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|-----------|--------------------------------|--------------|--------------------------------|
| Lecturer: | Date | Approved by: | Date |
| | May 19 th , 2022 | | May 19 th , 2022 |

| | | | | | | |
|---|-------------------|----------------------------|---------------------|-----------|-----------------------------|---|
| <div></div> <div>UNIVERSITY OF TECHNOLOGY - VNUHCM</div> <div>Faculty of Applied Science</div> | Final Exam | | Acad. year | 2021-2022 | Semester | 2 |
| | | | Date | | May 21 th , 2022 | |
| | Course title | Probability and Statistics | | | | |
| | Course ID | MT2013 | | | | |
| | Duration | 100 minutes | Question sheet code | 2121 | | |

Instructions to students:

- You are allowed to use your OWN materials and calculator. Total available score: 10.
- At the beginning of the working time, you **MUST** fill in your full name and student ID on this question sheet. There are 17 questions on 4 pages. Do not round in between steps.
- For the essay questions, all essential steps of calculations, analyses, justifications and final results are required for full credit. **Any answer without essential calculation steps, and/or analyses, and/or justifications will earn zero mark.** Give your answer as decimal numbers rounded to 4 decimal places.

Student's full name:

Student Id: Invigilator 1:

Group ID: Invigilator 2:

Part I: Multiple choice (6 points, 60 minutes)

Questions **1** through **5**, use the given information.

A big company conducted two surveys A and B. Assume that customers respond to the surveys independently, and that the number of responses received per hour of each survey follows a Poisson distribution. The company estimates that, on average, there are 6 responses received from survey A per hour and 2 responses received from survey B per hour.

- What is the average number of responses obtained from this company's two surveys per hour?
(A) The other answers are wrong. (B) 8 (C) 2 (D) 7 (E) 6
- What is the probability that survey A will receive 7 responses in 1.5 hours?
(A) 0.1396 (B) 0.1377 (C) The other answers are wrong. (D) 0.1171 (E) 0.0034
- Find the standard deviation of the number of responses received from the two surveys per hour.
(A) 1.4602 (B) 2.8284 (C) The other answers are wrong. (D) 1.4142 (E) 1.6982
- Compute the probability that the company will receive 8 responses in 1 hour for both surveys.
(A) 0.1033 (B) 0.1396 (C) 0.0009 (D) The other answers are wrong. (E) 0.1396
- If the company received no responses for both surveys within the first 13.4 minutes, what is the probability of having at least one response in the first 18.6 minutes?
(A) 0.9997 (B) 0.8647 (C) 0.5001 (D) 0.9975 (E) The other answers are wrong.

Questions **6** through **10**, use the given information.

A fast-food establishment has been averaging about 2 thousand dollars of business per weekday. To see whether business is changing due to a deteriorating economy (which may or may not be good for the fast-food industry), management has decided to carefully study the figures for the next 8 days. Suppose the figures are given as below (in thousand dollars) and the revenue is following the normal distribution.

5, 4.1, 0.9, 2.9, 1.7, 4.8, 3.3, 1.2

Is there enough evidence, at the 1% level, to conclude that the average revenue is greater than 2 thousand dollars.

6. Determine the alternative hypothesis H_1 .
Ⓐ $\mu > 2$ Ⓑ $\mu \geq 2$ Ⓒ $\mu \neq 2$ Ⓓ $\mu < 2$ Ⓔ $\mu \leq 2$
7. Compute the test statistic.
Ⓐ -0.2528 Ⓑ The other answers are wrong. Ⓒ 1.7472 Ⓓ 0.2472 Ⓔ 1.2472
8. Determine the rejection region.
Ⓐ $(2.998, +\infty)$ Ⓑ $(-\infty, 2.998)$ Ⓒ $(2.33, +\infty)$ Ⓓ $(3.5, +\infty)$ Ⓔ $(-\infty, -3.5) \cup (3.5, +\infty)$
9. What is an appropriate statistical conclusion?
Ⓐ The hypothesis H_1 is wrong. Ⓑ The other answers are wrong. Ⓒ There is sufficient evidence to reject H_0 . Ⓓ There is not sufficient evidence to reject H_0 . Ⓔ There is sufficient evidence to reject H_1 .
10. Find a 99% confidence interval for the mean revenue (thousand dollars) of this company.
Ⓐ $[1.0099, 4.9652]$ Ⓑ $[1.5293, 4.4457]$ Ⓒ The other answers are wrong. Ⓓ $[1.4093, 2.5093]$ Ⓔ $[3.5093, 4.3093]$

Questions 11 through 15, use the given information.

