Acceptance of Personal Loan

Code

Logistic Regression

Logistic Regression using *Universal Bank* data

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```
pacman::p_load(caret, data.table, gains, leaps, MASS, tidyverse)
theme_set(theme_classic())
```

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```
bank.dt <- fread("C:/Users/nehaj/Documents/Neha/Fall Semester/BA with R/UniversalBank.csv")
bank.dt <- bank.dt[ , -c(1,5)]  # Drop ID and zip code columns

names(bank.dt) <- gsub('\\s', '_', names(bank.dt))

# Convert "Education" to categorical variable
bank.dt$Education <- factor(bank.dt$Education, levels = c(1, 2, 3),
                            labels = c("Undergrad", "Graduate", "Adv/Prof"))
bank.df <- setDF(bank.dt)
```

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```
set.seed(13)
train.index <- createDataPartition(bank.df$Personal_Loan, p = 0.6, list = FALSE)
train.df <- bank.df[train.index, ]
valid.df <- bank.df[-train.index, ]
```

Logistic Regression

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```
logit.reg <- glm(Personal_Loan ~ ., data = train.df, family = "binomial")

options(scipen=999)
summary(logit.reg)
```

```
Call:
glm(formula = Personal_Loan ~ ., family = "binomial", data = train.df)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.2045  -0.1775  -0.0620  -0.0172   4.2626

Coefficients:
                      Estimate  Std. Error z value             Pr(>|z|)
(Intercept)        -12.5159238   2.5703338  -4.869  0.00000111950785903 ***
Age                 -0.0649415   0.0958633  -0.677             0.498128
Experience           0.0688205   0.0948753   0.725             0.468220
Income               0.0624108   0.0041009  15.219 < 0.0000000000000002 ***
Family               0.5957165   0.1026411   5.804  0.00000000647977887 ***
CCAvg                0.2322143   0.0620682   3.741             0.000183 ***
EducationGraduate    4.6375429   0.3902387  11.884 < 0.0000000000000002 ***
EducationAdv/Prof    4.7296016   0.3869380  12.223 < 0.0000000000000002 ***
Mortgage             0.0018824   0.0008384   2.245             0.024752 *
Securities_Account  -0.9446436   0.3943880  -2.395             0.016611 *
CD_Account           3.7151142   0.4644609   7.999  0.00000000000000126 ***
Online              -0.6877936   0.2197240  -3.130             0.001747 **
CreditCard          -0.8705782   0.2851185  -3.053             0.002263 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 1888.24  on 2999  degrees of freedom
Residual deviance:  659.37  on 2987  degrees of freedom
AIC: 685.37

Number of Fisher Scoring iterations: 8
```

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```
# Generate odds-ratios
exp(coef(logit.reg))
```

```
      (Intercept)               Age        Experience            Income            Family
   0.000003667781    0.937122308015    1.071243929687    1.064399531604    1.814330445959
           CCAvg  EducationGraduate  EducationAdv/Prof          Mortgage Securities_Account
   1.261390003957  103.290245128931  113.250434961855    1.001884158245    0.388818107387
       CD_Account            Online        CreditCard
  41.063277844014    0.502683993185    0.418709391866
```

Model Selection

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```
logitnew <- stepAIC(logit.reg, trace = 0)  # trace = 0 suppress intermediate steps
```

Performance Evaluation

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```
logit.reg.pred <- predict(logit.reg, valid.df[, -8], type = "response")

t(t(head(logit.reg.pred, 10)))
```

```
           [,1]
4  0.11222917924
7  0.01603865523
9  0.04864222900
12 0.00412516046
20 0.00008996875
26 0.00002054548
29 0.00109654546
32 0.00075153116
43 0.81600545051
49 0.03869372932
```

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```
head(logit.reg.pred,10)
```

```
           4            7            9           12           20           26            2
9
0.11222917924 0.01603865523 0.04864222900 0.00412516046 0.00008996875 0.00002054548 0.0010965454
6
          32           43           49
0.00075153116 0.81600545051 0.03869372932
```

