

Question 2

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Part A

COPD is significantly associated with BMI squared, based on a wald test ($T(\text{wald}) = 2.7034716$, $p = 0.0068619$).

Part B

COPD is significantly associated with BMI squared, based on a wald test ($T(\text{likelihood ratio}) = 7.9529394$, $p = 0.0048009$).

Part C

Yes, both the wald test and likelihood ration test indicated that there is evidence that COPD has a quadratic relationship with BMI ($\alpha = 0.05$).

Part D

Since we are using a higher order term for BMI, in order to avoid high correlation between BMI and its higher order term, BMI squared, we should center the variable.

Appendix

```
knitr::opts_chunk$set(echo = TRUE)
data = read.table("copd.txt", header = T)

library(aod)

# part A
model1 = glm(copd ~ age + gender + smoker + BMI + BMIsquared, data = data, family = binomial)
summary(model1)
t_w = summary(model1)$coefficients[6, 3]
p_w = 2 * (1 - pnorm(t_w))

# part B
model0 = glm(copd ~ age + gender + smoker + BMI, data = data, family = binomial)
t_lr = (-2 * log(exp(logLik(model0)) / exp(logLik(model1))))[1]
df = 1
p_lr = pchisq(t_lr, df, lower.tail = F)
```