February 19, 2007

FW663 Midterm I Exam

This exam is a take-home, open-book exercise. There are 3 sets of questions; you must answer all of them. You may use any reference material (class notes, assigned reading, library material, WWW site, etc.). Under NO circumstances are you to discuss this exam with classmates or any other individual. You are to work independently and you should not confer with others. If you need clarification on a question, please email gwhite@cnr.colostate.edu or doherty@cnr.colostate.edu and ask for clarification by 5:00pm Tuesday, 20 February. This exam is to be turned in by 4:00 pm Wednesday, 21 February, to Dr. Doherty or Dr. White. Turn in this sheet and your answers and computer files on CDs, or USB drives. **Question 1 should be stapled in a separate bundle with its own CD from Questions 2 and 3 because each bundle will be graded by a different individual. Identify each page of your answer sheets and your computer files with your student number only.** Only put your name (via your signature) on this sheet.

By my signature below, I certify that I have not collaborated with anyone concerning any material related to this examination.

_____	_____	_____
Student Number	Signature	Date

Question 1 (40 points): Survival of Sooty Terms. Pretty much a real issue, but simulated data.

This question is based on a real bird on a real island with a real incinerator. The data are simulated and some of the biology is simplified. Although not needed to answer the question, for those interested in the problem, see these websites for more information. Again this is for your information only – not expected to be needed to answer the question.

Sooty Terns see http://bna.birds.cornell.edu/BNA/account/Sooty_Tern/
Johnston Atoll see http://en.wikipedia.org/wiki/Johnston_Atoll
JACADS incerator see http://www.johnstonmemories.com/jacads.htm
SOI index see http://www.bom.gov.au/climate/current/soihtm1.shtml

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The Sooty Tern (*Sterna fuscata*) is a long-lived seabird species that colonially nests on islands around the world. The tern lays one egg a year, but does not reach maturity (i.e.; able to breed) until age three. Birds do return to the breeding island in the second year of life as "pre-breeders" and much courtship behavior takes place. Interestingly, the Sooty Tern does not have a gland to help waterproof feathers and the tern is thought to stay aloft the entire time not on land.

One place that Sooty Terns live is Johnston Atoll (located about 800 miles southwest of Hawaii). Johnston Atoll is a National Wildlife Refuge with over 500,000 seabirds nesting on it. Johnston Atoll has also served as an important military outpost. During World War II the Atoll served as an emergency runway for airplanes. Atmospheric nuclear tests were conducted from the Atoll in the middle of 20th century. In fact, a malfunctioning nuclear weapon had to be destroyed on the launch pad – spreading plutonium around the island. During the Vietnam War, herbicides and nerve gas were stored on the island. Due to an arms-reduction treaty with Russia, the US built an incinerator on Johnston Atoll to burn nerve gas munitions. The US Fish and Wildlife Service and EPA are charged with assessing the effects of this incinerator on seabirds and contract a biologist to perform the work. One part of the assessment is to estimate survival of Sooty Terns upwind and downwind of the incinerator. Pollutants come out of the incinerator smokestack during burning and the area downwind of the incinerator is thought to be negatively affected. In fact the housing for people is only located upwind and when the prevailing winds aren't blowing in the correct direction, burning does not take place. During June of each year from 1985 to 1993 terns are marked and recaptured upwind and downwind of the proposed incinerator site (2 areas). During this time no differences in survival due to location are expected. Each tern is noted as a juvenile (banded at the nest), pre-breeder, or breeder upon initial capture (3 age classes). The incinerator was finished being constructed and started operation in June of 1993 and stopped operation in June 1999. Data were collected through June 1999. Some hypotheses concerning the incinerator include that birds downwind of the operating incinerator are negatively affected only after the first year of operation, that birds are affected during all years of operation, that effects decrease over time, and that only fledglings are affected. El Niño and La Niña are also suspected of affecting tern survival and such an effect can be indexed by the Southern Oscillation Index (SOI) collected in

December of each year (The December SOI values are provided electronically in the input file as well as below). Negative SOI values indicate El Niño conditions and positive values indicate La Niña conditions. El Niño conditions are thought to be bad for tern survival, and La Niña is thought to be good for tern survival. Detection may differ by age, area, and time.

Assume $\hat{c} = 1$. Southern Oscilliation Index (SOI) values

Year	SOI
1985	2.1
1986	-13.6
1987	-4.5
1988	10.8
1989	-5
1990	-2.4
1991	-16.7
1992	-5.5
1993	1.6
1994	-11.6
1995	-5.5
1996	7.2
1997	-9.1
1998	13.3
1999	12.8

There are 15 occasions (1985-1999). The six groups for the input file (**`terns.inp`**) are ordered:

group 1 - Birds banded upwind as adults (Up Ad)
group 2 - Birds banded downwind as adults (Dw Ad)
group 3 - Birds banded upwind as pre-breeders (stage lasts 1 year) (Up PB)
group 4 - Birds banded downwind as pre-breeders (stage lasts 1 year) (Dw PB)
group 5 - Birds banded upwind as juveniles at nest (stage lasts 1 year) (Up Juv)
group 6- Birds banded downwind as juveniles at nest (stage lasts 1 year) (Dw Juv)

The data for this problem are in the file **`terns.inp`**. Make sure to hand in a copy of your MARK files (both the DBF and FPT files) as part of your answers

