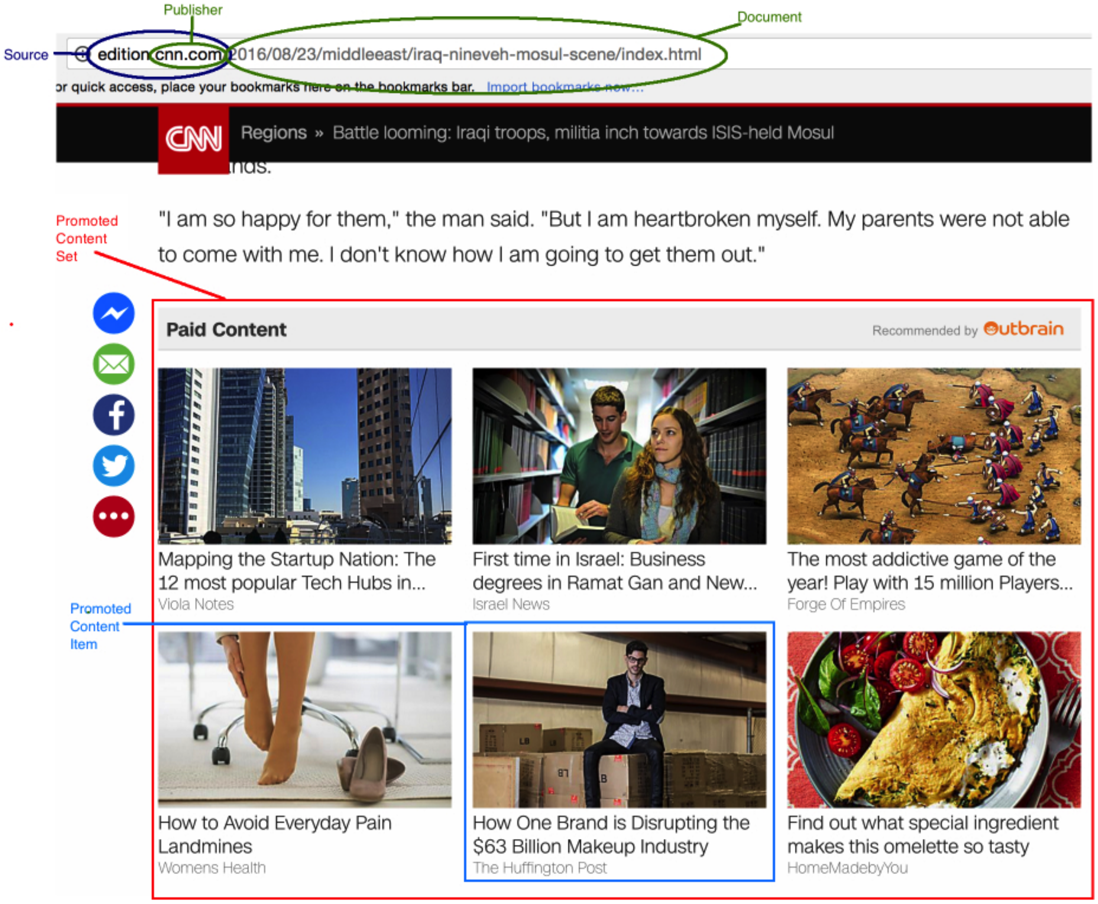
Click or not

group 2

(1)Problem Description

- The internet is a stimulating treasure trove of possibility. Every day we stumble on news stories relevant to our communities or experience the serendipity of finding an article covering our next travel destination.
- We are challenged to predict which pieces of content its global base of users are likely to click on.



edition.cnn.com/2016/08/23/middleeast/iraq-nineveh-mosul-scene/index.html

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nds.

"I am so happy for them," the man said. "But I am heartbroken myself. My parents were not able to come with me. I don't know how I am going to get them out."

