Biometry mid-term exam Spring 2012

NAME: _____

Ungraded poll question:

Rank your interest in each of the three topics for Week 14 (1=most interested, 3=least interested) :

Experimental design (e.g., split plot designs, etc.):

Spatial statistics (e.g., point patterns, kriging, etc.):

Time series (e.g., autocorrelation functions, etc.):

(250 pts total):

Section 1 – Short answer

1. (10 pts) What is the probability density function for a Poisson distribution with parameter λ?

2. (10 pts) What is the probability mass function for a binomial distribution with parameters n and p?

3. (10 pts) What distribution has the following probability density function?

$$f(x|\alpha,\beta) = \frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)} x^{\alpha-1}(1-x)^{\beta-1}, \alpha > 0, \beta > 0$$

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4. (15 pts) Complete the following limits:

$$\lim_{n\to\infty} Binom(n,p) \to$$

$$\lim_{\lambda\to\infty} Pois(\lambda) \to$$

$$\lim_{\alpha\to\infty} Gamma(\alpha,\beta) \to$$

5. (10 pts) Fill in the blanks to construct the 1-α confidence interval for the mean of X where X~N(μ,σ^2) when the parametric variance is unknown.

$$P(\qquad\qquad \leq \mu \leq \qquad\qquad) = 1-\alpha$$

6. (10 pts) Using an equation, state the Central Limit Theorem.

7. (10 pts) Using an equation, state Bayes Theorem.

8. (1 pt each) Name the R functions used to do the following tests:

The t-test: _____

The Wilcoxon rank sum test: _____

The F-test: _____

The correlation test: _____

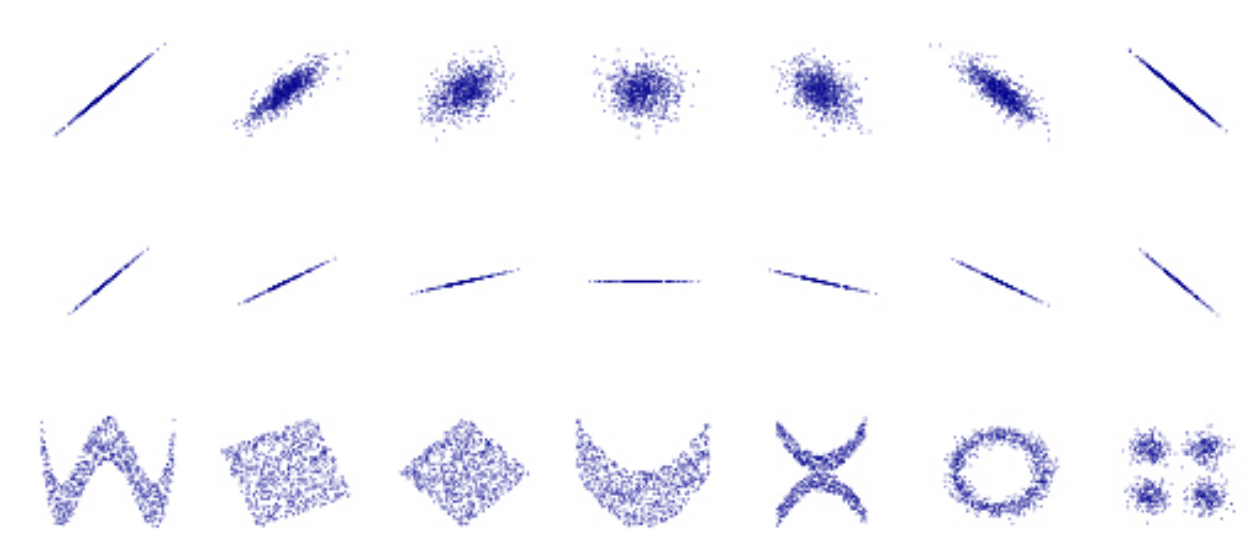
The chi-squared test: _____

The Binomial (a.k.a. proportions) test: _____

The Kolmogorov-Smirnov test: _____

9. (10 pts) When and why do we use Fisher's transformation of the correlation coefficient r?

10. (13 pts) Estimate the Pearson product-moment correlation coefficients for the following scatterplots (write answer next to scatterplot, there are 21 panels in total). Note that for some panels, only rough estimates will be possible; make sure that the relative magnitude and signs are correct among the plots. There is one panel for which the Pearson product-moment correlation coefficient is Undefined. Please mark it accordingly.



11. (15 pts) Fill in the three empty boxes.

Test	Hypothesis (assuming two-tailed tests)	Test statistic T	f(T|H_0) (Distribution of T under H_0)	Assumptions
Two sample paired t-test	$H_0: \mu_A = \mu_B$ $H_A: \mu_A \neq \mu_B$			

Section 2 – Long answer

12. (40 pts) Assume you have a fair coin. How many times would you have to flip the coin to prove that the coin is fair (or, stated more precisely, how many times would you have to flip the coin in order for the width of your 95^{th} percentile confidence intervals to be smaller than 0.01). (Since you don't have calculators, your answer should be an equation that includes DEFINED variables. You must define any variables used in your calculation.)

12.(40 pts) Consider the following data for the abundance of a certain species of bird.

Sex	Spring	Summer	Fall	Winter
Males	163	135	71	43
Females	86	77	40	38

Explain using words and equations how you would test the null hypothesis that the ratio of males to females was the same in all four seasons using (I) a parametric test and (II) a non-parametric test.

13. (50 pts) In a study of tadpole predation, *n* identical tanks containing N tadpoles each (and their predators) are monitored and the number of tadpoles eaten k_i (i=1,2,…,n) in each tank (i=1,2,…n) recorded.

Part I: What is the appropriate distribution for the number of tadpoles eaten (10 pts)?

Part II: Using the probability distribution in Part I, write down the likelihood function describing the likelihood of getting the set of observations k_i (i=1,2,…,n) conditional on the parameters of the distribution (10 pts).

Part III: Using the result from Part II, calculate the maximum likelihood estimator (or estimators) for the distribution parameter(s). (Full credit requires that you show all your work for the calculation.) (20 pts)

(PAGE LEFT BLANK AS EXTRA SPACE FOR SHOWING YOUR WORK)

Part IV: Defining all necessary parameters, write the R code required to calculate the maximum likelihood estimator(s). Substantial partial credit will be given if you can write down the correct steps, even if you are not sure the correct R functions to use. No points will be deducted for syntax errors that do not reflect errors in statistical thinking. (10 pts)