BST 140.652 Final Exam
Notes:

- You may use your one 8.5 by 11 formula sheet.
- Please use only the basic mathematical functions on your calculator.
- Show your work on all questions. Simple "yes" or "no" answers will be graded as if blank.
- Please be neat and write legibly. Use the back of the pages if necessary.
- There are three questions one per page. Each question has multiple parts.
- Good luck!

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signature and **printed name**

1. A matched retrospective case/control study was conducted to investigate an airborne environmental toxicant's effect on lung cancer. The data are given below

	Cases	
Controls	Exposed	Unexposed
Exposed	13	0
Unexposed	5	15

   a. Consider the null hypothesis $H_0 : P(E \mid C) = P(E \mid \bar{C})$ where C is case status and E is exposure status. Argue that this null hypothesis implies the hypothesis $H_0 : O(C \mid E) = O(C \mid \bar{E})$ where O refers to odds. You can use any fact proved in class or homework. Be clear, but brief.

   b. Perform the relevant test by reporting a P-value. Interpret your result.

   c. State the assumptions required for the test.

2. Consider comparing a treatment for redness placebo. The two are applied to **three** subjects' left and right eyes respectively. Suppose that a quantitative measure of the redness in each eye is obtained. Let W_+ denote the sign-rank statistic (sum of the positive ranks) for the difference in this measure between the treated and untreated eye (treated - untreated).

   a. Derive the distribution for W_+.

   b. Researchers are interested in whether or not the treatment *reduces* redness. The treatment is known not to increase redness. Suppose data were such that $W_+ = 6$. Give an appropriate P-value and interpret the results of the test. Remember to state your hypotheses; defining any notation that you use.

3. These are three unrelated problems.

   a. Consider the person/time data below comparing cancer incidence rates between four groups.

Group	Number of cancer cases	Person years at risk
1	Y_1	t_1
2	Y_2	t_2
3	Y_3	t_3
4	Y_4	t_4

   Consider the null hypothesis that the incidence rates are the same across the four groups; $H_0 : \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda$. Under the null hypothesis, what would the ML estimate of λ be (symbolically)? Do not derive!!! Just give the answer.

   b. Consider the P-values of six tests.

Test	P-value
1	.155
2	.040
3	.002
4	.001
5	.204
6	.035

   Perform the these tests, controlling the familywise error rate at $.05$.

   c. Consider two pathologists rating tumors on a scale of $1-4$. Give the most extreme example that you can of a contingency table (by filling in some fictitious counts) that demonstrate association but not agreement.