Matlab Files for Logistic Regression

NR_logistic.m

```
% This Matlab code provides a function that uses the Newton-Raphson algorithm
% to calculate ML estimates of a simple logistic regression.  Most of the
% code comes from Anders Swensen, "Non-linear regression."  There are two
% elements in the beta vector, which we wish to estimate.
%
function [beta,J_bar] = NR_logistic(data,beta_start)
  x=data(:,1);                  % x is first column of data
  y=data(:,2);                  % y is second column of data
  n=length(x)
  diff = 1; beta = beta_start;  % initial values
  while diff>0.0001             % convergence criterion
    beta_old = beta;
    p = exp(beta(1)+beta(2)*x)./(1+exp(beta(1)+beta(2)*x));
    l = sum(y.*log(p)+(1-y).*log(1-p))
    s = [sum(y-p);                % scoring function
         sum((y-p).*x)];
    J_bar = [sum(p.*(1-p))    sum(p.*(1-p).*x);    % information matrix
             sum(p.*(1-p).*x) sum(p.*(1-p).*x.*x)]
    beta = beta_old + J_bar\s       % new value of beta
    diff = sum(abs(beta-beta_old)); % sum of absolute differences
  end
```

beetle.m

```
% This Matlab program illustrates the use of the Newton-Raphson algorithm
% to obtain maximum likelihood estimates of a logistic regression.  The data
% and much of the code are taken from Anders Swensen, "Non-linear regression,"
% www.math.uio_no/avdc/kurs/ST110/materiale/opti_30.ps.
% First, load and transform data:
load 'beetle.dat';                    % load data
m=length(beetle(:,1))                 % count the rows in the data matrix
x=[];                                 % create empty vectors
y=[];
for j=1:m                             % expand group data into individual data
 x=[x,beetle(j,1)*ones(1,beetle(j,2))];
 y=[y,ones(1,beetle(j,3)),zeros(1,beetle(j,2)-beetle(j,3))];
end
beetle2=[x;y]';
% Next, specify starting points for iteration on parameter values:
beta0 = [0;
         0]
% Finally, call the function NR_logistic and use its output
[betaml,Jbar] = NR_logistic(beetle2,beta0)
covmat = inv(Jbar)
stderr = sqrt(diag(covmat))
```

Data and Output for Logistic Regression

Data input

Dose	Number of insects	Number killed
1.6907	59	6
1.7242	60	13
1.7552	62	18
1.7842	56	28
1.8113	63	52
1.8369	59	53
1.8610	62	61
1.8839	60	60

Iterations in the Newton-Raphson algorithm

Iteration s	$\beta_0^{(s)}$	$\beta_1^{(s)}$	$l(\beta^{(s)})$
0	0.0000	0.0000	-333.4038
1	-37.8564	21.3374	-200.0098
2	-53.8532	30.3835	-187.2743
3	-59.9652	33.8442	-186.2471
4	-60.7078	34.2648	-186.2354
5	-60.7175	34.2703	-186.2354
6	-60.7175	34.2703	-186.2354

Estimated covariance matrix

$$\begin{pmatrix} 26.8398 & -15.0822 \\ -15.0822 & 8.4806 \end{pmatrix}$$

Standard errors of estimators for β_0 and β_1

5.1807, 2.9121