Alzhimer diagnosis

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#<https://www.kaggle.com/datasets/rabieelkharoua/alzheimers-disease-dataset>

#Demographic Details #Age: The age of the patients ranges from 60 to 90 years. #Gender: Gender of the patients, where 0 represents Male and 1 represents Female. #Ethnicity: The ethnicity of the patients, coded as follows: #0: Caucasian #1: African American #2: Asian #3: Other #EducationLevel: The education level of the patients, coded as follows: #0: None #1: High School #2: Bachelor’s #3: Higher

#Lifestyle Factors #BMI: Body Mass Index of the patients, ranging from 15 to 40. #Smoking: Smoking status, where 0 indicates No and 1 indicates Yes. #AlcoholConsumption: Weekly alcohol consumption in units, ranging from 0 to 20. #PhysicalActivity: Weekly physical activity in hours, ranging from 0 to 10. #DietQuality: Diet quality score, ranging from 0 to 10. #SleepQuality: Sleep quality score, ranging from 4 to 10.

#Medical History #FamilyHistoryAlzheimers: Family history of Alzheimer’s Disease, where 0 indicates No and 1 indicates Yes. #CardiovascularDisease: Presence of cardiovascular disease, where 0 indicates No and 1 indicates Yes. #Diabetes: Presence of diabetes, where 0 indicates No and 1 indicates Yes. #Depression: Presence of depression, where 0 indicates No and 1 indicates Yes. #HeadInjury: History of head injury, where 0 indicates No and 1 indicates Yes. #Hypertension: Presence of hypertension, where 0 indicates No and 1 indicates Yes.

#Clinical Measurements #SystolicBP: Systolic blood pressure, ranging from 90 to 180 mmHg. #DiastolicBP: Diastolic blood pressure, ranging from 60 to 120 mmHg. #CholesterolTotal: Total cholesterol levels, ranging from 150 to 300 mg/dL. #CholesterolLDL: Low-density lipoprotein cholesterol levels, ranging from 50 to 200 mg/dL. #CholesterolHDL: High-density lipoprotein cholesterol levels, ranging from 20 to 100 mg/dL. #CholesterolTriglycerides: Triglycerides levels, ranging from 50 to 400 mg/dL.

#Cognitive and Functional Assessments #MMSE: Mini-Mental State Examination score, ranging from 0 to 30. Lower scores indicate cognitive impairment. #FunctionalAssessment: Functional assessment score, ranging from 0 to 10. Lower scores indicate greater impairment. #MemoryComplaints: Presence of memory complaints, where 0 indicates No and 1 indicates Yes. #BehavioralProblems: Presence of behavioral problems, where 0 indicates No and 1 indicates Yes. #ADL: Activities of Daily Living score, ranging from 0 to 10. Lower scores indicate greater impairment.

#Symptoms #Confusion: Presence of confusion, where 0 indicates No and 1 indicates Yes. #Disorientation: Presence of disorientation, where 0 indicates No and 1 indicates Yes. #PersonalityChanges: Presence of personality changes, where 0 indicates No and 1 indicates Yes. #DifficultyCompletingTasks: Presence of difficulty completing tasks, where 0 indicates No and 1 indicates Yes. #Forgetfulness: Presence of forgetfulness, where 0 indicates No and 1 indicates Yes.

#Diagnosis Information #Diagnosis: Diagnosis status for Alzheimer’s Disease, where 0 indicates No and 1 indicates Yes.

## Warning: package 'DescTools' was built under R version 4.3.3

## Warning: package 'corrplot' was built under R version 4.3.3

## corrplot 0.95 loaded

## Warning: package 'ggplot2' was built under R version 4.3.2

##   
## Attaching package: 'dplyr'

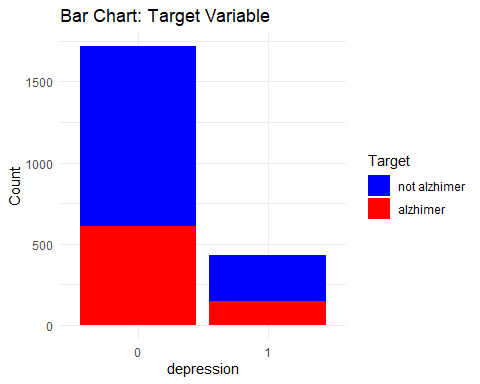
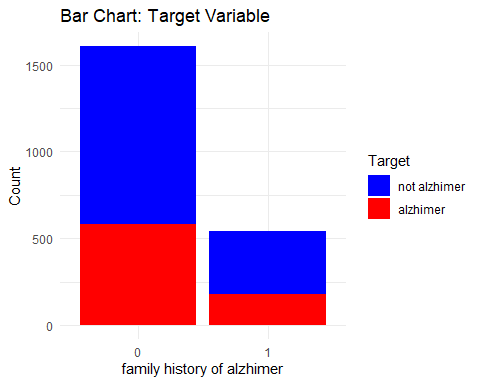
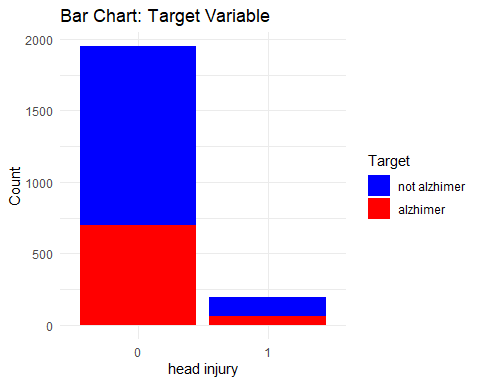
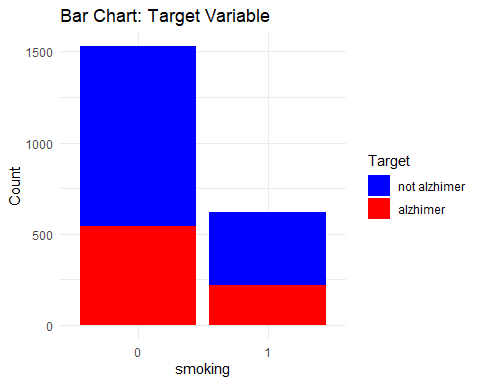
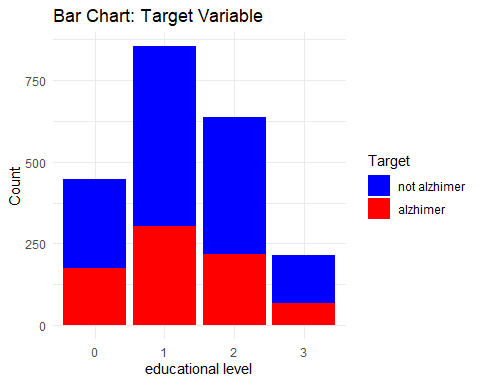
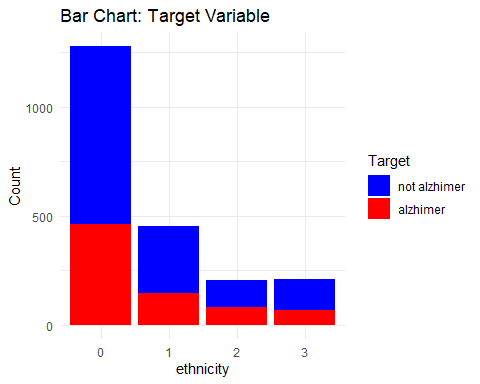
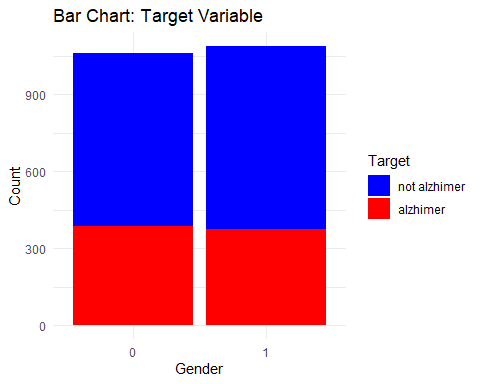
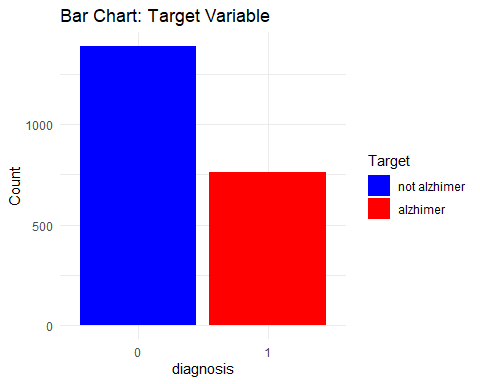
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## select