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```
head(train)
```

```
[1]  49 485 321 153  74 228
```

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```
# generate confusion matrix
table(valid.df$Personal_Loan , logit.reg.pred > 0.5)
```

```
   FALSE TRUE
  0  1783   23
  1    60  134
```

Lift Chart

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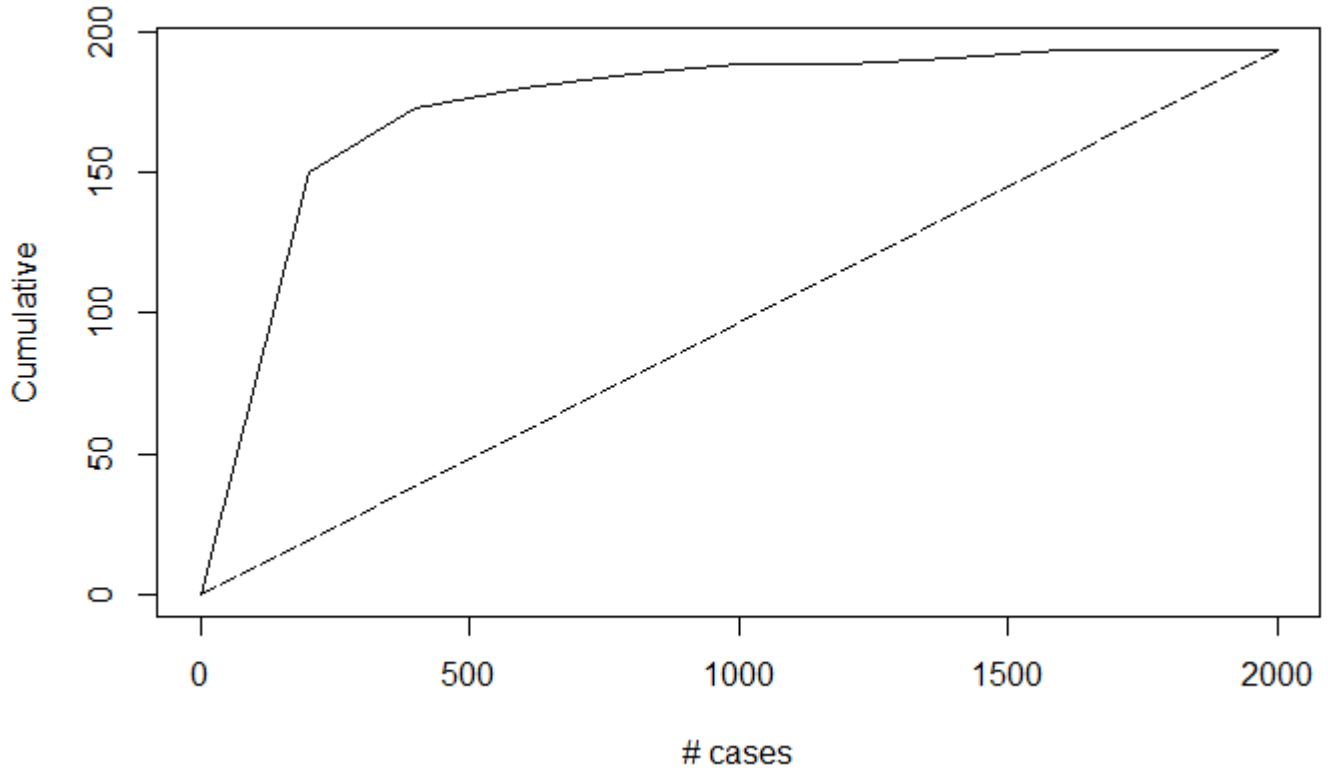
```
gain <- gains(valid.df$Personal_Loan, logit.reg.pred, groups = 10)

  ### Plot Lift Chart
plot(c(0,gain$cume.pct.of.total*sum(valid.df$Personal_Loan))~c(0,gain$cume.obs),
     xlab = "# cases", ylab = "Cumulative", main = "", type = "l")
lines(c(0,sum(valid.df$Personal_Loan))~c(0, dim(valid.df)[1]), lty = 5)
```



