MIDTERM 1 (ver 1)

Great Blue Herons

STA 110 E:: Statistics and Data Analysis in Psychology and Biological Sciences
Thursday, 29 Feb 1996.
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Name ______________________________

Notes:

1. This is an open book and open notes exam.
2. You must show your work and explain your answer in order to receive credit.
3. The exam has 5 problems.
4. The exam carries 100 points.
5. The points assigned to each problem are indicated at the beginning of that problem. Use them to plan your time. You have 75 minutes to finish.

Problem	1	2	3	4	5	Total
Score	/15	/20	/20	/20	/25	

Great Blue Herons 1 [15 pts]. Boiley, Champoux, and Boubronnas *et al.*[1] investigated retinoids and β-carotene in the eggs of Great Blue Herons collected at sites along the St. Lawrence River. Retinoids in the eggs were investigated because they are considered a biomarker for chemical contaminants that impair the mechanisms for storage of retinoids. The following set of observations was found by Boiley, Champoux, and Boubronnas *et al.* (1994) for sum of PCB's ($\mu g \quad g^{-1}$) in eggs of Great Blue Herons collected at nine different sites.

3.482	4.123	3.448	2.300	1.757	1.600	7.818	4.770	7.159

Find the:
(i) mean
(ii) standard deviation for the first four observations
(iii) five-number summary
(iv) identify outliers if present

[1]Boiley, M.H., Champoux, L., Bourbonnais, D.H., DesGranges, J.L., Rodrigue, J., and Spear, P.A. (1994). β-carotene and retinoids in eggs of Great Blue Herons (*Ardea herodias*) in relation to St. Lawrence contamination. *Ecotoxicology,* **3**, *271-286.*

Great Blue Herons 2 [20 pts]. It was found that 34% of eggs of Great Lakes' Herring Gulls collected at a particular site have toxic levels of DDT (is toxic).

A particular method for using a biomarker to asses DDT levels in the eggs of Great Lakes' Herring Gulls indicates toxic levels in 93% of the contaminated eggs and indicates toxic levels in 21% of eggs not contaminated with DDT. One egg is sellected at random. What is the probability that the egg

(i) is not toxic.

(ii) is indicated as non-toxic.

(iii) is not toxic given that it is indicated as non toxic.

Great Blue Herons 3 [20 pts]. It was found that 34% eggs of Great Lakes' Herring Gulls collected at a particular site have toxic levels of DDT. A random sample of $n = 4$ eggs of Great Lakes' Herring Gulls is selected. Let X be the number of contaminated eggs in the sample.

(i) Find the mean and the variance of X.

(ii) What is the probability that there is at least one contaminated egg in the sample?

(iii) If the sample size $n = 200$, find an approximation to the probability that $X = 60$.

Great Blue Herons 4 [20 pts].

(i) Construct the 98 % confidence interval for the population mean for sum of PCB's ($\mu g \;\; g^{-1}$) in eggs of Great Blue Heron using the data set from problem **1** (the sample standard deviation for the 9 observations is $s = 2.219$).

(ii) If you knew the population standard deviation $\sigma = 2$, what sample size you would need to obtain a 98% confidence interval of length less than or equal 0.2.

Great Blue Herons 5 [25 pts]. The average level of PCB's in a sample of five collected eggs of Great Blue Herons at a particular site near an area with heavy industrial use is found to be 6.3 ($\mu g \;\; g^{-1}$). Previous studies suggest that the population mean for levels of PCB's in the eggs of Great Blue Herons is 5.7 ($\mu g \;\; g^{-1}$) and the population standard deviation $\sigma = 0.6 \;\; (\mu g \;\; g^{-1})$.

(i) What research hypothesis (H_1) would you suggest?

(ii) Perform the test at level $\alpha = 0.05$.

(iii) Would you change your decision if $\alpha = 0.005$?

(iv) Find the p-value.

(v) What is β? Find β against the alternative $H_1 : \mu = 7$.