**Question 1**

The Poisson distribution is often used to model the discrete (integer) number of occurrences of some event in a defined time period or space, when the events occur independently. Examples include the number of fish caught on in a haul, the number of organisms within a specific area, the number of tropical cyclones during a season. Its expected value and variance are equal and, as such, variability increases with Y. The probability mass function can is parameterized as follows:

where is the rate parameter (expected number of occurrences),

is the number of observed number of occurrences,

sample

The log likelihood can be parameterized by taking the log of the probability mass function:

For optimization we often take the log of “f( )”.

1. Find the analytical Maximum Likelihood Estimate of by taking the derivative of “” and setting it equal to zero.
2. In R fit a Poisson distribution to the number of mackerel eggs collected as part of the 1992 mackerel survey using analytical and numerical methods (“optim”). The data are in “mack.csv”
3. Plot the observed data vs data simulated from the same distribution. How do they compare?

Extra Credit: Newton’s Method is a numerical approach for finding when the root of a the negative log-likelihood function = 0. It works by taking an initial guess for () then repeating:

Where nll is the first derivative of the negative log-likelihood and is the second derivative of the negative log-likelihood. Until some convergence criteria, such as:

In R, write a Newton’s Method and solve for .

1. How many iterations does Newton’s method need to converge?
2. The standard error of can be calculated as . How does that compare to using optim?

Send me your answers: grant.adams@noaa.gov