

一、單選題 (各 3 分)

1. 下圖機率分布的平均值 Given the probability distribution below, the mean is
  - A. 等於中位數 equal to the median.
  - B. 大於中位數 greater than the median.
  - C. 小於中位數 less than the median.
  - D. 無法與中位數相比大小 not comparable to the median.
  
2. 平均值為  $\mu$ ，標準差為  $\sigma$  的常態分布可標示為 A normal distribution with mean  $\mu$  and standard deviation  $\sigma$  is denoted as
  - A.  $N(0, 1)$
  - B.  $N(\mu, \sigma)$
  - C.  $N(\mu, \sigma^2)$
  - D.  $N(\mu^2, \sigma^2)$
  
3. 本課程用來代表「族群變方」的符號為  
What is the notation we used in the class for POPULATION VARIANCE?
  - A.  $\bar{X}$
  - B.  $\mu$
  - C.  $S^2$
  - D.  $\sigma^2$
  
4. 以班上 15 位男學生為樣本，建立某大學 10,000 名男學生平均身高的 90% 信賴區間為 (175, 185) 公分，請問上述研究族群為何? Use 15 male students in the class as a sample to construct a 90% confidence interval for the average height of all 10,000 male students in a university. The result is (175, 185) cm. What is the population of interest for the research?
  - A. 班上 15 位男學生。 15 male students in the class.
  - B. 班上所有學生。 All students in the class.
  - C. 全校 10,000 位男學生。 10,000 male students in the university
  - D. 全校學生。 All students in the university
  
5. 續上題，下列關於信賴區間的敘述何者正確? Continue on the previous question. Which of the following is the best interpretation of this interval?
  - A. 若重複抽樣並建立 90% 信賴區間，則約有 90% 的信賴區間包含真正的族群平均身高。 If we took repeated samples and created 90% confidence intervals, then the true average height of this population would be contained in approximately 90% of these intervals.
  - B. 若重複抽樣並建立 90% 信賴區間，則約有 90% 的樣本均值介於 175 與 185 之間。 If we took repeated samples and created 90% confidence intervals, then approximately 90% of the sample means would be between 175 and 185.
  - C. 樣本中約有 90% 的男學生身高介於 175 與 185 之間。 About 90% of the males in the sample have height between 175 and 185.
  - D. 族群中約有 90% 的男學生身高介於 175 與 185 之間。 About 90% of the males in

the population have height between 175 and 185.

6. 某醫院研發檢驗乳癌診斷指標，指標診斷結果若呈陽性反應及判定為乳癌。若罹患乳癌，但診斷結果呈陽性反應，犯了何種錯誤？A hospital develops a clinical index for women's breast cancer prognosis. A patient having a positive result of the index is diagnosed having breast cancer. What type of error is occurred when the result is positive but the woman actually does not have any breast cancer.

- A. Type I      B. Type II      C. Type III      D. Type IV

7. 承上題，假定某地區有 10% 的婦女患有乳癌，假設檢驗呈陽性反應且的確罹患乳癌的機率是 90%；若未患乳癌，但診斷結果仍呈陽性反應的機率是 1%。若某婦女診斷結果為陽性，求她真正罹患乳癌的機率約為多少？

Continue on the previous question. Suppose the occurrence of the breast cancer in a region is 10%. The probability that a woman having breast cancer gets a positive result of the prognosis index is 90%. However, the probability that a woman not having breast cancer gets a positive result of the prognosis index is 1%. One lady gets a positive result of the index. What is the probability that she really has breast cancer?

- A. 1%      B. 5%      C. 10%      D. 90%

8. 天氣預報有下表兩種正確的假設及行動。若晴天卻帶傘犯了型 I 錯誤，請問該檢驗的虛無假設 ( $H_0$ ) 應為何？Two possible assumptions and the decisions regarding to a weather forecast are listed below. Suppose Type I error occurs when bringing an umbrella in a sunny day. What is the null hypothesis ( $H_0$ ) for this test?

假設 Hypothesis	晴天 Sunny day	雨天 Rainy day
行動 Decision	不用帶傘 need NOT to bring an umbrella	需帶傘 need to bring an umbrella

- A. 晴天 Sunny day  
B. 不用帶傘 Need NOT to bring an umbrella  
C. 雨天 Rainy day  
D. 需帶傘 Need to bring an umbrella

9. 令  $\alpha$  為型 I 錯誤發生之機率， $\beta$  為型 II 錯誤發生之機率，則下列敘述何者正確？Let  $\alpha$  be the probability that Type I error would occur and  $\beta$  be the probability that Type II error would occur. Which of the following is the correct statement?

- A.  $\alpha + \beta = 1$

- B. 樣本大小 (n) 增加時，通常  $\beta$  較小。 $\beta$  usually decreases along with the increase of the sample size (n).
- C. 可以調整檢定的臨界點 (critical value)，使  $\alpha, \beta$  同時減小。It is possible to simultaneously reduce  $\alpha$  and  $\beta$  by adjusting the critical value of a hypothesis test.
- D. 以上皆非。None of the above is correct.

10. 欲檢定某作物上、下部葉子之乾物重是否相同？經抽樣調查後，資料如下表 (單位:公克)。則本試驗為\_\_\_\_檢定。 The research objective is to test whether the dry weights (g) of the upper leaf and the lower leaf are the same. Then the hypothesis test is a \_\_\_\_ test.

