocs1_TC_1      1   72.508 3666.5 800.01
## + VBlocs1_TC_8      1   46.547 3692.5 802.35
## + TC_LANGFAM_Baltic  1   31.762 3707.2 803.67
## + METRIC_Citizens    1   27.049 3712.0 804.09
## + TC_LANGFAM_Armenian 1   22.991 3716.0 804.45
## <none>                      3739.0 804.50
## + ComVBlocs2_y      1    8.898 3730.1 805.71
## + FC_NonCOB         1    1.972 3737.0 806.32
## + VBlocs2_TC_1      1    0.761 3738.2 806.43
## + FC_LANGFAM_Baltic  1    0.330 3738.7 806.47
## + FC_NonCitizens    1    0.212 3738.8 806.48
## + ComVBlocs1_y      1    0.154 3738.9 806.48
## + Neighbours_y      1    0.140 3738.9 806.48
## + VBlocs2_FC_1      1    0.094 3738.9 806.49
## + VBlocs1_FC_1      1    0.001 3739.0 806.50
##
## Step:  AIC=782.12
## Points ~ CAP_DIST_km
##
##      Df Sum of Sq  RSS   AIC
## + ComLANGFAM_y      1   70.885 3402.7 777.30
## + TC_LANGFAM_Baltic  1   63.040 3410.6 778.06
## + VBlocs1_TC_8      1   36.194 3437.4 780.66
## + VBlocs1_TC_1      1   24.176 3449.4 781.81
## + TC_LANGFAM_Armenian 1   21.212 3452.4 782.10
## <none>                      3473.6 782.12
## + FC_NonCOB         1   15.109 3458.5 782.68
## + TC_NumNeigh      1   12.374 3461.2 782.94
## + METRIC_Citizens    1   11.153 3462.5 783.06
## + VBlocs2_TC_1      1   10.932 3462.7 783.08
## + FC_LANGFAM_Baltic  1    9.439 3464.2 783.22
## + ComVBlocs1_y      1    8.402 3465.2 783.32
## + FC_NonCitizens    1    3.664 3469.9 783.78
## + ComVBlocs2_y      1    2.939 3470.7 783.84
## + Neighbours_y      1    1.726 3471.9 783.96
## + VBlocs1_FC_1      1    0.408 3473.2 784.09
## + VBlocs2_FC_1      1    0.013 3473.6 784.12
## - CAP_DIST_km      1  265.405 3739.0 804.50
##
## Step:  AIC=777.3
## Points ~ CAP_DIST_km + ComLANGFAM_y
##
##      Df Sum of Sq  RSS   AIC
## + TC_LANGFAM_Baltic  1   50.876 3351.8 774.31
## + VBlocs1_TC_8      1   41.952 3360.8 775.19
## + VBlocs2_TC_1      1   25.732 3377.0 776.79
## <none>                      3402.7 777.30
## + ComVBlocs1_y      1   16.703 3386.0 777.67

```