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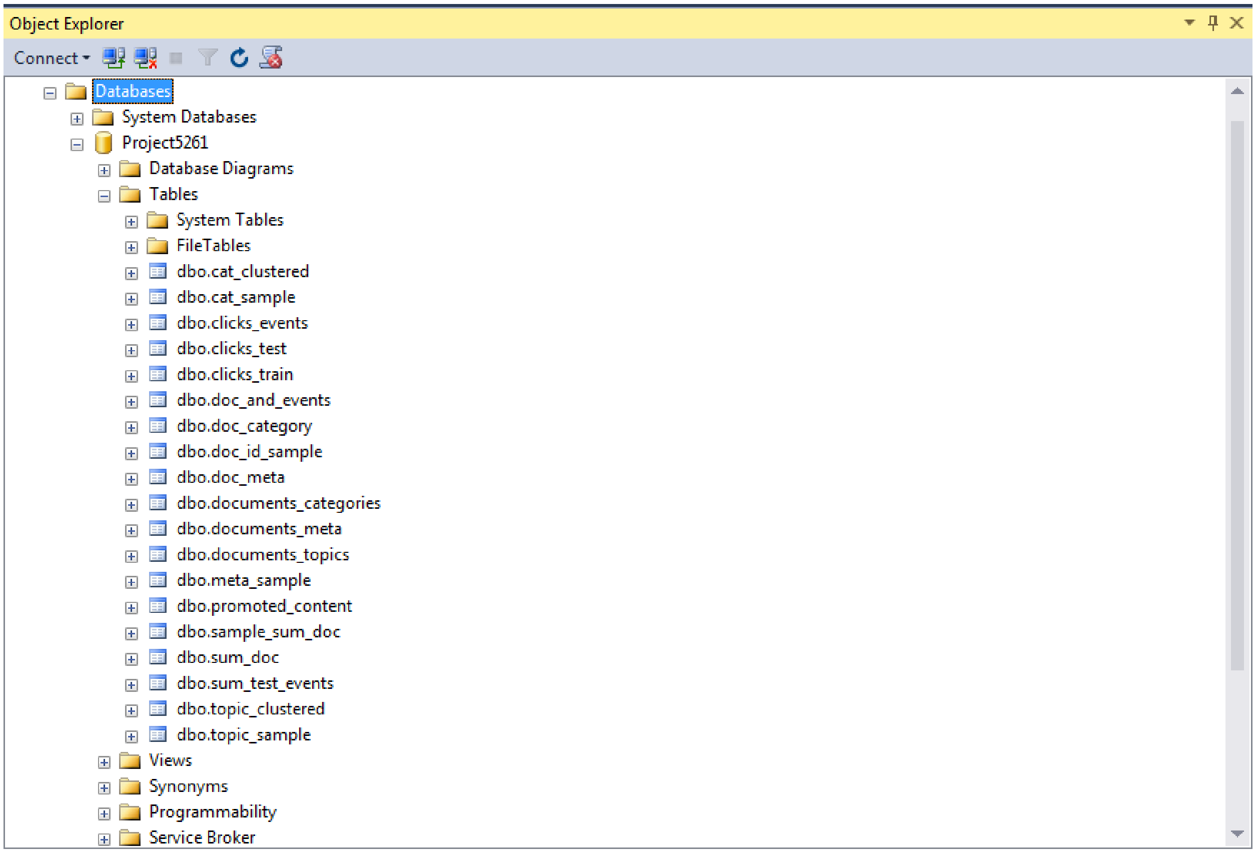
(2)Data

