Subject： 統計學 (二)	開課班別： 統計學整合開課	Teacher: Han-Ming Wu

Date：24 April. (Thur) 13:10-14:50	※Allowed:「O」, Prohibited:「×」				1. 需加發計算紙或答案紙請在試題內封袋備註。
Pages: 3, Copies: 45	Calculator	Textbook	Class notes	3C product	2. 為環保節能減碳，試題一律採雙面印刷, 有特殊印製需求, 請註記 : A 卷
備註：注意事項要看!! (Scope: §ch9∼ 12)	O	×	×	×	

Notes:

(1) Fill in the student ID number and name on the answer sheet。Write down the exam sheet number you take on the top right corner of the answer sheet : **A** (default) or **B**.

(2) Answer all questions in English (ignore the grammar and spelling)。

(3) Answer each question in the order it appears。The total score is 122.

(4) It is recommended to use a dark ballpoint pen。(pencil is allowed)

(5) The calculation process (for parts **IV** and **V**) is required (calculate to 4 decimal places)。

(6) Return both the answer sheet and the question sheet.

(-) Declaration (0%): Please transcribe the following oath onto the first page of the answer sheet in either Chinese or English. (複寫下列宣誓詞至答案卷的第一頁上)。(10 points will be deducted if not written.)(不寫扣 10 分)

0. ” 本人姓名 恪遵各項考試規則，若如違反，願受校方最嚴厲處罰，謹誓。”

”I (your name here) will strictly adhere to all examination rules. If I break this oath, I am willing to accept the most severe punishment imposed by the school. Solemnly sworn.”

(I) Multiple choice (32%, 8% each); select one correct answer.

1. A researcher studies whether a sleep training program improves participants' sleep quality. She measures each participant's sleep score before and after the program, then analyzes the paired differences. Which of the following best describes the key advantage of using a matched-pairs design over independent samples in this study? (A). It reduces variability by controlling for individual differences, increasing the power to detect an effect. (B). It allows the use of a smaller sample size without sacrificing statistical significance. (C). It eliminates the need to check assumptions like normality or homogeneity of variance. (D). It ensures the sample is representative of the general population.

2. To avoid the problem of not having access to Tables of F distribution when F values are needed for the lower tail, the denominator of the test statistic for a two-tailed test should be the one with (A). the larger sample size.　(B). the smaller sample size.　(C). the larger sample variance.　(D). the smaller sample variance.

3. A sample of 20 cans of tomato juice showed a standard deviation of 0.4 ounces. A 95% confidence interval estimate of the variance for the population is (A). 0.2313 to 0.8533.　(B). 0.2224 to 0.7924.　(C). 0.0925 to 0.3413.　(D). 0.3042 to 0.5843.　$\big(\chi^2_{0.975,19} = 8.907, \chi^2_{0.025,19} = 32.852, \chi^2_{0.95,19} = 10.117, \chi^2_{0.05,19} = 30.144, \chi^2_{0.975,20} = 9.591, \chi^2_{0.025,20} = 34.170, \chi^2_{0.95,20} = 10.851, \chi^2_{0.05,20} = 31.410\big)$

國立政治大學 113 學年度第 2 學期　Midterm Exam　考試命題紙

考試科目：統計學 (二)	開課班別：統計學整合開課	命題教授：Han-Ming Wu

考試日期：24 April.（Thur）13:10-14:50	※准帶項目打「O」，否則打「×」	1. 需加發計算紙或答案紙請在試題內封袋備註。

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備註：注意事項要看!! (Scope: §ch9~ 12)	O	×	×	×	×	

4. A researcher wants to determine if there is a relationship between gender (Male/Female) and preference for a new product (Like/Dislike) using a statistical testing. They collect data from a random sample of 200 participants. Which of the following statements is correct? (A). He can conduct either a chi-square test for homogeneity or a chi-square test for independence. (B). The null hypothesis states that gender and product preference are independent. (C). The chi-square test compares observed frequencies to expected frequencies assuming dependence between the variables. (D). A p-value greater than 0.05 means there is strong evidence of an association between gender and product preference.

(II) Fill-in-the-blank (Correct spelling should be used if possible.) (20%)

5. (10%) Given two upper tail F values, $F(0.025, 20, 19)$ and $F(0.025, 19, 20)$, how can we get $F(0.975, 20, 19)$? _____

6. (10%) The chi-square test is a versatile hypothesis testing tool. What are its three main applications? Test of Independence, _____, and _____.

(III) Short answer (20%, 10% each)(write down the statement (or definition), formula if any, interpretation)

7. When conducting inference about the difference between two population means using a matched-pairs (paired samples) design, what is the key assumption about this testing?

8. What is the so-called "Level of Significance"?

(IV) Calculation (30%, 5% each)

9. **Hiring and Firing Plans at Private and Public Companies.** A Deloitte employment survey asked a sample of human resource executives how their company planned to change its workforce over the next 12 months. A categorical response variable showed three options: The company plans to hire and add to the number of employees, the company plans no change in the number of employees, or the company plans to lay off and reduce the number of employees. Another categorical variable indicated if the company was private or public. Sample data for 180 companies are summarized as follows.

	Company	
Employment Plan	Private	Public
Add Employees	37	32
No Change	19	34
Lay-Off Employees	16	42

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(a) Formulate hypotheses that can be used to determine if the employment plan for the next 12 months is independent of the type of company. (At a 0.05 level of significance.)

(b) What is the value of the test statistic?

(c) Using the p-value approach to do a decision?

(d) Using the critical value approach to do a decision?

(e) What is your conclusion?

(f) Discuss any differences in the employment plans for private and public companies over the next 12 months.

(V) Bonus (20%)

10. When a student, name John, conducts a two-tailed chi-square test for a population variance, How can he get the p-value? The textbook shows that it can be multiplied the upper tail probability of chi-square value by 2 directly to get the p-value. But in fact, John thinks the chi-square is an asymmetrical density function, how and why can he just multiplied it by 2? (You can use the formula or equations to explain.)

Probability Table (機率表)

Area in Upper Tail	0.20	0.10	0.05	0.025	0.01	0.005
χ^2 value ($df = 1$)	1.642	2.706	3.841	5.024	6.635	7.879
χ^2 value ($df = 2$)	3.219	4.605	5.991	7.378	9.210	10.597
χ^2 value ($df = 3$)	4.642	6.251	7.815	9.348	11.345	12.838
χ^2 value ($df = 4$)	5.989	7.779	9.488	11.143	13.277	14.860

Formula (公式)

- $df = \dfrac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{1}{n_1-1}\left(\frac{s_1^2}{n_1}\right)^2 + \frac{1}{n_2-1}\left(\frac{s_2^2}{n_2}\right)^2}$

<The blank pages at the back can be used as scratch paper. (後面空白頁可當計算紙)>

注意： 1、考試求公平及公正，請同學務必自律，維護學校與學生之榮譽。

2、考試時不得有交談、窺視、夾帶、抄襲、傳遞、代考或其它作弊等舞弊行為，考畢務必交卷，不得攜卷出場，違者依考場規則議處。