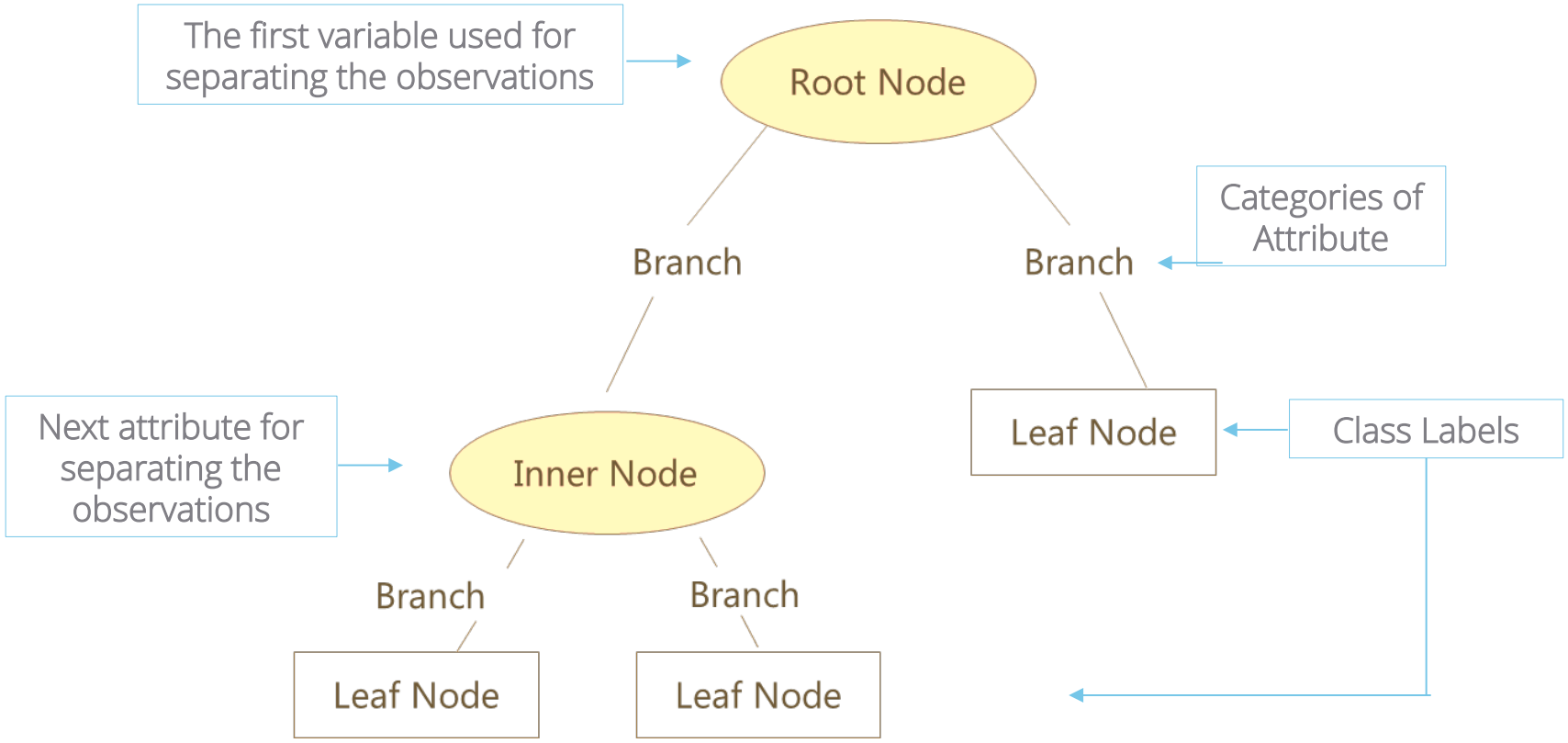
Decision Tree Method-WORKSHOP
ML ALGORITHM

Decision Tree – Basic Components



* Class labels show observations belong to which class. The leaf node also shows Number of observations and Error rate (Actual classification vs classification given by the tree)