植株代號 plant id	1	2	3	4	5	6	7	8
上部 upper leaf	4.3	5.2	6.3	4.6	5.4	4.8	5.4	3.8
下部 lower leaf	3.9	4.4	6.2	4.5	4.8	3.3	4.4	2.3

- A. 左尾 left-tailed
- B. 右尾 right-tailed
- C. 雙尾 two-tailed
- D. 無尾 no-tail

11. 呈上題，本資料應採用何種檢定最適當？Continue on the previous question. What is the most appropriate test for this data?

- A. 自由度 7 的 t 檢定。T-test with 7 degrees of freedom.
- B. 自由度 8 的 t 檢定。T-test with 8 degrees of freedom.
- C. 自由度 14 的 t 檢定。T-test with 14 degrees of freedom.
- D. 自由度 15 的 t 檢定。T-test with 15 degrees of freedom.

12. 呈第 10 題，分析結果顯示作物上、下部葉子平均乾物重差值的 95% 信賴區間為 (0.28, 1.22)。則以下何者為正確結論？Continue on Question 10. The result of the statistical analysis showed the 95% confidence interval for the difference between the average dry weight (g) of the upper leaf and that of the lower leaf is (0.28, 1.22). Which of the following is the correct conclusion?

- A. 設  $\alpha = 0.05$ , 作物上、下部葉子乾物重有顯著差異。Let  $\alpha = 0.05$ . The dry weights (g) of the upper leaf and the lower leaf are significantly different.
- B. 設  $\alpha = 0.05$ , 作物上、下部葉子乾物重無顯著差異 Let  $\alpha = 0.05$ . The dry weights (g) of the upper leaf and the lower leaf are the same.
- C. 資訊不足無從判斷。There is not enough information to draw conclusion.

13. 卡方無法應用於下列何項檢定？Which of the following is NOT an application of chi-square test?

- A. 適合度檢驗 goodness-of-fit test

- B. 獨立性檢驗 independence test
- C. 單一樣本變方檢驗 test on one sample variance
- D. 兩樣本變方同質性檢驗 test on equality of two sample variances

14. 相關係數是用來描述 The correlation coefficient is used to describe

- A. 兩分立變數的關聯性 the association between two discrete variables.
- B. 兩連續變數的關連性 the association between two continuous variables.
- C. 任意兩分立或連續變數的關連性 the association between two continuous or discrete variables.
- D. 以上皆是 all of the above.

15. 相關係數為 0 代表 A zero value of correlation coefficient means

- A. 兩變數間無關係 there is no association between two variables.
- B. 兩變數間無限性關係 there is no linear association between two variables.
- C. 兩變數互相獨立 two variables are independent to each other.
- D. 兩變數間具有線性關係 two variables are linear dependent on each other.

計算題:

1. 節制飲食是否能延長壽命？為回答此一提問，營養學家進行以下實驗：

將新生老鼠隨機分配至兩種不同飲食環境：無限制飲食與 80% 飲食量，並記錄老鼠壽命。實驗結果如下。A nutritionist wanted to test whether a reduced diet can elongate the lifespan. She designed an experiment that randomly allocate the newborn mice to accept one of two different diets: unlimited and 80% (reduced) diet and recorded the lifespans of the mice. The results are showing below.

老鼠編號 Mouse id	1	2	3	4	5
無限制飲食 Unlimited diet	2.5	3.1	2.3	1.9	2.4
80% 飲食量 reduced diet	3.1	2.9	3.8	3.9	4.0

(1) (12 分) 計算各處理之樣本平均及樣本變方。Compute the sample means and variances for two diets.

(2) (6 分) 在顯著水準 10% 之下，利用 F 檢定檢驗兩種不同飲食的老鼠壽命之變方是否有顯著差異？Test whether the variances of two samples are significant different using F-test under the significant level  $\alpha = 0.05$ . ( $F_{0.025, 4, 4} = 9.60$ ;  $F_{0.975, 4, 4} = 0.10$ )

(3) (7 分) 根據上題結果，在顯著水準 5% 之下，用 t 分布檢定 80% 飲食量之老鼠壽命是否大於無限制飲食之老鼠壽命。Based on the result of the previous question, test whether the mice treated with reduced diet have longer lifespans than those treated with unlimited diet under the significant level  $\alpha = 0.05$ . ( $t_{0.025, 4} = 2.78$ ;  $t_{0.05, 4} =$

2.13;  $t_{0.025, 8} = 2.31$ ;  $t_{0.05, 8} = 1.86$ )

2. 某教授想瞭解某作物三種不同品種(A,B,C)種子的發芽率是否一致，因此各品種隨機抽取 50 顆種子作發芽試驗，得到以下資料。A professor wants to know whether the germination rates are different among three varieties of a special crop. The professor randomly collected 50 seeds from each variety and observed the percentage of germination as below.

	A	B	C
發芽種子數 Number of seeds germinated	24	21	16
未發芽種子數 Number of seeds not germinated	26	29	34

(1) (7 分) 在 5% 顯著水準下，利用 Z-test 檢定品種 C 發芽率是否小於 0.5。Test whether the percentage of germination of Variety C is less than 50% using z-test under the significant level  $\alpha = 0.05$ . ( $Z_{0.95} = 1.645$ )

(2) (8 分) 在 5% 顯著水準下，以卡方檢定檢驗作物三種不同品種種子的發芽率是否一致 (計算檢定統計量值時，須使用連續性校正)。Test whether the percentages of germination among three varieties are different using Chi-squared test under the significant level  $\alpha = 0.05$ . (It is required to apply continuity correction when computing test statistic.)

( $\chi^2_{0.05, 2} = 5.99$ ;  $\chi^2_{0.025, 2} = 7.37$ ;  $\chi^2_{0.05, 3} = 7.81$ ;  $\chi^2_{0.025, 3} = 9.35$ )