The following experiment was conducted to compare the yields of two varieties of tomato plants. 9 plants of the first variety and 8 plants of the second variety were randomly selected and planted in a field. The first variety produced an average yield of 12.5 kilograms per plant with a sample standard deviation of 4 kilograms. The second variety produced an average yield of 14.5 kilograms per plant with a sample standard deviation of 5 kilograms. Suppose that the yields are normally distributed. Does this provide sufficient evidence to conclude that the mean yield of the first variety is smaller than that of the second variety at the level of significance $\alpha = 0.1$.

11. Determine the alternative hypothesis H_1 .
Ⓐ $\mu_1 \leq \mu_2$ Ⓑ $\mu_1 > \mu_2$ Ⓒ $\mu_1 \geq \mu_2$ Ⓓ $\mu_1 < \mu_2$ Ⓔ $\mu_1 \neq \mu_2$
12. Choose a suitable test.
Ⓐ z-test. Ⓑ F-test. Ⓒ The other answers are wrong. Ⓓ t-test with 16 degrees of freedom. Ⓔ t-test with 15 degrees of freedom.
13. Compute the test statistic.
Ⓐ -0.4158 Ⓑ -2.4158 Ⓒ The other answers are wrong. Ⓓ -0.9140 Ⓔ -0.9158
14. Find the rejection region.
Ⓐ $(-\infty, -1.64485)$ Ⓑ $(-\infty, -1.341)$ Ⓒ $(-\infty, -1.753)$ Ⓓ $(1.3406, +\infty)$ Ⓔ $(-\infty, -1.753) \cup (1.753, +\infty)$
15. Determine an appropriate statistical conclusion.
Ⓐ There is not sufficient evidence to reject H_0 . Ⓑ The other answers are wrong. Ⓒ The hypothesis H_1 is wrong. Ⓓ There is sufficient evidence to reject H_0 . Ⓔ There is sufficient evidence to reject H_1 .

Part II: Essay (4 points)

16. A nutritionist randomly divided 15 bicyclists into three groups of five each. Members of the first group were given vitamin supplements to take with each of their meals over the next 3 weeks. The second group was instructed to eat a particular type of high-fiber whole-grain cereal for the next 3 weeks. Members of the third group were instructed to eat as they normally do. After the 3-week period elapsed, the nutritionist had each bicyclist ride 6 miles. The following times were recorded:

| Group | Time (minutes) | | | | |
|---------------|----------------|------|------|------|------|
| Vitamin | 19.1 | 21.5 | 19.5 | 18.1 | 20.1 |
| Fiber cereal | 13.2 | 13.9 | 15.4 | 14.9 | 14.6 |
| Control group | 30.7 | 29.7 | 28.9 | 29.9 | 28.6 |

Suppose that the given data verifies the ANOVA assumptions and the level of significance is 5 percent.

- Are these data consistent with the hypothesis that neither the vitamin nor the fiber cereal affects the speed of a bicyclist?
- Find a 95% confidence interval on the difference in the mean times between bicyclists of vitamin group and Fiber cereal group.
- Interpret the results of the multiple comparison test using the Fisher's LSD method.

17. The following data relate the traffic density, described in the number of automobiles per mile, to the average speed of traffic on a moderately large city thoroughfare. The data were collected at the same location at 10 different times within a span of 3 months.

| | | | | | | | | | | |
|-----------------|------|------|------|------|------|------|------|------|------|------|
| Density (X) | 69 | 56 | 62 | 119 | 84 | 74 | 73 | 90 | 38 | 22 |
| Speed (Y) | 25.4 | 32.5 | 28.6 | 11.3 | 21.3 | 22.1 | 22.3 | 18.5 | 37.2 | 44.6 |

Suppose that the data verify the assumptions of simple linear regression model with the response variable Y and the independent variable X .

- (a) Find the fitted linear regression line.
- (b) Find the coefficient of determination and interpret this value.
- (c) Find a 95% confidence interval for the slope of regression line.

Answers of multiple choice questions.

| Question | Key |
|---|-----|
| 1 B | D |
| 2 D | A |
| 3 B | C |
| 4 B ^C has E | D |
| 5 C | E |
| 6 A | A |
| 7 C | A |
| 8 A | B |
| 9 D | C |
| 10 A | C |
| 11 D | A |
| 12 E | ?? |
| 13 E | E |
| 14 B | D |
| 15 A | E |
| (L.O.1.1, L.O.1.2, L.O.1.3, L.O.2.1, L.O.2.3) | ?? |
| (L.O.1.1, L.O.1.2, L.O.1.3, L.O.2.1, L.O.2.3) | ?? |

Final Exam (MT2013)

UNIVERSITY OF TECHNOLOGY - VNUHCM

Faculty of Applied Science

Department of Applied Mathematics

MT2013 - Probability and Statistics - SEMESTER 202/203

FINAL EXAM

Date: August 5, 2021. Time: 7:00

Duration: 60 minutes

INTRODUCTION:

