

36-402 Homework 7

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```
## Loading required package: nlme
```

```
## This is mgcv 1.8-27. For overview type 'help("mgcv-package")'.
```

Question 1

a)

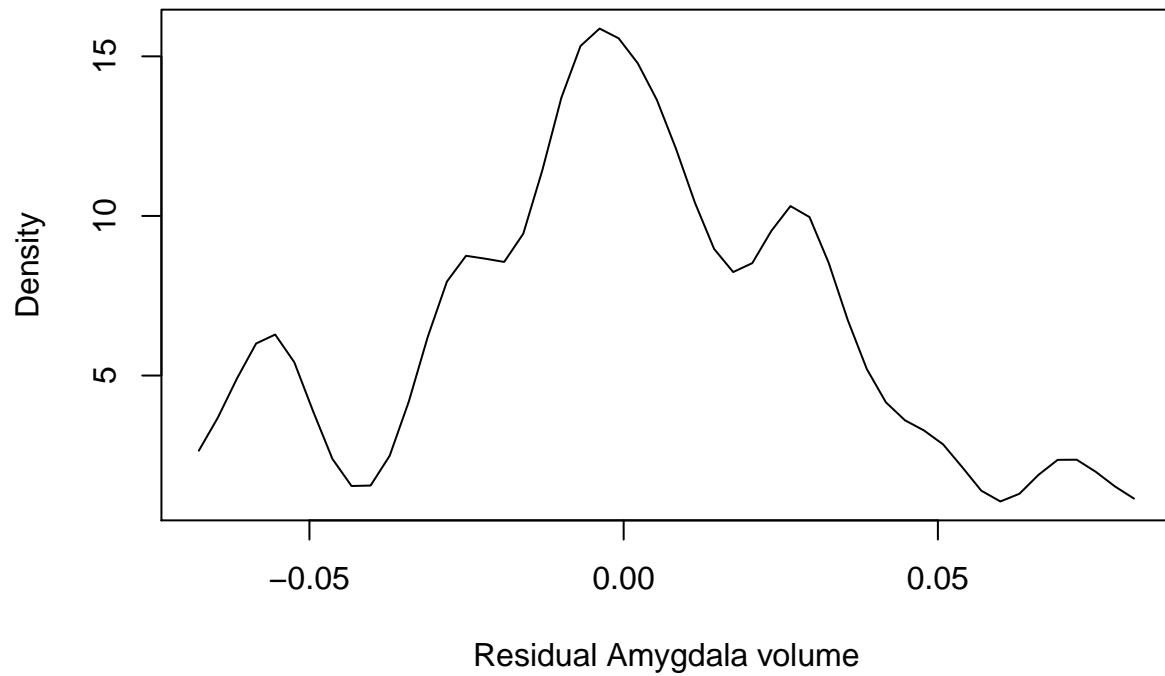


Table 1: Bandwidth for amygdala kernel density

x
0.00548

b)

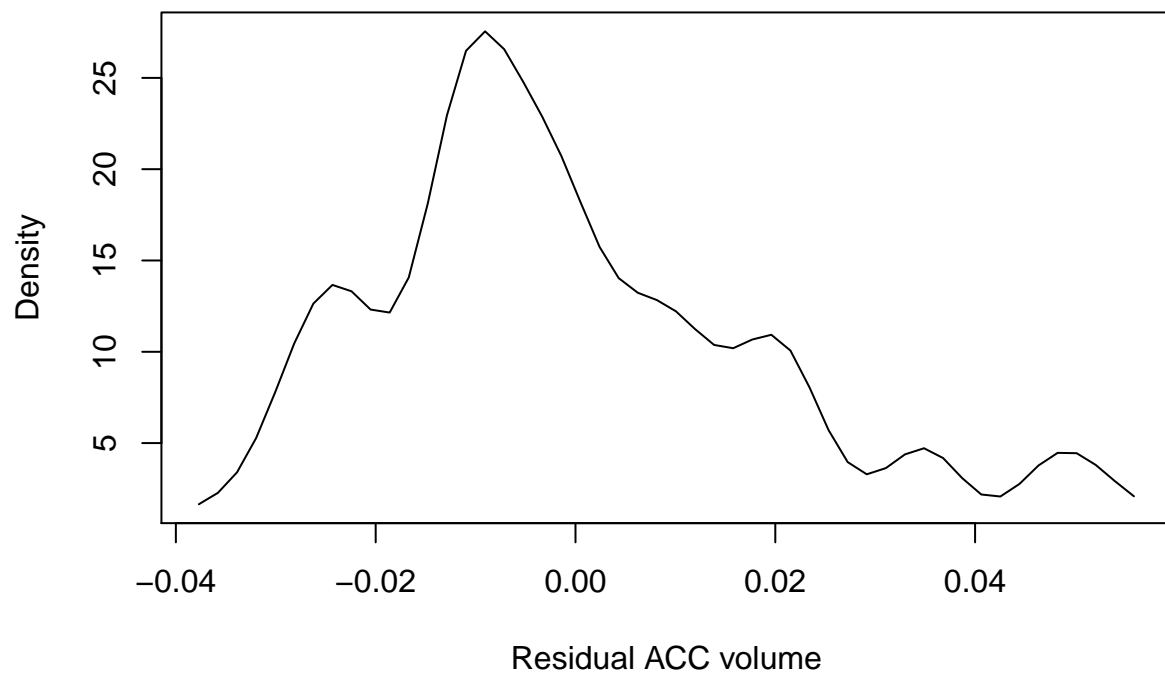


Table 2: Bandwidth for acc kernel density

	x
	0.00372

Question 2

a)

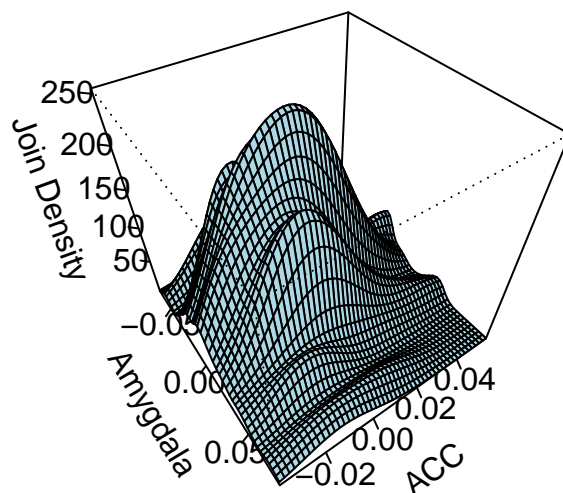
Table 3: Bandwidths for joint kernel density

	x
Amygdala	0.00616
ACC	0.01290

The bandwidths are different from before, and they should not be expected to be the same.

b)