```

## + FC_NonCOB          1    15.430 3387.3 777.80
## + METRIC_Citizens     1    14.712 3388.0 777.87
## + TC_LANGFAM_Armenian  1    13.149 3389.6 778.02
## + VBlocs1_TC_1        1    12.959 3389.8 778.04
## + TC_NumNeigh         1    12.642 3390.1 778.07
## + FC_LANGFAM_Baltic   1     4.879 3397.8 778.83
## + ComVBlocs2_y        1     4.540 3398.2 778.86
## + FC_NonCitizens      1     4.101 3398.6 778.90
## + VBlocs2_FC_1        1     0.457 3402.3 779.26
## + Neighbours_y        1     0.412 3402.3 779.26
## + VBlocs1_FC_1        1     0.000 3402.7 779.30
## - ComLANGFAM_y        1    70.885 3473.6 782.12
## - CAP_DIST_km         1   241.965 3644.7 798.04
##
## Step:  AIC=774.31
## Points ~ CAP_DIST_km + ComLANGFAM_y + TC_LANGFAM_Baltic
##
##              Df Sum of Sq    RSS    AIC
## + VBlocs1_TC_8      1    43.268 3308.6 772.01
## + ComVBlocs1_y      1    29.494 3322.3 773.39
## <none>                3351.8 774.31
## + TC_LANGFAM_Armenian  1    18.016 3333.8 774.53
## + FC_NonCOB          1    13.570 3338.3 774.97
## + METRIC_Citizens     1    12.787 3339.1 775.05
## + VBlocs2_TC_1        1     8.533 3343.3 775.47
## + FC_LANGFAM_Baltic   1     5.298 3346.5 775.79
## + TC_NumNeigh         1     4.275 3347.6 775.89
## + FC_NonCitizens      1     3.719 3348.1 775.95
## + ComVBlocs2_y        1     3.259 3348.6 775.99
## + VBlocs1_TC_1        1     2.398 3349.4 776.08
## + Neighbours_y        1     2.050 3349.8 776.11
## + VBlocs2_FC_1        1     0.628 3351.2 776.25
## + VBlocs1_FC_1        1     0.184 3351.7 776.30
## - TC_LANGFAM_Baltic   1    50.876 3402.7 777.30
## - ComLANGFAM_y        1    58.721 3410.6 778.06
## - CAP_DIST_km         1   269.781 3621.6 797.94
##
## Step:  AIC=772.01
## Points ~ CAP_DIST_km + ComLANGFAM_y + TC_LANGFAM_Baltic + VBlocs1_TC_8
##
##              Df Sum of Sq    RSS    AIC
## + ComVBlocs1_y      1    32.618 3276.0 770.73
## <none>                3308.6 772.01
## + TC_LANGFAM_Armenian  1    18.725 3289.8 772.13
## + FC_NonCOB          1    13.685 3294.9 772.64
## + METRIC_Citizens     1     5.994 3302.6 773.41
## + TC_NumNeigh         1     5.829 3302.7 773.43
## + FC_LANGFAM_Baltic   1     5.594 3303.0 773.45
## + VBlocs2_TC_1        1     5.454 3303.1 773.47
## + FC_NonCitizens      1     4.502 3304.1 773.56
## + ComVBlocs2_y        1     1.995 3306.6 773.81
## + Neighbours_y        1     1.498 3307.1 773.86
## + VBlocs2_FC_1        1     1.230 3307.3 773.89
## + VBlocs1_TC_1        1     1.200 3307.4 773.89

```



```

## + VBlocs1_FC_1      1      0.017 3308.6 774.01
## - VBlocs1_TC_8      1     43.268 3351.8 774.31
## - TC_LANGFAM_Baltic  1     52.191 3360.8 775.19
## - ComLANGFAM_y      1     63.911 3372.5 776.35
## - CAP_DIST_km       1    258.041 3566.6 794.87
##
## Step: AIC=770.73
## Points ~ CAP_DIST_km + ComLANGFAM_y + TC_LANGFAM_Baltic + VBlocs1_TC_8 +
##      ComVBlocs1_y
##
##              Df Sum of Sq    RSS    AIC
## + VBlocs1_TC_1      1     28.390 3247.6 769.85
## <none>                      3276.0 770.73
## + FC_NonCOB         1     15.470 3260.5 771.17
## + FC_LANGFAM_Baltic  1     12.587 3263.4 771.46
## + VBlocs1_FC_1      1     10.573 3265.4 771.66
## + TC_LANGFAM_Armenian 1     10.569 3265.4 771.66
## + TC_NumNeigh       1      8.978 3267.0 771.83
## + VBlocs2_FC_1      1      8.103 3267.9 771.91
## - ComVBlocs1_y      1     32.618 3308.6 772.01
## + FC_NonCitizens    1      6.403 3269.6 772.09
## + METRIC_Citizens   1      6.287 3269.7 772.10
## + Neighbours_y      1      1.748 3274.2 772.56
## + ComVBlocs2_y      1      1.279 3274.7 772.60
## + VBlocs2_TC_1      1      0.011 3275.9 772.73
## - VBlocs1_TC_8      1     46.392 3322.3 773.39
## - TC_LANGFAM_Baltic  1     65.965 3341.9 775.33
## - ComLANGFAM_y      1     74.554 3350.5 776.18
## - CAP_DIST_km       1    281.816 3557.8 796.05
##
## Step: AIC=769.85
## Points ~ CAP_DIST_km + ComLANGFAM_y + TC_LANGFAM_Baltic + VBlocs1_TC_8 +
##      ComVBlocs1_y + VBlocs1_TC_1
##
##              Df Sum of Sq    RSS    AIC
## + VBlocs1_FC_1      1     36.877 3210.7 768.07
## + VBlocs2_TC_1      1     21.698 3225.9 769.63
## + TC_LANGFAM_Armenian 1     21.038 3226.5 769.70
## <none>                      3247.6 769.85
## + VBlocs2_FC_1      1     18.364 3229.2 769.98
## + FC_LANGFAM_Baltic  1     15.511 3232.1 770.27
## + FC_NonCOB         1     11.929 3235.6 770.63
## - VBlocs1_TC_1      1     28.390 3276.0 770.73
## + TC_NumNeigh       1      8.894 3238.7 770.94
## + METRIC_Citizens   1      7.840 3239.7 771.05
## + FC_NonCitizens    1      4.935 3242.6 771.35
## + Neighbours_y      1      1.809 3245.8 771.67
## + ComVBlocs2_y      1      0.630 3246.9 771.79
## - VBlocs1_TC_8      1     42.333 3289.9 772.14
## - TC_LANGFAM_Baltic  1     43.188 3290.8 772.23
## - ComVBlocs1_y      1     59.808 3307.4 773.89
## - ComLANGFAM_y      1     66.130 3313.7 774.53
## - CAP_DIST_km       1    234.047 3481.6 790.89
##

```

