STAT 520 Homework 3

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September 22, 2017

3.1. 1. Random variable in this question is OXY and the covariate is body mass.

2. By doing Box-Cox plot with 6 bins in Figure 1, we find a straight line could be used to roughly describe the relation between log mean and log standard deviation, with a slope of about 1.09. That suggests a variance function of something like $V(\mu_i) = \mu_i^{2.18}$. While for gamma random component we have μ_i^2, I would choose the random component of this model to be **gamma**.

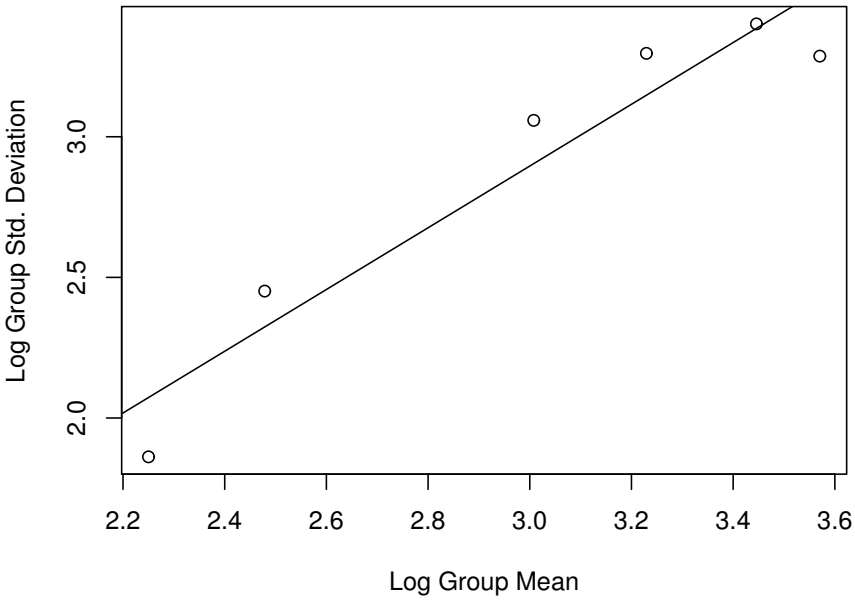


Figure 1: Box-Cox Plot from OXY and body mass

3. In the plot of the logarithm of responses against the covariate values in Figure 2. With the exception of a couple of points, a straight line seems to be a reasonable description of this plot, so we might try a model with **gamma random component** and **log link**.

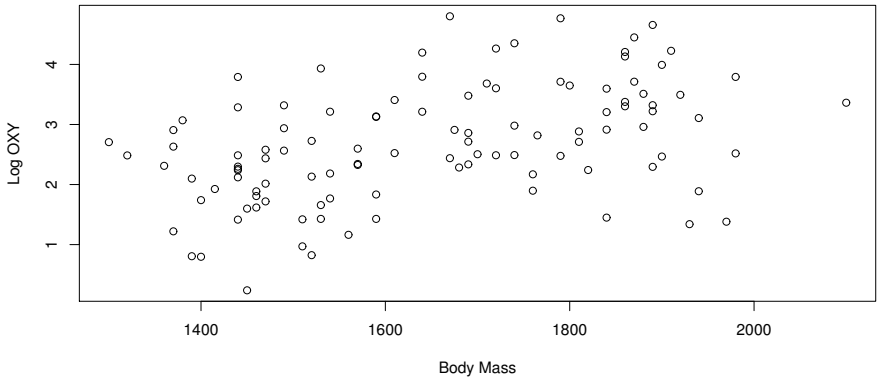
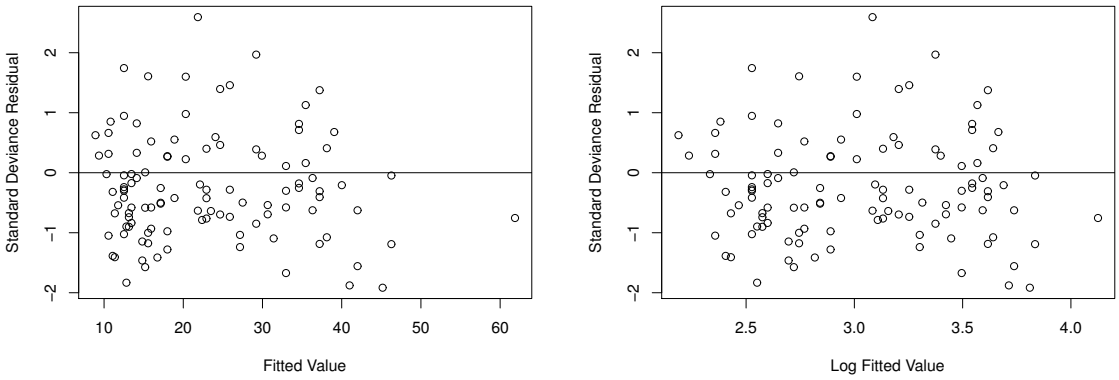


Figure 2: Scatterplot of log transformed responses against covariates

And after fitting this model, we gave the residual plots in Figure 3 and from the one with log fitted values we can see the residual plot is pretty good. Hence the log link function not a bad choice here.



