MS Module 15 Logistic regression odds ratio practice exam questions

[Module 15 for the 2nd edition of the textbook and Module 21 for the 3rd edition of the textbook.]

(The attached PDF file has better formatting.)

A probability Y is related to the independent variable X by logistic regression:

$$Y = \text{probability}(x) = \exp(\beta_0 + \beta_1 x) / (1 + \exp(\beta_0 + \beta_1 x))$$

! When X = 5.4, the probability Y is 31%
! When X = 6.2, the probability Y is 39%

Question 15.1: Odds ratio

At X = 5.4, what is the odds ratio of Y?

Answer 15.1: 31% / (1 – 31%) = 0.449

(odds ratio = probability / (1 – probability)

Question 15.2: Odds ratio

At X = 6.2, what is the odds ratio of Y?

Answer 15.2: 39% / (1 – 39%) = 0.639

(odds ratio = probability / (1 – probability)

Question 15.3: Multiplicative change in the odds ratio

What is the multiplicative change in the odds ratio, or $\exp(\beta_1)$, when x increases by 1 unit?

Answer 15.3: $(0.639 / 0.449)^{(1/(6.2 - 5.4))} = 1.554$

(the multiplicative change in the odds ratio, or $\exp(\beta_1)$, when x increases by 1 unit, =

(odds at point X_2 / odds at point X_1)$^{(1 / (\text{value of X2} - \text{value of X1}))}$

Question 15.4: Odds ratio

At X = 6.9, what is the odds ratio of Y?

Answer 15.4: $0.639 \times 1.554^{(6.9 - 6.2)} = 0.870$

(odds ratio at point X_3 = odds ratio at point X_2 × (multiplicative change in odds ratio)$^{(\text{value of point X3} - \text{value of point X2})}$

Question 15.5: Probability of Y

At X = 6.9, what is the probability of Y?

Answer 15.5: 0.870 / (1 + 0.870) = 46.52%

(probability = odds ratio / (1 + odds ratio)