```

## Step: AIC=768.07
## Points ~ CAP_DIST_km + ComLANGFAM_y + TC_LANGFAM_Baltic + VBlocs1_TC_8 +
##      ComVBlocs1_y + VBlocs1_TC_1 + VBlocs1_FC_1
##
##      Df Sum of Sq    RSS    AIC
## + TC_LANGFAM_Armenian  1    21.397 3189.3 767.86
## + VBlocs2_TC_1        1    20.949 3189.7 767.91
## <none>                  3210.7 768.07
## + FC_NonCOB           1    10.153 3200.5 769.02
## + TC_NumNeigh         1     8.347 3202.3 769.21
## + FC_LANGFAM_Baltic   1     5.874 3204.8 769.47
## + METRIC_Citizens     1     5.614 3205.1 769.49
## - VBlocs1_TC_8        1    33.896 3244.6 769.55
## + Neighbours_y        1     5.043 3205.6 769.55
## + FC_NonCitizens      1     3.454 3207.2 769.72
## + VBlocs2_FC_1        1     3.153 3207.5 769.75
## - VBlocs1_FC_1        1    36.877 3247.6 769.85
## + ComVBlocs2_y        1     0.558 3210.1 770.02
## - TC_LANGFAM_Baltic   1    48.982 3259.7 771.08
## - VBlocs1_TC_1        1    54.694 3265.4 771.66
## - ComLANGFAM_y        1    58.846 3269.5 772.08
## - ComVBlocs1_y        1    96.669 3307.4 775.89
## - CAP_DIST_km         1   248.005 3458.7 790.70
##
## Step: AIC=767.86
## Points ~ CAP_DIST_km + ComLANGFAM_y + TC_LANGFAM_Baltic + VBlocs1_TC_8 +
##      ComVBlocs1_y + VBlocs1_TC_1 + VBlocs1_FC_1 + TC_LANGFAM_Armenian
##
##      Df Sum of Sq    RSS    AIC
## + VBlocs2_TC_1        1    87.874 3101.4 760.61
## <none>                  3189.3 767.86
## - TC_LANGFAM_Armenian  1    21.397 3210.7 768.07
## + TC_NumNeigh         1    10.349 3178.9 768.78
## + FC_NonCOB           1     7.337 3182.0 769.10
## + METRIC_Citizens     1     7.227 3182.1 769.11
## - VBlocs1_TC_8        1    33.397 3222.7 769.31
## + FC_LANGFAM_Baltic   1     4.887 3184.4 769.35
## + VBlocs2_FC_1        1     4.680 3184.6 769.37
## + Neighbours_y        1     4.000 3185.3 769.44
## + FC_NonCitizens      1     1.942 3187.4 769.66
## - VBlocs1_FC_1        1    37.236 3226.5 769.70
## + ComVBlocs2_y        1     0.251 3189.0 769.83
## - ComLANGFAM_y        1    45.403 3234.7 770.54
## - TC_LANGFAM_Baltic   1    48.481 3237.8 770.85
## - VBlocs1_TC_1        1    67.280 3256.6 772.77
## - ComVBlocs1_y        1    94.322 3283.6 775.51
## - CAP_DIST_km         1   236.335 3425.6 789.52
##
## Step: AIC=760.61
## Points ~ CAP_DIST_km + ComLANGFAM_y + TC_LANGFAM_Baltic + VBlocs1_TC_8 +
##      ComVBlocs1_y + VBlocs1_TC_1 + VBlocs1_FC_1 + TC_LANGFAM_Armenian +
##      VBlocs2_TC_1
##
##      Df Sum of Sq    RSS    AIC

```