- You are NOT allowed to use any software/electrical devices during the exam, except your pocket calculators, printed/written documents, camera and a computer/laptop (for doing the exam). This means that you are NOT allowed to open any pdf file. The table of statistical distributions will be provided in the exam.
- You must have your camera to be turned on and show your face during the exam. On your screen, there must be one big window for BKEX and one small window for Google!Meeting showing only your face (put at a corner of the screen). You must start recording the screen of your laptop/computer 5 minutes before the exam begins and keep recording the screen of your laptop/computer during the exam (Click here to know how to do it) - Do not use any live streaming apps for recording. After you submit your answer and end the exam, you must immediately upload the recorded video (small resolution, less than 1GB) to a Google Form (on BKEX, the same page where you get the link to do the exam).
- Do not round in between steps. Round the final answers to four decimal places (e.g. 5.1234).
- Students must fill in answer boxes or choose correct answers, then submit their answers on time (Do not wait until the very last minute). The maximum score: 100 points.
- Students are allowed to try 2 times on each question with a penalty of 30% for the second try after the first full-credit try.

1. (0 pts)

I hereby declare that I will follow the Code of Student Conduct as defined by the University, the Faculty, and the Department, and that I will not cheat or condone cheating in this exam. I am aware that in the efforts to maintain exam integrity I may be required by my lecturer, after receiving the exam and before receiving the final grade, to explain some of my answers.

(Tôi xin cam đoan rằng, với tất cả lòng tự trọng của mình, tôi sẽ tuân thủ các quy định của trường, khoa, và bộ môn và tôi sẽ không gian lận hay đồng lõa với việc gian lận dưới bất kỳ hình thức nào trong kỳ thi này. Tôi hiểu rằng, nhằm đảm bảo tính toàn vẹn của kỳ thi, giảng viên có thể yêu cầu tôi giải thích cách làm và đáp số của mình cho các câu hỏi của kỳ thi. Nếu tôi không thể giải thích hay giải thích không rõ ràng cách làm và đáp số của mình, bài thi của tôi có thể bị trừ điểm.)

Your full name: _____

Your student ID: _____

If you have any concern about some questions of the exam, please discuss it in the box below and send your instructors an email after the exam.

Below are some statistical tables. Please click [+] for more details.

[Statistical Tables](#) [+]

2. (5 pts)

Let $P(A) = 0.33$, $P(B) = 0.21$, and $P(A \cap B) = 0.1$, compute $P(A \cup B)$.

Answer: _____

3. (5 pts)

Messages that arrive at a service center for an information systems manufacturer have been classified on the basis of the number of keywords (used to help route messages) and the type of message, either e-mail or voice. Also, 79% of the messages arrive via e-mail and the rest are voice. The following table shows the probabilities of the number of keywords received by each type of message.

| Number of keywords | 0 | 1 | 2 |
|--------------------|-----|-----|-----|
| E-mail | 0.1 | 0.3 | 0.6 |
| Voice | 0.2 | 0.4 | 0.4 |

Find the expected value of the number of keywords in a message.

Answer: _____.

4. (10 pts)

The number of hits on a certain website follows a Poisson distribution with a mean rate of 3 hits per minute. What is the probability that less than 3 hits are received in a period of 30 seconds?

Answer: _____.

5. (10 pts)

Lifetimes of batteries in a certain application are normally distributed with mean 53 hours and standard deviation 5 hours. Find the critical time such that 22% of batteries will survive greater than this time.

6. (20 pts)

A standard drug is known to be effective in 85 percent of cases in which it is used to treat a certain infection. A new drug has been developed, and testing has found it to be effective in 135 cases out of 179. Scientists want to know if the data show enough evidence to prove that there are differences in the effectiveness rates between two drugs.

1. Choose a suitable alternative hypothesis.

H1:

- A. ☐ $\mu < 85$
- B. ☐ $p \neq 85$
- C. ☐ $p \geq 85$
- D. ☐ $\mu \geq 85$
- E. ☐ $\mu > 85$
- F. ☐ $\mu \leq 85$
- G. ☐ $\mu \neq 85$
- H. ☐ $p < 85$
- I. ☐ $p \leq 85$
- J. ☐ $p > 85$

2. Find the test statistic:

- A. ☐ F (F-test)
- B. ☐ Z (Z-test)
- C. ☐ T (T-test)

= _____

3. Hence, we conclude that at the $\alpha = 0.02$ level of significance,

- A. ☐ we have a strong evidence to confirm that there are differences in the effectiveness rates between two drugs.
- B. ☐ we do not have enough evidence to confirm that there are differences in the effectiveness rates between two drugs.