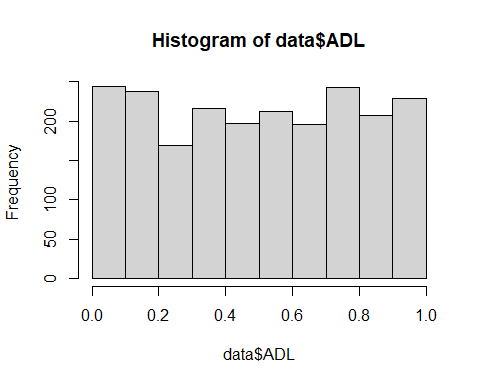
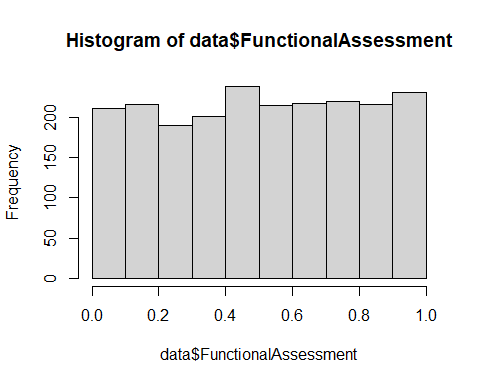
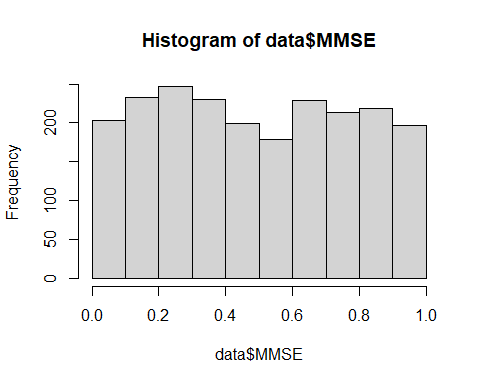
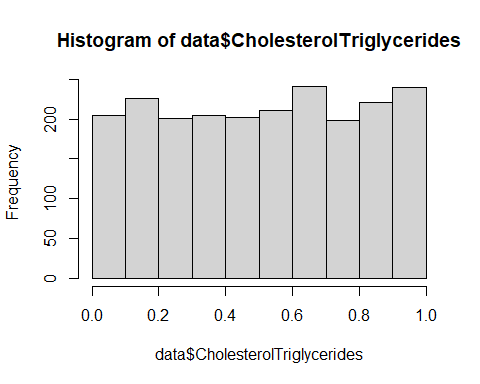
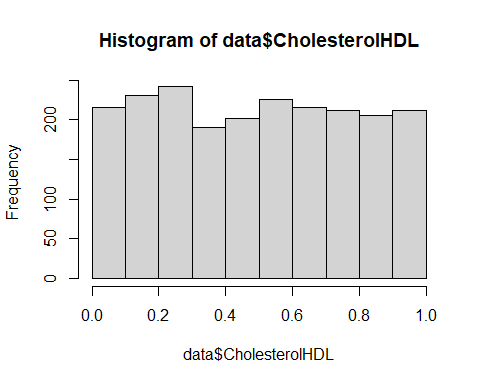
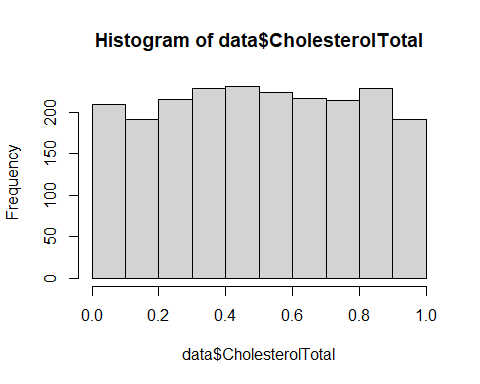
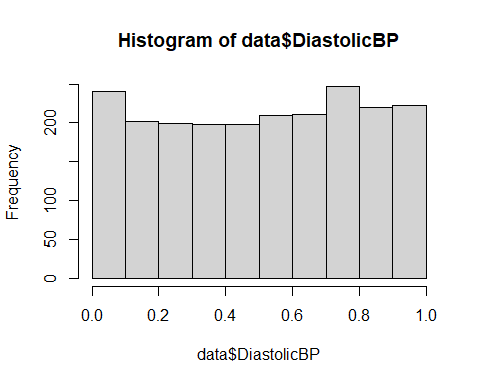
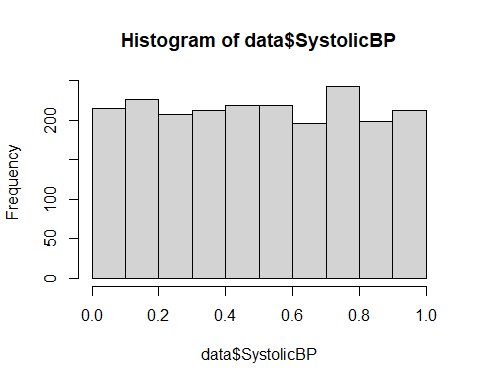
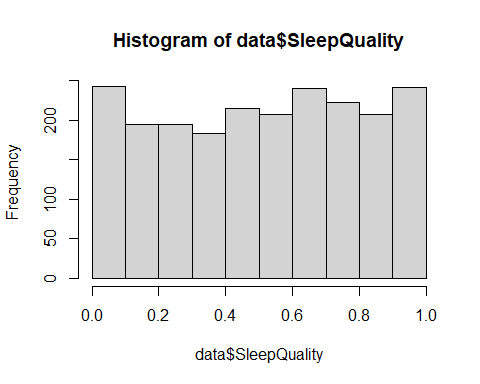
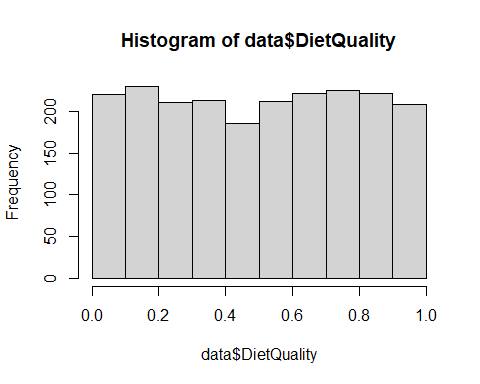
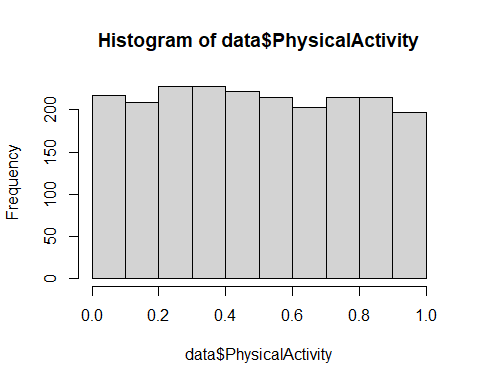
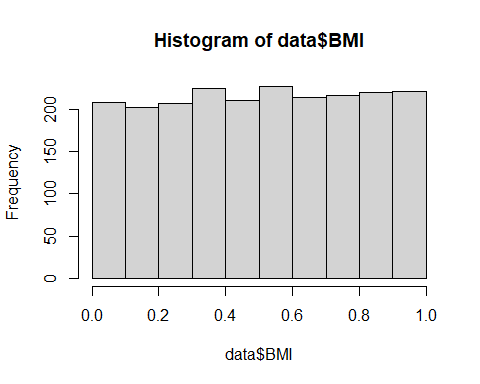
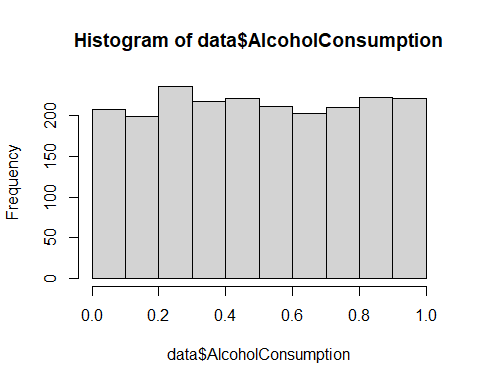
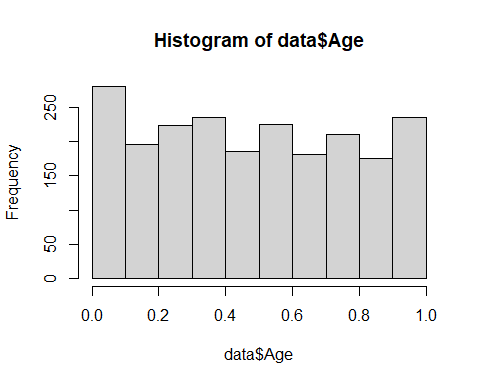