```

## - TC_LANGFAM_Baltic      1      2.571 3104.0 758.89
## - VBlocs1_TC_8          1     10.690 3112.1 759.75
## <none>                    3101.4 760.61
## + METRIC_Citizens        1     10.877 3090.5 761.45
## + TC_NumNeigh            1     10.456 3091.0 761.49
## + FC_LANGFAM_Baltic      1      9.565 3091.9 761.59
## + FC_NonCOB              1      6.361 3095.1 761.93
## + Neighbours_y          1      5.582 3095.8 762.02
## + VBlocs2_FC_1          1      2.839 3098.6 762.31
## - VBlocs1_FC_1          1     35.869 3137.3 762.42
## + FC_NonCitizens         1      1.171 3100.2 762.49
## + ComVBlocs2_y           1      0.002 3101.4 762.61
## - ComLANGFAM_y           1     59.897 3161.3 764.94
## - VBlocs2_TC_1          1     87.874 3189.3 767.86
## - TC_LANGFAM_Armenian    1     88.321 3189.7 767.91
## - ComVBlocs1_y           1     93.776 3195.2 768.47
## - VBlocs1_TC_1          1    155.116 3256.5 774.77
## - CAP_DIST_km           1    228.684 3330.1 782.16
##
## Step:  AIC=758.89
## Points ~ CAP_DIST_km + ComLANGFAM_y + VBlocs1_TC_8 + ComVBlocs1_y +
##          VBlocs1_TC_1 + VBlocs1_FC_1 + TC_LANGFAM_Armenian + VBlocs2_TC_1
##
##              Df Sum of Sq    RSS    AIC
## - VBlocs1_TC_8      1     13.289 3117.3 758.30
## <none>                3104.0 758.89
## + METRIC_Citizens    1      9.926 3094.1 759.83
## + FC_LANGFAM_Baltic  1      8.975 3095.0 759.93
## + TC_NumNeigh        1      8.877 3095.1 759.94
## + FC_NonCOB          1      6.440 3097.6 760.20
## + Neighbours_y       1      6.009 3098.0 760.24
## + VBlocs2_FC_1       1      2.925 3101.1 760.57
## + TC_LANGFAM_Baltic  1      2.571 3101.4 760.61
## + FC_NonCitizens     1      1.279 3102.7 760.75
## - VBlocs1_FC_1       1     37.179 3141.2 760.83
## + ComVBlocs2_y       1      0.008 3104.0 760.88
## - ComLANGFAM_y       1     57.829 3161.8 763.00
## - TC_LANGFAM_Armenian 1     93.274 3197.3 766.69
## - ComVBlocs1_y       1     94.996 3199.0 766.86
## - VBlocs2_TC_1       1    133.784 3237.8 770.85
## - VBlocs1_TC_1       1    209.703 3313.7 778.52
## - CAP_DIST_km        1    244.417 3348.4 781.97
##
## Step:  AIC=758.3
## Points ~ CAP_DIST_km + ComLANGFAM_y + ComVBlocs1_y + VBlocs1_TC_1 +
##          VBlocs1_FC_1 + TC_LANGFAM_Armenian + VBlocs2_TC_1
##
##              Df Sum of Sq    RSS    AIC
## <none>                3117.3 758.30
## + METRIC_Citizens    1     13.872 3103.4 758.82
## + VBlocs1_TC_8       1     13.289 3104.0 758.89
## + FC_LANGFAM_Baltic  1      8.293 3109.0 759.42
## + Neighbours_y       1      7.230 3110.0 759.53
## + TC_NumNeigh        1      7.116 3110.2 759.54

```

```
## + FC_NonCOB          1      6.110 3111.2 759.65
## + TC_LANGFAM_Baltic   1      5.170 3112.1 759.75
## + VBlocs2_FC_1        1      1.628 3115.7 760.13
## + FC_NonCitizens      1      0.934 3116.3 760.20
## + ComVBlocs2_y         1      0.001 3117.3 760.30
## - VBlocs1_FC_1        1     42.995 3160.3 760.83
## - ComLANGFAM_y         1     54.620 3171.9 762.05
## - TC_LANGFAM_Armenian  1    100.155 3217.4 766.77
## - ComVBlocs1_y         1    100.525 3217.8 766.81
## - VBlocs2_TC_1        1    151.850 3269.1 772.04
## - VBlocs1_TC_1        1    233.936 3351.2 780.25
## - CAP_DIST_km         1    253.205 3370.5 782.15
```