- Data comes from Kaggle.com
- Raw data includes Content of websites, information of users who browsed the website and information of ads on the websites.
- Data contains all kinds of information, which is challenging and interesting.
- Given the information of website, users and ads on the website, We will predict the probility of each ad being clicked and use Mean Average Precision to evaluate the result.



```
⊟ Databases
    ⊞ System Databases
    ⊟ Project5261
        ⊞ Database Diagrams
        ⊟ Tables
            ⊞ System Tables
            ⊞ FileTables
            ⊞ dbo.cat_clustered
            ⊞ dbo.cat_sample
            ⊞ dbo.clicks_events
            ⊞ dbo.clicks_test
            ⊞ dbo.clicks_train
            ⊞ dbo.doc_and_events
            ⊞ dbo.doc_category
            ⊞ dbo.doc_id_sample
            ⊞ dbo.doc_meta
            ⊞ dbo.documents_categories
            ⊞ dbo.documents_meta
            ⊞ dbo.documents_topics
            ⊞ dbo.meta_sample
            ⊞ dbo.promoted_content
            ⊞ dbo.sample_sum_doc
            ⊞ dbo.sum_doc
            ⊞ dbo.sum_test_events
            ⊞ dbo.topic_clustered
            ⊞ dbo.topic_sample
        ⊞ Views
        ⊞ Synonyms
        ⊞ Programmability
        ⊞ Service Broker
```

Figure 1:

$$MAP@12 = \frac{1}{|U|} \sum_{u=1}^{|U|} \sum_{k=1}^{min(12,n)} P(k)$$

Figure 2:

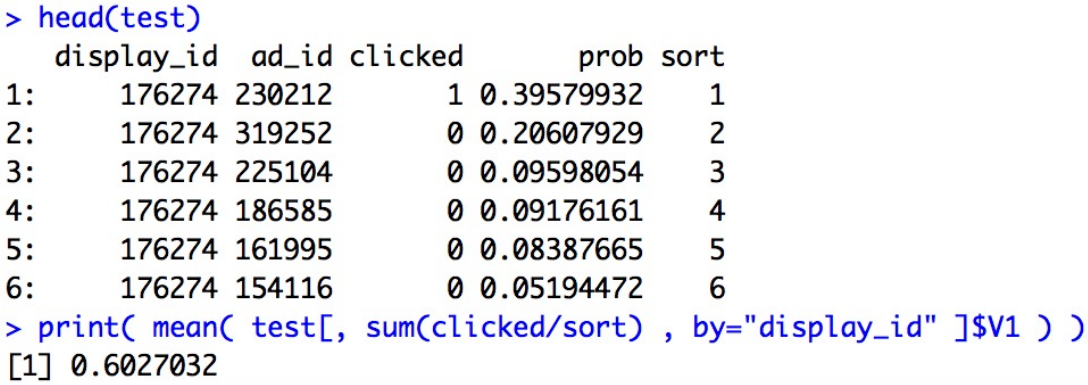
(3)First Attempt

- Firstly we tried a relatively Bayesian method which focus on the click itself.

$$W = \frac{Rv + Cm}{v + m}$$

Figure 3:

- R is the average clicked rate of an ad.
- v is the times an ad was displayed.
- C is the mean clicked rate around all ads in the data.
- m is the minimum displaying times required for an ad.
- The method is very efficient and the result is not bad.



```
> head(test)
   display_id  ad_id clicked       prob sort
1:     176274 230212       1 0.39579932    1
2:     176274 319252       0 0.20607929    2
3:     176274 225104       0 0.09598054    3
4:     176274 186585       0 0.09176161    4
5:     176274 161995       0 0.08387665    5
6:     176274 154116       0 0.05194472    6
> print( mean( test[, sum(clicked/sort) , by="display_id" ]$V1 ) )
[1] 0.6027032
```