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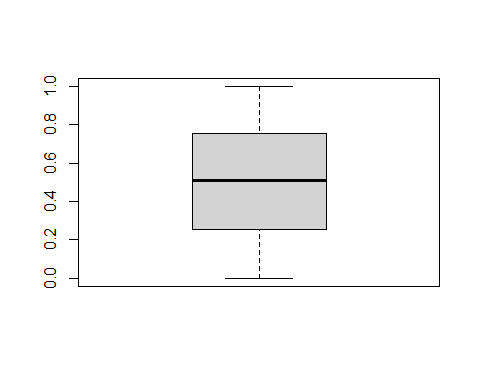
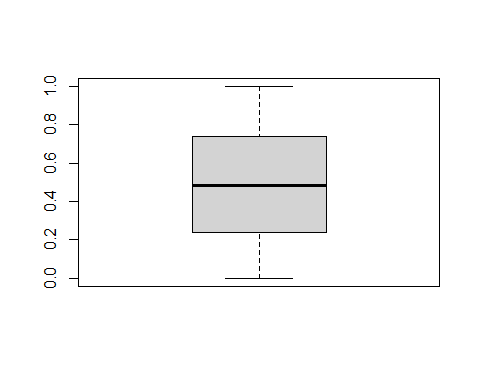
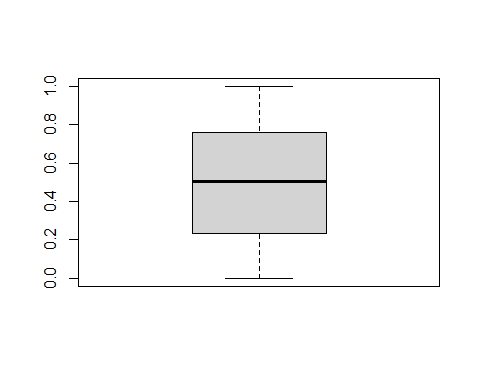
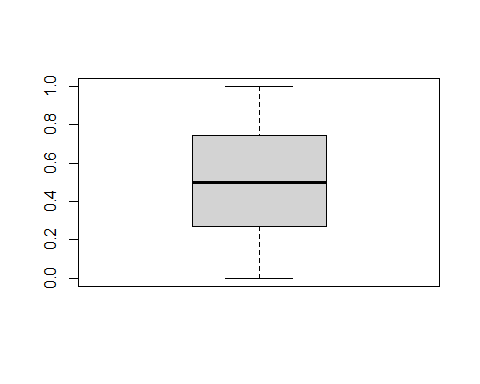
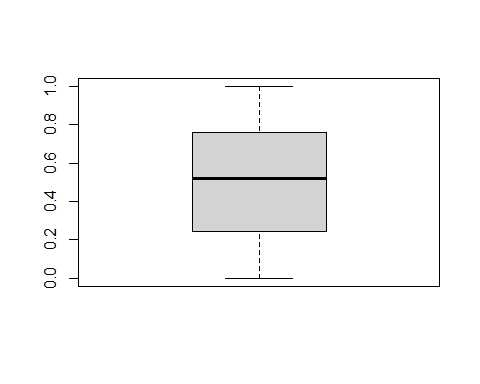
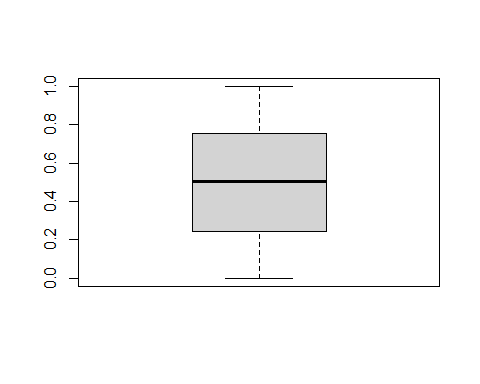
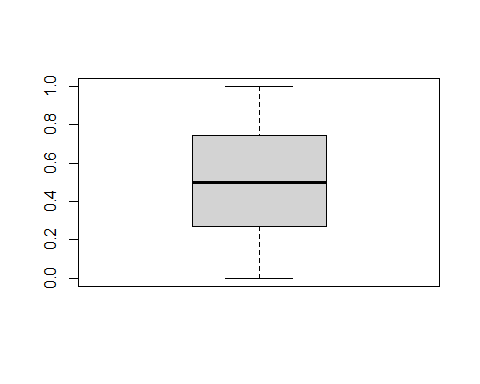
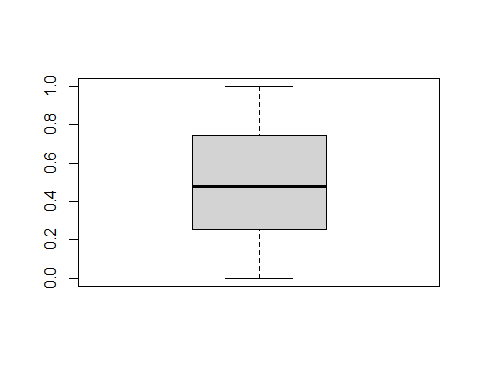
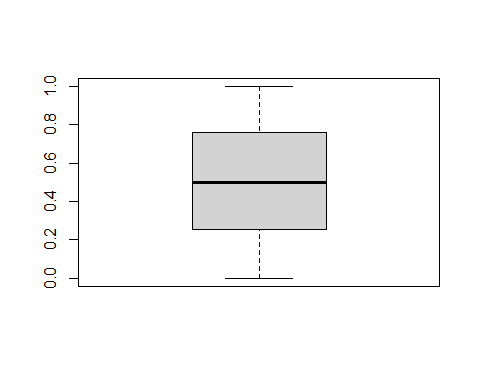
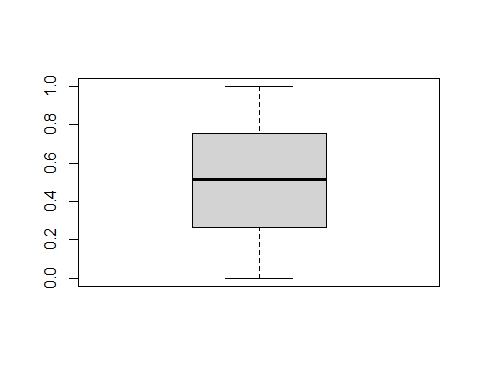
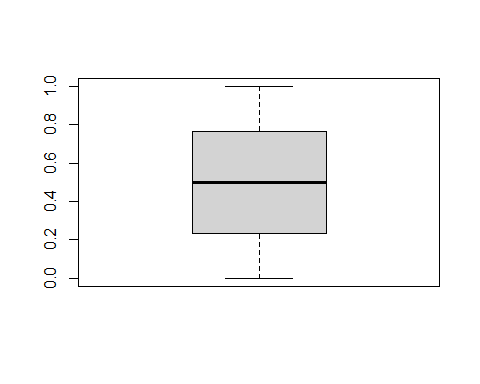
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##   
## intersect, setdiff, setequal, union