```
# extract out significant predictors
```

```
jury_sign_external_factors <- jury_external_model$sign_factors
```

```
# define the significant factors
```

```
jury_all_factors <- c(jury_sign_competition_factors, jury_sign_performance_factors, jury_sign_external_
```

```
# fit step wise linear model
```

```
jury_all_model <- step_lm_model(dataset = jury_data, pred_cols = jury_all_factors)
```

```
## Start: AIC=804.5
```

```
## Points ~ 1
```

```
##
```

	Df	Sum of Sq	RSS	AIC
## + CAP_DIST_km	1	265.405	3473.6	782.12
## + speechiness	1	150.596	3588.4	792.89
## + TC_SingerGender_Female	1	95.380	3643.6	797.94
## + ComLANGFAM_y	1	94.325	3644.7	798.04
## + acousticness	1	87.688	3651.3	798.64
## + VBlocs1_TC_1	1	72.508	3666.5	800.01
## + TC_LANGFAM_Armenian	1	22.991	3716.0	804.45
## <none>			3739.0	804.50
## + TC_PerfType_Mixed	1	14.558	3724.5	805.20
## + instrumentalness	1	6.390	3732.6	805.93
## + duration_ms	1	2.567	3736.4	806.27
## + VBlocs2_TC_1	1	0.761	3738.2	806.43
## + ComVBlocs1_y	1	0.154	3738.9	806.48
## + VBlocs1_FC_1	1	0.001	3739.0	806.50

```
##
```

```
## Step: AIC=782.12
```

```
## Points ~ CAP_DIST_km
```

```
##
```

	Df	Sum of Sq	RSS	AIC
## + acousticness	1	79.221	3394.4	776.49
## + speechiness	1	75.416	3398.2	776.86
## + ComLANGFAM_y	1	70.885	3402.7	777.30
## + TC_SingerGender_Female	1	52.874	3420.7	779.05
## + VBlocs1_TC_1	1	24.176	3449.4	781.81
## + duration_ms	1	23.443	3450.2	781.88
## + TC_LANGFAM_Armenian	1	21.212	3452.4	782.10
## <none>			3473.6	782.12
## + VBlocs2_TC_1	1	10.932	3462.7	783.08

```

## + TC_PerfType_Mixed      1    10.561 3463.0 783.12
## + ComVBlocs1_y          1     8.402 3465.2 783.32
## + instrumentalness       1     1.085 3472.5 784.02
## + VBlocs1_FC_1          1     0.408 3473.2 784.09
## - CAP_DIST_km           1    265.405 3739.0 804.50
##
## Step:  AIC=776.49
## Points ~ CAP_DIST_km + acousticness
##
##              Df Sum of Sq    RSS    AIC
## + speechiness      1    138.671 3255.7 764.68
## + TC_SingerGender_Female 1     89.368 3305.0 769.66
## + ComLANGFAM_y      1     55.758 3338.6 773.01
## <none>                3394.4 776.49
## + ComVBlocs1_y      1     20.413 3374.0 776.49
## + VBlocs2_TC_1      1     19.676 3374.7 776.56
## + TC_LANGFAM_Armenian 1     12.244 3382.1 777.29
## + TC_PerfType_Mixed 1     10.881 3383.5 777.43
## + duration_ms       1      9.937 3384.4 777.52
## + VBlocs1_TC_1      1      7.760 3386.6 777.73
## + instrumentalness   1      1.536 3392.8 778.34
## + VBlocs1_FC_1      1      0.278 3394.1 778.46
## - acousticness      1     79.221 3473.6 782.12
## - CAP_DIST_km       1    256.938 3651.3 798.64
##
## Step:  AIC=764.68
## Points ~ CAP_DIST_km + acousticness + speechiness
##
##              Df Sum of Sq    RSS    AIC
## + TC_PerfType_Mixed      1     60.648 3195.1 760.46
## + TC_SingerGender_Female 1     45.738 3210.0 762.00
## + ComLANGFAM_y           1     25.739 3230.0 764.05
## + instrumentalness       1     19.971 3235.7 764.65
## <none>                3255.7 764.68
## + VBlocs1_TC_1          1     16.164 3239.5 765.03
## + ComVBlocs1_y          1     14.304 3241.4 765.22
## + TC_LANGFAM_Armenian    1     14.267 3241.4 765.23
## + VBlocs2_TC_1          1      7.743 3248.0 765.89
## + duration_ms           1      0.011 3255.7 766.68
## + VBlocs1_FC_1          1      0.005 3255.7 766.68
## - speechiness           1    138.671 3394.4 776.49
## - acousticness          1    142.476 3398.2 776.86
## - CAP_DIST_km           1    156.989 3412.7 778.27
##
## Step:  AIC=760.46
## Points ~ CAP_DIST_km + acousticness + speechiness + TC_PerfType_Mixed
##
##              Df Sum of Sq    RSS    AIC
## + TC_SingerGender_Female 1     31.743 3163.3 759.15
## + instrumentalness       1     29.320 3165.7 759.41
## + ComLANGFAM_y           1     28.458 3166.6 759.50
## + VBlocs1_TC_1          1     25.197 3169.9 759.84
## <none>                3195.1 760.46
## + TC_LANGFAM_Armenian    1     15.543 3179.5 760.84

```