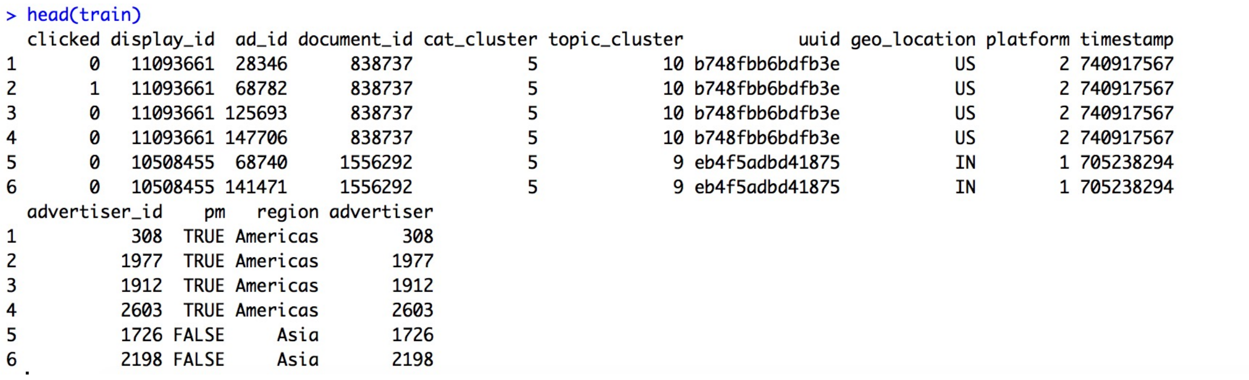
Figure 4:

(4)Advanced Exploation

- We want to use more information in the dataset to get a more precise result.
- Logistics Regression is a good way to predict probility.

Data Processing

- The raw data is way too large to process in R. SQL is the only choice.
- Delete unrelative information
- Use k-means cluster to reduce the number of catagories in data.

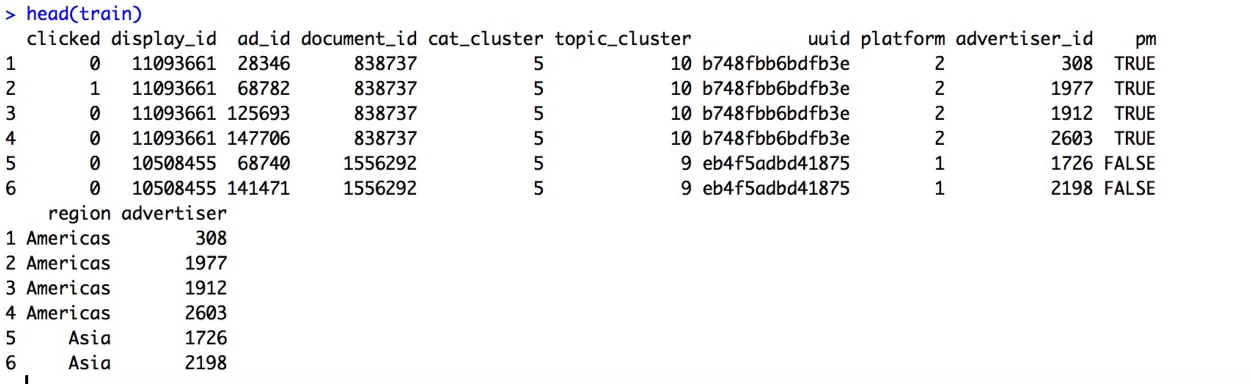


```
> head(train)
  clicked display_id  ad_id document_id cat_cluster topic_cluster           uuid geo_location platform timestamp
1       0   11093661  28346      838737           5            10 b748fbb6bdfb3e           US        2 740917567
2       1   11093661  68782      838737           5            10 b748fbb6bdfb3e           US        2 740917567
3       0   11093661 125693      838737           5            10 b748fbb6bdfb3e           US        2 740917567
4       0   11093661 147706      838737           5            10 b748fbb6bdfb3e           US        2 740917567
5       0   10508455  68740     1556292           5             9 eb4f5adbd41875           IN        1 705238294
6       0   10508455 141471     1556292           5             9 eb4f5adbd41875           IN        1 705238294
  advertiser_id    pm   region advertiser
1           308  TRUE Americas        308
2          1977  TRUE Americas       1977
3          1912  TRUE Americas       1912
4          2603  TRUE Americas       2603
5          1726 FALSE     Asia       1726
6          2198 FALSE     Asia       2198
```

