Exploring Predictors Related to Diabetes

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AIM

The aim of this project was to gain an understanding of different variables that relate to diabetes.

RATIONALE

- We used visualizations to explore relationships between variables.
- We analyzed the prevalence of diabetes within African American communities in central Virginia.

THE DATA

- Faraway package in R: *diabetes*.
- 403 objects and 19 variables.
- Numeric continuous variables: cholesterol, age, weight, and high density lipoprotein.
- Categorical variables: gender, location, and frame.

	id	chol	stab.glu	hdl	ratio	glyhb	location	age	gender	height	weight	frame	bp.1s	bp.1d	bp.2s	bp.2d	waist	hip	time.ppn
1	1000	203	82	56	3.6	4.31	Buckingham	46	female	62	121	medium	118	59	NA	NA	29	38	720
2	1001	165	97	24	6.9	4.44	Buckingham	29	female	64	218	large	112	68	NA	NA	46	48	360
3	1002	228	92	37	6.2	4.64	Buckingham	58	female	61	256	large	190	92	185	92	49	57	180
4	1003	78	93	12	6.5	4.63	Buckingham	67	male	67	119	large	110	50	NA	NA	33	38	480
5	1005	249	90	28	8.9	7.72	Buckingham	64	male	68	183	medium	138	80	NA	NA	44	41	300
6	1008	248	94	69	3.6	4.81	Buckingham	34	male	71	190	large	132	86	NA	NA	36	42	195

DATA CLEANING

- Dropped: id column, second systolic and second diastolic blood pressure columns.
- Filled the missing values in the remaining columns with the median of each column and added a categorical variable, *diabetes,* for some visualizations.