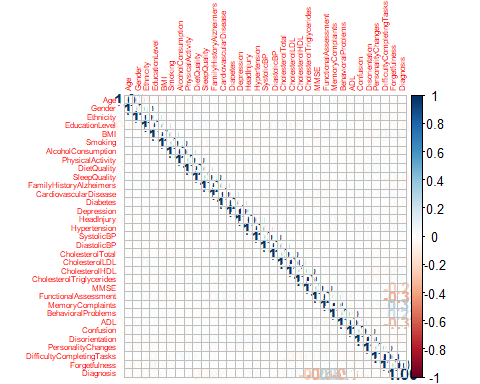
# the data has 2149 observations and 35 variables

#removing variables of the patient ID and the doctor assigned to the patient

#bar chart plot for qualitative and discrite variables  #normalizing the data to make sure it ranges from zero to 1 for all variables using min max scaling

#ploting histogram for numerical variables 

#ploting boxplot for numerical variables to check for outliers  #the variables doesn’t show any signs of outliers

#ploting heatmap with the corelation matrix between variables  # there are no signs of multicolinearity between avriables #there are correlation between the decision variable(alzhimer or not) and other variables like MMSE, functional assessment, Memorey complaints, behavioral problems , and ADL

#doing Test of hypothesis (univariate, bivariate, and Multivariate case) and some regression models for exploratory purposes

##   
## Welch Two Sample t-test  
##   
## data: Age by Diagnosis  
## t = 0.2523, df = 1525.5, p-value = 0.8008  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.02330009 0.03017870  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.4981761 0.4947368

##   
## Call:  
## lm(formula = Age ~ Diagnosis, data = data)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.49818 -0.26140 0.00182 0.26849 0.50526   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 0.498176 0.008043 61.943 <2e-16 \*\*\*  
## Diagnosis -0.003439 0.013524 -0.254 0.799   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.2997 on 2147 degrees of freedom  
## Multiple R-squared: 3.012e-05, Adjusted R-squared: -0.0004356   
## F-statistic: 0.06467 on 1 and 2147 DF, p-value: 0.7993

##   
## Welch Two Sample t-test  
##   
## data: CholesterolTotal by Diagnosis  
## t = -0.29428, df = 1530.5, p-value = 0.7686  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.0290895 0.0214997  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.4996865 0.5034814

##   
## Welch Two Sample t-test  
##   
## data: data$FunctionalAssessment by Diagnosis  
## t = 18.552, df = 1660.4, p-value < 2.2e-16  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## 0.1974709 0.2441632  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.5862550 0.3654379

##   
## Welch Two Sample t-test  
##   
## data: data$PhysicalActivity by Diagnosis  
## t = -0.27642, df = 1576.9, p-value = 0.7823  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.02880307 0.02168757  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.4911975 0.4947553

##   
## Welch Two Sample t-test  
##   
## data: data$AlcoholConsumption by Diagnosis  
## t = 0.35271, df = 1557.6, p-value = 0.7244  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.02093179 0.03010999  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.5038140 0.4992249

##   
## Welch Two Sample t-test  
##   
## data: data$DietQuality by Diagnosis  
## t = -0.39404, df = 1560.2, p-value = 0.6936  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.03096475 0.02060492  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.4970942 0.5022741

##   
## Welch Two Sample t-test  
##   
## data: data$SleepQuality by Diagnosis  
## t = 2.6282, df = 1567.7, p-value = 0.008669  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## 0.008820703 0.060724853  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.5206091 0.4858363

##   
## Welch Two Sample t-test  
##   
## data: data$FamilyHistoryAlzheimers by Diagnosis  
## t = 1.5433, df = 1615.4, p-value = 0.123  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.008096426 0.067864908  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.2627790 0.2328947

##   
## Welch Two Sample t-test  
##   
## data: data$EducationLevel by Diagnosis  
## t = 2.0409, df = 1565, p-value = 0.04143  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## 0.001078394 0.054361592  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.4386849 0.4109649

##   
## Welch Two Sample t-test  
##   
## data: data$BMI by Diagnosis  
## t = -1.2148, df = 1537.9, p-value = 0.2246  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.041609263 0.009782526  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.5005717 0.5164851

##   
## Welch Two Sample t-test  
##   
## data: data$Diabetes by Diagnosis  
## t = 1.4892, df = 1650.9, p-value = 0.1366  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.007478118 0.054640029  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.1591073 0.1355263

##   
## Welch Two Sample t-test  
##   
## data: data$CardiovascularDisease by Diagnosis  
## t = -1.4323, df = 1476.8, p-value = 0.1523  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.054835232 0.008552408  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.1360691 0.1592105

##   
## Welch Two Sample t-test  
##   
## data: data$Depression by Diagnosis  
## t = 0.27377, df = 1573.2, p-value = 0.7843  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.03042448 0.04029527  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.2023038 0.1973684

##   
## Welch Two Sample t-test  
##   
## data: data$HeadInjury by Diagnosis  
## t = 1.0112, df = 1648.4, p-value = 0.3121  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.01219953 0.03816293  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.09719222 0.08421053

##   
## Welch Two Sample t-test  
##   
## data: data$MMSE by Diagnosis  
## t = 12.025, df = 1851.4, p-value < 2.2e-16  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## 0.1191988 0.1656592  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.5422595 0.3998305