Figure 5:

Variable Selection

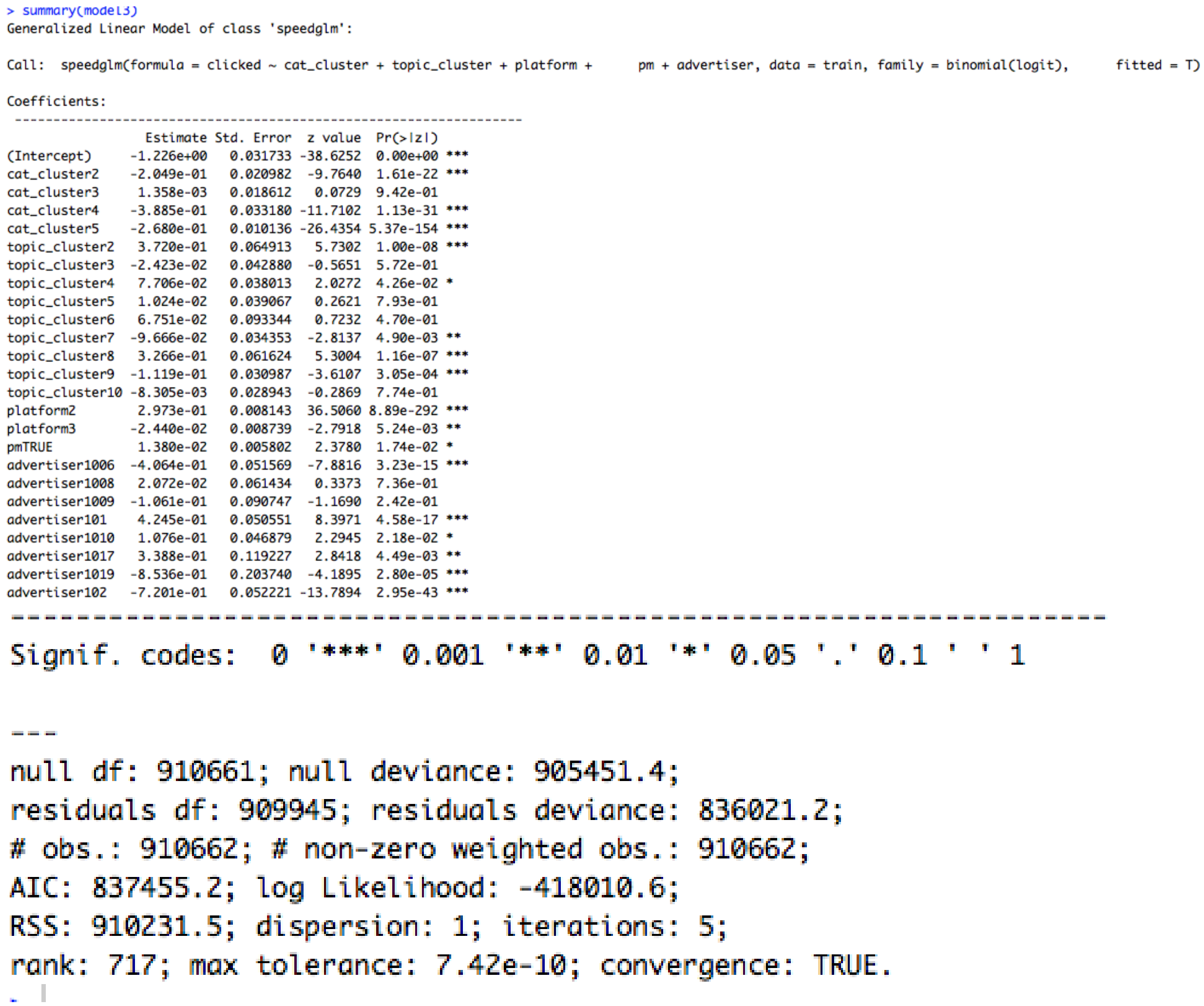
- After processing, there still are plenty of variables.
- Since regression includes matrix calculation, we still need to select necessary variables to reduce calculation time.
- Backward selection is applied to select variables.



```
> head(train)
  clicked display_id  ad_id document_id cat_cluster topic_cluster           uuid platform advertiser_id    pm
1       0   11093661  28346      838737           5            10 b748fbb6bdfb3e        2           308  TRUE
2       1   11093661  68782      838737           5            10 b748fbb6bdfb3e        2          1977  TRUE
3       0   11093661 125693      838737           5            10 b748fbb6bdfb3e        2          1912  TRUE
4       0   11093661 147706      838737           5            10 b748fbb6bdfb3e        2          2603  TRUE
5       0   10508455  68740     1556292           5             9 eb4f5adbd41875        1          1726 FALSE
6       0   10508455 141471     1556292           5             9 eb4f5adbd41875        1          2198 FALSE
    region advertiser
1 Americas        308
2 Americas       1977
3 Americas       1912
4 Americas       2603
5     Asia       1726
6     Asia       2198
```