(a) (b)

Figure 3: Residual Plots

4. Results of fitting a basic GLM:

$\hat{\beta}_0$	-0.9605936
$\hat{\beta}_1$	0.002421781
95 % CI for $\hat{\beta}_0$	(-2.47653, 0.5553304)
95 % CI for $\hat{\beta}_1$	(0.001487, 0.0033130)
unscaled deviance	76.5991
scaled deviance	89.41392
log likelihood for fitted model	-144.0595
log likelihood for saturated model	-99.35258

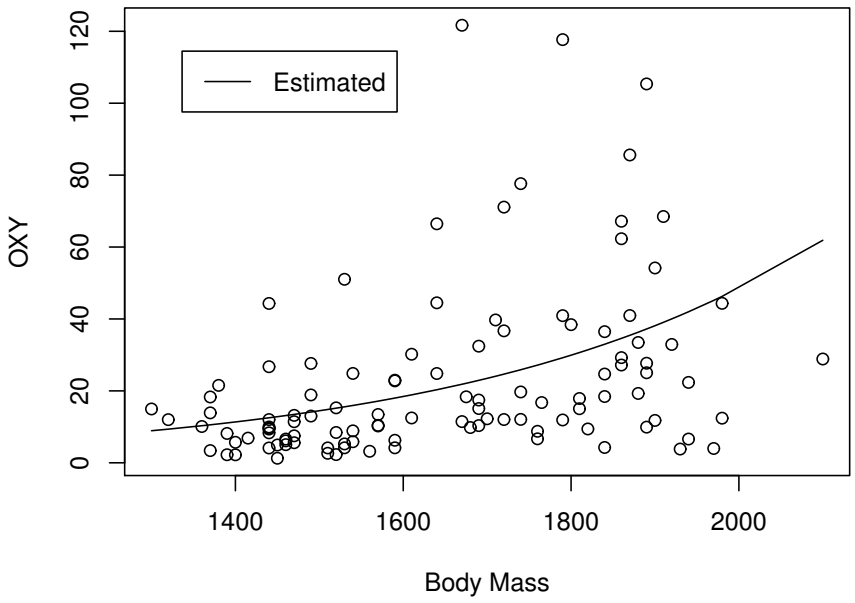


Figure 4: Scatter plot and estimated expected value

3.2. 1. Scatter plot of simulated data:

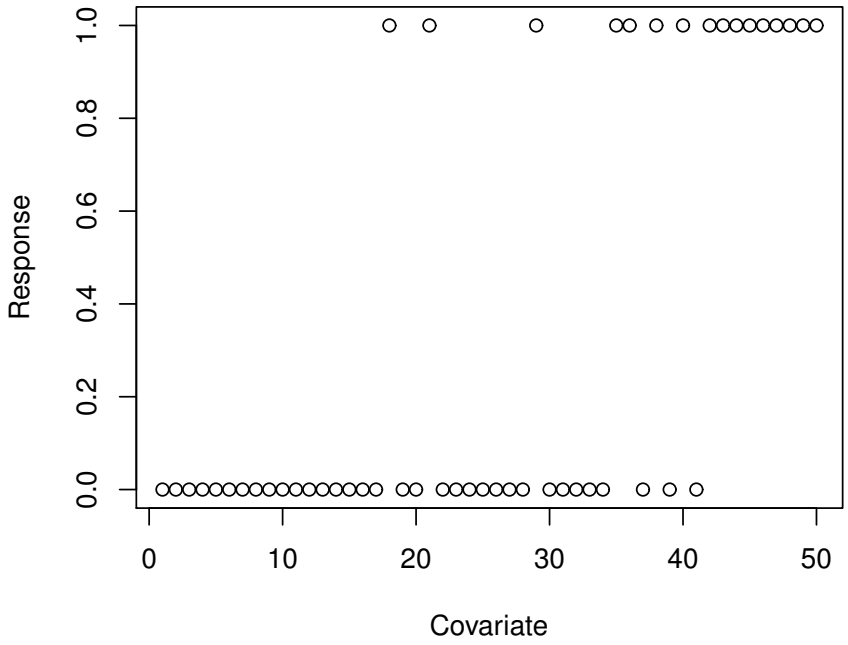


Figure 5: Scatter plot of simulated data

$\hat{\beta}_0$	-5.253796
$\hat{\beta}_1$	0.1365626
95 % CI for $\hat{\beta}_0$	(-7.81967727, -2.6879138)
95 % CI for $\hat{\beta}_1$	(0.06938077, 0.2037445)
unscaled deviance	33.63338
scaled deviance	33.63338
log likelihood for fitted model	-16.82295

