Bruce Campbell ST-617 HW 1

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Chapter 3

Problems 6 and 9

Problem 6

For a logistic regression model we fit

$$p(X) = \frac{e^{\beta_0+\beta_1 X_1+\beta_2 X_2}}{1+e^{\beta_0+\beta_1 X_1+\beta_2 X_2}}$$

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beta_0 = -6
beta_1 = 0.05
beta_2 = 1

x_1 = 40
x_2 = 3.5

P_x <- function(beta_0, beta_1, beta_2, x_1, x_2) {
    e_x_dot_y <- exp(beta_0 + beta_1 * x_1 + beta_2 * x_2)
    result = e_x_dot_y/(1 + e_x_dot_y)
    return(unname(result))
}

prob_A = P_x(beta_0, beta_1, beta_2, x_1, x_2)
```

If a student studies 40 hours and has a GPA of 3.5 the estimated probability of getting an A is 0.3775407

b) Calculate the number of hours of study needed to have a 50% chance of getting an A

Let $\alpha = \beta_0 + \beta_2 * x_2 = -2.5$ and treat x_1 as an unknown in the log-odds equation

$$log\left(\frac{P(X)}{1-P(X)}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2$$

Which simplifies to $x_1 = \frac{2}{3} * \frac{1}{0.05} = 13.33$ when we put it 3.5 for x_2 and 0.5 for $P(X)$

Problem 9

a)

We use the definition of odds

$$odds = \frac{P(X)}{1-P(X)}$$

to calculate the probability. If the odds are .37 then $P(X) = \frac{.37}{1.37} = .27$ So the fraction of people defaulting with an odds of .37 is .27

b)

If someone has a 16% chance of default on a credit card payment then the associated odds is $\frac{.16}{(1-.16)} = .19$.