7. (25 pts)

In semiconductor manufacturing, wet chemical etching is often used to remove silicon from the backs of wafers prior to metallization. The etch rate is an important characteristic in this process and known to follow a normal distribution. Two different etching solutions have been compared using two random samples of wafers. The observed etch rates are as follows (in mils per minute):

| | | | | | | | |
|-------------------|-----|------|-----|------|-----|------|-----|
| Solution 1 | 7.4 | 8.4 | 9.6 | 10.9 | 8.3 | 10 | 9.4 |
| Solution 2 | 9.1 | 10.2 | 9.7 | 9.6 | 8.8 | 10.5 | 9.5 |

Assuming the normality and $\alpha = 0.1$, do the data support the claim that the mean etch rate is the same for both solutions?

- a. The alternative hypothesis H_1 :

$$\mu_1 - \mu_2$$

- A. $_ < _$
 B. $_ > _$
 C. $_ = _$
 D. $_ \neq _$
 E. $_ \geq _$
 F. $_ > _$

0

- b. Compute the statistic:

- A. T
B. F
C. Z

Note: Choose Z for z.test (using normal distribution), T for t.test (using Student distributions), and F for F.test (using Fisher distributions).

- c. Determine the acceptance region (the complementary region to the rejection region):

- d. Make a conclusion:

- A. ☐ We can reject H_0
 B. ☐ We fail to reject H_0

Do not round in between steps. (Type oo for Infinity and -oo for Negative Infinity)

8. (25 pts)

A new-car dealer is interested in the relationship between the number of salespeople working on a weekend (x) and the number of cars sold (y). He has collected the data in 12 consecutive Sundays and applied a simple linear regression model to analyze those data. Some summary statistics have resulted as below.

- The means of x and y : $\bar{x} = 6.8333$, $\bar{y} = 16.3333$.

- $S_{xx} = \sum_{i=1}^n (x_i - \bar{x})^2 = 193.6667$,

$$S_{xy} = \sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y}) = 11.6667, S_{yy} = SST = \sum_{i=1}^n (y_i - \bar{y})^2 = 4.6667.$$

1. Find the estimated linear regression line.

$$\hat{y} = \underline{\hspace{2cm}} + \underline{\hspace{2cm}} x$$

2. Predict the number of cars sold in a certain Sunday which has 14 salespeople.

$$\underline{\hspace{2cm}}$$

3. Find the sum square for errors. $SSE = \underline{\hspace{2cm}}$

4. Compute the coefficient of determination? $\underline{\hspace{2cm}}$

5. Find the standard error of the slope $\hat{\beta}_1$. $SE(\hat{\beta}_1) = \underline{\hspace{2cm}}$.

+++++

Key - Form 1

1. ~ ~ ~
2. 0.44
3. 1.437
4. 0.80884683053806
5. [56.85,56.9]
6. -3.5899013674807 ~ B: $p \neq 85$ ~ A: we have a strong evidence to confirm that there are differences in the effectiveness rates between two drugs. ~ B: Z (Z-test)
7. B: ~ D: \neq ~ ~ A: T ~ [-0.9728,-0.97275294637405] or [-0.9728,-0.97275294637405] ~ [-1.79,-1.78] or [-1.84,-1.83] ~ [1.78,1.79] or [1.83,1.84] ~ B: We fail to reject H_0
8. [16.7645,16.765] ~ 0.15060216857382 ~ [0.0452,0.0452] ~ 15.921654316411 ~ 0.060241125603937 ~ [3.9639,3.9644]

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Make-up Final Exam (MT2013)

UNIVERSITY OF TECHNOLOGY - VNUHCM
Faculty of Applied Science
Department of Applied Mathematics

MT2013 - Probability and Statistics - SEMESTER 202/203

FINAL EXAM

Date: August 7, 2021. Time: 8:00

Duration: 60 minutes

INTRODUCTION:

- You are NOT allowed to use any software/electrical devices during the exam, except your pocket calculators, printed/written documents, camera and a computer/laptop (for doing the exam). This means that you are NOT allowed to open any pdf file. The table of statistical distributions will be provided in the exam.
- You must have your camera to be turned on and show your face during the exam. On your screen, there must be one big window for BKEL and one small window for Google!Meeting showing only your face (put at a corner of the screen). You must start recording the screen of your laptop/computer 5 minutes before the exam begins and keep recording the screen of your laptop/computer during the exam (Click here to know how to do it) - Do not use any live streaming apps for recording. After you submit your answer and end the exam, you must immediately upload the recorded video (small resolution, less than 1GB) to a Google Form (on BKEX, the same page where you get the link to do the exam).
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- Students must fill in answer boxes or choose correct answers, then submit their answers on time (Do not wait until the very last minute). The maximum score: 100 points.
- Students are allowed to try 2 times on each question with a penalty of 30% for the second try after the first full-credit try.

1. (0 pts)

I hereby declare that I will follow the Code of Student Conduct as defined by the University, the Faculty, and the Department, and that I will not cheat or condone cheating in this exam. I am aware that in the efforts to maintain exam integrity I may be required by my lecturer, after receiving the exam and before receiving the final grade, to explain some of my answers.