The fitted line and true line are shown in Figure 6:

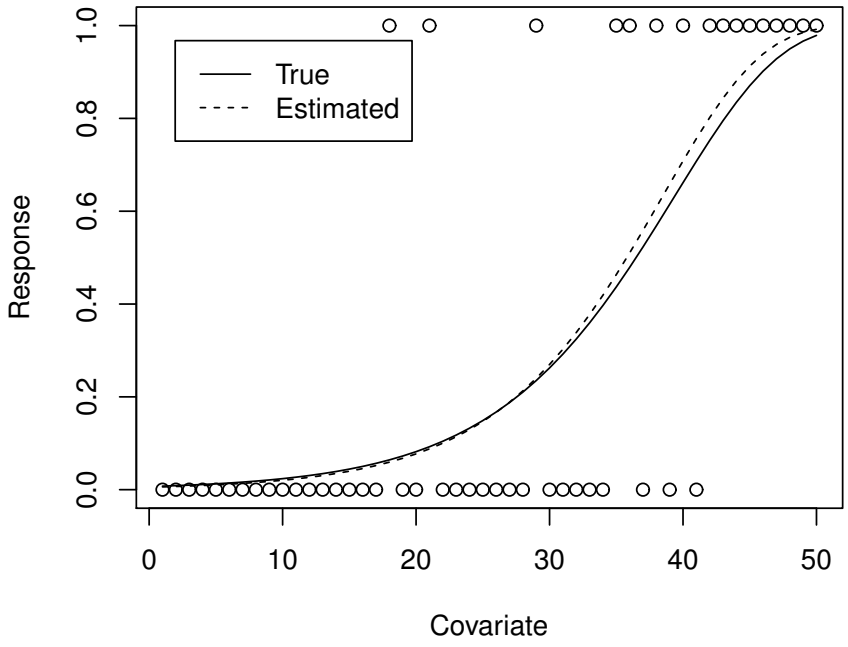


Figure 6: True and estimated line

2. Fitted expectations and pointwise 95% confidence band:

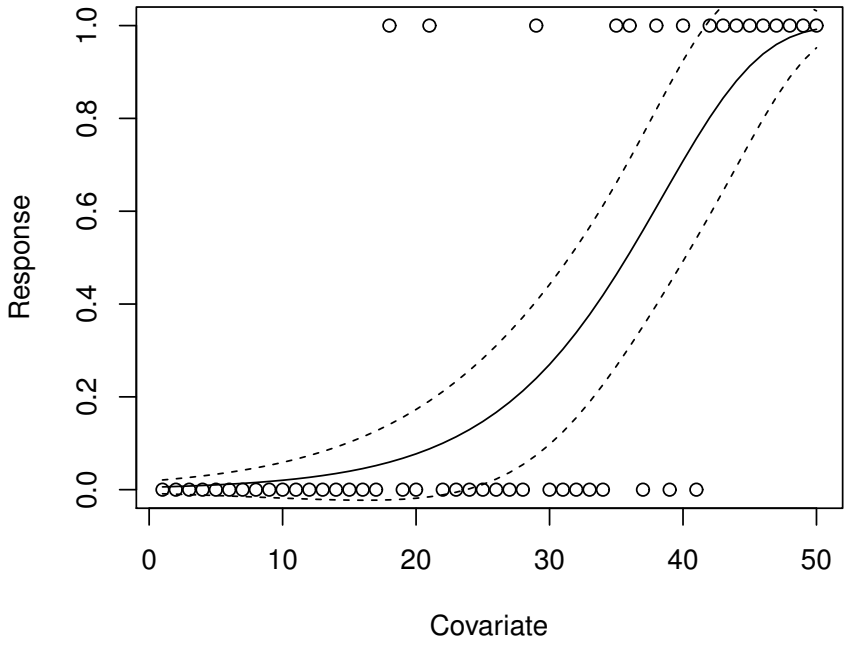


Figure 7: Fitted line with 95% pointwise confidence band