##   
## Welch Two Sample t-test  
##   
## data: data$BehavioralProblems by Diagnosis  
## t = -9.528, df = 1136.8, p-value < 2.2e-16  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.2057706 -0.1354954  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.09647228 0.26710526

##   
## Welch Two Sample t-test  
##   
## data: data$MemoryComplaints by Diagnosis  
## t = -13.305, df = 1129.5, p-value < 2.2e-16  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.2988062 -0.2220039  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.1159107 0.3763158

##   
## Welch Two Sample t-test  
##   
## data: data$Confusion by Diagnosis  
## t = 0.89686, df = 1600.9, p-value = 0.3699  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.01923705 0.05164961  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.2109431 0.1947368

##   
## Welch Two Sample t-test  
##   
## data: data$Disorientation by Diagnosis  
## t = 1.159, df = 1627.6, p-value = 0.2466  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.01302620 0.05065456  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.1648668 0.1460526

##   
## Welch Two Sample t-test  
##   
## data: data$DifficultyCompletingTasks by Diagnosis  
## t = -0.41802, df = 1537.6, p-value = 0.676  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.03945020 0.02558942  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.1562275 0.1631579

##   
## Welch Two Sample t-test  
##   
## data: data$PersonalityChanges by Diagnosis  
## t = 0.968, df = 1618.8, p-value = 0.3332  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.01584352 0.04671958  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.1562275 0.1407895

##   
## Welch Two Sample t-test  
##   
## data: data$Forgetfulness by Diagnosis  
## t = 0.016416, df = 1561.3, p-value = 0.9869  
## alternative hypothesis: true difference in means between group 0 and group 1 is not equal to 0  
## 95 percent confidence interval:  
## -0.04029358 0.04097374  
## sample estimates:  
## mean in group 0 mean in group 1   
## 0.3016559 0.3013158

##   
## Call:  
## lm(formula = Diagnosis ~ ., data = data)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.97094 -0.27277 -0.03904 0.27542 1.46077   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 1.0284502 0.0563449 18.253 <2e-16 \*\*\*  
## Age -0.0460853 0.0262633 -1.755 0.0794 .   
## Gender -0.0030871 0.0156904 -0.197 0.8440   
## Ethnicity -0.0121502 0.0236312 -0.514 0.6072   
## EducationLevel -0.0362091 0.0261119 -1.387 0.1657   
## BMI -0.0099517 0.0272373 -0.365 0.7149   
## Smoking -0.0274969 0.0173420 -1.586 0.1130   
## AlcoholConsumption -0.0231935 0.0272095 -0.852 0.3941   
## PhysicalActivity -0.0017765 0.0273928 -0.065 0.9483   
## DietQuality 0.0129677 0.0269953 0.480 0.6310   
## SleepQuality -0.0469020 0.0267342 -1.754 0.0795 .   
## FamilyHistoryAlzheimers -0.0143348 0.0180670 -0.793 0.4276   
## CardiovascularDisease 0.0240946 0.0223592 1.078 0.2813   
## Diabetes -0.0005064 0.0219624 -0.023 0.9816   
## Depression 0.0098334 0.0195833 0.502 0.6156   
## HeadInjury -0.0330098 0.0271045 -1.218 0.2234   
## Hypertension 0.0311393 0.0220809 1.410 0.1586   
## SystolicBP -0.0044367 0.0268813 -0.165 0.8689   
## DiastolicBP 0.0102881 0.0262988 0.391 0.6957   
## CholesterolTotal -0.0014334 0.0276604 -0.052 0.9587   
## CholesterolLDL -0.0534166 0.0271167 -1.970 0.0490 \*   
## CholesterolHDL 0.0415256 0.0271469 1.530 0.1263   
## CholesterolTriglycerides 0.0421909 0.0269437 1.566 0.1175   
## MMSE -0.3898570 0.0272932 -14.284 <2e-16 \*\*\*  
## FunctionalAssessment -0.5556372 0.0272164 -20.416 <2e-16 \*\*\*  
## MemoryComplaints 0.3518820 0.0193431 18.192 <2e-16 \*\*\*  
## BehavioralProblems 0.3136349 0.0216339 14.497 <2e-16 \*\*\*  
## ADL -0.5088044 0.0266401 -19.099 <2e-16 \*\*\*  
## Confusion -0.0159417 0.0194074 -0.821 0.4115   
## Disorientation -0.0198528 0.0215624 -0.921 0.3573   
## PersonalityChanges -0.0005531 0.0219531 -0.025 0.9799   
## DifficultyCompletingTasks 0.0029834 0.0215520 0.138 0.8899   
## Forgetfulness 0.0033929 0.0171238 0.198 0.8430   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.3617 on 2116 degrees of freedom  
## Multiple R-squared: 0.4364, Adjusted R-squared: 0.4279   
## F-statistic: 51.21 on 32 and 2116 DF, p-value: < 2.2e-16

## Analysis of Variance Table  
##   
## Response: Diagnosis  
## Df Sum Sq Mean Sq F value Pr(>F)   
## Age 1 0.015 0.015 0.1131 0.7366792   
## Gender 1 0.213 0.213 1.6284 0.2020639   
## Ethnicity 1 0.107 0.107 0.8145 0.3668964   
## EducationLevel 1 0.955 0.955 7.2997 0.0069515 \*\*   
## BMI 1 0.314 0.314 2.4004 0.1214564   
## Smoking 1 0.012 0.012 0.0904 0.7637330   
## AlcoholConsumption 1 0.029 0.029 0.2197 0.6392950   
## PhysicalActivity 1 0.012 0.012 0.0889 0.7656093   
## DietQuality 1 0.037 0.037 0.2840 0.5941597   
## SleepQuality 1 1.503 1.503 11.4880 0.0007133 \*\*\*  
## FamilyHistoryAlzheimers 1 0.454 0.454 3.4712 0.0625858 .   
## CardiovascularDisease 1 0.553 0.553 4.2263 0.0399252 \*   
## Diabetes 1 0.484 0.484 3.7010 0.0545129 .   
## Depression 1 0.016 0.016 0.1190 0.7301204   
## HeadInjury 1 0.274 0.274 2.0939 0.1480318   
## Hypertension 1 0.684 0.684 5.2302 0.0222962 \*   
## SystolicBP 1 0.172 0.172 1.3167 0.2513123   
## DiastolicBP 1 0.037 0.037 0.2843 0.5939675   
## CholesterolTotal 1 0.025 0.025 0.1906 0.6624689   
## CholesterolLDL 1 0.472 0.472 3.6063 0.0576969 .   
## CholesterolHDL 1 0.870 0.870 6.6467 0.0100009 \*   
## CholesterolTriglycerides 1 0.216 0.216 1.6481 0.1993554   
## MMSE 1 27.218 27.218 208.0383 < 2.2e-16 \*\*\*  
## FunctionalAssessment 1 61.152 61.152 467.4016 < 2.2e-16 \*\*\*  
## MemoryComplaints 1 46.096 46.096 352.3296 < 2.2e-16 \*\*\*  
## BehavioralProblems 1 24.375 24.375 186.3087 < 2.2e-16 \*\*\*  
## ADL 1 47.877 47.877 365.9376 < 2.2e-16 \*\*\*  
## Confusion 1 0.089 0.089 0.6839 0.4083272   
## Disorientation 1 0.113 0.113 0.8642 0.3526771   
## PersonalityChanges 1 0.000 0.000 0.0005 0.9816534   
## DifficultyCompletingTasks 1 0.002 0.002 0.0185 0.8916951   
## Forgetfulness 1 0.005 0.005 0.0393 0.8429564   
## Residuals 2116 276.843 0.131   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