	chol	stab.glu	hdl	ratio	glyhb	location	age	gender	height	weight	frame	bp.1s	bp.1d	waist	hip	time.ppn
1	203	82	56	3.6	4.31	Buckingham	46	female	62	121	medium	118	59	29	38	720
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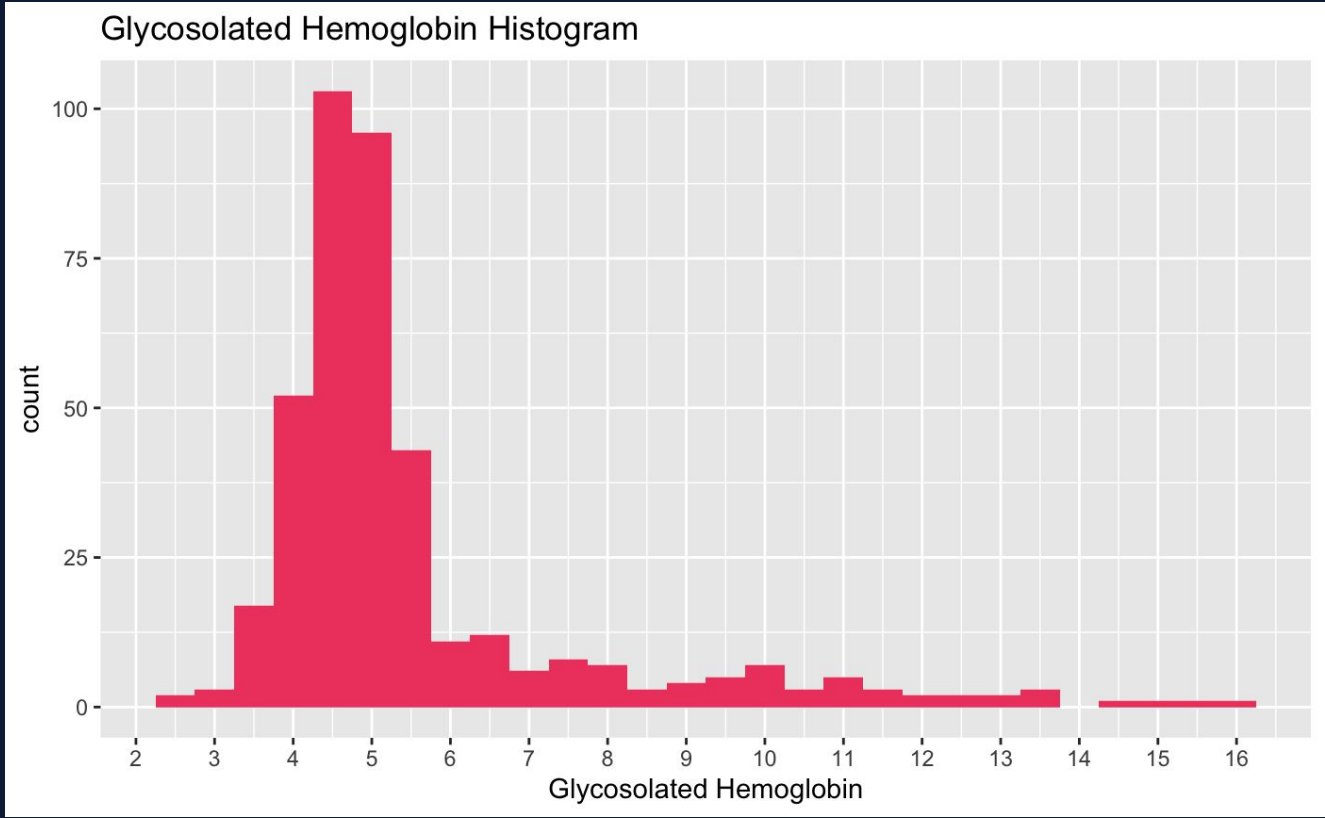
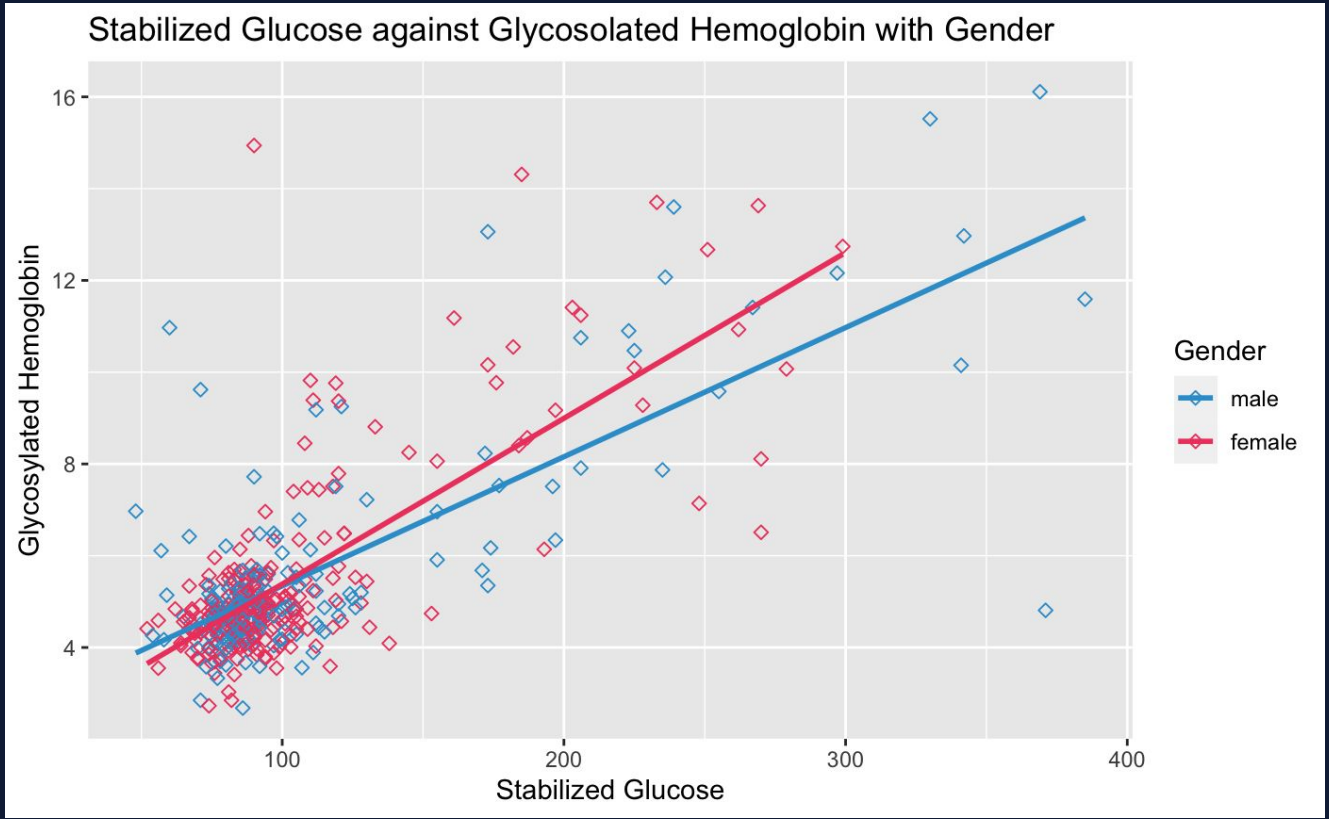
EXPLORING VISUALIZATIONS