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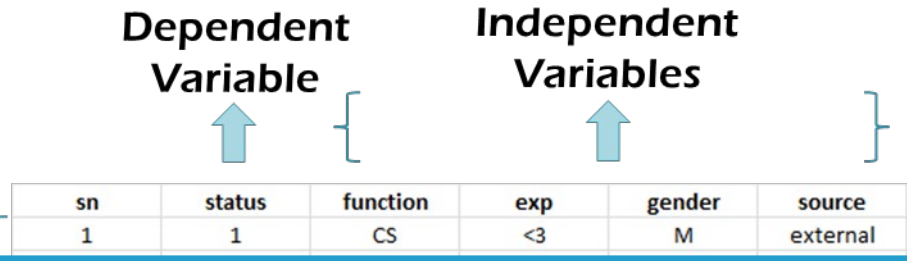
Data Snapshot

EMPLOYEE CHURN DATA



Columns	Description	Type	Measurement	Possible values
sn	Serial Number	-	-	-
status	= 1 If the Employee Left Within 18 Months of Joining = 0 Otherwise	Binary	1,0	2
function	Employee Job Profile	Categorical	CS, FINANCE, MARKETING	3
exp	Experience in Years	Categorical	<3,3-5,>5	3
gender	Gender of the Employee	Categorical	M,F	2
source	Whether the Employee was Appointed via Internal or External Links	categorical	external, internal	2

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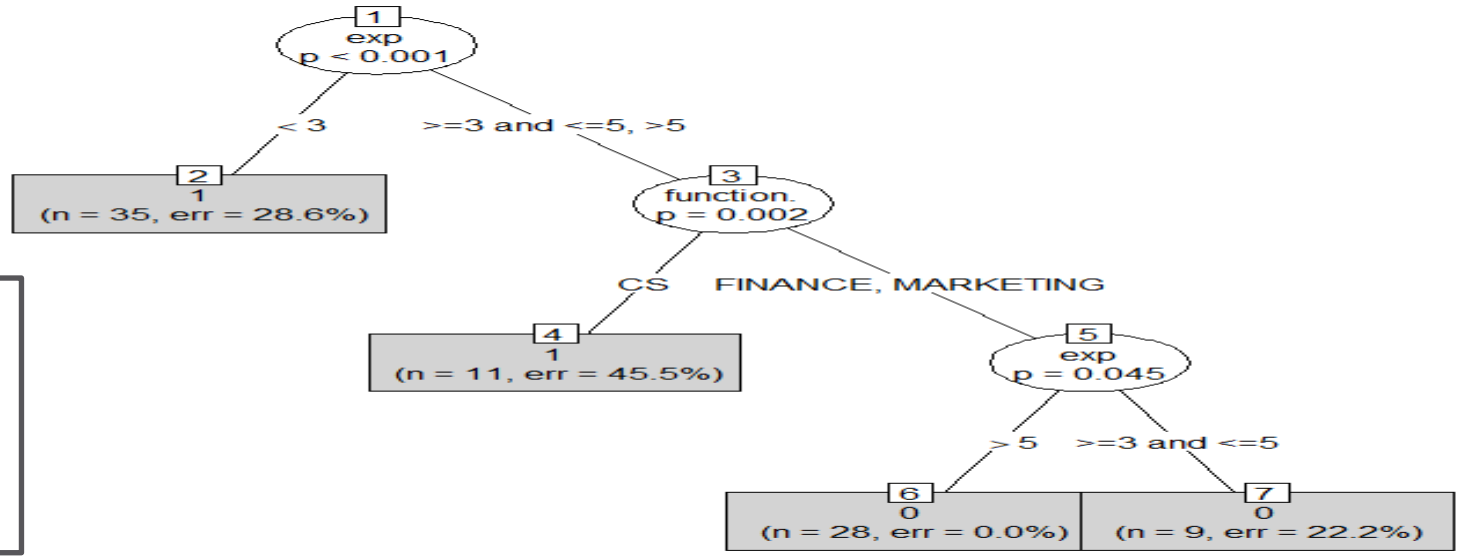
Decision Tree in R....
CHAID-like Implementation in "partykit"

```
empdata<-read.csv(file.choose(),heade=T,stringsAsFactors =T)
install.packages("partykit")
library(partykit)
empdata$status<-as.factor(empdata$status) # classification problem
ctree<-partykit::ctree(formula=status~function.+exp+gender+source,
                       data=empdata)
plot(ctree,type="simple")
```