```

## + ComVBlocs1_y          1    14.410 3180.7 760.96
## + VBlocs2_TC_1          1     3.457 3191.6 762.10
## + VBlocs1_FC_1          1     0.478 3194.6 762.41
## + duration_ms           1     0.423 3194.6 762.41
## - TC_PerfType_Mixed     1    60.648 3255.7 764.68
## - CAP_DIST_km           1   130.876 3325.9 771.75
## - acousticness          1   161.877 3356.9 774.82
## - speechiness           1   188.437 3383.5 777.43
##
## Step: AIC=759.15
## Points ~ CAP_DIST_km + acousticness + speechiness + TC_PerfType_Mixed +
##         TC_SingerGender_Female
##
##              Df Sum of Sq    RSS    AIC
## + instrumentalness      1    43.000 3120.3 756.62
## + ComLANGFAM_y          1    27.022 3136.3 758.31
## + TC_LANGFAM_Armenian    1    25.348 3138.0 758.49
## + VBlocs1_TC_1          1    19.361 3144.0 759.12
## + ComVBlocs1_y          1    19.161 3144.2 759.14
## <none>                  3163.3 759.15
## - TC_SingerGender_Female 1    31.743 3195.1 760.46
## + duration_ms           1     3.475 3159.8 760.79
## + VBlocs1_FC_1          1     0.337 3163.0 761.12
## + VBlocs2_TC_1          1     0.314 3163.0 761.12
## - TC_PerfType_Mixed     1    46.652 3210.0 762.00
## - CAP_DIST_km           1   118.946 3282.3 769.37
## - speechiness           1   133.991 3297.3 770.88
## - acousticness          1   178.237 3341.6 775.30
##
## Step: AIC=756.62
## Points ~ CAP_DIST_km + acousticness + speechiness + TC_PerfType_Mixed +
##         TC_SingerGender_Female + instrumentalness
##
##              Df Sum of Sq    RSS    AIC
## + TC_LANGFAM_Armenian    1    32.595 3087.7 755.15
## + ComVBlocs1_y          1    27.071 3093.3 755.74
## + ComLANGFAM_y          1    20.625 3099.7 756.43
## <none>                  3120.3 756.62
## + VBlocs1_TC_1          1    10.652 3109.7 757.49
## + duration_ms           1     6.691 3113.6 757.91
## + VBlocs1_FC_1          1     0.178 3120.1 758.60
## + VBlocs2_TC_1          1     0.055 3120.3 758.62
## - instrumentalness      1    43.000 3163.3 759.15
## - TC_SingerGender_Female 1    45.422 3165.7 759.41
## - TC_PerfType_Mixed     1    54.577 3174.9 760.36
## - CAP_DIST_km           1    89.387 3209.7 763.97
## - speechiness           1   163.151 3283.5 771.49
## - acousticness          1   199.538 3319.9 775.14
##
## Step: AIC=755.15
## Points ~ CAP_DIST_km + acousticness + speechiness + TC_PerfType_Mixed +
##         TC_SingerGender_Female + instrumentalness + TC_LANGFAM_Armenian
##
##              Df Sum of Sq    RSS    AIC

```