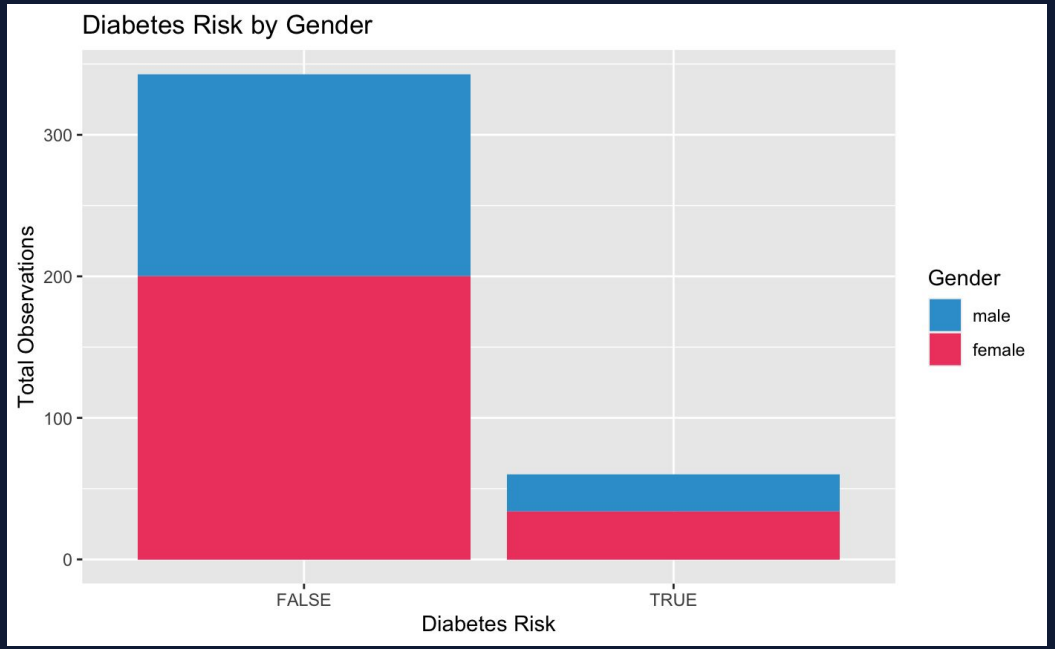


EXPLORING VISUALIZATIONS



EXPLORING VISUALIZATIONS

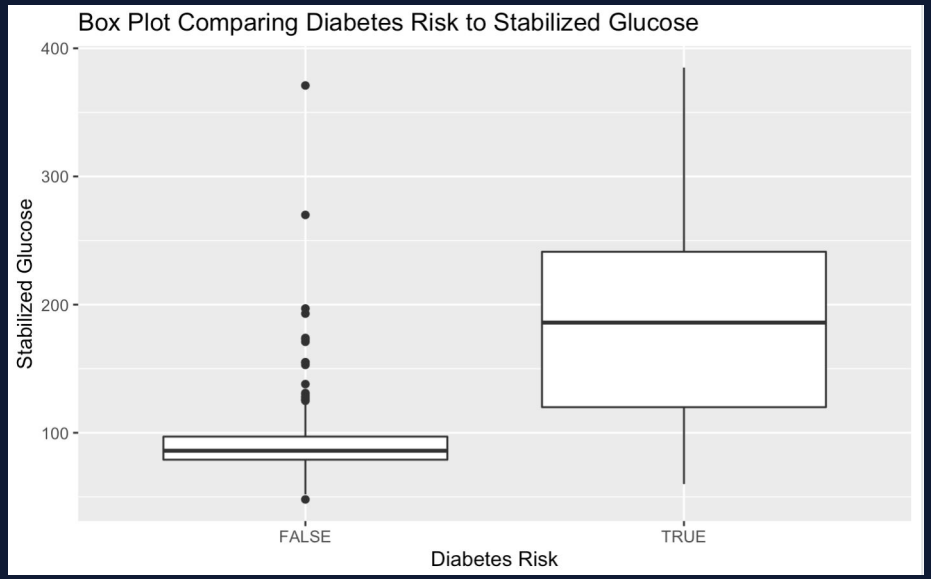
- Response: Glycosylated hemoglobin
- ~14.9% of subjects considered at risk of diabetes

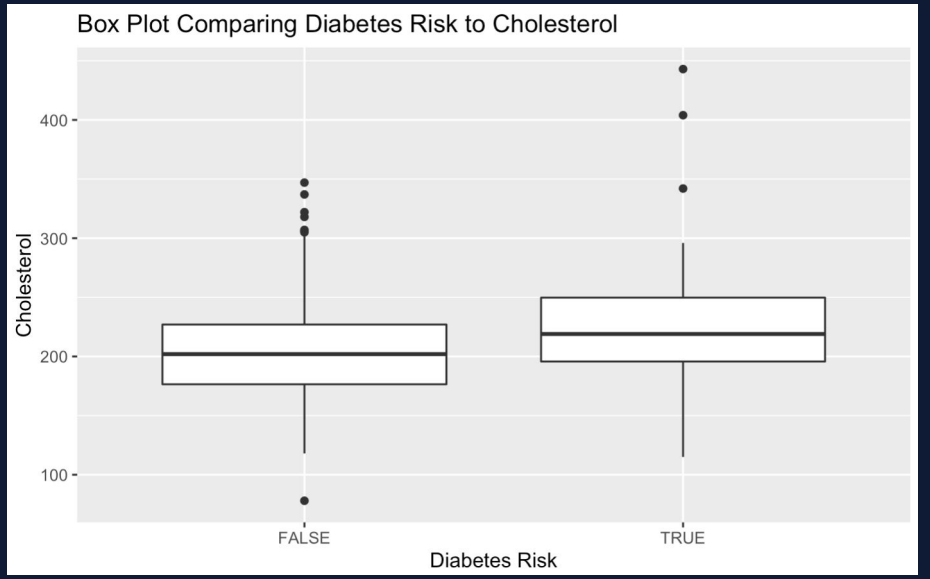


diabetes = TRUE when glycosylated hemoglobin >7

EXPLORING VISUALIZATIONS

The visualizations below illustrate the differences in stabilized glucose and cholesterol of subjects with and without a risk of diabetes.

