Introduction to Statistical Methods

Fall 2021 | Exam 4

Total Score: 20 Points + 4 Bonus Points

NOTE: If your calculator can't do exponentiation or taking the log, you only need to write down the expressions and do not need to calculate the results.

1. Consider the Logistic regression model predicting the chances of success ($Y = 1$):

$$logit(p_i) = log\frac{p_i}{1-p_i} = \beta_0 + \beta_1 X_1 + \beta_2 X_2$$

The estimated coefficients are: $\hat{\beta}_0 = 7.5$, $\hat{\beta}_1 = 2$, and $\hat{\beta}_2 = -4$.

(a) (4pts) What is the predicted *odds* of success for Person A with $X_1 = 1$ and $X_2 = 2$?

(b) (4pts) What is the predicted *probability* of success for Person A?
Hint: $p_i = \frac{exp(\beta_0+\beta_1 X_1+\beta_2 X_2)}{1+exp(\beta_0+\beta_1 X_1+\beta_2 X_2)}$.

(c) (4pts) Consider Person B with $X_1 = 2$. To keep Person B's predicted odds of success the same as Person A's, what should Person B's X_2 value be?

2. In her seminal work, Devah Pager's 2003 paper that came from her dissertation, titled "The Mark of a Criminal Record," examines the consequences of incarceration for the employment outcomes of black and white job seekers. She adopts an experimental audit approach — in which matched pairs of individuals applied for real entry-level jobs — to formally test the degree to which a criminal record affects subsequent employment opportunities. Please see below for a table reported in this article, which presents estimated coefficients in a logistic regression model predicting the likelihood of receiving a callback.

APPENDIX B

TABLE B1
LOGISTIC REGRESSION OF THE EFFECTS OF CRIMINAL RECORD AND RACE ON APPLICANTS' LIKELIHOOD OF RECEIVING A CALLBACK

	Coefficient	Robust SE
Criminal record	−.99	.24***
Black	−1.25	.28***
Criminal record × black ...	−.29	.38

NOTE.—SEs are corrected for clustering on employer ID in order to account for the fact that these data contain two records per employer (i.e., criminal record versus no criminal record). This model also controls for location (city vs. suburb) and contact with the employer, variables that mediate the relationship between race, crime, and employer responses.
*** $P < .001$.

(a) (4pts) First, let's ignore the interaction effect (i.e suppose that the model only includes criminal record and black but not their interaction. That is, we ignore the interaction term here.). Holding other factors constant, what is the *ratio* between the odds that a callback will happen when the job seeker has a criminal record and the odds that a callback will happen when the job seeker does **not** have a criminal record?

(b) (4pts) Still ignoring the interaction effect, holding other factors constant, what is the *ratio* between the odds that a callback will happen when the job seeker is **white** and the odds that a callback will happen when the job seeker is **black**?

(c) (Bonus 4pts) Now, suppose that the interaction term is included and is statistically significant. **Among black job seekers**, what is the *ratio* between the odds that a callback will happen when the job seeker has a criminal record and the odds that a callback will happen when the job seeker does **not** have a criminal record?