Exam 1 A - MATH 4322

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Fall 2022

Name: _____ **PSID**: _____

Instructions

- Allow one sheet of notes front and back to be turned in for extra credit.
- Allow calculator.
- Total possible points 100.
- For multiple choice circle your answer on this test paper.
- For short answer questions answer fully on this test paper, partial credit will be given.
- Once completed turn in to TA or instructor.
- Data sets are coming from

UCI Machine Learning Repository

Problem 1

(36 possible points) We want to understand how the input variables relate to miles per gallon, `mpg`. The input variables are:

- `cylinders` - as qualitative 4, 6 or 8
- `displacement` - cubic inches
- `horsepower` - gross horsepower
- `weight` - per 1000 pounds

a. Is this a inference or prediction statistical learning problem?

b. Is this a regression or classification problem?

c. Give the model formula for our problem. Use the variable names in the formula.

d. Give the R code to get the model for predicting the `mpg` based on the 4 input variables.

e. The following is the output from the data. Write out the equation with the estimates.

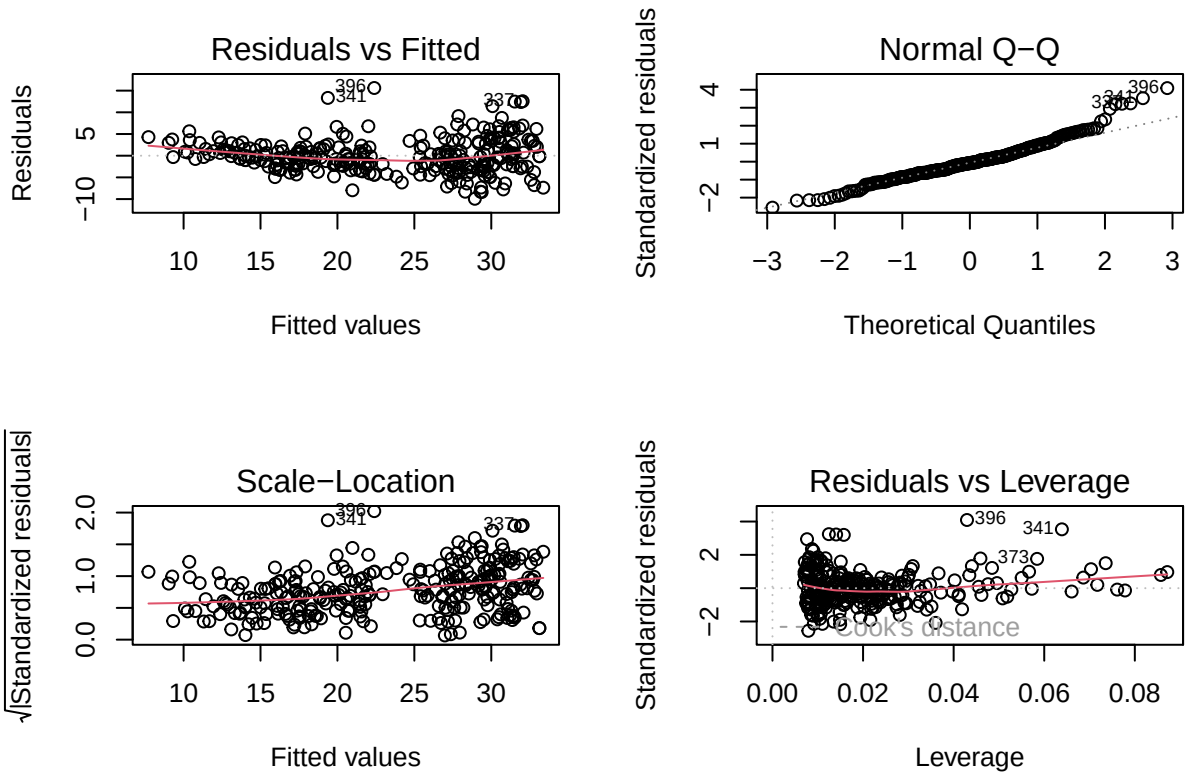
	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	44.5313	1.5297	29.1111	0.0000
cylinders6	-4.1951	1.0709	-3.9174	0.0001
cylinders8	-2.6522	1.8066	-1.4681	0.1432
displacement	0.0090	0.0104	0.8617	0.3896
horsepower	-0.0576	0.0152	-3.7828	0.0002
weight	-5.1079	0.8346	-6.1202	0.0000

f. Give the interpretation of the coefficient for the variable `horespower`.

g. Are there any variables that are not needed in this model? Justify your answer.

h. What are the assumptions of this model?

i. The plot below are the diagnostics plots. Are any of the assumptions violated with this model?



Problem 2

(32 possible points) We want to predict whether a person will donate blood or not. The variables are:

- `Monetary` - total blood donated in c.c per 1000.
- `Recency` - months since last donation.
- `Donate` - a binary variable representing whether he/she donated blood (1 stand for donating blood; 0 stands for not donating blood).

a. Is this a inference or prediction statistical learning problem?

b. Is this a regression or classification problem?

c. Give the model formula for our problem. Use the variable names in the formula.

d. Give the R code to get the model for predicting the probability of donating blood based on the 2 input variables.

e. The following is the output from the data. Write out the equation with the estimates.

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-0.5643	0.1988	-2.84	0.0045
Recency	-0.1228	0.0190	-6.47	0.0000
Monetary	0.2616	0.0769	3.40	0.0007

f. Give the predicted probability of donating blood for a donor that has donated 1400 c.c. of blood and last dontation was 4 months ago.