#classification using hotelling t^2 test (i used the most significant variables according to correlation matrix and anova test)

## Loading required package: corpcor

##   
## Attaching package: 'Hotelling'

## The following object is masked from 'package:dplyr':  
##   
## summarise

## Test stat: 1625.1   
## Numerator df: 7   
## Denominator df: 2141   
## P-value: 0

#we got a p-value of zero which indicates that we reject the null hypothesis so we can say that the model is significant

# doing classification using logistic regression

## Accuracy: 0.8186047   
##

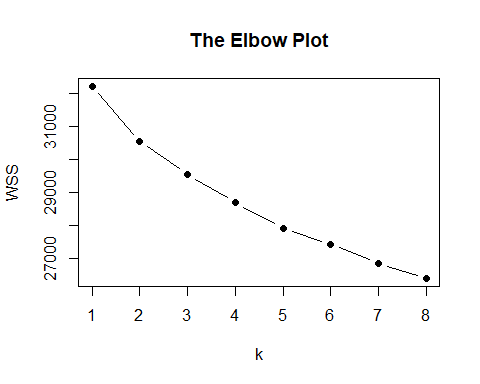
## Actual  
## Predicted 0 1  
## 0 350 70  
## 1 47 178

# we have testing accuraccy of 83% with tp 342tp and 196 tn

#clustering using kmeans

## R2 = 1

## Warning: did not converge in 10 iterations

 #we took only 3 clusters according to elbow plot and we got r^2 to be 1

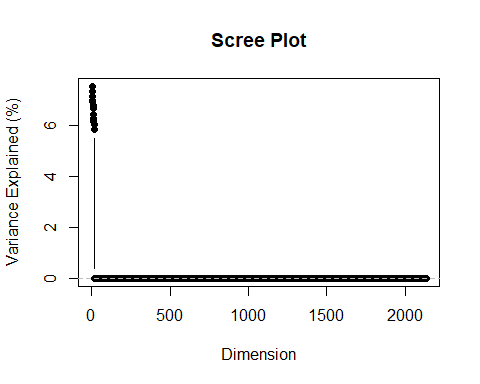
#multideminsional scaling

## Warning: package 'robustbase' was built under R version 4.3.3

#m-estimators removed only 14 observation that m-estimators identified

#MDS

## [1] 7.510332 14.999992 22.321697 29.438407 36.412468 43.316307  
## [7] 50.098974 56.752152 63.175780 69.583754 75.850696 82.017713  
## [13] 88.146369 94.156874 100.000000 100.000000 100.000000 100.000000  
## [19] 100.000000 100.000000 100.000000 100.000000 100.000000 100.000000  
## [25] 100.000000 100.000000 100.000000 100.000000 100.000000 100.000000  
## [31] 100.000000 100.000000 100.000000 100.000000 100.000000 100.000000  
## [37] 100.000000 100.000000 100.000000 100.000000 100.000000 100.000000  
## [43] 100.000000 100.000000 100.000000 100.000000 100.000000 100.000000  
## [49] 100.000000 100.000000 100.000000 100.000000 100.000000 100.000000  
## [55] 100.000000 100.000000 100.000000 100.000000 100.000000 100.000000  
## [61] 100.000000 100.000000 100.000000 100.000000 100.000000 100.000000  
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## [127] 100.000000 100.000000 100.000000 100.000000 100.000000 100.000000  
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## [145] 100.000000 100.000000 100.000000 100.000000 100.000000 100.000000  
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## [1057] 100.000000 100.000000 100.000000 100.000000 100.000000 100.000000  
## [1063] 100.000000 100.000000 100.000000 100.000000 100.000000 100.000000  
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## [1105] 100.000000 100.000000 100.000000 100.000000 100.000000 100.000000  
## [1111] 100.000000 100.000000 100.000000 100.000000 100.000000 100.000000  
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## [1405] 100.000000 100.000000 100.000000 100.000000 100.000000 100.000000  
## [1411] 100.000000 100.000000 100.000000 100.000000 100.000000 100.000000  
## [1417] 100.000000 100.000000 100.000000 100.000000 100.000000 100.000000  
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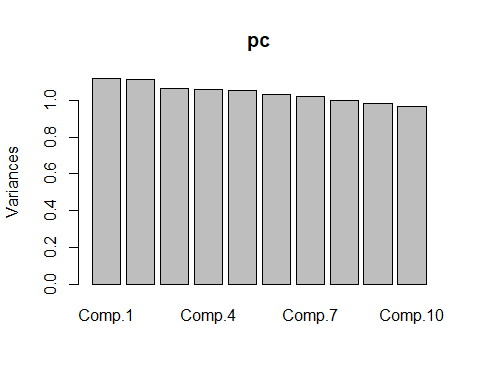


