Name Jerry

Student Number

STA 441s 2016 Quiz 6

1. (6 points) In a study of factors related to successful brain surgery, the explanatory variables were age of patient in years (x_1), and experience of the surgeon, measured in number of times he or she had carried out the procedure (x_2). The response variable was $Y = 1$ for a successful surgery, or $Y = 0$ for unsuccessful. Denoting the probability of success by π, the logistic regression model is

$$\ln\left(\frac{\pi}{1-\pi}\right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2$$

   (a) You want to test whether, controlling for patient's age, the surgeon's experience is related to whether the surgery is successful. In symbols, what is the null hypothesis?

   $H_0: \beta_2 = 0$

   (b) You want to test whether, controlling for surgeon's experience, the patient's age is related to whether the surgery is successful. In symbols, what is the null hypothesis?

   $H_0: \beta_1 = 0$

   (c) You want to test patient's age and surgeon's experience simultaneously. In symbols, what is the null hypothesis?

   $H_0: \beta_1 = \beta_2 = 0$

   (d) For fixed age of patient, each time the surgeon has carried out the procedure in the past multiplies the odds of success by ... what? Answer in terms of symbols from the logistic regression model.

   e^{β_2}

   (e) For any fixed level of surgeon's experience, each each additional year of the patient's age multiplies the odds of success by ... what? Answer in terms of symbols from the logistic regression model.

   e^{β_1}

   (f) Would you expect β_1 to be positive or negative? Why?

   Negative, because then $e^{\beta_1} < 1$, and increasing age goes with smaller chance of success.

$$\ln\left(\frac{\pi}{1-\pi}\right) = \ln\left(\frac{P(Y=1|\mathbf{X}=\mathbf{x})}{P(Y=0|\mathbf{X}=\mathbf{x})}\right) = \beta_0 + \beta_1 x_1 + \ldots + \beta_{p-1} x_{p-1}$$

$$P(Y=1|\mathbf{X}=\mathbf{x}) = \frac{e^{\beta_0+\beta_1 x_1+\ldots+\beta_{p-1}x_{p-1}}}{1+e^{\beta_0+\beta_1 x_1+\ldots+\beta_{p-1}x_{p-1}}}$$

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2. (4 points) In your analysis of the **heart** data, consider the model with just years of education and number of cigarettes per day.

   (a) You wish to test whether, controlling for smoking, education has any connection to coronary heart disease. What is the value of the (chi-squared) test statistic? The answer is a number from your printout.

   $\chi^2 = 14.5234$

   (b) Controlling for smoking, each additional year of education multiplies the estimated odds of coronary heart disease by ... what? The answer is a number from your printout.

   0.809

   (c) You wish to test whether, controlling for education, smoking has any connection to coronary heart disease. What is the value of the (chi-squared) test statistic? The answer is a number from your printout.

   $\chi^2 = 6.9519$

   (d) Controlling for education, each additional cigarette per day multiplies the estimated odds of coronary heart disease by ... what? The answer is a number from your printout.

   1.008

This time you will *not* attach your printouts.