(Tôi xin cam đoan rằng, với tất cả lòng tự trọng của mình, tôi sẽ tuân thủ các quy định của trường, khoa, và bộ môn và tôi sẽ không gian lận hay đồng lõa với việc gian lận dưới bất kỳ hình thức nào trong kỳ thi này. Tôi hiểu rằng, nhằm đảm bảo tính toàn vẹn của kỳ thi, giảng viên có thể yêu cầu tôi giải thích cách làm và đáp số của mình cho các câu hỏi của kỳ thi. Nếu tôi không thể giải thích hay giải thích không rõ ràng cách làm và đáp số của mình, bài thi của tôi có thể bị trừ điểm.)

Your full name: _____

Your student ID: _____

If you have any concern about some questions of the exam, please discuss it in the box below and send your instructors an email after the exam.

Below are some statistical tables. Please click [+] for more details.

[Statistical Tables](#) [+]

2. (5 pts)

Let A and B be events with $P(A) = 0.45$ and $P(A \cap B) = 0.4$. Find the probability $P(B)$ such that A and B are independent.

Answer: _____.

3. (5 pts)

On the basis of a physical examination and symptoms, a physician assesses the probabilities that a patient has no tumour, a benign tumour, or a malignant tumour as 0.6, 0.2 and 0.2, respectively. A thermographic test is subsequently given to the patient. This test gives a negative result with probability 0.9 if there is no tumour, with probability 0.7 if there is a benign tumour, and with probability 0.2 if there is a malignant tumour. If a patient has a negative test result, what is the probability that this person has no tumour?

Answer: _____.

4. (10 pts)

A commuter encounters 4 traffic lights each day on her way to work. Let X represent the number of these that are red lights. The probability mass function of X is as follows.

| | | | | | |
|----------|------|------|------|------|------|
| X | 0 | 1 | 2 | 3 | 4 |
| P | 0.24 | 0.15 | 0.11 | 0.19 | 0.31 |

What is the probability that the average number of red lights encountered in 209 days is less than 2 per day?

Answer: _____.

5. (10 pts)

The time to recharge the flash is tested in a number of cell-phone cameras. The probability that a camera passes the test is 0.9, and the cameras perform independently. What is the smallest sample size needed so that the probability of at least one camera failing is at least 97%?

Answer: _____.

6. (20 pts)

The following data show the fracture strengths (MPa) of 5 ceramic bars fired in a particular kiln: 96, 86, 92, 94, 91. Assume that fracture strengths follow a normal distribution.

- Construct a 99% two-sided confidence interval for the mean fracture strength:

_____ <

A. $__\sigma$

B. $__s$

C. $__\bar{x}$

D. $__\mu$

E. $__s^2$

F. $__\hat{p}$

G. $__p$

H. $__\sigma^2$

< _____

- If the population standard deviation is 4 (MPa), how many observations must be collected to ensure that the radius of a 99% two-sided confidence interval for the mean fracture strength is at most 1 (MPa)?

$n \geq$ _____

(Type oo for Infinity and -oo for Negative Infinity)

7. (25 pts)

Tensile-strength tests were carried out on two different grades A and B of wire rod resulting in the accompanying data.

| Brand | Sample size | Sample mean | Sample standard deviation |
|-------|-------------|-------------|---------------------------|
| A | 109 | 110.6 | 7.4 |
| B | 84 | 108.1 | 17.2 |

Does the data provide compelling evidence for concluding that true average strength for the grade A exceeds that for the grade B at the 0.1 level of significance?

a. The alternative hypothesis H_1 :

$$\mu_1 - \mu_2$$

A. ☐ $>$

B. ☐ $>$

C. ☐ \leq

D. ☐ $=$

E. ☒ \neq

F. ☐ $<$

0

b. Compute the statistic:

A. ☐ T

B. ☐ Z

C. ☐ F

= _____

Note: Choose Z for z.test (using normal distribution), T for t.test (using Student distributions), and F for F.test (using Fisher distributions).

c. Determine the acceptance region (the complementary region to the rejection region): (_____, _____)

d. Make a conclusion:

A. ☐ We fail to reject H_0

B. ☐ We can reject H_0

Do not round in between steps. (Type oo for Infinity and -oo for Negative Infinity)

8. (25 pts)

An electronics engineer is interested in the effect on tube conductivity of three different types of coating for cathode ray tubes in a telecommunications system display device. 6 tubes were randomly chosen and treated by each types. The engineer has collected the data and reported some summary statistics as below.