Figure 6:

Result

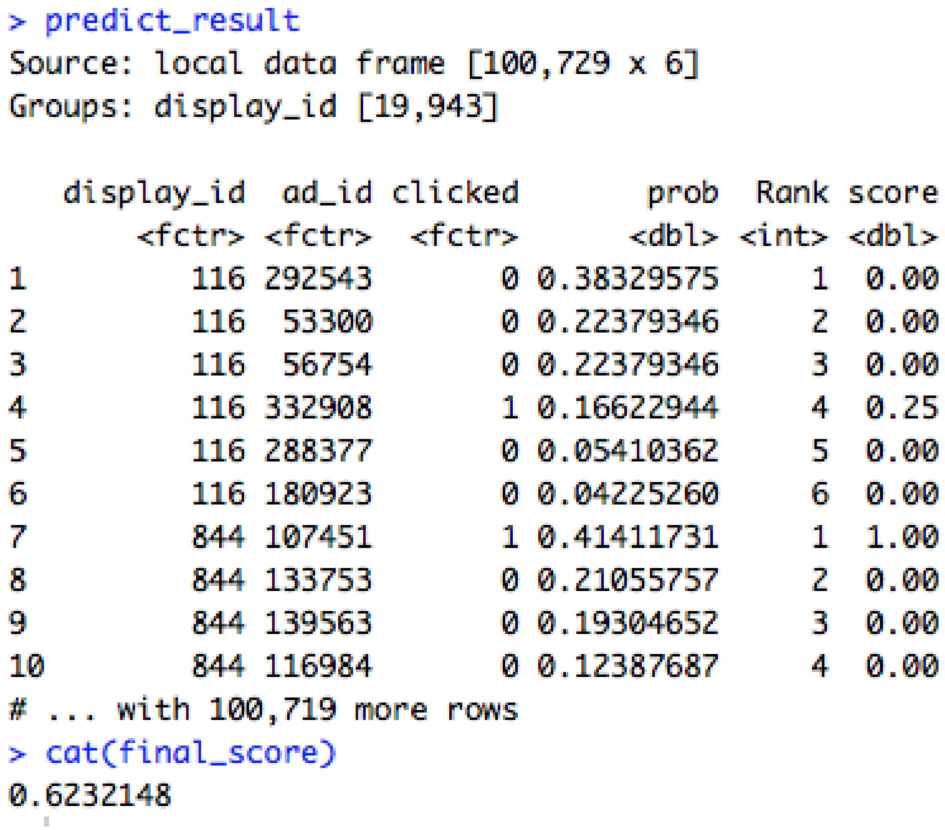


```
> summary(model3)
Generalized Linear Model of class 'speedglm':

Call:  speedglm(formula = clicked ~ cat_cluster + topic_cluster + platform +      pm + advertiser, data = train, family = binomial(logit),      fitted = T)

Coefficients:
 ------------------------------------------------------------------
                  Estimate Std. Error  z value  Pr(>|z|)
(Intercept)      -1.226e+00   0.031733 -38.6252  0.00e+00 ***
cat_cluster2     -2.049e-01   0.020982  -9.7640  1.61e-22 ***
cat_cluster3      1.358e-03   0.018612   0.0729  9.42e-01
cat_cluster4     -3.885e-01   0.033180 -11.7102  1.13e-31 ***
cat_cluster5     -2.680e-01   0.010136 -26.4354 5.37e-154 ***
topic_cluster2    3.720e-01   0.064913   5.7302  1.00e-08 ***
topic_cluster3   -2.423e-02   0.042880  -0.5651  5.72e-01
topic_cluster4    7.706e-02   0.038013   2.0272  4.26e-02 *
topic_cluster5    1.024e-02   0.039067   0.2621  7.93e-01
topic_cluster6    6.751e-02   0.093344   0.7232  4.70e-01
topic_cluster7   -9.666e-02   0.034353  -2.8137  4.90e-03 **
topic_cluster8    3.266e-01   0.061624   5.3004  1.16e-07 ***
topic_cluster9   -1.119e-01   0.030987  -3.6107  3.05e-04 ***
topic_cluster10  -8.305e-03   0.028943  -0.2869  7.74e-01
platform2         2.973e-01   0.008143  36.5060 8.89e-292 ***
platform3        -2.440e-02   0.008739  -2.7918  5.24e-03 **
pmTRUE            1.380e-02   0.005802   2.3780  1.74e-02 *
advertiser1006   -4.064e-01   0.051569  -7.8816  3.23e-15 ***
advertiser1008    2.072e-02   0.061434   0.3373  7.36e-01
advertiser1009   -1.061e-01   0.090747  -1.1690  2.42e-01