Joint Density of Residual Amygdala and ACC volumes



The two volumes of brains do not seem to be statistically independent, and we do not expect them to be as there is likely to be some correlation between them, coming from the same brain.

Question 3

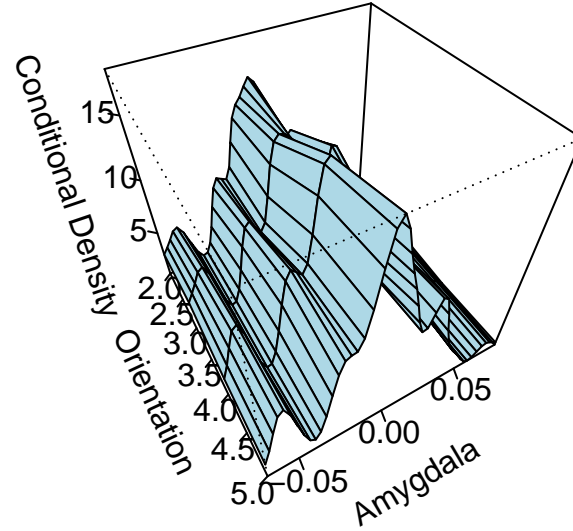
a)

Table 4: Bandwidths for conditional kernel density

	x
Orientation	0.53965
Amygdala	0.00528

The bandwidth for amygdala volume is close to that of the one found in problem 1 a). If the volume of the amygdala was independent of the political orientation, then we would expect the bandwidth to be the same. However, we cannot conclude anything just from the similarity of bandwidths.