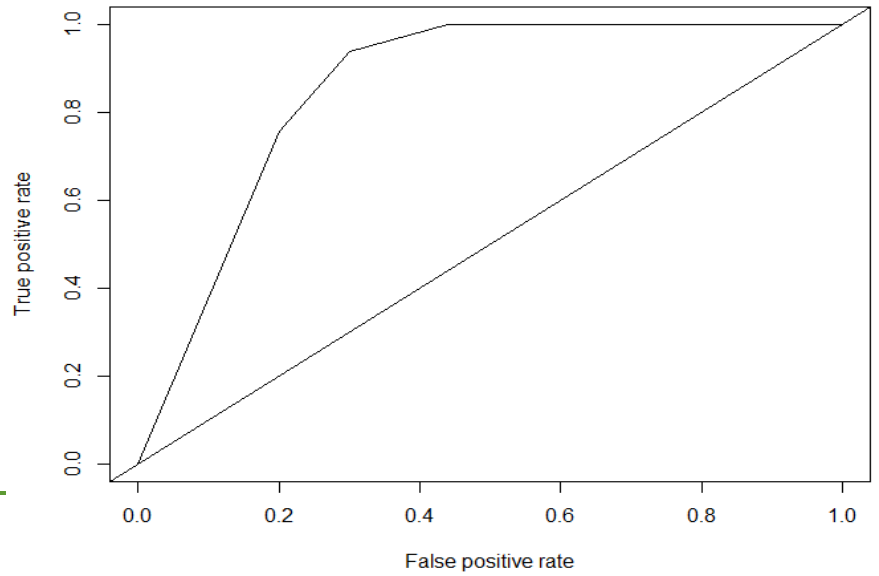


35 employees with exp<3.
Out of which 25 have Y=1 and 10 have Y=0
25/35=0.714

Decision Tree in R....
ROC Curve for "partykit" tree

```
predtree<-predict(ctree,empdata,type="prob")
library(ROCR)
pred<-prediction(predtree[,2],empdata$status)
perf<-performance(pred,"tpr","fpr")
plot(perf)
abline(0,1)

## Area under ROC Curve in R (AUC)
auc<-performance(pred,"auc")
auc@y.values
```




```
[[1]]
[1] 0.8563636
```

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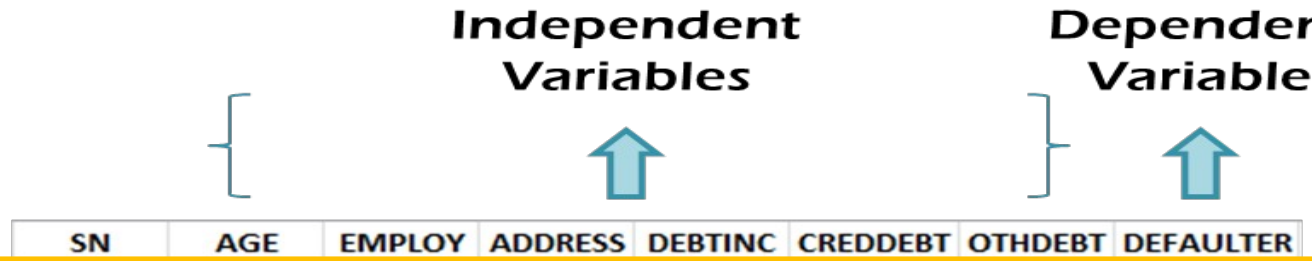
BANK LOAN:Data Snapshot

BANK LOAN



Column	Description	Type	Measurement	Possible Values
SN	Serial Number		-	-
AGE	Age Groups	Categorical	1(<28 years),2(28-40 years),3(>40 years)	3
EMPLOY	Number of years customer working at current employer	Continuous	-	Positive value
ADDRESS	Number of years customer staying at current address	Continuous	-	Positive value
DEBTINC	Debt to Income Ratio	Continuous	-	Positive value
CREDDEBT	Credit to Debit Ratio	Continuous	-	Positive value
OTHDEBT	Other Debt	Continuou	-	Positive value

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Decision Tree for Continuous & Categorical Independent Variables

```
# ctree() for Continuous Independent Variables

bankloan<-read.csv("BANK LOAN.csv",header=T)

str(bankloan)
```