| | Type 1 | Type 2 | Type 3 |
|--|------------------------|------------------------|---------------------|
| Number of tubes | 6 | 6 | 6 |
| The average conductivity | $\bar{y}_A = 149.6667$ | $\bar{y}_B = 149.6667$ | $\bar{y}_C = 148.5$ |
| The average conductivity of the entire dataset: $\bar{y} = 149.2778$ | | | |
| The sum of squares: $\sum_{i=1}^{18} y_i^2 = 401135$ | | | |

1. Use the given information to complete the table of the analysis of variance.

| Source of variation | SS | df | MS | F |
|---------------------|----|----|----|---|
| Treatment | | | | |
| Error | | | | |
| Total | | | | |

2. Hence, we conclude that at the $\alpha = 0.1$ level of significance,

- the coating type doesn't affect the conductivity of cathode ray tubes in a telecommunications system display device.
- the coating type affects the conductivity of cathode ray tubes in a telecommunications system display device.

+++++

Key - Form 1

- ~ ~ ~
- 0.88888888888889
- 0.75
- 0.0502
- 34
- $[84.0311, 84.0479] \sim D: \mu \sim [99.5521, 99.5689] \sim [106, 107]$

7. C: ~ A: > ~ ~ B: Z ~ [1.2462,1.2462218729155] ~ -oo ~ [1.28,1.29] ~ A: We fail to reject H_0
8. 2.72237778 ~ 1.3364622213309 ~ 2.0370031689253 ~ A: the coating type doesn't affect the conductivity of cathode ray tubes in a telecommunications system display device. ~ 5.4447555599999 ~ 20.046933319964 ~ 2 ~ 15 ~ 25.491688879963 ~ 17

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Final exam 211 (12/12/2021)

UNIVERSITY OF TECHNOLOGY - VNUHCM
Faculty of Applied Science
Department of Applied Mathematics

MT2013 - Probability and Statistics - SEMESTER 211

FINAL EXAM

Date: December 12, 2021. Time: 12:00

Duration: 60 minutes

INTRODUCTION:

- You are NOT allowed to use any software/electrical devices during the exam, except your pocket calculators, printed/written documents, camera and a computer/laptop (for doing the exam). This means that you are NOT allowed to open any pdf file. The table of statistical distributions will be provided in the exam.
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- Do not round in between steps. Only round your answers to four decimal places (e.g. 5.1234) when you fill in the blank
- You must fill in answer boxes or choose correct answers, then submit your answers on time (Do not wait until the very last minute). The maximum score: 100 points.
- You are allowed to try only 1 time on each question.

1. (0 pts)

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(Tôi xin cam đoan rằng, với tất cả lòng tự trọng của mình, tôi sẽ tuân thủ các quy định của trường, khoa, và bộ môn và tôi sẽ không gian lận hay đồng lõa với việc gian lận dưới bất kỳ hình thức nào trong kỳ thi này. Tôi hiểu rằng, nhằm đảm bảo tính toàn vẹn của kỳ thi, giảng viên có thể yêu cầu tôi giải thích cách làm và đáp số của mình cho các câu hỏi của kỳ thi. Nếu tôi không thể giải thích hay giải thích không rõ ràng cách làm và đáp số của mình, bài thi của tôi có thể bị trừ điểm.)

Your full name: _____

Your student ID: _____

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Below are some statistical tables. Please click [+] for more details.

[Statistical Tables](#) [+]

2. (5 pts)

If A, B, and C are mutually exclusive events, is it possible for $P(A) = 0.5$, $P(B) = 0.4$ and $P(C) = 0.3$?

- A. ☐ No
B. ☐ Yes

3. (20 pts)

A company producing cereals offers a toy in every 5 cereal package in celebration of their 50th anniversary. A father immediately buys 30 packages.

1. What is the probability of finding 3 toys in the 30 packages?

Answer: _____

2. What is the probability of finding no toy at all?

Answer: _____

3. What are the mean and standard deviation of number of toys in the 30 packages?

Mean: _____

Standard deviation: _____

4. (20 pts)

A producer of candy packages hypothesizes that his production does not adhere to the weight standard of 250 grams. As a measure of quality control, he weighs 8 packages and obtains the following results in grams:

254, 246, 255, 265, 253, 253, 253, 254

Is there sufficient evidence to support the claim that the mean weights of candy packages is greater than 250 grams ? Assume that the population distribution of the weights is normal and the significance level is 1%.

1. The alternative hypothesis H_1 :

μ

- A. $__ >$
- B. $__ <$
- C. $__ \neq$
- D. $__ >$
- E. $__ =$
- F. $__ \leq$

2. Compute the statistic:

- A. $__ F$
- B. $__ Z$
- C. $__ T$

= _____

Note: Choose Z for z.test (using the standard normal distribution), T for t.test (using the Student distributions), and F for F.test (using the Fisher distributions).

3. Determine the acceptance region (the complementary region to the rejection region): (_____, _____)

Note: Type oo for Infinity and -oo for Negative Infinity.