Plot of Cond. Density of Resid. Amygdala Vol. against Orientation



The plot seems to indicate that there is no relationship between the size of the amygdala and the political orientation, as the distribution of residual volume of amygdala seems relatively similar across all values of political orientation.

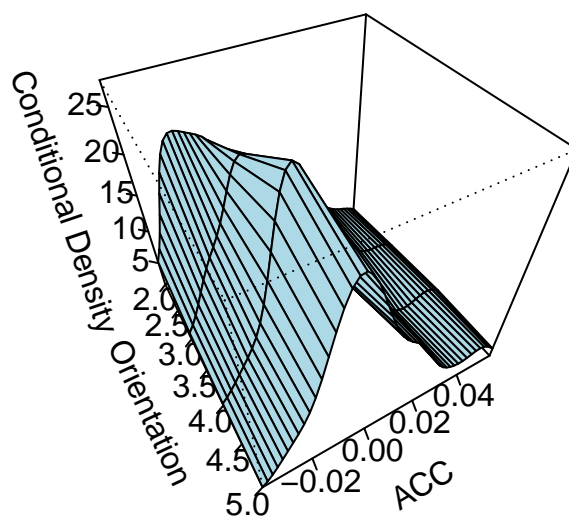
b)

Table 5: Bandwidths for conditional kernel density

	x
Orientation	0.39636
ACC	0.00632

The bandwidth for ACC volume is not similar to any of the ones found before. Once again, we do not expect to find the same bandwidth as before if the two variables are not independent.

Plot of Cond. Density of Resid. ACC Vol. against Orientation



The plot seems to indicate a weak relationship between the size of the amygdala and the political orientation, where as the distribution of volume and its peak shifts to larger values, the political orientation score tends to be higher.

Question 4

a)

```
conservative <- as.integer(brain$orientation <= 2)
```

b)

TODO

c)

Orientation	Freq
2	13
3	24
4	41
5	12

Conservative	Freq
0	77
1	13

As there are only 13 entries with political orientation score ≤ 2 , we can see that the vector `conservative` has the right counts.

