BI476
Spring 2018
Midterm Exam
4/23/2018
Time Limit: 100 Minutes

Name: ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

ID: ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

This exam contains 9 pages (including this cover page) and 18 problems. Check to see if any pages are missing. Enter all requested information on the top of this page, and put your initials on the top of every page, in case the pages become separated.

This is an open-book exam. You can use your books, notes, or any calculator on this exam.

Question:	1	2	3	4	5	6	7	8	9	10
Points:	20	2	2	2	2	2	2	2	2	2
Score:										

Question:	11	12	13	14	15	16	17	18		Total
Points:	2	5	5	10	10	10	10	10		100
Score:										

True or False

1. (20 points) Mark the following statement as TRUE or FALSE. If FALSE, tell the reason.

   (a) ___The main purpose of randomization in RCTs is to reduce the bias (to balance the confounding factors).

   (b) ___In a cohort study, one and only one (more than one) outcome can be used to assess the effect of the exposure.

   (c) ___A cohort study is a prospective (or retrospective) study.

   (d) ___Paired t-test can be applied to test for the parallel and equivalence design in clinical trials.

   (e) ___Double Blinding is the gold-standard of a randomized clinical trial.

   (f) ___The bias induced by historical control can be completely alleviated by concurrent control.

   (g) ___Randomization can be used to control for the potential confounding factors in a case-control study.

   (h) ___Both Efron's biased coin randomization and Wei's urn randomization are dynamic randomization.

   (i) ___A randomized clinical design can be nested, such as permuted block design nested in cluster design.

   (j) ___The order of the covariates in an analysis of covariance has no effect on the assessment of the main effect of the factors.

Multiple Choices

2. (2 points) In order to balance the confounder, randomization is the critical process in an RCT. Which ones of the following approaches are not really systematic, randomization approach:

    A. Allocation based on the admission date or day (even or odd) - quasi-randomization

    B. Allocation based on the hospital or clinic record number (even or odd) - quasi-randomization

    C. Allocation based on the availability of the intervention. - ad lib

    D. Allocation based on the clinic center. - ad lib

    E. Allocation based on the dice throwing.

3. (2 points) Of the 202 patients suffering from protrusion of the intervertebral disc in a hospital, the distribution of age is summarized in the following frequency table. The best intuitive way to present the distribution of age is through

Table 1: Frequency table of age suffering from protrusion

Age (Year)	10+	20+	30+	40+	50+	60+	Total
Patients	6	40	50	85	20	1	202

    A. barchart   B. histogram   C. pie graph   D. scatter plot

4. (2 points) In order to predict the vital capacity through weight, which of the following method should be used?

    A. Pearson's correlation   B. Spearman's correlation   C. linear regression   D. analysis of variance   E. case-control study

5. (2 points) A permuted block randomization study is conducted to compare 4 medicines. A two-way analysis of variance shows that $F_{medicine} = 7.604(p < .01)$ and $F_{block} = 1.596(p > .05)$. According to the significance level $\alpha = .05$, the conclusions about the effects of 4 medicines and 5 blocks should be

    A. Both of the effects of 4 medicines and the effects of 5 blocks are different.

    B. Can NOT determien whether the effects of medicines and blocks are different.

    C. The effects of 4 medicines are different; but could NOT determine whether the effects of blocks are different.

    D. The effects of blocks are different; but could NOT determien whether the effects of medicines are different.

    E. There are big differences of the effects among 4 medicines, but could NOT say that the effects of 5 blocks are different.

6. (2 points) In which of the following situations, the continuity correction is not necessary for performing a χ^2-test for a 2×2 contingency table?

    A. $T > 1$ and $n > 40$ B. $T > 5$ or $n > 40$ C. $T > 5$ and $n > 40$ D. $1 < T < 5$
    E. $T > 5$ and $n < 40$

7. (2 points) In order to evaluate the effects (the outcome are recored as no change, better, effective, cured) of 3 drugs, which of the following is the best tool?