- **str()** is used to check the structure of all variables.
- We convert DEFAULTER and AGE to factor variables using **as.factor()** as in our data these 2 variables are categorical.

```
# Output
```

```
> str(bankloan)
'data.frame':   700 obs. of  8 variables:
 $ SN       : int  1 2 3 4 5 6 7 8 9 10 ...
 $ AGE      : int  3 1 2 3 1 3 2 3 1 2 ...
 $ EMPLOY   : int  17 10 15 15 2 5 20 12 3 0 ...
 $ ADDRESS  : int  12 6 14 14 0 5 9 11 4 13 ...
 $ DEBTINC  : num  9.3 17.3 5.5 2.9 17.3 10.2 30.6 3.6 24.4 19.7 ...
 $ CREDDEBT : num  11.36 1.36 0.86 2.66 1.79 ...
 $ OTHDEBT  : num  5.01 4 2.17 0.82 3.06 ...
 $ DEFAULTER: int  1 0 0 0 1 0 0 0 1 0 ...
```

```
bankloan$AGE<-as.factor(bankloan$AGE)
bankloan$DEFAULTER<-as.factor(bankloan$DEFAULTER)

bankctree<-partykit::ctree(DEFAULTER~AGE+EMPLOY+ADDRESS+DEBTINC+
                           CREDDEBT+OTHDEBT, data=bankloan)
```

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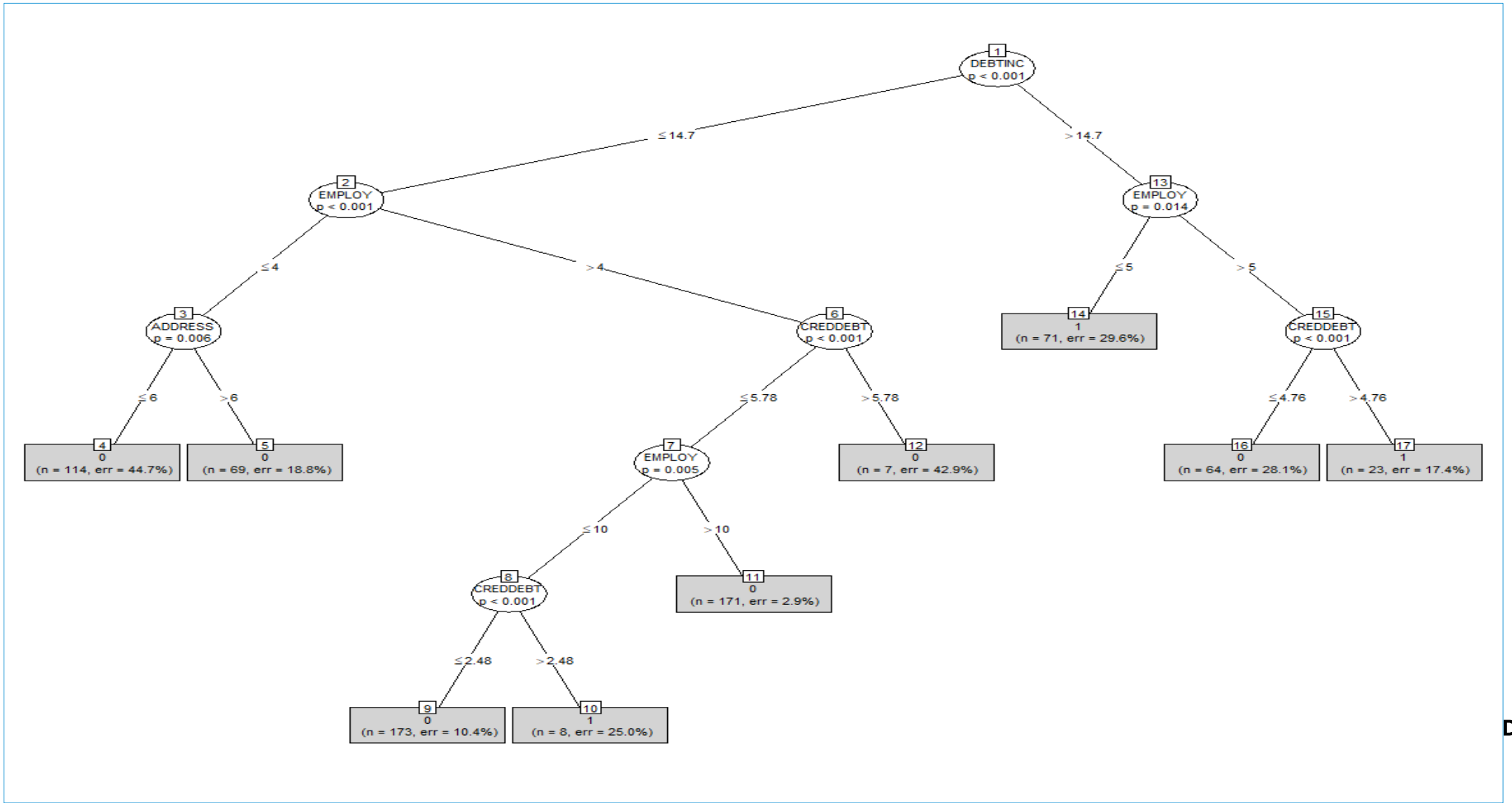
Decision Tree for Continuous & Categorical Independent Variables

```
plot(bankctree,type="simple", gp=gpar(cex=0.7))
```

