**LOGISTIC REGRESSION:**

1. **Classify whether application accepted or not using Logistic regression**

**#CREDIT CARD**

**card\_app<-glm(card~.,family="binomial",data = creditcard)**

**summary(card\_app)**

Call:

glm(formula = card ~ ., family = "binomial", data = creditcard)

Deviance Residuals:

Min 1Q Median 3Q Max

-8.49 0.00 0.00 0.00 8.49

Coefficients:

Estimate Std. Error z value Pr(>|z|)

(Intercept) 1.938e+14 8.850e+06 21898781 <2e-16 \*\*\*

X 8.203e+10 4.908e+03 16712515 <2e-16 \*\*\*

reports -5.265e+14 1.437e+06 -366540548 <2e-16 \*\*\*

age 3.978e+12 2.211e+05 17992987 <2e-16 \*\*\*

income -4.678e+12 1.472e+06 -3178985 <2e-16 \*\*\*

share 1.764e+16 4.362e+07 404458593 <2e-16 \*\*\*

expenditure -6.835e+11 1.568e+04 -43584653 <2e-16 \*\*\*

owneryes -8.506e+13 4.361e+06 -19501393 <2e-16 \*\*\*

selfempyes 1.665e+14 7.375e+06 22571127 <2e-16 \*\*\*

dependents -1.451e+13 1.621e+06 -8948607 <2e-16 \*\*\*

months -4.196e+11 3.145e+04 -13342062 <2e-16 \*\*\*

majorcards 8.479e+13 4.858e+06 17453988 <2e-16 \*\*\*

active 1.069e+13 3.175e+05 33660613 <2e-16 \*\*\*

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

Null deviance: 1404.6 on 1318 degrees of freedom

Residual deviance: 11606.1 on 1306 degrees of freedom

AIC: 11632

Number of Fisher Scoring iterations: 25

**Conclusion: All the variables are significant also difference between Null variance & Residual variance is high, the model or set of variables are best fit.**

**AIC value is 11632 for all**

1. **Output variable -> y**

**y -> Whether the client has subscribed a term deposit or not Binomial ("yes" or "no")**

**1st Iteration**

**Bank<-glm(y~.,family = "binomial",data = bank.full)**

**summary(Bank)**

Call:

glm(formula = y ~ ., family = "binomial", data = bank.full)

Deviance Residuals:

Min 1Q Median 3Q Max

-5.7286 -0.3744 -0.2530 -0.1502 3.4288

Coefficients:

Estimate Std. Error z value Pr(>|z|)

(Intercept) -2.536e+00 1.837e-01 -13.803 < 2e-16 \*\*\*

age 1.127e-04 2.205e-03 0.051 0.959233

jobblue-collar -3.099e-01 7.267e-02 -4.264 2.01e-05 \*\*\*

jobentrepreneur -3.571e-01 1.256e-01 -2.844 0.004455 \*\*

jobhousemaid -5.040e-01 1.365e-01 -3.693 0.000221 \*\*\*

jobmanagement -1.653e-01 7.329e-02 -2.255 0.024130 \*

jobretired 2.524e-01 9.722e-02 2.596 0.009436 \*\*

jobself-employed -2.983e-01 1.120e-01 -2.664 0.007726 \*\*

jobservices -2.238e-01 8.406e-02 -2.662 0.007763 \*\*

jobstudent 3.821e-01 1.090e-01 3.505 0.000457 \*\*\*

jobtechnician -1.760e-01 6.893e-02 -2.554 0.010664 \*

jobunemployed -1.767e-01 1.116e-01 -1.583 0.113456

jobunknown -3.133e-01 2.335e-01 -1.342 0.179656

maritalmarried -1.795e-01 5.891e-02 -3.046 0.002318 \*\*

maritalsingle 9.250e-02 6.726e-02 1.375 0.169066

educationsecondary 1.835e-01 6.479e-02 2.833 0.004618 \*\*

educationtertiary 3.789e-01 7.532e-02 5.031 4.88e-07 \*\*\*

educationunknown 2.505e-01 1.039e-01 2.411 0.015915 \*

defaultyes -1.668e-02 1.628e-01 -0.102 0.918407

balance 1.283e-05 5.148e-06 2.493 0.012651 \*

housingyes -6.754e-01 4.387e-02 -15.395 < 2e-16 \*\*\*

loanyes -4.254e-01 5.999e-02 -7.091 1.33e-12 \*\*\*

contacttelephone -1.634e-01 7.519e-02 -2.173 0.029784 \*

contactunknown -1.623e+00 7.317e-02 -22.184 < 2e-16 \*\*\*

day 9.969e-03 2.497e-03 3.993 6.53e-05 \*\*\*

monthaug -6.939e-01 7.847e-02 -8.842 < 2e-16 \*\*\*

monthdec 6.911e-01 1.767e-01 3.912 9.17e-05 \*\*\*

monthfeb -1.473e-01 8.941e-02 -1.648 0.099427 .

