APPLIED REGRESSION **Home Work - 8 - Solution** **SPRING**

Name: _____ **Instructor: D. Kushary**

Problem-1.

(a) The estimated model is

$$\hat{\pi} = \frac{1}{1 + e^{-(6.0709 - 0.0177\, x)}} \quad \text{where x = Speed}$$

(b) Null deviance= 34.617 Residual deviance= 20.364, it shows a significant improvement over null model. But to check the goodness of fit we use the HL-test which shows Chi-square = 4.8315 with 6 degrees of freedom and p-value = 0.5656. Hence it is good fit to the data.

(c) The $\hat{\beta}_1 = -0.0177$. Odds Ratio = $e^{\hat{\beta}_1} = 0.9825$. Using odds ration we can say that for every 1 unit increase of speed, the odds of hitting the target goes down by 100x(0.9825 - 1) = 1.75%.

(d) To test the addition of quadratic term: we set up the test as

$H_0 : \beta_2 = 0 \quad vs \quad H_1 : \beta_2 \neq 0$

The p-value for the above test is 0.989 which is much bigger than any reasonable α and hence we do not reject the null hypothesis. So addition of quadratic term did not improve the model significantly.

Problem-2.

(a) The estimated model is

$$\hat{\pi} = \frac{1}{1 + e^{-(-7.047 - 0.00007382\, x_1 + 0.9879\, x_2)}} \quad \text{where} \quad x_1 = \text{Income and} \quad x_2 = Age$$

(b) Null deviance= 27.726 Residual deviance= 21.082, it shows a significant improvement over null model. But to check the goodness of fit we use the HL-test which shows Chi-square = 4.7136 with 6 degrees of freedom and p-value = 0.581. Hence it is good fit to the data.

(c) The $\hat{\beta}_1 = 0.00007382$. Odds Ratio = $e^{\hat{\beta}_1} = 1.000074$. Using odds ration we can say that for every 1 unit ($1) increase of income, the odds of buying a car does not really change.

The $\hat{\beta}_2 = 0.9879$. Odds Ratio = $e^{\hat{\beta}_2} = 2.6855$. Using odds ration we can say that for every 1 unit (1 year) increase in age, the odds of buying a car goes up by 168.55%.

(d) The estimated probability that a family with an income of $45,000 and a car that is 5 years old will purchase a new vehicle in the next 6 months is 0.771.

(e) To test the addition of the interaction term: we set up the test as

$H_0 : \beta_3 = 0 \quad vs \quad H_1 : \beta_3 \neq 0$

The p-value for the above test is 0.107 which is much bigger than $\alpha = 0.05$ and hence we do not reject the null hypothesis. So addition of interaction term did not improve the model significantly.

(f) Odds ration for increasing the income by $1000 is $= e^{1000 \times \hat{\beta}_1} = e^{1000 \times 0.00007382} = 1.076613$. It means that odds of buying car goes up by 7.66%.

(g) 95% confidence interval for β_1 (the coefficients of x_1) is (-0.00005106, 0.0001987) and

95% confidence interval for β_2 (the coefficients of x_2) is (-2.683594, 4.659366)