advertiser101     4.245e-01   0.050551   8.3971  4.58e-17 ***
advertiser1010    1.076e-01   0.046879   2.2945  2.18e-02 *
advertiser1017    3.388e-01   0.119227   2.8418  4.49e-03 **
advertiser1019   -8.536e-01   0.203740  -4.1895  2.80e-05 ***
advertiser102    -7.201e-01   0.052221 -13.7894  2.95e-43 ***
 -------------------------------------------------------------------
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

---
null df: 910661; null deviance: 905451.4;
residuals df: 909945; residuals deviance: 836021.2;
# obs.: 910662; # non-zero weighted obs.: 910662;
AIC: 837455.2; log Likelihood: -418010.6;
RSS: 910231.5; dispersion: 1; iterations: 5;
rank: 717; max tolerance: 7.42e-10; convergence: TRUE.
```



```
> predict_result
Source: local data frame [100,729 x 6]
Groups: display_id [19,943]

   display_id  ad_id clicked       prob  Rank score
       <fctr> <fctr>  <fctr>      <dbl> <int> <dbl>
1         116 292543       0 0.38329575     1  0.00
2         116  53300       0 0.22379346     2  0.00
3         116  56754       0 0.22379346     3  0.00
4         116 332908       1 0.16622944     4  0.25
5         116 288377       0 0.05410362     5  0.00
6         116 180923       0 0.04225260     6  0.00
7         844 107451       1 0.41411731     1  1.00
8         844 133753       0 0.21055757     2  0.00
9         844 139563       0 0.19304652     3  0.00
10        844 116984       0 0.12387687     4  0.00
# ... with 100,719 more rows
> cat(final_score)
0.6232148
```

(5)Summary

- We use two methods to predict which ad will be clicked, both of them give us ideal result.