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## 638 3.932063e-02 -4.934403e-01 3.737270e-01 -1.201644e-01 -3.502351e-01  
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## 645 2.331024e-01 3.590643e-01 -1.192227e-01 -2.266195e-01 5.204850e-01  
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## 998 2.762430e-01 -2.129577e-01 -1.799068e-01 3.142673e-01 -7.930435e-02  
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## 1163 2.171337e-01 -1.117825e-02 5.260402e-02 -4.723213e-01 -4.983220e-01  
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## 1337 3.767872e-01 -3.421324e-03 4.764499e-02 4.788777e-01 2.887361e-01  
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## 1514 3.985506e-01 5.463144e-01 2.991059e-02 1.915674e-01 1.384845e-01  
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## 1518 -8.908720e-02 -2.071571e-01 8.516929e-02 5.413961e-02 7.940133e-02  
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## 1520 -2.307648e-01 3.163219e-02 8.718154e-02 -9.968552e-02 1.477375e-01  
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## 1522 -6.387618e-01 1.986472e-01 9.907456e-02 -4.648314e-02 -2.969926e-01  
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## 1855 -8.894855e-02 2.116073e-01 1.674364e-02 4.282846e-01 -7.350449e-02  
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## 1857 -4.107710e-01 -2.195671e-02 -1.403046e-01 2.616503e-01 4.542864e-02  
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## 1864 -1.022272e-02 3.763228e-01 6.131511e-01 -2.480204e-01 1.020561e-01  
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## 1868 -2.347956e-01 -2.810874e-03 -2.274499e-01 -3.998781e-02 4.338189e-02  
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## 1941 -1.109175e-01 3.008770e-01 -5.106365e-01 2.394446e-01 -1.717014e-01  
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## 27 -3.267431e-01 0.0584668463 0.1985780274  
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## 35 -1.989737e-01 0.3455498035 0.6073492562  
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## [1831] -4.512874e-16 -4.542144e-16 -4.557218e-16 -4.604070e-16 -4.608619e-16  
## [1836] -4.610833e-16 -4.614362e-16 -4.626866e-16 -4.629487e-16 -4.635050e-16  
## [1841] -4.650745e-16 -4.651520e-16 -4.655425e-16 -4.663384e-16 -4.684432e-16  
## [1846] -4.691850e-16 -4.698096e-16 -4.714797e-16 -4.730335e-16 -4.747329e-16  
## [1851] -4.754858e-16 -4.757294e-16 -4.759590e-16 -4.770439e-16 -4.776146e-16  
## [1856] -4.801497e-16 -4.851126e-16 -4.862553e-16 -4.869475e-16 -4.897431e-16  
## [1861] -4.915395e-16 -4.916437e-16 -4.917865e-16 -4.933011e-16 -4.934874e-16  
## [1866] -4.936960e-16 -4.944015e-16 -4.949803e-16 -4.989586e-16 -4.994121e-16  
## [1871] -5.001011e-16 -5.026287e-16 -5.055143e-16 -5.068981e-16 -5.072911e-16  
## [1876] -5.075228e-16 -5.083567e-16 -5.083699e-16 -5.084798e-16 -5.087402e-16  
## [1881] -5.089830e-16 -5.094889e-16 -5.104294e-16 -5.124239e-16 -5.155910e-16  
## [1886] -5.178127e-16 -5.192066e-16 -5.205204e-16 -5.209323e-16 -5.229249e-16  
## [1891] -5.256742e-16 -5.295109e-16 -5.307946e-16 -5.313315e-16 -5.313794e-16  
## [1896] -5.321210e-16 -5.321288e-16 -5.344071e-16 -5.363406e-16 -5.371151e-16  
## [1901] -5.382184e-16 -5.382796e-16 -5.388940e-16 -5.394158e-16 -5.399097e-16  
## [1906] -5.407468e-16 -5.422989e-16 -5.432651e-16 -5.452855e-16 -5.458328e-16  
## [1911] -5.461835e-16 -5.467916e-16 -5.528249e-16 -5.553225e-16 -5.572373e-16  
## [1916] -5.575813e-16 -5.636070e-16 -5.640581e-16 -5.644633e-16 -5.650932e-16  
## [1921] -5.658972e-16 -5.681752e-16 -5.685723e-16 -5.696699e-16 -5.703120e-16  
## [1926] -5.721647e-16 -5.723608e-16 -5.726733e-16 -5.739161e-16 -5.763718e-16  
## [1931] -5.786769e-16 -5.815192e-16 -5.829861e-16 -5.882553e-16 -5.908681e-16  
## [1936] -5.933394e-16 -5.947708e-16 -5.984173e-16 -5.994870e-16 -6.039219e-16  
## [1941] -6.044732e-16 -6.098739e-16 -6.098863e-16 -6.112057e-16 -6.132147e-16  
## [1946] -6.139922e-16 -6.155880e-16 -6.209177e-16 -6.210866e-16 -6.285650e-16  
## [1951] -6.299505e-16 -6.313204e-16 -6.330895e-16 -6.406227e-16 -6.448235e-16  
## [1956] -6.450268e-16 -6.451612e-16 -6.491872e-16 -6.508188e-16 -6.510046e-16  
## [1961] -6.542496e-16 -6.563905e-16 -6.618215e-16 -6.624592e-16 -6.641962e-16  
## [1966] -6.655670e-16 -6.721135e-16 -6.730879e-16 -6.743052e-16 -6.745655e-16  
## [1971] -6.749801e-16 -6.815417e-16 -6.847223e-16 -6.872021e-16 -6.878338e-16  
## [1976] -6.894648e-16 -6.961198e-16 -6.968658e-16 -6.989378e-16 -7.024689e-16  
## [1981] -7.074026e-16 -7.095623e-16 -7.105173e-16 -7.152512e-16 -7.165524e-16  
## [1986] -7.181923e-16 -7.240035e-16 -7.241420e-16 -7.243805e-16 -7.313998e-16  
## [1991] -7.354252e-16 -7.376982e-16 -7.421341e-16 -7.427953e-16 -7.476935e-16  
## [1996] -7.492069e-16 -7.512023e-16 -7.532965e-16 -7.565859e-16 -7.567598e-16  
## [2001] -7.652922e-16 -7.719808e-16 -7.889618e-16 -7.931518e-16 -7.949953e-16  
## [2006] -7.952006e-16 -7.971831e-16 -8.039620e-16 -8.084707e-16 -8.109088e-16  
## [2011] -8.195198e-16 -8.239905e-16 -8.257691e-16 -8.275501e-16 -8.470377e-16  
## [2016] -8.477963e-16 -8.503056e-16 -9.025969e-16 -9.131578e-16 -9.425140e-16  
## [2021] -9.528146e-16 -9.717702e-16 -9.944891e-16 -9.971058e-16 -1.013340e-15  
## [2026] -1.024830e-15 -1.026676e-15 -1.035503e-15 -1.065372e-15 -1.076614e-15  
## [2031] -1.094292e-15 -1.099539e-15 -1.100210e-15 -1.128142e-15 -1.135838e-15  
## [2036] -1.136758e-15 -1.150039e-15 -1.153830e-15 -1.204791e-15 -1.212505e-15  
## [2041] -1.219673e-15 -1.239859e-15 -1.281812e-15 -1.289990e-15 -1.322349e-15  
## [2046] -1.336429e-15 -1.348069e-15 -1.359471e-15 -1.462038e-15 -1.490777e-15  
## [2051] -1.502089e-15 -1.583776e-15 -1.690453e-15 -1.700623e-15 -1.709618e-15  
## [2056] -1.717823e-15 -1.735911e-15 -1.756698e-15 -1.794669e-15 -1.797059e-15  
## [2061] -1.930046e-15 -2.025160e-15 -2.226519e-15 -2.234729e-15 -2.369097e-15  
## [2066] -2.371279e-15 -2.601504e-15 -2.805045e-15 -2.879744e-15 -2.888660e-15  
## [2071] -2.913921e-15 -3.109581e-15 -3.112268e-15 -3.128855e-15 -3.266554e-15  
## [2076] -3.950866e-15 -4.041598e-15 -4.181623e-15 -4.224348e-15 -4.304965e-15  
## [2081] -4.312690e-15 -4.422886e-15 -4.425243e-15 -4.467115e-15 -4.586637e-15  
## [2086] -4.674158e-15 -4.724519e-15 -4.818449e-15 -4.832960e-15 -5.165750e-15  
## [2091] -5.730719e-15 -5.876555e-15 -6.030446e-15 -7.113307e-15 -7.131396e-15  
## [2096] -7.420919e-15 -7.793409e-15 -8.158803e-15 -9.069088e-15 -1.152933e-14  
## [2101] -1.865934e-14 -2.060982e-14 -2.796690e-14 -3.623498e-14 -4.784455e-14  
## [2106] -5.383735e-14 -5.869930e-14 -6.325232e-14 -7.447771e-14 -8.732787e-14  
## [2111] -9.238679e-14 -1.016507e-13 -1.052211e-13 -1.127341e-13 -1.189136e-13  
## [2116] -1.242325e-13 -1.348352e-13 -1.418175e-13 -1.477697e-13 -1.644664e-13  
## [2121] -1.679454e-13 -1.858777e-13 -2.158208e-13 -2.386099e-13 -2.538220e-13  
## [2126] -2.721106e-13 -2.851034e-13 -3.118298e-13 -3.155915e-13 -3.549284e-13  
## [2131] -3.945937e-13 -4.646820e-13 -4.674678e-13 -7.661971e-13 -2.190363e-12  
##   
## $x  
## NULL  
##   
## $ac  
## [1] 0  
##   
## $GOF  
## [1] 0.8814637 0.8814637

