IS606 - Homework 8

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8.2 Baby Weights, Part II (p395)

a) Write the equation of the regression line.

$$y = 120.07 - 1.93x_{parity}$$

b) Interpret the slope in the context, and calculate the predicted birth weight of first borns and others. The slope 120.07 indicates the first born (parity = 0) would be predicted to weigh 120.07 ounces. The others born, based on the slope of -1.93 would be 118.14 oz.

c) Is there a statistically significant relationship between the average birth weight and parity? Given the p-value of 0.1052 for the parity parameter, I conclude there is not a statistically significant relationship between average birth weight and parity.

8.4 Absenteeism (p397)

a) Write the equation of the regression line.

$$y = 18.93 - 9.11x_{eth} + 3.10x_{sex} + 2.15x_{lrn}$$

b) Interpret each one of the slopes in this context.

- The slope of `eth` indicates that, all else being equal, there is a 9.11 day reduction in the predicted absenteeism when the subject is no aboriginal.
- The slope of `sex` indicates that, all else being equal, there is a 3.10 day increase in the predicted absenteeism when the subject is male.
- The slope of `lrn` indicates that, all else being equal, there is a 2.15 day increase in the predicted absenteeism when the subject is a slow learner.

c) Calculate the residual for the first observation in the data set: a student who is aboriginal, male, a slow learner, and missed 2 days of school. Using the R code below, we compute the predicted absentee days and further compute the residual against the actual missed days of school.

```
eth <- 0
sex <- 1
lrn <- 1
actualDaysMissed <- 2

absDaysPred <- 18.93 - 9.11 * eth + 3.1 * sex + 2.15 * lrn
absDaysPred
```

```
## [1] 24.18
```

```
residual <- actualDaysMissed - absDaysPred
residual
```

```
## [1] -22.18
```

The residual is -22.18 days.

d) The variance of the residuals is 240.57 and the variance of the number of absent days for all students in the data set is 264.17. Calculate the R^2 and adjusted R^2. Note that there are 146 observations in the data set. The following R code computes the R^2 and adjusted R^2:

```
n <- 146
k <- 3
varRes <- 240.57
varOut <- 264.17

R2 <- 1 - (varRes / varOut)
R2
```

```
## [1] 0.08933641
```

```
adjustedR2 <- 1 - (1 - R2) * ( (n-1) / (n-k-1) )
adjustedR2
```

```
## [1] 0.07009704
```

8.8 Absenteeism, Part II (p399)

Based on the adjusted R^2=0.0723, the learner status variable, `lrn`, should be removed first.

8.16 Challenger disaster, Part I (p403)

a) Each column of the table above represents a different shuttle mission. Examine these data and describe what you observe with respect to the relationship between temperatures and damaged O-rings. Observationally, I see that damaged o-rings are infrequent when temperature is greater than or equal to 66^o. On the other hand, 63^o and below, there is consistent damage to one or more o-rings.

b) Failures have been coded as 1 for a damaged O-ring and 0 for an undamaged O-ring, and a logistic regression model was fit to these data. ... Describe the key components of this summary table in words. The model summary is given below:

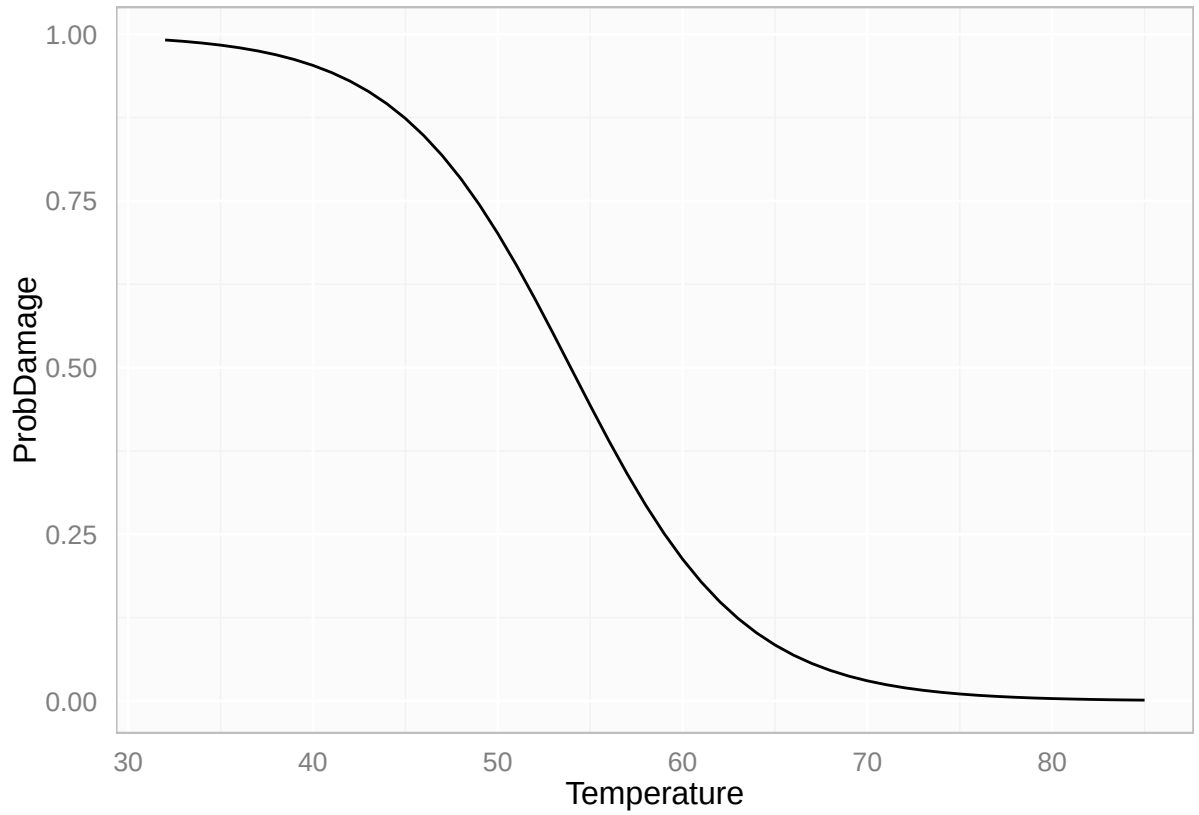
```
##             Estimate StdError zValue PrAbsZ
## Intercept    11.6630   3.2963   3.54  4e-04
## Temperature  -0.2162   0.0532  -4.07  0e+00
```

The key components are the Intercept and the Temperature values. The Estimate identifies the parameter estimate for the model. The Z value and the P-value aid with distinguishing significant parameters from less significant parameters.

c) Write out the logistic model using the point estimates of the model parameters.

$$\log_e(\frac{p_i}{1-p_i}) = 11.6630 - 0.2162x_{temp}$$

d) Based on the model, do you think concerns regarding O-rings are justified? Explain. First, lets look at the model probabilities graphically.



Given the high probabiliy of damage to O-rings under 50^o ($> 70.12\%$) according to the model and the fact that the O-rings are "Criticality 1" components, I do think concerns regarding the O-rings are justified.

"Criticality 1" : meaning that there was no backup if both the primary and secondary O-rings failed, and their failure would destroy the Orbiter and kill its crew. See https://en.wikipedia.org/wiki/Space_Shuttle_Challenger_disaster.

8.18