

Name: _____ Student number: _____

MID-TERM BIOL 300: February 2012

Instructions:

1. Make sure that your copy of the test includes 6 pages, including this one.
2. Answers can be in ink or pencil. If you want the possibility of re-marking, use ink.
4. Other than a non-programmable calculator, no electronic devices are permitted. Please turn off your cell phone and leave it in your bag.
3. Students who engage in dishonest practices will be subject to disciplinary action.
4. By taking this test and putting your name above, you are declaring that your answers on this test are all your own work.
5. Students may not speak or in any other way communicate with other students while in the examination room.
6. Students may not expose their written paper to other students. The excuse of accidental exposure, forgetfulness, or ignorance will not be accepted.

Some questions have a box for the final answer. Please put the final answer in this box, and show your work in the other space provided (use the back of the page if necessary).

I have read and fully understand these instructions.

Student signature _____

Mark allocation:

Question	Marks possible	Your mark
1.	16	
2.	23	
3.	21	
4.	10	
5.	10	
6.	20	
Total	100	

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1. What statistical test would you use in each of the following situations? Give the full name of the test, and if needed state the frequency distribution used for your null model. (For this question, you do NOT need to do the tests.)

- a. A friend hands you a large stack of playing cards. You pick one card at a time randomly, replacing the card and shuffling each time. Out of 9 cards, 7 are red and 2 are black. You want to test the null hypothesis that half of the cards in the deck are red and half are black. (4 points)

1a.

- b. You are interested in whether a rare grassland plant (“species A”) has a clumped, random, or dispersed distribution in space. You examine 50 quadrats, each 1 meter by 1 meter in size, and you count the number of individuals of species A in each quadrat. (4 points)

1b.

- c. You measure the heights of 29 randomly sampled Western Hemlock trees in Pacific Spirit Park, and then want to use the data to test the null hypothesis that the mean height of the population of these trees in the park is 35 m. (4 points)

1c.

- d. You are studying survival rates (i.e. proportion that survive) of two species of birds during a severe storm. You want to test the null hypothesis that survival rate is the same in the two species. Your total sample size is only 17 individuals. (4 points)

1d.

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2. In birds, wing length shows a strong relationship with long-distance flight ability. A random sample of 5 Swainson's Thrushes (a species that migrates to South America) in Pacific Spirit Park had the following wing lengths, in centimeters:

9.6 9.8 9.6 9.3 9.1

For fun, we calculated the sum of these wing lengths ((sum of Y_i) = 47.4 cm) and the sum of the squared wing lengths ((sum of (Y_i^2)) = 449.66 mm²). Using this sample, calculate estimates of the following summary statistics for the population (remember to include a few decimal places in your calculations, to avoid rounding error):

a. Median (3 points)

2a.

b. Mean (3 points)

2b.

c. Variance (3 points)

2c.

d. Standard deviation (3 points)

2d.

e. Standard error of the mean (4 points)

2e.

f. 99% confidence interval for the population mean (7 points)

2f.

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3. In birds, dark feathers are thought to be more resistant than light feathers to feather-degrading bacteria. Coastal Plain Swamp Sparrows are more darkly colored than Southern Swamp Sparrows. Some researchers wanted to examine whether this might be due to an evolutionary response to higher exposure to feather-degrading bacteria in the habitats where the Coastal Plain Swamp Sparrows live. They temporarily captured some of each sparrow species and determined how many of each had feather-degrading bacteria in their feathers. The results are shown in this contingency table:

	Bacteria	No bacteria
Coastal Plain Swamp Sparrow	33	7
Southern Swamp Sparrow	18	27

a. What is the name of a good statistical test to apply to these data? (2 points)

3a.

b. Clearly state an appropriate null hypothesis and an alternative hypothesis. (4 points)

c. Assuming random sampling, carry out the statistical test (which you stated above) to determine whether you can reject the null hypothesis (which you stated above). Assume $\alpha = 0.05$. Give the P-value as precisely as possible from the statistical tables, and interpret your results in words. Show your work. (15 points)

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4. Songbirds visiting a feeder are at risk of being preyed upon by predators such as Cooper's Hawks. Typically, the songbirds take turns watching for predators while others are feeding, and the watchers make an alarm call if they perceive a predator. The watchers are very careful, and sometimes alarm when there are no predators.

The probability of a predator being present on a visit to the feeder is 0.03. When a predator is present, the probability of an alarm call is 0.80; when there is no predator, the probability of an alarm is 0.30. You are a hungry songbird, trying to decide whether to go to the feeder. You hear an alarm call. What is the probability that a predator is present? (10 points)

4.

5. In the African savannah, elephants like to eat very young trees. Imagine that, in a section of the savannah, the mean height of young trees is 20.0 cm, with a variance of 16.0 cm². Assume that young tree height is normally distributed. What percentage of young trees would be eaten if elephants eat all trees shorter than 26.0 cm? (10 points)

5.

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6. You plan to conduct a hypothesis test using a significance value of $\alpha = 0.05$.

a. What is the probability of committing a Type I error? (3 points)

6a.

b. Explain what a Type II error is: (3 points)

c. What effect does increasing sample size have on the probability of a Type I error? (3 points)

d. What effect does increasing sample size have on the probability of a Type II error? (3 points)

e. Still using a significance value of $\alpha = 0.05$, you plan to conduct hypothesis tests on four independent null hypotheses, using independent data sets every time. If all the null hypotheses are true, what is the probability that two out of four will be rejected? (8 points)

6e.