#we reached nearley 90% at 13 so we can take k to be =13

#pca

## Importance of components:  
## Comp.1 Comp.2 Comp.3 Comp.4 Comp.5  
## Standard deviation 1.05767184 1.05512839 1.03227924 1.02980833 1.02697703  
## Proportion of Variance 0.07457798 0.07421973 0.07104003 0.07070035 0.07031212  
## Cumulative Proportion 0.07457798 0.14879771 0.21983774 0.29053808 0.36085021  
## Comp.6 Comp.7 Comp.8 Comp.9 Comp.10  
## Standard deviation 1.01740644 1.01167642 0.99873512 0.9909549 0.98288017  
## Proportion of Variance 0.06900772 0.06823261 0.06649812 0.0654661 0.06440356  
## Cumulative Proportion 0.42985793 0.49809054 0.56458866 0.6300548 0.69445833  
## Comp.11 Comp.12 Comp.13 Comp.14 Comp.15  
## Standard deviation 0.97451176 0.97057575 0.95676705 0.94806459 0.93659220  
## Proportion of Variance 0.06331155 0.06280115 0.06102688 0.05992176 0.05848033  
## Cumulative Proportion 0.75776987 0.82057103 0.88159791 0.94151967 1.00000000  
##   
## Loadings:  
## Comp.1 Comp.2 Comp.3 Comp.4 Comp.5 Comp.6 Comp.7  
## Age 0.122 0.339 0.490 0.409 0.169  
## BMI 0.124 -0.281 -0.134 0.167 -0.513 0.220   
## AlcoholConsumption 0.409 -0.164 -0.214 0.342   
## PhysicalActivity 0.247 -0.142 -0.533   
## DietQuality 0.347 0.223 -0.367 0.151 -0.563  
## SleepQuality 0.278 0.421 0.351 0.346 -0.129   
## SystolicBP -0.425 -0.131 -0.241  
## DiastolicBP -0.138 0.220 -0.192 0.301 -0.196 -0.437  
## CholesterolTotal -0.191 0.352 -0.267 -0.502   
## CholesterolLDL -0.325 0.516 -0.202 -0.276   
## CholesterolHDL 0.111 -0.340 0.370 -0.217 0.209 0.470  
## CholesterolTriglycerides 0.420 0.264 -0.101 -0.129 -0.352 0.211  
## MMSE 0.459 -0.236 -0.294 0.297   
## FunctionalAssessment -0.279 0.505 0.197 -0.121   
## ADL -0.214 0.431 -0.135 -0.318 -0.187 0.342  
## Comp.8 Comp.9 Comp.10 Comp.11 Comp.12 Comp.13 Comp.14  
## Age 0.209 0.207 0.395 0.353   
## BMI -0.279 0.285 0.352 0.409   
## AlcoholConsumption 0.244 0.158 0.695 0.187 -0.117 -0.116   
## PhysicalActivity 0.342 0.577 -0.239 -0.202 -0.102 0.250   
## DietQuality 0.181 -0.126 0.109   
## SleepQuality 0.200 -0.108 -0.462   
## SystolicBP 0.603 0.382 0.373   
## DiastolicBP -0.448 0.268 -0.186 0.427 0.283   
## CholesterolTotal 0.124 -0.172 -0.208 0.590 -0.247   
## CholesterolLDL -0.174 0.280 0.467 -0.204 -0.151   
## CholesterolHDL 0.200 0.239 -0.207 0.276 -0.280 -0.161   
## CholesterolTriglycerides -0.331 -0.168 0.392 0.442 -0.154   
## MMSE 0.212 0.176 -0.527 0.201 0.208 0.131 0.256   
## FunctionalAssessment -0.115 0.434 -0.149 0.281 -0.526   
## ADL -0.118 -0.121 0.345 0.156 -0.110 0.533   
## Comp.15  
## Age 0.235   
## BMI -0.272   
## AlcoholConsumption   
## PhysicalActivity   
## DietQuality 0.524   
## SleepQuality -0.451   
## SystolicBP -0.280   
## DiastolicBP   
## CholesterolTotal   
## CholesterolLDL 0.330   
## CholesterolHDL 0.294   
## CholesterolTriglycerides -0.195   
## MMSE -0.168   
## FunctionalAssessment 0.136   
## ADL 0.160



## [1] 15

# we reached cumulitave variance prop of nearly 90% at component 13 so we can take 13 components

#cannocicalanalysis

## $cor  
## [1] 0.043398194 0.014993285 0.007573608  
##   
## $xcoef  
## [,1] [,2] [,3]  
## SystolicBP 0.024305487 0.015370779 -0.06857819  
## DiastolicBP 0.068157591 0.002852714 0.02539004  
## CholesterolTotal 0.006415535 -0.075091884 -0.01303115  
##   
## $ycoef  
## [,1] [,2] [,3]  
## MMSE -0.050638933 0.03800444 -0.04132063  
## FunctionalAssessment 0.056539851 0.04020668 -0.02844816  
## CholesterolHDL 0.008090739 -0.04948089 -0.05572002  
##   
## $xcenter  
## SystolicBP DiastolicBP CholesterolTotal   
## 0.4984449 0.5054023 0.5018395   
##   
## $ycenter  
## MMSE FunctionalAssessment CholesterolHDL   
## 0.4914157 0.5081814 0.4937341

## Canonical Correlations:

## [1] 0.043398194 0.014993285 0.007573608

##   
## Canonical Coefficients for Set 1:

## [,1] [,2] [,3]  
## SystolicBP 0.024305487 0.015370779 -0.06857819  
## DiastolicBP 0.068157591 0.002852714 0.02539004  
## CholesterolTotal 0.006415535 -0.075091884 -0.01303115

##   
## Canonical Coefficients for Set 2:

## [,1] [,2] [,3]  
## MMSE -0.050638933 0.03800444 -0.04132063  
## FunctionalAssessment 0.056539851 0.04020668 -0.02844816  
## CholesterolHDL 0.008090739 -0.04948089 -0.05572002

##   
## Correlation Matrix of Canonical Variables:

## [,1] [,2] [,3] [,4] [,5]  
## [1,] 1.000000e+00 2.324439e-16 -4.795874e-16 4.339819e-02 7.938916e-19  
## [2,] 2.324439e-16 1.000000e+00 -1.011523e-15 -8.617327e-17 1.499328e-02  
## [3,] -4.795874e-16 -1.011523e-15 1.000000e+00 8.478879e-17 8.850661e-17  
## [4,] 4.339819e-02 -8.617327e-17 8.478879e-17 1.000000e+00 3.277849e-17  
## [5,] 7.938916e-19 1.499328e-02 8.850661e-17 3.277849e-17 1.000000e+00  
## [6,] -5.037473e-17 -1.725157e-17 7.573608e-03 -3.632521e-17 -2.357923e-16  
## [,6]  
## [1,] -5.037473e-17  
## [2,] -1.725157e-17  
## [3,] 7.573608e-03  
## [4,] -3.632521e-17  
## [5,] -2.357923e-16  
## [6,] 1.000000e+00

## Warning: package 'vcd' was built under R version 4.3.3

## Loading required package: grid

## Contingency Table:

##   
## 0 1  
## 0 675 386  
## 1 714 374

##   
## Chi-square Test Results:

##   
## Pearson's Chi-squared test with Yates' continuity correction  
##   
## data: table\_data  
## X-squared = 0.85972, df = 1, p-value = 0.3538

##   
## Cramér's V:

## [1] 0.02097471

#there is very weak association between gender and diagnosis