monthjan -1.262e+00 1.217e-01 -10.367 < 2e-16 \*\*\*

monthjul -8.308e-01 7.740e-02 -10.733 < 2e-16 \*\*\*

monthjun 4.536e-01 9.367e-02 4.843 1.28e-06 \*\*\*

monthmar 1.590e+00 1.199e-01 13.265 < 2e-16 \*\*\*

monthmay -3.991e-01 7.229e-02 -5.521 3.36e-08 \*\*\*

monthnov -8.734e-01 8.441e-02 -10.347 < 2e-16 \*\*\*

monthoct 8.814e-01 1.080e-01 8.159 3.37e-16 \*\*\*

monthsep 8.741e-01 1.195e-01 7.314 2.58e-13 \*\*\*

duration 4.194e-03 6.453e-05 64.986 < 2e-16 \*\*\*

campaign -9.078e-02 1.014e-02 -8.955 < 2e-16 \*\*\*

pdays -1.027e-04 3.061e-04 -0.335 0.737268

previous 1.015e-02 6.503e-03 1.561 0.118476

poutcomeother 2.035e-01 8.986e-02 2.265 0.023543 \*

poutcomesuccess 2.291e+00 8.235e-02 27.821 < 2e-16 \*\*\*

poutcomeunknown -9.179e-02 9.347e-02 -0.982 0.326093

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

Null deviance: 32631 on 45210 degrees of freedom

Residual deviance: 21562 on 45168 degrees of freedom

AIC: 21648

Number of Fisher Scoring iterations: 6

**2nd Iteration:**

**Bank2<-glm(y~job+marital+education+balance+housing+loan+contact+**

**day+month+duration+campaign+poutcome,data =bank.full,family = "binomial" )**

**summary(Bank2)**

Call:

glm(formula = y ~ job + marital + education + balance + housing +

loan + contact + day + month + duration + campaign + poutcome,

family = "binomial", data = bank.full)

Deviance Residuals:

Min 1Q Median 3Q Max

-5.7290 -0.3747 -0.2532 -0.1501 3.4268

Coefficients:

Estimate Std. Error z value Pr(>|z|)

(Intercept) -2.527e+00 1.298e-01 -19.470 < 2e-16 \*\*\*

jobblue-collar -3.116e-01 7.261e-02 -4.292 1.77e-05 \*\*\*

jobentrepreneur -3.586e-01 1.254e-01 -2.860 0.004241 \*\*

jobhousemaid -5.043e-01 1.360e-01 -3.707 0.000210 \*\*\*

jobmanagement -1.646e-01 7.323e-02 -2.248 0.024567 \*

jobretired 2.541e-01 8.738e-02 2.907 0.003644 \*\*

jobself-employed -2.983e-01 1.120e-01 -2.664 0.007720 \*\*

jobservices -2.252e-01 8.404e-02 -2.680 0.007359 \*\*

jobstudent 3.822e-01 1.070e-01 3.571 0.000356 \*\*\*

jobtechnician -1.760e-01 6.892e-02 -2.554 0.010661 \*

jobunemployed -1.779e-01 1.116e-01 -1.594 0.111000

jobunknown -3.122e-01 2.331e-01 -1.339 0.180441

maritalmarried -1.785e-01 5.865e-02 -3.043 0.002339 \*\*

maritalsingle 9.191e-02 6.311e-02 1.456 0.145313

educationsecondary 1.822e-01 6.445e-02 2.827 0.004699 \*\*

educationtertiary 3.783e-01 7.472e-02 5.063 4.12e-07 \*\*\*

educationunknown 2.493e-01 1.039e-01 2.399 0.016423 \*

balance 1.289e-05 5.127e-06 2.515 0.011903 \*

housingyes -6.755e-01 4.350e-02 -15.529 < 2e-16 \*\*\*

loanyes -4.254e-01 5.986e-02 -7.108 1.18e-12 \*\*\*

contacttelephone -1.614e-01 7.432e-02 -2.172 0.029827 \*

contactunknown -1.622e+00 7.310e-02 -22.189 < 2e-16 \*\*\*

day 9.898e-03 2.496e-03 3.965 7.33e-05 \*\*\*

monthaug -6.914e-01 7.838e-02 -8.822 < 2e-16 \*\*\*

monthdec 6.943e-01 1.767e-01 3.930 8.51e-05 \*\*\*

monthfeb -1.433e-01 8.927e-02 -1.605 0.108545

monthjan -1.258e+00 1.217e-01 -10.339 < 2e-16 \*\*\*

monthjul -8.288e-01 7.734e-02 -10.717 < 2e-16 \*\*\*

monthjun 4.558e-01 9.364e-02 4.868 1.13e-06 \*\*\*

monthmar 1.592e+00 1.198e-01 13.293 < 2e-16 \*\*\*

monthmay -3.992e-01 7.222e-02 -5.527 3.26e-08 \*\*\*

monthnov -8.693e-01 8.394e-02 -10.357 < 2e-16 \*\*\*

monthoct 8.858e-01 1.079e-01 8.211 < 2e-16 \*\*\*

monthsep 8.763e-01 1.195e-01 7.336 2.20e-13 \*\*\*

duration 4.194e-03 6.453e-05 64.988 < 2e-16 \*\*\*

campaign -9.037e-02 1.013e-02 -8.925 < 2e-16 \*\*\*

poutcomeother 2.163e-01 8.939e-02 2.419 0.015542 \*

poutcomesuccess 2.300e+00 7.980e-02 28.817 < 2e-16 \*\*\*

poutcomeunknown -9.765e-02 5.747e-02 -1.699 0.089284 .

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

Null deviance: 32631 on 45210 degrees of freedom

Residual deviance: 21565 on 45172 degrees of freedom

AIC: 21643

Number of Fisher Scoring iterations: 6

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Iterations** | **Null Deviance** | **Residual Deviance** | **Difference (Null & Residual)** | **AIC** |
| **1st** | **32631** | **21562** | **11069** | **21648** |
| **2nd** | **32631** | **21565** | **11066** | **21643** |

**prob<-predict(mylogit,bank.full,type="response")**

**prob**

**#cnfusion and considering threshold as 0.5**

**confusion<-table(prob<0.5,bank.full$y)**

**confusion**

|  |  |  |
| --- | --- | --- |
|  | **NO** | **YES** |
| **False** | **980** | **1836** |
| **True** | **38942** | **3453** |

**Prob: (980+3453)/44761**

**=0.09~9%**

Result: Probability of whether client has subscribed or not is 9%