```

## + VBlocs1_TC_1          1    28.246 3059.5 754.10
## <none>                    3087.7 755.15
## + ComVBlocs1_y          1    17.264 3070.5 755.29
## + ComLANGFAM_y          1    14.616 3073.1 755.58
## - TC_LANGFAM_Armenian   1    32.595 3120.3 756.62
## + duration_ms           1     4.363 3083.4 756.68
## + VBlocs2_TC_1          1     0.599 3087.1 757.08
## + VBlocs1_FC_1          1     0.105 3087.6 757.14
## - instrumentalness      1    50.246 3138.0 758.49
## - TC_PerfType_Mixed     1    54.749 3142.5 758.96
## - TC_SingerGender_Female 1    59.618 3147.3 759.48
## - CAP_DIST_km           1    83.765 3171.5 762.01
## - speechiness           1   163.203 3250.9 770.20
## - acousticness          1   186.353 3274.1 772.54
##
## Step: AIC=754.1
## Points ~ CAP_DIST_km + acousticness + speechiness + TC_PerfType_Mixed +
##          TC_SingerGender_Female + instrumentalness + TC_LANGFAM_Armenian +
##          VBlocs1_TC_1
##
##              Df Sum of Sq    RSS    AIC
## + ComVBlocs1_y      1    71.797 2987.7 748.24
## + VBlocs2_TC_1      1    42.354 3017.1 751.49
## <none>                3059.5 754.10
## - VBlocs1_TC_1      1    28.246 3087.7 755.15
## + ComLANGFAM_y      1     7.973 3051.5 755.24
## + duration_ms        1     7.013 3052.5 755.35
## + VBlocs1_FC_1      1     0.140 3059.3 756.09
## - instrumentalness   1    37.868 3097.3 756.18
## - TC_LANGFAM_Armenian 1    50.189 3109.7 757.49
## - TC_SingerGender_Female 1    51.988 3111.5 757.68
## - CAP_DIST_km        1    57.183 3116.7 758.23
## - TC_PerfType_Mixed  1    64.649 3124.1 759.03
## - acousticness       1   136.572 3196.1 766.56
## - speechiness        1   178.413 3237.9 770.87
##
## Step: AIC=748.24
## Points ~ CAP_DIST_km + acousticness + speechiness + TC_PerfType_Mixed +
##          TC_SingerGender_Female + instrumentalness + TC_LANGFAM_Armenian +
##          VBlocs1_TC_1 + ComVBlocs1_y
##
##              Df Sum of Sq    RSS    AIC
## + VBlocs1_FC_1      1    39.932 2947.8 745.79
## + VBlocs2_TC_1      1    39.710 2948.0 745.82
## <none>                2987.7 748.24
## + ComLANGFAM_y      1    10.867 2976.8 749.04
## + duration_ms        1     8.316 2979.4 749.32
## - instrumentalness   1    39.659 3027.3 750.61
## - TC_LANGFAM_Armenian 1    47.333 3035.0 751.45
## - TC_SingerGender_Female 1    56.673 3044.4 752.46
## - CAP_DIST_km        1    57.232 3044.9 752.53
## - ComVBlocs1_y      1    71.797 3059.5 754.10
## - TC_PerfType_Mixed  1    76.021 3063.7 754.56
## - VBlocs1_TC_1      1    82.779 3070.5 755.29

```