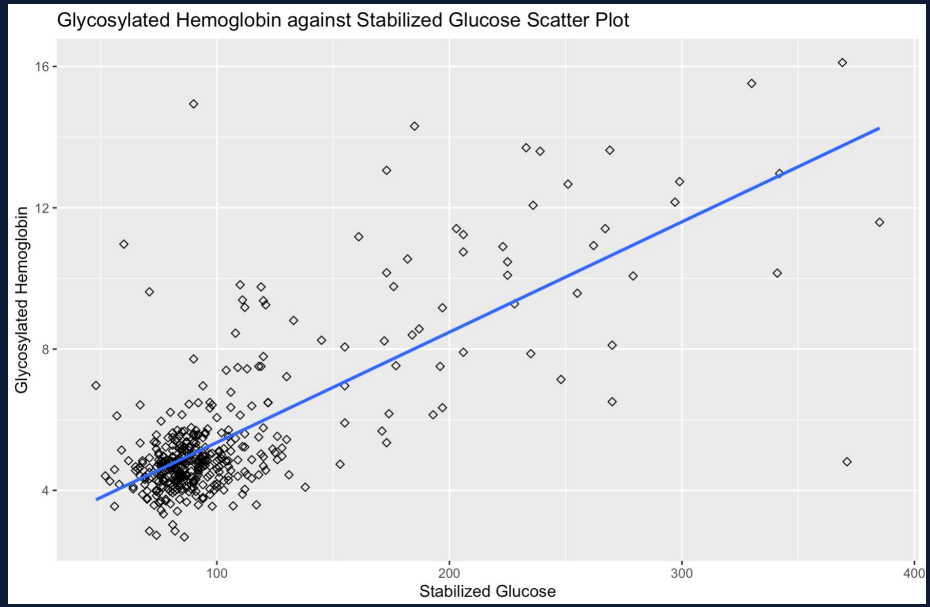




EXPLORING LINEAR REGRESSION

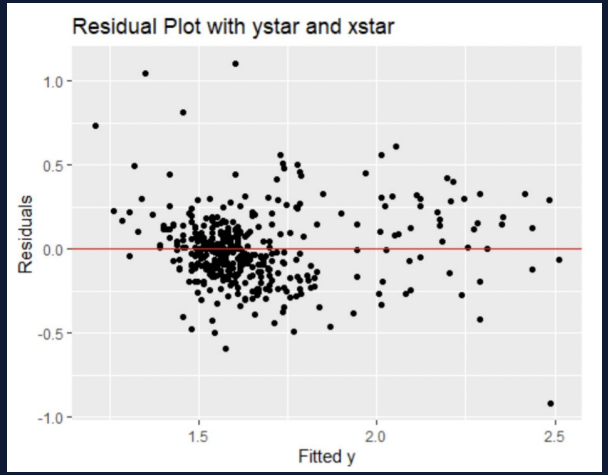
The regression indicates a positive relationship between stabilized glucose and glycosylated hemoglobin.

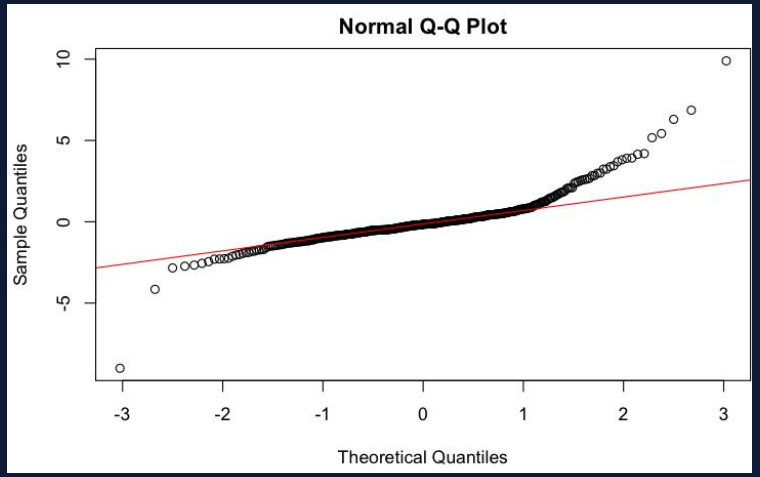
```
Call:
lm(formula = glyhb ~ stab.glu, data = df)

Residuals:
    Min      1Q  Median      3Q     Max
-9.0083 -0.6916 -0.1592  0.4255  9.8950

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 2.235123   0.163877   13.64   <2e-16 ***
stab.glu    0.031221   0.001376   22.69   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.464 on 401 degrees of freedom
Multiple R-squared:  0.5622,    Adjusted R-squared:  0.5611
F-statistic:   515 on 1 and 401 DF,  p-value: < 2.2e-16
```