    A. t-test   B. ANOVA   C. χ^2-test   D. Kruskal-Wallis rank-sum test   E. Mann-Whitney U-test

8. (2 points) When using Wilcoxon's rank-sum test to compare two independent samples, the observations in these two groups are $\{0, 0, 7, 14, 32, 40\}$ and $\{0, 1, 2, 4, 4, 8\}$. The zeros in the two groups should be ranked as

    A. 2,3;1   B. 1.5,1.5;3   C. 2,2;2   D. 2.5,2.5;1   E. should be removed

9. (2 points) In order to study the effect of the drug "magic", 50 patients with stomach ulcer are chosen from a hospital. They are randomized to two groups: the "magic" group and the "grains" group, which is usually prescribed to the patients with stomach ulcer. The drug "grains" is called the

    A. experiment control   B. blank control   C. standard control   D. historical control E. mutual control

10. (2 points) Prevalence is a

    A. rate   B. proportion   C. ratio   D. cummulative incidence

11. (2 points) You would like to see if persons who have grab bars placed in their shower are less likely to suffer falls there. You plan to enroll 100 persons to receive the grab bars and compare their fall experience over the next year with 100 persons who did not receive grab bars. Which of the statements below is a feature of this study design?

    A. Studies of this design are unlikely to be affected seriously by bias whether or not they are randomized.

    B. The preferred outcome measure for this design is the odds ratio.

    C. The study as described yields age-specific incidence rates for history of fall in the past year.

    D. The study design is well suited to address temporal sequence of risk factors and outcomes.

Short Answer

12. (5 points) In order to detect the associationship between smoking habits and bronchitis, a questionaire is designed. Three questions are proposed by the investigator:

    (1) do you smoke?

    (2) do you often smoke? (never, occasionally, sometimes, frequently)

    (3) how many cigarettes did you smoke yesterday?

    Answer the following questions:

    (a) What are the types of data collected by the 3 questions?

(b) What are the relationships between these data?

(c) What are the advantages and disadvantages of them?

13. (5 points) Two-way ANOVA and repeated-measures ANOVA.

(a) What's the difference betwen two-way ANOVA and repeated-measures ANOVA?

(b) Write down the ANOVA tables for the two ANOVA analyses.

14. (10 points) Equivalence design.

(a) When do we need to conduct a equivalence design?

(b) Write down the null hypotheses of equivalence design?

(c) For a binomial outcome, how to conduct analysis to assess the clinical equivalence?

15. (10 points) Randomization techniques.
   (a) What are the advantages of simple complete randomization over fixed randomization?

   (b) What are the advantages of Wei's Urn randomizaton over Efron's biased coin randomization?

(c) What are the advantages of random permuted block design over simple permuted block design?

Data Analysis

16. (10 points) Fasting blood-glucose is measured in 17 pregnant women (9 with pregnant syndrome, 8 without). The results are summarized in the following table. Do the two groups show different levels in glucose endurance on average? Try to provide the detailed analysis procedure.

Table 2: Fasting blood-glucose (mmol/L) for the two groups of pregnant women

Without pregnant syndrome	2.50	-1.60	1.70	3.00	0.40	4.50	4.60	2.50	
With pregnant syndrome	3.70	6.50	5.00	5.20	0.80	0.20	0.60	3.40	6.60

17. (10 points) To evaluate 4 medicines on reducing blood-fat, 120 patients with high blood-fat were recruited according to certain criteria. They were randomized to 4 groups (each with 30 individuals) under double-blinded fashion. Low-density lipoprotein (LDL) was measured before treatment and 6 weeks after the treatment. The data were analyzed by ANOVA, and the results are summarized in the following table. Please fill in the blanks, while giving the necessary explanation and the final conclusion.

Table 3: Results of ANOVA for comparison between 4 medicines

Source of variation	SS	DF	MS	F	p-value
Between-groups	_____	_____	_____	_____	$< .001$
Within-groups	46.4	_____	_____		
Total	82.4	119			

18. (10 points) In a study of bladder cancer in Shanghai, an experiment was conducted on 721 subjects to see whether a new diagnosis techniques could be predictive in determining whether a tumor is malignant. Seven predictors were measured. But we only consider the **thickness** (a scale from 1 to 10). We consider the following two logistic regression models:

Table 4: The thickness and the malignancy of tumors

Thickness	1	2	3	4	5	6	7	8	9	10
# Malignant	156	56	97	72	83	15	1	3	0	0
# Tumors	159	60	109	84	127	33	23	43	14	69

```
fit1 <- glm(p ~ thickness, family="binomial", weights=n)
fit2 <- glm(p ~ thickness + I(thickness^2), family="binomial",
    weights=n)
```

(a) Which model is preferable? Why?

(b) Use each model to estimate the probability that a tumor is malignant if the thickness score is 5 and again when the score is 7. How do the estimates cmpared to the observed probability?