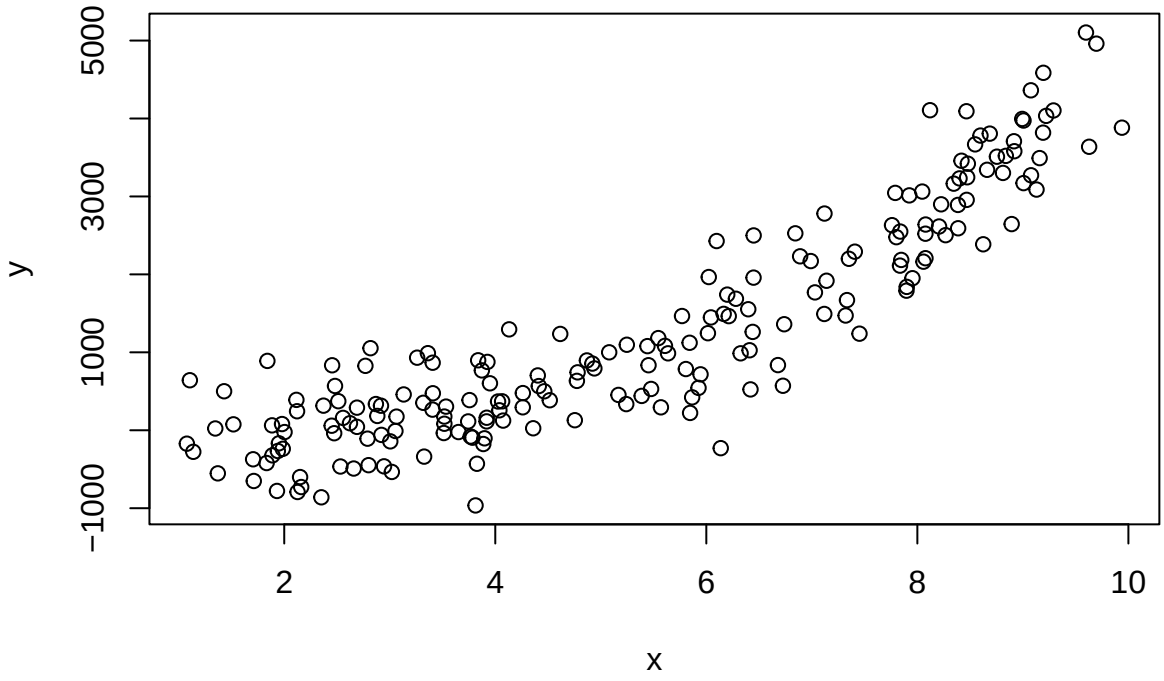
g. The following is the output from `R`. Determine R^2 and give an interpretation.

Null deviance:	625.95	on	560	degrees of freedom
Residual deviance:	550.16	on	558	degrees of freedom

Problem 3

(8 possible points)

a. Using the following plot below do we have a linear relationship?



b. The following is an output for a regression model with degree 1, 2, 3 and 4 respectively, based on the data represented from the plot above. According to these statistics, write out the formula for the best model.

	Adj.R2	Cp	BIC
Degree 1	0.81	114.39	-322.54
Degree 2	0.88	2.57	-408.60
Degree 3	0.88	3.21	-404.69
Degree 4	0.88	5.00	-399.61

Problem 4

(8 points) A graduate program is making decisions to admit students into the program with the variables `GPA`, and the score on the `GRE`. The response variable is `Decision`, there are three decisions that are made; *yes*, *no*, and *conditional*.

a. Circle the best model to use for this example.

i. Simple Linear Regression

ii. Logistic Regression

iii. Multiple Linear Regression

iv. Linear Discriminat Analysis (LDA)

v. Polynomial Regression

b. The following is the confusion matrix based on the model. What is the error rate?

	Yes	No	Conditional
Yes	21	0	3
No	0	21	2
Conditional	1	0	20

i. 0.0882

ii. 0.875

iii. 0.913

iv. 0.9118

v. 0.9524

Problem 5

(4 points) The following is the ANOVA table from problem 1, where $n = 288$ and the MSE for the full model from problem 1 is 15.2. What is the C_p statistic?

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
horsepower	1	10782.97	10782.97	656.78	0.0000
weight	1	1868.22	1868.22	113.79	0.0000
Residuals	285	4679.13	16.42		

a. 425.38

b. -161.09

c. 4

d. 27.83

e. 23.83

Problem 6

(4 points) Suppose we have $p = 4$ predictors. How many possible additive models contain subsets of the 4 predictors?

a. 4

b. 8

c. 16

d. 32

e. 100

Problem 7

(4 points) Which stepwise selection begins with a model containing no predictors, and then adds predictors to the model, one-at-a-time, until all of the significant predictors are in the model.

a. forward

b. backward

c. best subset

d. none of these

Problem 8

(4 points) The following is a 95% prediction interval for the `mpg` from problem 1, with only `weight` as the predictor. We wanted to predict where `weight` is 2845 pounds. Which statement is correct?

	fit	lwr	upr
1	24.50	16.41	32.58

a. For one automobile that weighs 2845, we predict the `mpg` to be between 16.41 and 32.58 with 95% confidence.

b. On average for all automobiles that weigh 2845, we we predict the `mpg` to be between 16.41 and 32.58 with 95% confidence.

c. For one automobile that regardless of the weight, we predict the `mpg` to be between 16.41 and 32.58 with 95% confidence.

d. On average for all automobiles regardless of the weight, we we predict the `mpg` to be between 16.41 and 32.58 with 95% confidence.

e. For an automobile that weights 2845 pounds, the `mpg` will be 24.5.