d)

```
brain$conservative <- conservative
```

Question 5

a)

Table 8: Logistic Regression Coefficients

	x
(Intercept)	-2.46
amygdala	22.00
acc	-65.50

The coefficient of the intercept indicates that the log-odds of the ratio of being conservative to otherwise is predicted to be -2.46 when all the predictors have volumes of 0.

For each unit increase in amygdala volume, the log-odds of ratio of being conservative to otherwise is predicted to increase by 22, holding everything else constant.

For each unit increase in ACC volume, the log-odds of ratio of being conservative to otherwise is predicted to decrease by 65.5, holding everything else constant.

b)

Table 9: Bootstrapped 95% C.I for Coefficients

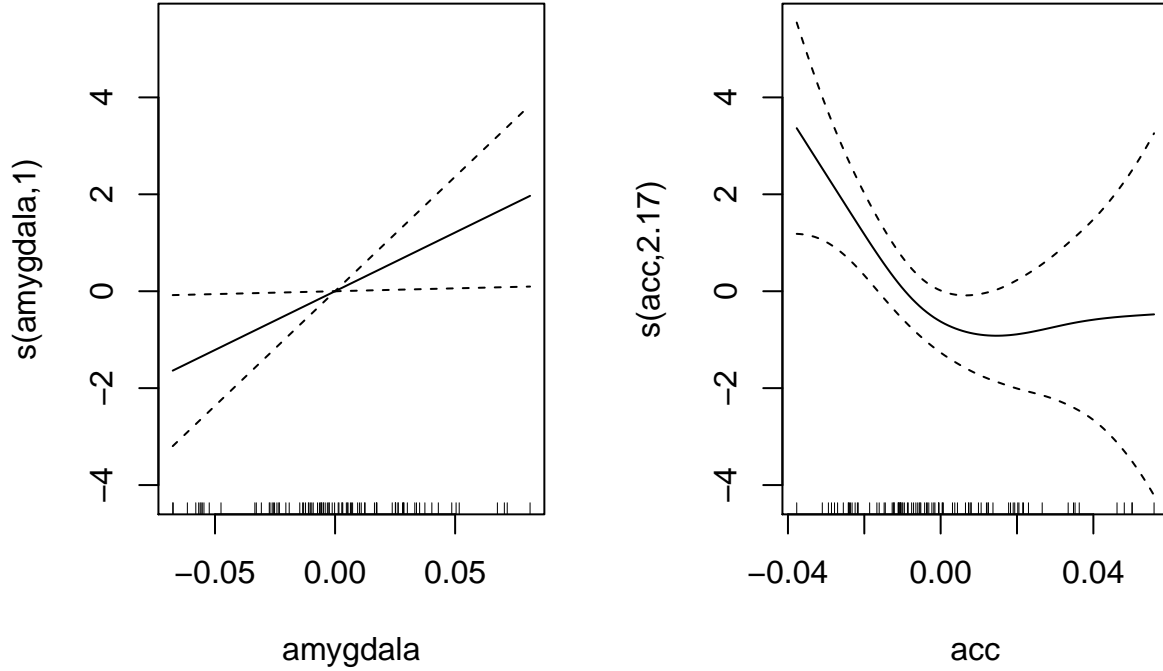
	lower	upper
(Intercept)	-3.27	0.14
amygdala	-9.92	42.63
acc	-127.89	89.79

The restriction to 3 significant places was reasonable as the bootstrapped standard errors are much larger than any accuracy lost in truncating to 3 significant places.

Question 6

Table 10: Intercept of GAM

	x
(Intercept)	-2.33