4. Make a conclusion:

- A. $__ \text{We fail to reject } H_0$
- B. $__ \text{We can reject } H_0$

5. (25 pts)

Two friends play a computer game and each of them repeats the same level 7 times. The scores obtained are:

| | | | | | | | |
|-----------------------|-----|-----|-----|-----|-----|-----|-----|
| The 1st person | 248 | 263 | 248 | 260 | 241 | 236 | 243 |
| The 2nd person | 262 | 251 | 242 | 234 | 253 | 249 | 242 |

Assume that the two score distributions are normal. Test the claim that their mean scores are different, using a 10% level of significance.

1. The alternative hypothesis H_1 :

- A. $\sigma_1 = \sigma_2$
- B. $\mu_1 = \mu_2$
- C. $p_1 = p_2$

- A. $\sigma_1 \neq \sigma_2$
- B. $\mu_1 > \mu_2$
- C. $\mu_1 < \mu_2$
- D. $\mu_1 \neq \mu_2$
- E. $p_1 < p_2$
- F. $p_1 > p_2$

0

Note: Choose μ for the means, σ for the standard deviations, p for the proportions.

2. Compute the statistic:

- A. t
- B. F
- C. Z

= _____

Note: Choose Z for z.test (using the standard normal distribution), T for t.test (using the Student distributions), and F for F.test (using the Fisher distributions).

3. Determine the acceptance region (the complementary region to the rejection region):

Answer: (_____, _____).

Note: Type oo for Infinity and -oo for Negative Infinity.

4. Make a conclusion:

- A. $\mu_1 \neq \mu_2$ We have enough evidence to confirm that the mean scores are different between two persons.
- B. $\mu_1 = \mu_2$ We don't have enough evidence to confirm that the mean scores are different between two persons.

6. (30 pts)

To study the association of the monthly average temperature (in degree Celsius, X) and the occupation in a certain hotel (in %, Y), a sample of 10 months were collected. The following table shows a summary of some simple calculations.

| | Temperature (x) | Occupation (y) |
|---|---------------------|--------------------|
| Sum of observed values $\left(\sum_i x_i \text{ or } \sum_j y_j\right)$ | 93.2 | 511.62 |
| Sum of squares $\left(\sum_i x_i^2 \text{ or } \sum_j y_j^2\right)$ | 2345.26 | 26540.8996 |

Furthermore, $\sum_{i=1}^{10} x_i y_i = 5443.686$.

Fit a simple regression model to explore the effect of the monthly average temperature to the occupation.

1. Compute the slope and the y-intercept:

- i. The slope: _____
 ii. The y-intercept: _____

2. Compute the sums of squares:

| SST | SSR | SSE |
|-----|-----|-----|
| | | |

3. Estimate the variance of random errors: $\sigma^2 =$ _____

4. Construct a 95% confidence interval for the slope:

(_____, _____)

Note: Type oo for Infinity and -oo for Negative Infinity.

5. Determine the coefficient of determination: $R^2 =$ _____

+++++

Key - Form 1

1. ~ ~ ~
2. A: No
3. 0.078531821242166 ~ 0.0012379400392854 ~ 6 ~ 2.1908902300207
4. A: We fail to reject H_0 ~ A: > 250 ~ C: $T \sim [2.2461, 2.246108481144] \sim -\infty \sim [2.99, 3]$
5. B: $\&\mu;1 - \&\mu;2 \sim D: \neq$ ~ ~ A: $T \sim [0.1687631851389, 0.1688] \sim [-1.79, -1.78] \sim [1.78, 1.79] \sim B$: We don't have enough evidence to confirm that the mean scores are different between two persons.
6. ~ ~ ~ 0.45738259124117 ~ 46.899194249632 ~ 365.39716 ~ 308.91053058016 ~ 56.486629419844 ~ 7.0608286774805 ~ [0.2976, 0.2983] ~ [0.6164, 0.6171] ~ 0.84541032168985

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Make-up final exam 211

1. (0 pts)

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Your full name: _____

Your student ID: _____

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Below are some statistical tables. Please click [+] for more details.

[Statistical Tables](#) [+]

2. (20 pts)

Consider the joint probability mass function for the type of customer service X (0 = telephonic hotline, 1 = Email) and of satisfaction score Y (1 = unsatisfied, 2 = satisfied, 3 = very satisfied):

| $X \backslash Y$ | 1 | 2 | 3 |
|------------------|------|------|------|
| 0 | 0.03 | 0.35 | 0.14 |
| 1 | 0.38 | c | 0.1 |

1. Find the constant c .

Answer: _____

2. If a customer chooses to use the Email service, what is the probability that this person is **NOT unsatisfied**?

Answer: _____

3. Find the average and the standard deviation of the satisfaction score.

The average: _____

4. Among 16 customers who used the customer services, find the probability that 5 of them chose the Email service.

Answer: _____

3. (5 pts)

The systolic blood pressures of adults, in the appropriate units, are normally distributed with a mean of 126.2 and a standard deviation of 3.7. Find percentage of adults whose systolic blood pressures are greater than 125.2.

