MS Module 15 Logistic regression probability of success 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.)

[The practice problems in the 24 modules explain the statistical procedures; the practice exam questions in this thread shows what you will be asked on the final exam.]

A statistician uses a logistic regression model:

! The independent variable X is a quantitative predictor.
! The dependent variable Y is 1 if the observation is a success and 0 otherwise.

The estimate of β_1 is -0.21

The odds of success at X = 1.8 are 0.4493

Question 15.1: Probability of success

What is the probability of success at X = 1.8?

Answer 15.1: 0.4493 / (1 + 0.4493) = 31.00%

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

Question 15.2: Multiplicative change in the odds ratio

What is the multiplicative change in the odds ratio when x increases by 1 unit?

Answer 15.2: $e^{-0.21}$ = 0.8106

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

Question 15.3: Odds of success

What are the odds of success at X = 2.7?

Answer 15.3: 0.4493 × 0.8106$^{(2.7 - 1.8)}$ = 0.3719

(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 15.4: Probability of success

What is the probability of success at X = 2.7?

Answer 15.4: 0.3719 / (1 + 0.3719) = 27.11%

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

Question 15.5: Odds of success

What are the odds of success at X = 0?

Answer 15.5: $0.4493 \times 0.8106^{(0 - 1.8)} = 0.6557$

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

Question 15.6: Probability of success

What is the probability of success at X = 0?

Answer 15.6: $0.6557 / (1 + 0.6557) = 39.60\%$

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

Question 15.7: β_0

What is β_0?

Answer 15.7: $\ln(0.6557) = -0.4221$

($\beta_0 = \ln(\text{odd ratio at X} = 0)$)