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1) a) Construct and run a $\{\varphi(\text{age})\ p(\text{age})\}$ model.
Construct and run a $\{\varphi(\text{age+area})\ p(\text{age})\}$ model.
Construct and run a $\{\varphi(\text{age+SOI})\ p(\text{age})\}$ model.
Construct and run a $\{\varphi(\text{age+area+SOI})\ p(\text{age})\}$ model.

b) Present a table of model results. (20 pts)

c) What are your conclusions concerning important factors affecting survival? Supply beta estimates and confidence intervals. (5 pts)

d) Present a graph of survival and a graph of detection for the 3 ages in the two areas across the study period. Due to having six lines on the graph do not include confidence intervals. (5 pts)

2) Justify, and specify 2 additional models to those above (do not run these models). (5 pts)

3) If not all birds return at age 2 – some individuals choose to stay at sea until year 3 – how would this affect survival rates of pre-breeders and breeders? [5 pts]

Question 2 (35 points): Estimation of fidelity in mallards. Real problem, simulated data.

Within waterfowl in general, and ducks in particular, females often have higher mortality rates, probably due to their greater role in parental care, and waterfowl generally have a male-biased sex ratios. This allows for females to have a choice of mates on the winter grounds, with males then following females to their preferred breeding areas. However, survival rates are known to vary annually due to breeding habitat conditions, hunting season regulation changes, and wintering area conditions.

Historically, the fidelity of waterfowl to breeding and rearing areas has been thought to mostly be associated with females returning to the area where they were hatched. Thus, following this scenario, female ducks of species such as the mallard (*Anas platyrhynchos*) are thought to be more philopatric than males, and adults are more philopatric than juvenile birds.

To study philopatry in mallards, a team of waterfowl biologists have banded mallards at Greenhead National Wildlife Refuge (GNWR) in North Dakota, 1993-2002. Each August, mallards of both sexes are banded, with young birds (hatch year – HY) and adults (after hatch year – AHY) both identified. The amount of effort to capture birds each year was reasonably constant, but the total number of captures varied because of changes in water levels on the refuge. Two different types of bands from the Bird Banding Laboratory (BBL) were used. In early years, all bands with the words "ADVISE, WRITE WASHINGTON DC" stamped on them were used, but in 1995 a new band type was instituted with a toll-free telephone number stamped on them. As a result of both the convenience of a toll-free phone number and advertisements placed in hunting magazines by the BBL, the reporting rates of bands have increased during the period of this study. Because you expect the band reporting rate to increase for all bands during the study, the data for both band types have been pooled into a single group (and thus band type is ignored in this analysis).

Fidelity to GNWR is thought to vary across years due to habitat conditions, but researchers are more concerned with estimating relative differences in fidelity rates for the 4 age X sex classes. Encounter histories for the birds banded, recaptured, or later recovered dead are in the file **`mallards.inp`**. The 4 groups (in order) are AHY Females, AHY Males, HY Females, are HY Males.

Because entire broods are occasionally banded, and paired adults are often banded, extra-binomial variation is expected with these data. Past work has suggested that $\hat{c}$ = 1.9 is appropriate. If you have time, you can check this assumption for some additional credit. As part of your answer, provide the MARK DBF and FPT files.

A. (20 pts) What set of models did you develop to answer this question about differences in fidelity of the 4 age and sex classes. Explain your reasoning for including each model.

B. (10 pts) What do you conclude about differences in the fidelity of the 4 age and sex classes?

C. (5 pts) Is there a change in band reporting rates for these data that can be explained by the increasing use of the toll-free phone number?

Question 3 (25 points): Population dynamics of Northern Spotted Owls. Real species and simulated data.

The northern spotted owl (*Strix occidentalis caurina*) owl is a medium-sized, nocturnal owl that inhabits coniferous forests along the Pacific Coast of North America from southern British Columbia to central California. Because of the association between northern spotted owls and old forests, conservation of the owl and its habitat has been extremely contentious among environmentalists, the timber industry, land managers, and scientists since the early 1970s. This species is particularly amenable to monitoring via capture-resighting techniques. Adult territorial birds (both sexes) are easily captured by "mousing", i.e., holding out a domestic mouse for the owl to take, and capturing them with a noose pole or net. Birds are then marked with colored plastic leg bands, giving each owl a unique identity.

Owls have been marked and monitored on multiple study areas in Washington, Oregon, and California from 1990 to the present. Here, we are going to analyze just 2 of these study areas, one from Oregon and one from Washington. Because of differences in the timber harvesting policies of the 2 states, we are interested in whether there are differences in the rate of population change between the 2 study areas. Each study area is monitored annually to detect previously marked owls, as well as to mark both members of pairs that are new territory holders. Although occasionally males will defend a territory without a female present, this is an uncommon situation.

Live encounter data are provided in the file **`NSO.inp`** for 17 occasions (1990-2006), with 4 groups (Oregon females, Oregon males, Washington females, Washington males). As part of your answer, provide the MARK DBF and FPT files.

A. (5 pts) Is there evidence of extra-binomial variation in these data? Provide the evidence for your answer.

B. (13 pts)What are your estimates of the rate of population change for the Oregon and Washington study areas? Are the different timber harvesting strategies having an impact on owls? Provide some justification for why you ran the models you did to estimate these parameters.

C. (7 pts) What do you consider to be the most important assumptions required to support the above conclusions? Provide your reasoning for each of the assumptions you give.