FISH 502 Assignment #9
DUE: March 27, 2008
Decision tables and management advice

Estimating model parameters and characterizing uncertainty is only half the battle in fisheries stock assessment. Fisheries stock assessment is about making decisions between alternative policy options. Total allowable catches (TAC) or annual quotas are based on predictions about the future biomass relative to management objectives. Decision tables consisting of a range of TAC options and probabilistic statements (i.e., a representation of risk) about the status of the stock or exploitation rates are usually constructed and presented to managers to allow for informed decision making.

Use your Age-structured assessment model (ASAM) and the Namibian Hake data to construct a decision table for harvest in 1988 using discrete TAC values ranging from 0 to 1.8 million t. For each quota policy, calculate the probability of the stock falling below the biomass reference point B_{MSY} in 1989, and the probability of the exploitation rate exceeding U_{MSY} in 1988 (for example, Table 1).

Table 1: Decision table format; one of the objectives of a risk based stock assessment is to construct such a table and populate the columns with probabilities such that a decision maker can evaluate how much risk is involved with a given TAC policy.

TAC	$P(B_{1989} < B_{MSY})$	$P(U_{1988} > U_{MSY})$
0	-	-
0.1	-	-
...	...	...
2MSY	-	-

To carry out this task, you'll have to append the 1988 quota policy to the observed catch time series and re-run ASAM to predict the biomass in 1989 (i.e., just run ASAM with one more year of catch data). For each quota option, and each parameter combination determine if the resulting biomass is greater or less than B_{MSY} and if the exploitation rate is less than or greater than U_{MSY} (i.e. biomass and exploitation status). Score these status points as binary values (0 for good, 1 for bad). If you then plot the binary scores versus TAC option you can fit a Generalized Linear Model (binomial(logit)) to these data and determine the probabilities for your decision table.

Question

What is the probability of $P(B_{1989} < B_{MSY})$ and $P(U_{1988} < U_{MSY})$ if the TAC for 1988 is set to the maximum likelihood estimate of MSY?

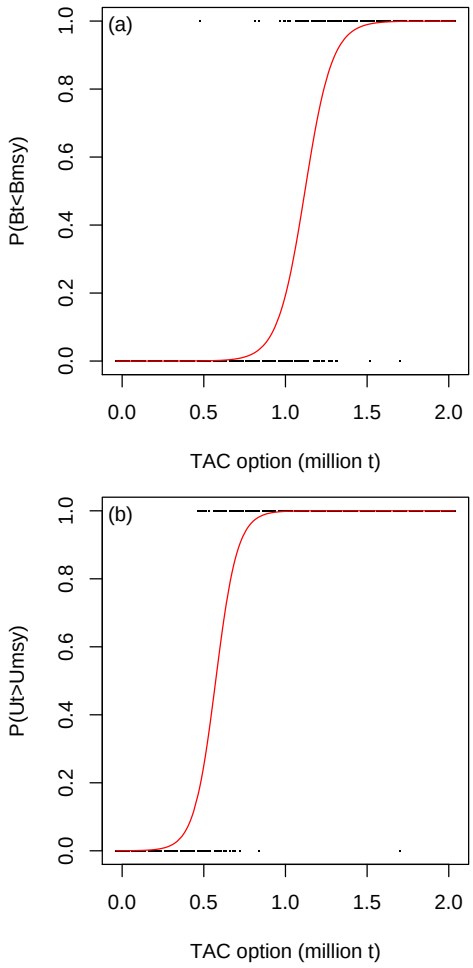

Figure 1: Probability of the 1989 biomass falling below B_{MSY} (panel a) and the probability of the exploitation rate exceeding U_{MSY} versus the 1988 quota option.

Psuedocode for a forecasting function

1. Append new TAC to catch vector.
2. Run ASAM for 1 to nyrs + 1 for a given Θ.
3. Score (0-good, 1-bad) biomass and exploitation status.
4. Repeat 1-3 for each combination of Θ and TAC option (say 100 random samples for Θ and 20 TAC options).
5. Fit Generalized Linear Models (e.g., glm(bstat ~ tac, family=binomial(logit), see Fig. 1) to the resulting outputs.
6. Fill in the corresponding probabilities in Table 1 based on the GLM regressions.