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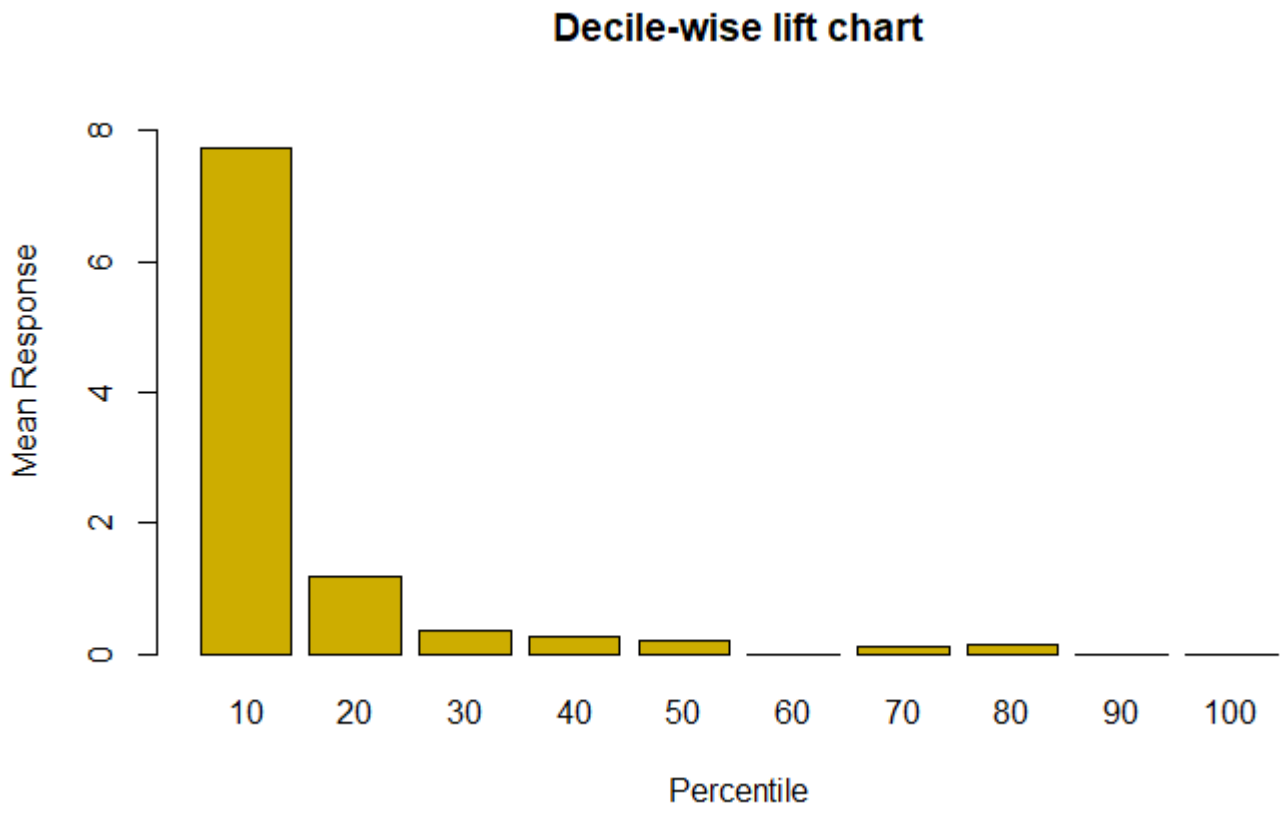
```
  ### Plot decile-wise chart
heights <- gain$mean.resp/mean(valid.df$Personal_Loan)
midpoints <- barplot(heights, names.arg = gain$depth,  ylim = c(0,9), col = "gold3",
                     xlab = "Percentile", ylab = "Mean Response",
                     main = "Decile-wise lift chart")
```


Decile-wise lift chart
Mean Response
0
2
4
6
8
10
20
30
40
50
60
70
80
90
100
Percentile