FISH 6004. Assignment 3

Due November 9, 2021

Marks: 25% of course total

Please copy R scripts and outputs into a word file and submit to me. Organize and label your results clearly. Use captions for any tables or figures you create. You will be marked for clarity of presentation as well as correct results. Email your completed assignment to me, noel.cadigan@mi.mun.ca

1. For the data y= c(2,8,4,1,5,5,2) that are Poisson distributed
    a. Plot the profile negative log-likelihood function of the Poisson mean, over the range 1 to 20. (*5 marks*)
    b. Indicate on the plot (use a vertical line) where the maximum likelihood estimate (mle) of the Poisson mean parameter is. Also, plot the average of the sample y. (*5 marks*)
2. The artificial survey data in assignment 1 (i.e. survey.dat) were generated from a Poisson distribution with a separate mean for each stratum.
    a. Fit a Poisson GLM with a mean parameter for each stratum (*10 marks*)
    b. Plot the means and 95% profile likelihood confidence intervals (*10 marks*)
    c. Based on these results, if 2 strata are to be combined in future surveys, which 2 strata would you suggest to combine? (*5 marks*)

Hints: R factors can be used to estimate the mean for each stratum. First create a factor variable, i.e. data$fstrat = factor(data$stratum). To fit a GLM with no intercept and a mean for each stratum, use the R model catch ~ -1 + fstrat in the GLM function.

3. Consider the logistic maturity model: $prob(age) = \frac{exp(\theta_0+\theta_1 age)}{1+exp(\theta_0+\theta_1 age)}$
    a. Derive the age at 50% maturity, A_{50} defined as prob(A_{50}) = 0.5. Show that the maturity range (MR) is MR = A_{75}-A_{25}= 2log(3)/θ_1. (*5 marks*)
    b. For the data in the attached file (mat_1993c.dat), estimate A_{50} and provide a 95% bootstrap confidence intervals for the estimate. (*5 marks*)
    c. For the data in b) estimate MR and provide a 95% bootstrap confidence intervals for the estimate. (*5 marks*)

More R help. There are several ways to bootstrap a GLM. The parametric bootstrap is really easy – it involves simulating bootstrap data from the statistical model using the parameter estimates, and then get bootstrapped parameter estimates. Here is some R code for the Binomial logistic regression in question 3). It assumed the data is in a list called matdata.

```
bootdata=matdata
ny = length(bootdata$y)
```

```
nboot=1000
boo = matrix(NA,nrow=nboot,ncol=length(coef(Binfit)))
for(i in 1:nboot){
  bootdata$y = rbinom(ny,bootdata$n,pred.prob)
  Binfiti <- glm(cbind(y,n-y) ~ age,family=binomial(link = "logit"),data=bootdata)
  boo[i,]=coef(Binfiti)
}
```

4. For the growth data in Example 3.6 in Haddon.
    a. Fit the Francis formulation of the VonB growth model. (*10 marks*).
    b. Provide residual plots. Does this model fit OK? (*5 marks*).
    c. Provide confidence intervals for parameters estimates. (*5 marks*).
    d. provide pair-wise plots of bootstrapped parameter estimates. Comment on the results compared to other models we fit to these data in class. (*5 marks*).

Hint: I think the easiest way to do this is using a residual function (i.e. gfit()).

5. For the 3LN redfish data provided
    a. fit a Schaefer Surplus Production model with B_o freely estimated but with MSY fixed at 21,000 tonnes. (13 marks)
    b. Provide a nice looking table of parameter estimates and confidence intervals. (5 marks)
    c. Plot biomass and harvest rates and identify relevant reference points on the graphs. Provide B/Bmsy and H/Hmsy. How do these results compared to the MSC published results we looked at in class? (7 marks).