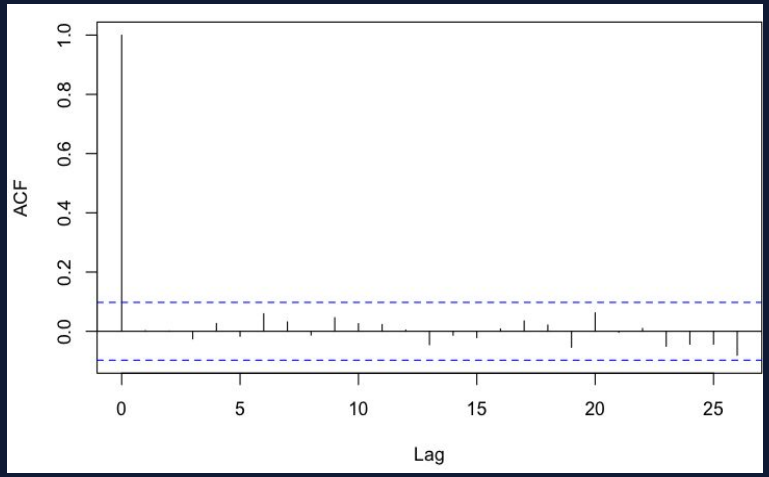


SATISFYING REGRESSION ASSUMPTIONS:

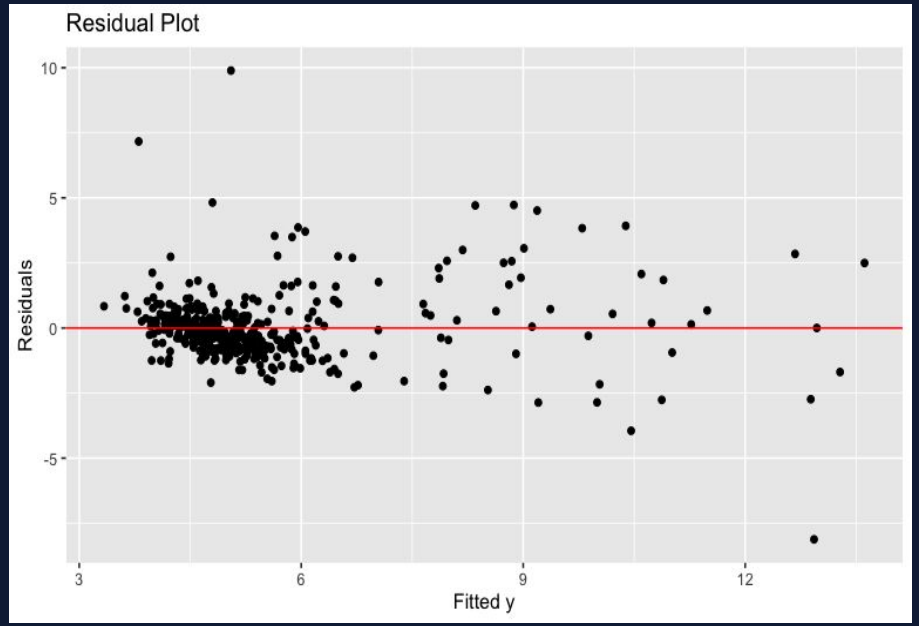
- Linear relationship
- Error terms normally distributed
- Constant variance
- Independent observations