Holding everything else constant, residual amygdala volume seems to have a positive linear relationship with the log-odds of being conservative to otherwise, where larger residual amygdala volumes result in increased log-odds of being conservative. However, holding everything else constant, residual acc volume seems to have a negative non-linear relationship with the log-odds instead. When the residuals are negative, it seems that increased residual volumes are associated with a decrease in the log-odds of being conservative. When the residuals are positive, it seems that the log-odds do not change much with any further increases in residual volumes.

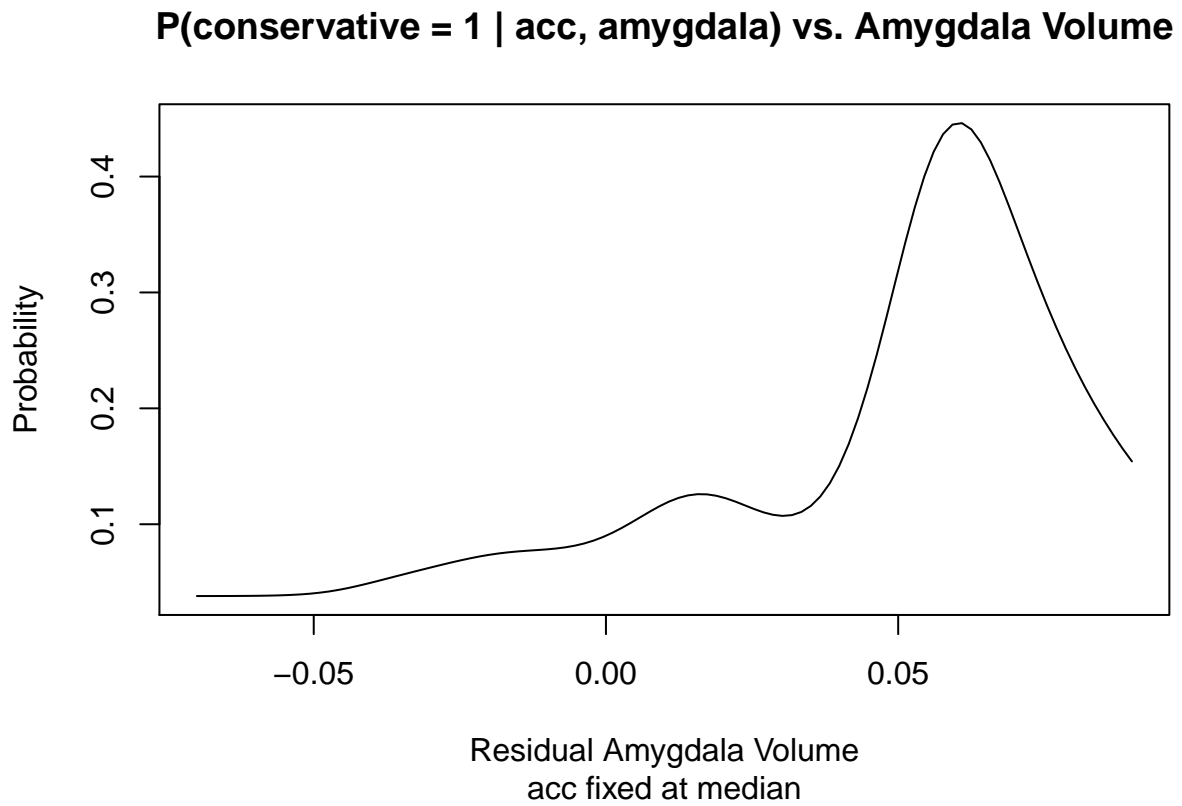
Question 7

a)

Table 11: Bandwidths of conditional density of conservative

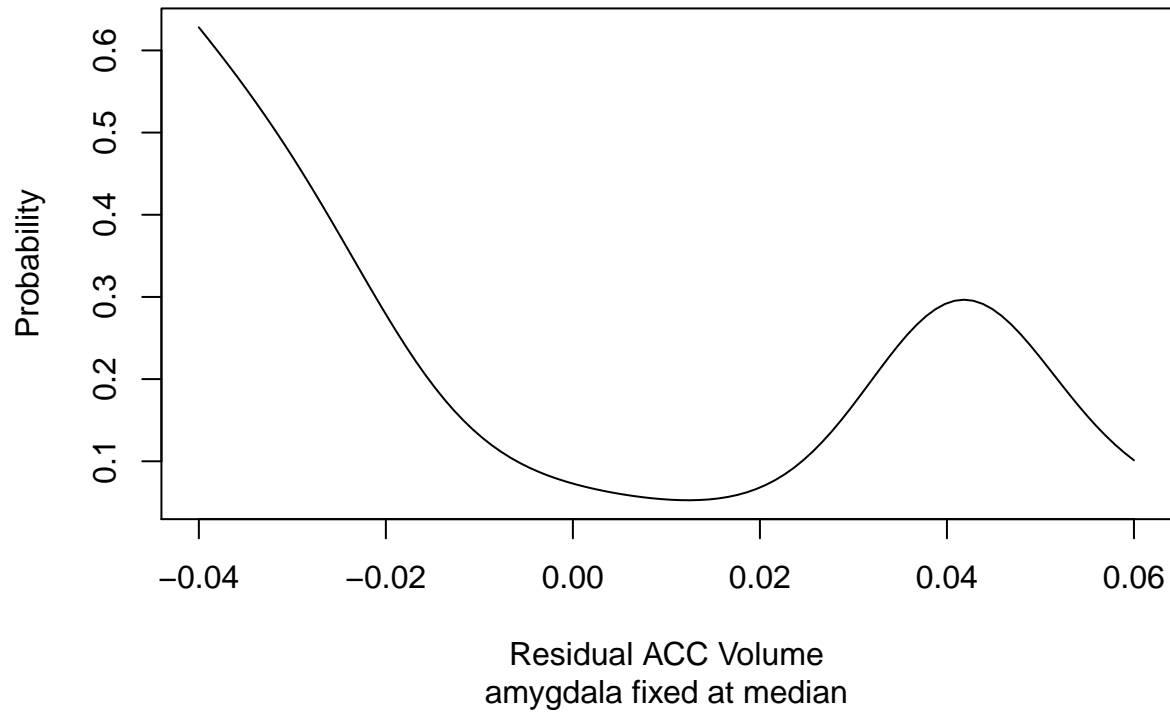
	x
Amygdala	0.01173
ACC	0.01035
Conservative	0.03803

b)



c)

P(conservative = 1 | acc, amygdala) vs. ACC Volume



Question 8

a)

Table 12: Misclassification rate of models

	x
GLM	0.167
GAM	0.144
npcdens	0.111

If we were to just predict non-conservatives all the time, we would have a misclassification error of 0.144.

b)

Table 13: LOOCV misclassification rate of models

	x
GLM	0.167
GAM	0.144
npcdens	0.111