**Chapter 14: REGRESSION WITH A DICHOTOMOUS DEPENDENT VARIABLE: LOGIT MODELS**

**PRACTICE PROBLEMS**

1. We are interested in understanding the causes of post-traumatic stress disorder (PTSD) among police officers. We draw a sample of 100 officers from an urban police department and collect three pieces of information:

1. Whether they have or are currently experiencing the symptoms of PTSD
2. The number of years they have been on the police force
3. Whether or not they used their firearm to shoot someone during their duties

We estimate a linear probability model with PTSD as our dependent variable and the number of years on the force as our only independent variable. We get the following results:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Coefficientsa** | | | | | | |
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
| B | Std. Error | Beta |
|  | (Constant) | .702 | .064 |  | 10.969 | .000 |
| Number of Years on Force | -.043 | .006 | -.609 | -7.167 | .000 |
|  | | | | | | |

R2 = .37

With these results, answer the following questions:

a. Write out the full regression equation.

b. Interpret the constant.

c. Interpret the slope coefficient.

d. Using an alpha of .05, what is your decision about the null hypothesis: byrsontheforce = 0? Explain.

e. Interpret the value of R2.

f. What is the predicted probability of having PTSD for an officer who has 5 years on the force?

g. What is the predicted probability of having PTSD for an officer who has 15 years on the force?

2. We then added a new variable to the model, whether the officer shot someone while on duty, and here are our results:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Coefficientsa** | | | | | | |
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
| B | Std. Error | Beta |
|  | (Constant) | .557 | .068 |  | 8.191 | .000 |
| Number of Years on Force | -.038 | .005 | -.535 | -7.600 | .000 |
| Officer Shot Someone | .329 | .077 | .326 | 4.273 | .000 |
|  | | | | | | |

R2 = .47

With these results, answer the following questions:

a. Write out the full regression equation.

b. Interpret the slope coefficient for the number of years on the force.

c. Interpret the slope coefficient for whether or not the officer shot someone.

d. Using an alpha of .05, what is your decision about the null hypothesis: byrsontheforce = 0? Explain.

e. Using an alpha of .05, what is your decision about the null hypothesis: bofficershotsomeone = 0? Explain.

f. Interpret the value of R2.

g. What is the predicted probability of having PTSD for an officer who has 5 years on the force and had shot someone while on duty?

3. We now estimate a logistic regression model with the same data, first only including the number of years on the police force as an independent variable. Here are our results:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables in the Equation** | | | | | | | |
|  | | B | S.E. | Wald | df | Sig. | Exp(B) |
|  | YearsForce | -.453 | .102 | 19.724 | 1 | .000 | .636 |
| Constant | 2.095 | .603 | 12.071 | 1 | .001 | 8.125 |

With these results, answer the following questions:

a. Write out the regression equation.

b. Interpret the regression coefficient in terms of the log of the odds of the dependent variable.

c. Interpret the regression coefficient in terms of the percent change in the odds of the dependent variable.

d. Interpret the regression coefficient in terms of the effect on the predicted probability of PSTD for someone with 10 years on the police force.

e. Interpret the regression coefficient in terms of the odds multiplier.

f. Using an alpha of .05, what is your decision about the null hypothesis that byrsontheforce = 0? Explain.

4. As we did with the linear probability model, we then added a new variable to the model, whether the officer shot someone while on duty, and here are our results:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables in the Equation** | | | | | | | |
|  | | B | S.E. | Wald | df | Sig. | Exp(B) |
|  | YearsOnForce | -.443 | .108 | 16.825 | 1 | .000 | .642 |
| ShotSomeone | 1.400 | .628 | 4.970 | 1 | .026 | 4.055 |
| Constant | 1.286 | .689 | 3.484 | 1 | .062 | 3.618 |

With these results, answer the following questions:

a. Write out the full regression equation.

b. Interpret each regression coefficient in terms of the log of the odds of the dependent variable.

c. Interpret each regression coefficient in terms of the percent change in the odds of the dependent variable.

d. Using an alpha of .05, what is your decision about the null hypothesis: byrsontheforce = 0? Explain.

e. Using an alpha of .05, what is your decision about the null hypothesis: bofficershotsomeone = 0? Explain.

f. What is the predicted probability of having PTSD for an officer who has 10 years on the force and had shot someone while on duty?