1: Defaulter

0: non-defaulter



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Note

- The “gp” argument is used to specify graphical parameters for customizing the appearance of the plot.
- These settings can control various aspects of the graphical output, such as colors, line types, line widths, font sizes, etc.
- For the “cex” parameter specifically, it controls the magnification of text and symbol sizes relative to the default size. The range for cex typically goes from 0 (which would effectively make text and symbols invisible) to any positive value greater than 0, where higher values increase the size of text and symbols.

Interpretation

- DEBTINC is the root node.
- This is a continuous variable. Ctree algorithm has automatically converted it into a categorical variable with 2 categories <=14.7 and >14.7.
- Customers with < 14.7 DEBTINC, and the number of years at the current employer are <=4, then

  a) if the number of years at the current address are <=6, there are 114 such customers.

  These customers are non-defaulters. The misclassification rate is 44.7%.
- b) if the number of years at the current address are > 6, there are 69 such customers.

  They should be classified as non-defaulters. The the misclassification rate is 18.8%.
- Out of 71 customers with DEBTINC > 14.7 and employed for <=5 years majority are defaulters.

- Out of 171 customers, with number of years with the current employer > 10, credit card date <=5.78 and

  Debt to income ratio <= 14.7, majority are non-defaulters.

- Age and OTHERDEBT do not appear in the Tree and hence are insignificant .

Logistic Regression in R

```
# Using glm function to develop binary logistic regression model

riskmodel<-glm(DEFAULTER~AGE+EMPLOY+ADDRESS+DEBTINC+CREDDEBT+OTHDEBT,
               family=binomial,data=data)
```

- **glm** is Generalized Linear Model. Logistic regression is type of GLM.
- LHS of ~ is dependent variable and independent variables on RHS are separated by '+'.
- **riskmodel** is the model object
- By setting the **family =binomial**, **glm()** fits a logistic regression model

Individual Hypothesis Testing in R

```
# Individual Testing
summary(riskmodel)

# Output:
```

- **summary()** function gives the output of glm.

```
Call:
glm(formula = DEFAULTER ~ AGE + EMPLOY + ADDRESS + DEBTINC +
    CREDDEBT + OTHDEBT, family = binomial, data = data)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.3495  -0.6601  -0.2974   0.2509   2.8583

Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept) -0.78821    0.26407  -2.985  0.00284 **
AGE2         0.25202    0.26651   0.946  0.34433
AGE3         0.62707    0.36056   1.739  0.08201 .
EMPLOY      -0.26172    0.03188  -8.211  < 2e-16 ***
ADDRESS     -0.09964    0.02234  -4.459 8.22e-06 ***
DEBTINC      0.08506    0.02212   3.845  0.00012 ***
CREDDEBT     0.56336    0.08877   6.347 2.20e-10 ***
OTHDEBT      0.02315    0.05709   0.405  0.68517
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 804.36  on 699  degrees of freedom
Residual deviance: 553.41  on 692  degrees of freedom
AIC: 569.41

Number of Fisher Scoring iterations: 6
```

Interpretation :

- Since p-value is <0.05 for Employ, Address, Debtinc, Creddebt, these independent variables are statistically

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Quick Recap

CI Tree	• `partykit::ctree()` in package "partykit" yields conditional inference trees for continuous & categorical independent variables

THANK YOU!!

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