Answer: _____

4. (22 pts)

It has been claimed that under 25 percent of entering college students have blood cholesterol levels of at least 200. In a group of 197 random selected students, there are 46 students confirmed to have blood cholesterol levels of at least 200. What conclusion do you draw at the 0.1 percent level of significance?

1. Compute the sample proportion: $\hat{p} =$ _____

2. Confirm the alternative hypothesis H_1 :

p

A. $>$

B. $<$

C. \neq

D. $=$

E. \leq

F. $>$

A. 0.25

B. 0.23

3. Compute the test statistic:

A. T

B. F

C. Z

= _____

Note: Choose Z for z.test (using normal distribution), T for t.test (using Student distributions), and F for F.test (using Fisher distributions).

4. Find the accepted region (the complementary region to the rejection region): (_____, _____)

5. Make a conclusion:

A. We fail to reject H_0 .

B. We reject H_0 .

(Type oo for Infinity and -oo for Negative Infinity)

5. (23 pts)

6 of Leonard's best friends try a new diet: the "Banting" diet. Each of them weighs him/herself before and after the diet. The data is as follows:

| Person (i) | 1 | 2 | 3 | 4 | 5 | 6 |
|------------------|----|-----|----|-----|----|----|
| Before diet (xi) | 95 | 105 | 96 | 88 | 84 | 94 |
| After diet (yi) | 85 | 101 | 97 | 107 | 83 | 91 |

Assuming the normality and the significance level is 5%. Does the data suggest that the weight before diet is less than that of after diet?

1. State the alternative hypothesis (X and Y represent the first sample and the second sample respectively)

H_1 :

- A. $\sigma_1 - \sigma_2$
- B. $p_1 - p_2$
- C. $\mu_1 - \mu_2$

- A. \neq
- B. $<$
- C. \leq
- D. $>$
- E. $=$
- F. $>$

0

2. Compute the statistic:

- A. Z
- B. F
- C. T

= _____

Note: Choose Z for z.test (using normal distribution), T for t.test (using Student distributions), and F for F.test (using Fisher distributions).

3. Determine the acceptance region (the complementary region to the rejection region):

Answer: _____, _____

4. Make a conclusion:

- A. We can reject H_0
- B. We fail to reject H_0

(Type oo for Infinity and -oo for Negative Infinity)

6. (30 pts)

To determine whether the percentage of calories in a person's diet that is due to fat is the same across the country, random samples of 15 volunteers were chosen in the 3 different regions. Each volunteer's percentage of total calories due to fat was determined, with the following summarized data resulting.

| | Region C | Region A | Region B |
|---|----------|----------|----------|
| Number of observations | 5 | 5 | 5 |
| Sum of observations for each type $\left(\sum_j x_{ij}\right)$ | 380.6 | 327.5 | 368.3 |
| Sum of squares for each type $\left(\sum_j x_{ij}^2\right)$ | 29192.42 | 21644.59 | 27353.85 |

Assuming the normality and $\alpha = 0.01$, make an appropriate conclusion based on an ANOVA.

1. Complete the table by providing appropriate values for blanks in the table:

| Source of variation | Degree of freedom | Sum of squares | Mean square | F |
|---------------------|-------------------|----------------|-------------|---|
| Treatment | | | | |
| Error | | | | |
| Total | | 948.396 | | |

2. Determine the rejection region: (_____, _____)

3. What conclusion can you draw about the null hypothesis?

- A. __ We don't have enough evidence to conclude that the results are significantly different for 3 regions.
 B. __ We have enough evidence to conclude that the results are significantly different for 3 regions.

(Type oo for Infinity and -oo for Negative Infinity)

+++++

Key - Form 1

1. ~ ~ ~
2. $0 \sim 0.20833333333333 \sim 1.83 \sim 0.083661490292233$
3. 0.6065
4. $0.23350253807107 \sim B: < \sim A: 0.25 \sim C: Z \sim [-0.53474854536332, -0.5347] \sim [-1.29, -1.28] \sim oo \sim A:$
We fail to reject H_0 .
5. $C: \mu_1 - \mu_2 \sim B: < \sim C: T \sim [-0.082703961697356, -0.0827] \sim [-2.02, -2.01] \sim oo \sim B:$ We fail to reject H_0
6. $B: 2 \sim 12 \sim 14 \sim 309.03600000001 \sim 639.35999999999 \sim 154.518 \sim 53.279999999999 \sim 2.9001126126127 \sim [6.92, 6.93] \sim oo \sim A:$ We don't have enough evidence to conclude that the results