Biostatistics 140.654
Fourth Term, 2021
April 12, 2021

Quiz 1 SOLUTION

The purpose of this quiz is to assess your knowledge of the course materials covered during the first two weeks of class and covered in Problem Set 1.

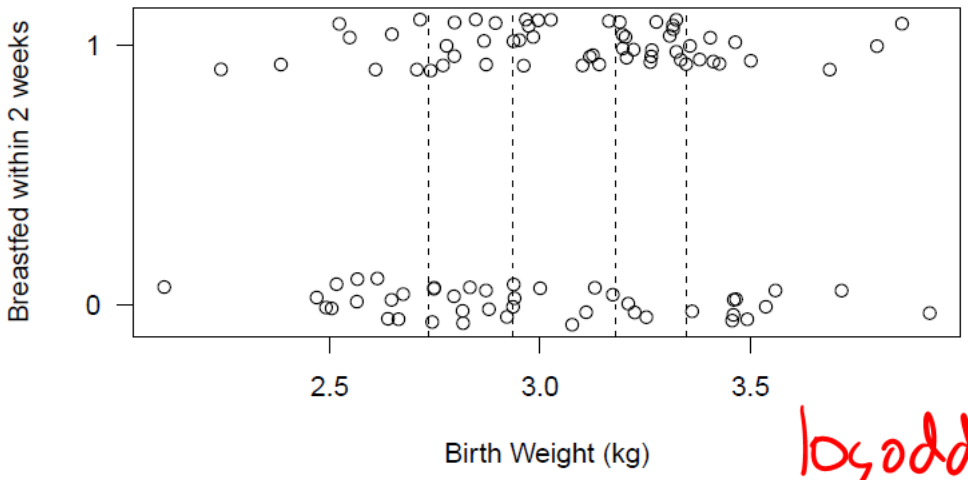
Instructions:

- **This is an open book quiz; you may consult your course notes and handouts.**
- **You should not discuss this quiz with any other student during Monday April 12th.**
- **This quiz is designed to be completed in 20-30 minutes.**
- **You can use calculators or R on your computer for arithmetic. But you should NOT use the 'glm' function in R to compute estimates of logistic regression coefficients.**
- **You may provide your solution by editing the word version of this quiz, annotating the pdf version of this quiz or writing your solution on paper and submitting a picture of your solution.**

By signing my name, I enter agree to abide by the instructions above and the Johns Hopkins University School of Public Health Academic Code:

Name (Print): _____

Signature: _____



$\text{log odds} = \beta_0 + \beta_1 BW$

1. **In the figure above, you will find a display of data from a set of 100 Nepali infants showing whether each infant began breastfeedling within the first 2 weeks (1 – yes, 0 – no; jittered) against the child's birth weight (kg). Vertical lines are drawn at roughly the quintiles of birth weight. Use these data to estimate the coefficients in a simple logistic regression model.**

   Report:

   a. **The logistic regression equation and your approximate estimates of the coefficients in your model.**

Strata	BW (midpoint)	N	# Y = 1	Pr(Y=1)	Log(Pr(Y=1)/(1-Pr(Y=1))
1	2.42	20	8	0.40	-0.41
2	2.84	20	9	0.45	-0.20
3	3.06	20	13	0.65	0.62
4	3.26	20	17	0.85	1.73
5	3.64	20	10	0.5	0.00

Data simulated as: Log(Pr(Y=1)/(1-Pr(Y=1)) = 0 + 1 (BW – 3)

Using the data above: Log(Pr(Y=1)/(1-Pr(Y=1)) = 0.3 + 0.8 (BW – 3)

$.8 = \log\left[\frac{Pr(Y=1|BW=x)}{Pr(Y=0|BW=x)}\right] - \log\left[\frac{Pr(Y=1|BW=x-1)}{Pr(Y=0|BW=x-1)}\right]$

$\exp(.8) = 2.2 = \frac{Pr(Y=1|BW=x)/Pr(Y=0|BW=x)}{Pr(Y=1|BW=x-1)/Pr(Y=0|BW=x-1)}$

b. The approximate predicted probability of breast feeding within 2 weeks for a child with birth weight of 2 kg

8/20 = .40

Exp(0.3 + 0.8 (2 – 3)) / (1 + Exp(0.3 + 0.8 (2 – 3)) = 0.38

c. Your findings in a sentence or two for a public health journal. Be numerate, eliminate jargon to the extent possible.

In a sample of Nepali newborns with birthweights ranging from roughly 2 to 4kg, we observe a positive relationship between being breastfed and birthweight. For newborns who weight 2 kg, we estimate that 38% will be breastfed and the odds of breastfeeding increase by a factor of 2 (i.e. exp(0.8) = 2.22) per kg increase in birthweight.

log OR > 0
OR > 1

2. Below find two 2x2 tables showing: whether or not a person spent more than $1000 on medical services (Y), whether the person has a major smoking cause disease (mscd=1) or not (mscd=0), and age group.

Age < 65

	MSCD	
Y	0	1
0	5436	119
1	2028	323

Age ≥ 65

	MSCD	
Y	0	1
0	2647	280
1	1878	881

1 ≥ 65
0 < 65

$= \gamma_0 + \gamma_1 mscd$

The scientific question is whether the mscd effect on risk of an expenditure above $1,000 is the same for persons younger than 65 vs. older.

$Logit[Pr(Y=1 \mid mscd, age)] = \beta_0 + \beta_1 mscd + \beta_2 age$

$= \alpha_0 + \alpha_1 mscd + \alpha_2 age + \alpha_3 mscd \cdot age$

a. Conduct an analysis to answer this question.

Age < 65:

log(OR) = log[(323*5436) / (119*2028)] = 1.98

Var(log(OR)) = 1/323 + 1/5436 + 1/119 + 1/2028 = 0.012

Age ≥ 65

Log(OR) = log[(881*2647) / (280*1878)] = 1.58

Var(log(OR)) = 1/881 + 1/2647 + 1/280 + 1/1878 = 0.0056

Generate Two CIs for log OR

Z test for diff logOR

Diff: 1.98 – 1.58 = 0.40

Var(DIFF) = 0.012 + 0.0056

Se(DIFF) = 0.13

95% CI: 0.40 – 2 * 0.13, 0.40 + 2 * 0.13 -> (0.14, 0.66)

b. Write a sentence or two to report your findings to a public health audience. Be numerate. Avoid jargon!

Among persons at least 65 years of age, the odds of a big expenditure are an estimated 4.85 times greater for persons with a MSCD vs. those without. Whereas, for persons under 65 years of age, the odds of a big expenditure are an estimated 7.24 times greater for persons with a MSCD vs. those without. Accounting for the sample size and variation in the data, these estimates indicate that the odds ratio of a big expenditure comparing persons with and without a MSCD is greater for persons under 65 years of age (ratio of odds ratios: 1.49, 95% 1.15 – 1.93).