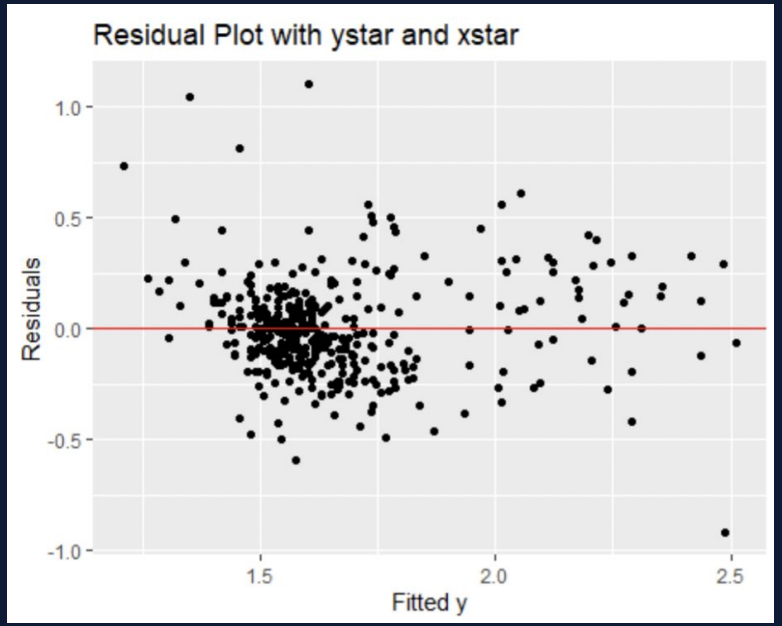






RESIDUAL COMPARISON BEFORE AND AFTER TRANSFORMATIONS





MODEL SELECTION

- After model diagnostics, we chose cholesterol, stabilized glucose, age, postprandial time, and ratio as predictors.

R^2	y = -1.6516 + 0.0034chol + 0.0287stab.glu + 0.1169ratio + 0.016age + 0.3016female + 0.0277height + 0.0006time
Mallow	y = 0.4162 + 0.0034chol + 0.0287stab.glu + 0.1131ratio + 0.0147age + 0.0006time
BIC	y = 0.8668 + 0.0286stab.glu + 0.1533ratio + 0.0163age + 0.0006time
Forward	y = 0.4162 + 0.0287stab.glu + 0.0034chol + 0.0147age + 0.0006time + 0.1131ratio
Backward	y = 0.4162 + 0.0034chol + 0.0287stab.glu + 0.1132ratio + 0.0147age + 0.0006time
Stepwise	y = 0.4162 + 0.0287stab.glu + 0.0034chol + 0.0147age + 0.0006time + 0.1132ratio

Multiple Linear Regression

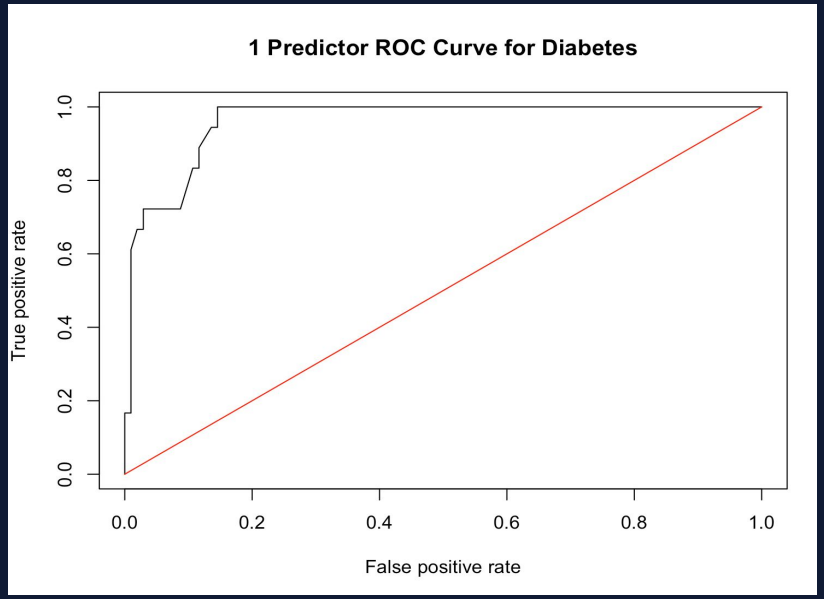
- After comparing two models, it was determined that model 1 would be best suited for our data.

