Math 583 old Quiz 11 Name___________

Coefficient Estimates Full Model Poisson Regression

Label	Estimate	Std. Error	Est/SE	p-value
Constant	-0.406023	0.877382	-0.463	0.6435
bombload	0.165425	0.0675296	2.450	0.0143
exper	-0.0135223	0.00827920	-1.633	0.1024
type	0.568773	0.504297	1.128	0.2594

Coefficient Estimates Reduced Model Poisson Regression

Label	Estimate	Std. Error	Est/SE	p-value
Constant	-1.70097	0.506773	-3.356	0.0008
bombload	0.231122	0.0467598	4.943	0.0000

1) The response Y is the *number* of locations where aircraft was damaged. The output is from a Poisson regression. The variable *exper* = total months of aircrew experience while *type* of aircraft was coded as 0 or 1. Using the reduced model, find $\hat{\mu}(x)$ if x = bombload = 8. $ESP = \underline{\beta}^T \underline{x} = \hat{\beta}_1 + \hat{\beta}_2 x_2 = -1.70097 + 0.231122(8)$

$= 0.1480$

$\hat{\mu} = e^{ESP} = e^{0.148} = \boxed{1.1595}$

Logistic Regression Output

Response = y, Terms = (size xray)

Label	Estimate	Std. Error	Est/SE	p-value
Constant	-2.04463	0.609684	-3.354	0.0008
size	1.58827	0.699810	2.270	0.0232
xray	2.11944	0.746659	2.839	0.0045

Number of cases: 53, Degrees of freedom: 50

Deviance: 53.353

2) In a prostate cancer study, let the response variable y = *nodal invovement* = 0 for if absent and 1 if present. Let x_1 = *size* = 0 for small, 1 for large. Let x_2 = *xray* = *xray result* = 0 for negative, 1 for positive. Logistic regression is used. Predict $\hat{\rho}(\boldsymbol{x})$ if size = x_2 = 1 and xray result = x_3 = 1.

$ESP = \underline{\beta}^T \underline{x} = \hat{\beta}_1 + \hat{\beta}_2 x_2 + \hat{\beta}_3 x_3 =$

$-2.04463 + 1.58827(1) + 2.11944(1) = 1.6631$

$\exp(ESP) = \exp(1.6631) = \underline{5.2755} = e^{1.6631}$

$\hat{\rho} = \frac{\exp(ESP)}{1 + \exp(ESP)} = \frac{5.2755}{1 + 5.2755} = \boxed{0.8407}$

3) The GAM analog to the binary logistic regression model is $Y_1, ..., Y_n$ are independent with

$$Y|AP \sim \text{binomial}(1, \rho(\text{AP})) \quad \text{where} \quad \text{P(success|AP)} = \rho(\text{AP}) = \frac{\exp(\text{AP})}{1+\exp(\text{AP})}.$$

Then

$$\hat{\rho}(\boldsymbol{x}) = \hat{\rho}(AP) = \rho(EAP) = \frac{\exp(EAP)}{1+\exp(EAP)}.$$

If $\boldsymbol{x}$ is such that EAP = 2, find $\hat{\rho}(\boldsymbol{x})$.

$$\hat{\rho} = \frac{e^2}{1+e^2} = \frac{7.3891}{8.3891} = \boxed{0.8808}$$

4) The GAM analog to the Poisson regression model is $Y_1, ..., Y_n$ are independent with

$$Y|AP \sim \text{Poisson}(\exp(\text{AP})).$$

Then $\hat{Y} = E(Y|\boldsymbol{x}) = E(Y|AP) = \mu(\boldsymbol{x}) = \exp(AP)$ and

$$\hat{\mu}(\boldsymbol{x}) = \hat{\mu}(AP) = \exp(EAP).$$

If $\boldsymbol{x}$ is such that EAP = 3, find $\hat{\mu}(\boldsymbol{x})$.

$$\hat{\mu} = e^3 = \boxed{20.0855}$$