```

## - acousticness          1    145.986 3133.7 762.04
## - speechiness           1    182.509 3170.2 765.87
##
## Step: AIC=745.79
## Points ~ CAP_DIST_km + acousticness + speechiness + TC_PerfType_Mixed +
##         TC_SingerGender_Female + instrumentalness + TC_LANGFAM_Armenian +
##         VBlocs1_TC_1 + ComVBlocs1_y + VBlocs1_FC_1
##
##
##           Df Sum of Sq    RSS    AIC
## + VBlocs2_TC_1      1     39.924 2907.8 743.28
## <none>                        2947.8 745.79
## + ComLANGFAM_y      1      8.784 2939.0 746.80
## + duration_ms       1      8.429 2939.3 746.84
## - VBlocs1_FC_1      1     39.932 2987.7 748.24
## - instrumentalness  1     43.487 2991.2 748.64
## - TC_LANGFAM_Armenian 1     47.160 2994.9 749.04
## - TC_SingerGender_Female 1     62.835 3010.6 750.77
## - CAP_DIST_km       1     63.824 3011.6 750.88
## - TC_PerfType_Mixed 1     72.126 3019.9 751.79
## - ComVBlocs1_y      1    111.589 3059.3 756.09
## - VBlocs1_TC_1      1    117.863 3065.6 756.77
## - acousticness      1    146.728 3094.5 759.87
## - speechiness       1    168.798 3116.6 762.22
##
## Step: AIC=743.28
## Points ~ CAP_DIST_km + acousticness + speechiness + TC_PerfType_Mixed +
##         TC_SingerGender_Female + instrumentalness + TC_LANGFAM_Armenian +
##         VBlocs1_TC_1 + ComVBlocs1_y + VBlocs1_FC_1 + VBlocs2_TC_1
##
##
##           Df Sum of Sq    RSS    AIC
## <none>                        2907.8 743.28
## - instrumentalness  1     19.569 2927.4 743.50
## + ComLANGFAM_y      1     14.662 2893.2 743.60
## - TC_SingerGender_Female 1     24.365 2932.2 744.04
## + duration_ms       1      0.128 2907.7 745.26
## - VBlocs2_TC_1      1     39.924 2947.8 745.79
## - VBlocs1_FC_1      1     40.147 2948.0 745.82
## - TC_PerfType_Mixed 1     71.443 2979.3 749.31
## - TC_LANGFAM_Armenian 1     82.391 2990.2 750.53
## - CAP_DIST_km       1     84.526 2992.3 750.76
## - acousticness      1    100.637 3008.5 752.54
## - ComVBlocs1_y      1    109.231 3017.1 753.48
## - VBlocs1_TC_1      1    155.201 3063.0 758.49
## - speechiness       1    158.449 3066.3 758.84

```

```
# extract out significant predictors
```

```
jury_sign_all_factors <- jury_all_model$sign_factors
```

```
# create a model formula
```

```
jury_final_model_form <- as.formula(paste('Points ~', paste(jury_sign_all_factors, collapse = ' + ')))
```

```
# create the maximum model
```

```
jury_final_model <- lm(jury_final_model_form, data = jury_data)
```

```
# get model summary
```

```
summary(jury_final_model)
```



```
##
## Call:
## lm(formula = jury_final_model_form, data = jury_data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -6.136 -2.494 -0.291  2.024  8.297
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)      4.0865     0.4637   8.812 < 2e-16 ***
## CAP_DIST_km       0.6617     0.1854   3.568 0.000414 ***
## acousticness      0.5032     0.1747   2.880 0.004247 **
## speechiness       0.8932     0.2004   4.457 1.15e-05 ***
## TC_PerfType_Mixed -9.6005     3.2765  -2.930 0.003632 **
## TC_LANGFAM_Armenian -3.1767     0.9880  -3.215 0.001435 **
## VBlocs1_TC_1       3.0611     0.6177   4.956 1.17e-06 ***
## ComVBlocs1_y      -2.2750     0.6857  -3.318 0.001011 **
## VBlocs1_FC_1       0.8442     0.4283   1.971 0.049601 *
## VBlocs2_TC_1       1.5367     0.4794   3.205 0.001484 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.027 on 321 degrees of freedom
## Multiple R-squared:  0.2132, Adjusted R-squared:  0.1912
## F-statistic: 9.667 on 9 and 321 DF,  p-value: 4.405e-13
```

```
# get anova results
anova(jury_final_model)
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CAP_DIST_km	1	265.40533	265.405333	28.961035	0.0000001
acousticness	1	79.22142	79.221423	8.644643	0.0035184
speechiness	1	138.67103	138.671029	15.131785	0.0001219
TC_PerfType_Mixed	1	60.64753	60.647531	6.617860	0.0105452
TC_LANGFAM_Armenian	1	15.54264	15.542641	1.696013	0.1937438
VBlocs1_TC_1	1	45.47158	45.471581	4.961860	0.0266052
ComVBlocs1_y	1	66.38236	66.382359	7.243644	0.0074881
VBlocs1_FC_1	1	31.78917	31.789172	3.468835	0.0634488
VBlocs2_TC_1	1	94.16292	94.162917	10.275059	0.0014840
Residuals	321	2941.71508	9.164221	NA	NA

```
# check variance inflation factors
vif(jury_final_model)
```

```
##      CAP_DIST_km      acousticness      speechiness      TC_PerfType_Mixed
##      1.214251      1.228278      1.363699      1.167945
## TC_LANGFAM_Armenian  VBlocs1_TC_1      ComVBlocs1_y      VBlocs1_FC_1
##      1.525300      3.277766      2.648599      1.656485
##      VBlocs2_TC_1
##      2.070903
```

```
# write the model to disk  
saveRDS(object = jury_final_model, file = './models/jury_final_model.RDS')
```