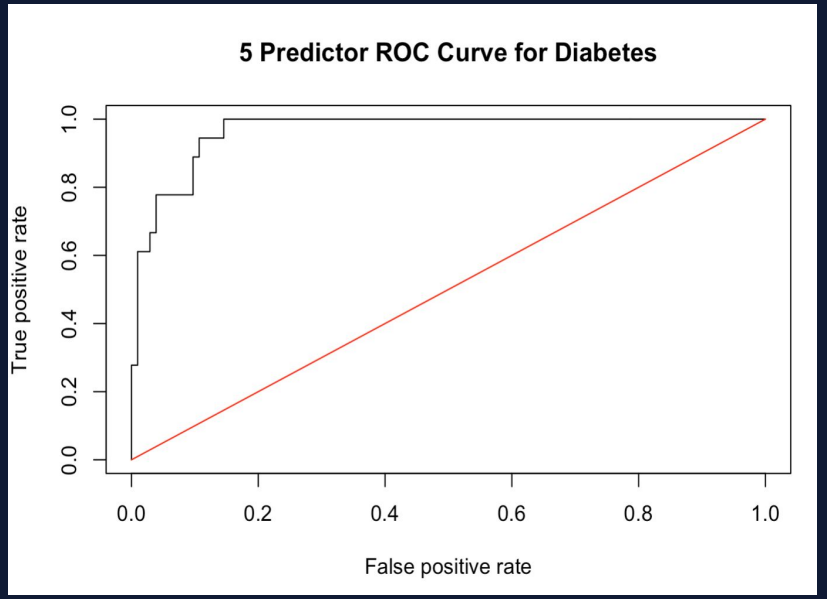
```
Analysis of Variance Table

Model 1: glyhb ~ stab.glu + age + time.ppn + chol + ratio
Model 2: glyhb ~ chol + stab.glu + hdl + ratio + age + height + weight +
    frame + bp.1s + bp.1d + waist + hip + time.ppn
  Res.Df    RSS Df Sum of Sq      F Pr(>F)
1    397 786.52
2    389 781.70  8    4.8204 0.2998 0.9658
```

```
Call:
lm(formula = glyhb ~ ., data = df)

Residuals:
    Min      1Q  Median      3Q     Max
-8.1591 -0.6610 -0.1499  0.4264  9.9282

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.9752899  2.0101961  -0.485   0.6278
chol         0.0034207  0.0030970   1.105   0.2700
stab.glu     0.0284783  0.0014618  19.481   <2e-16 ***
hdl         -0.0001114  0.0096717  -0.012   0.9908
ratio        0.1071249  0.1083805   0.988   0.3236
age          0.0130169  0.0056457   2.306   0.0217 *
height       0.0096589  0.0232156   0.416   0.6776
weight      -0.0017231  0.0047486  -0.363   0.7169
frame       -0.0816749  0.1206019  -0.677   0.4987
bp.1s        0.0036802  0.0045722   0.805   0.4214
bp.1d       -0.0038652  0.0069898  -0.553   0.5806
waist        0.0116304  0.0286548   0.406   0.6851
hip          0.0165060  0.0299911   0.550   0.5824
time.ppn     0.0005936  0.0002344   2.532   0.0117 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.418 on 389 degrees of freedom
Multiple R-squared:  0.6019,    Adjusted R-squared:  0.5886
F-statistic: 45.24 on 13 and 389 DF,  p-value: < 2.2e-16
```

Comparing ROCs and AUCs

Data indicated a simple linear regression model was nearly as effective in predicting diabetes risk as our 5 predictor model.





ISSUES, NOTES, AND INSIGHTS

- Size of the data set
- Missing values and data not collected
- SLR vs MLR
- Time to explore other variables
- 6.5 vs 7

I can do more, to lower my A1C.

SUMMARY

- We compared visualizations between variables such as glycosylated hemoglobin, stabilized glucose, and diabetes risk.
- Predictors such as age, total cholesterol, and stabilized glucose can impact diabetes risk.
- A linear regression relating stabilized glucose to glycosylated hemoglobin was most appropriate.
- Increase awareness of different predictors related to diabetes.