

科目：統計學

考生注意：

1. 依次序作答，只要標明題號，不必抄題。
2. 答案必須寫在答案卷上，否則不予計分。
3. 限用藍、黑色筆作答；試題須隨卷繳回。

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Please answer both questions.

1. Suppose you collect data from a survey on wages, education, experience, and gender.

In addition, you ask for information about marijuana usage. The original question is:

“on how many separate occasions last month did you smoke marijuana?”

- (1) (15%) Write an equation that would allow you to estimate the effects of marijuana usage on wage, while controlling for other factors. You should be able to make statements such as, “Smoking marijuana one more time per month is estimated to change wage by  $\beta_1\%$ ”.
- (2) (15%) Write a model that would allow you to test whether drug usage has different effects on wages for men and women. How would you test that there are no differences in the effects of drug usage for men and women?
- (3) (15%) Suppose you think it is better to measure marijuana usage by putting people into one of four categories: nonuser, light user (1 to 5 times per month), moderate user (6 to 10 times per month), and heavy user (more than 10 times per month). Now, write a model that allows you to estimate the effects of marijuana usage on wages.
- (4) (15%) Using the model in part (3), explain in detail how to test the null hypothesis that marijuana usage has no effect on wage. Be very specific and include a careful listing of degree of freedom.

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2. Consider the multiple regression model with three independent variables, assuming that the classical linear model assumptions hold:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + u$$

- (1) (10%) Let  $\hat{\beta}_1$  and  $\hat{\beta}_2$  denote the OLS estimators of  $\beta_1$  and  $\beta_2$ . Find

$Var(\hat{\beta}_1 - 3\hat{\beta}_2)$  in terms of the variances of  $\hat{\beta}_1$  and  $\hat{\beta}_2$  and the covariance between them.

- (2) (10%) Write the t statistic for testing  $H_0: \beta_1 - 3\beta_2 = 1$ .

- (3) (20%) Define  $\vartheta_1 = \beta_1 - 3\beta_2$  and  $\hat{\vartheta}_1 = \hat{\beta}_1 - 3\hat{\beta}_2$ . Write a regression equation involving

$\beta_0$ ,  $\vartheta_1$ ,  $\beta_2$  and  $\beta_3$  that allows you to directly obtain  $\hat{\vartheta}_1$  and its standard error.