UNIVERSITY OF BRITISH COLUMBIA
BIOLOGY 300 — MIDTERM EXAMINATION

Prof. D. Schluter

February 13, 1998

NOTE: There are 5 questions in total. Answer all 5 in the space provided.

TIME: 50 minutes

NAME: ____ (Please print)

STUDENT ID#: ____

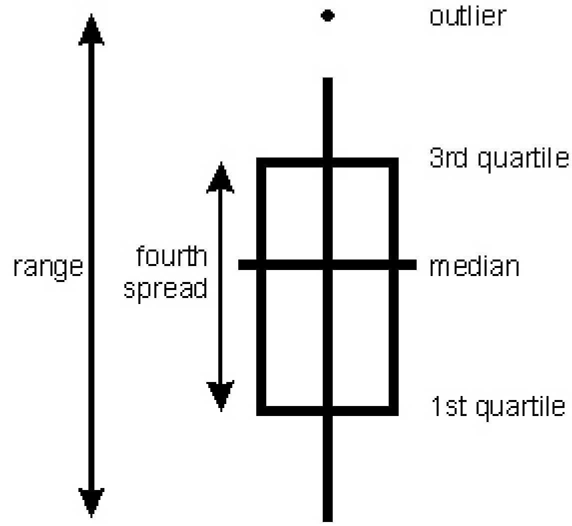
LAB SECTION (circle one):

MON. PM
TUE. AM
TUE. PM
WED. AM
WED. PM
THU. AM
THU. PM
FRI. PM

SCORE:

Question	Maximum	Obtained
1	6	________
2	6	________
3	6	________
4	6	________
5	6	________
Total	30	________

1. a) Illustrate a box plot and identify three of its features.



c) When testing a statistical hypothesis, why is it inappropriate to accept the null hypothesis when $P > 0.05$? (answer in 25 words or less).

Because of the possibility of a Type II error. It is always possible that a difference exists that we were unable to detect.

2. a) An ecologist studying a population of brown pelicans took beak measurements on 18 randomly sampled individuals. The following results were obtained for beak length: $\bar{X} = 34.5$, $s = 2.58$. Construct a 99% confidence interval for mean beak length in the pelican population. What assumption(s) do you make?
Assume that beak lengths have a normal distribution in the population, and that the 18 individuals consistitute a random sample.

$$34.5 \pm 2.898 \times 2.58/\sqrt{18}$$

$$32.7 \leq \mu \leq 36.3$$

b) A recent study of births in Scotland found that the ratio of males:females was 106:100. In a random sample of 2000 newborns, what is the probability that at least 1000 will be female?

Binomial calculation, use the normal approximation with continuity correction
$p = 100/206$, $\mu = np = 970.87$, $\sigma = \sqrt{np(1-p)} = 22.35$

$$z = \frac{1000 - 970 - .5}{22.35} = 1.281$$

$P(z \geq 1.281) = 0.100$

3. Define in less than 25 words:

a) Standard error.

The standard deviation of the distribution of possible values for the statistic. For example the standard error of the mean is the standard deviation of $\bar{x}$.

b) Significance level.

A probability (α) used as a criterion for rejecting the null hypothesis. If $P < \alpha$ then $\mathbf{H}_o$ is rejected.

c) Independent events.

Events A and B are independent if $\mathbf{P(A\ and\ B) = P(A) \times P(B)}$.

4. In the great tit (*Parus major*), only half of the males born in a given year survive their first winter. As part of a study into the causes of variation in male life history, a researcher examined whether male great tits from the same nest (i.e., brothers) had independent survival probabilities and whether these probabilities were the same for males in all nests. She banded two male offspring from each of 40 nests. She decided that if survival probabilities (p) of males were equal and independent, then the number of surviving brothers from a nest should follow a binomial distribution with $n = 2$ and $p = 0.5$. Her results are given below. With these data, test whether the number of surviving males from a nest follows a binomial distribution with $n = 2$ and $p = 0.5$.

No. of surviving males	Frequency of nests
0	15
1	10
2	15
	40

H$_o$: The number of surviving brothers follows a binomial distribution with $p = .5$
H$_A$: The number of surviving brothers does not follow a binomial distribution with $p = .5$

Use the binomial distribution with $p = .5$ **to generate expected frequencies:**

X	f_i	$\hat{f}_i$
0	**15**	**10**
1	**10**	**20**
2	**15**	**10**
	40	**40**

$\chi^2 = 10.00$, $\chi^2_{.05,2} = 5.991$.
Since $\chi^2 > 5.991$, $P < 0.05$, **reject H$_o$.**

5. Does work affect longevity? To test this, a study monitored the lives of two groups of men, all 50 years of age at the start of the study. Men in one group were retired and without employment. Men in the second group worked steadily throughout the study. After 10 years, the number of deaths in each group was recorded. Ten of the 65 retired men died before reaching the age of 60, whereas only 5 of the 70 working men died. With these data, test whether mortality rates differed between the two groups of men.

H_o: Mortality rates do not differ between groups (ie mortality is independent of work status).
H_A: Mortality rates differ between groups (ie mortality is not independent of work status).

	Retired	**Working**	**row sums**
Died	**10 (7.22)**	**5 (7.78)**	**15**
Survived	**55 (57.78)**	**65 (62.22)**	**120**
column sums	**65**	**70**	**135**

$\chi^2 = 1.559$ ($G = 1.570$), $df = 1$ **(use Yates correction)**
$\chi^2_{0.05,1} = 3.841$. **Since** $1.559 < \chi^2_{0.05,1}$, $P > 0.05$, **therefore do not reject H_o**