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Department of
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قسم الإحصاء وبحوث العمليات

King Saud University
جــامـعــة الملك سعود

Final Exam

December 22 2018	STAT 105	Academic year 1439-40H
08:00– 10:00	Statistical Methods	First Semester

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Section No.		رقم الشعبة
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Instructions:
- Switch off your mobile and place it under your seat.
- Time allowed is 120 Minutes.
- Do not copy answers from your neighbors. They have different questions forms.
- Choose the nearest number to your answer.
- Do not use pencils or red pens.
- For each question, put the code (Capital Letters) of the correct answer in the following table beneath the question number.
- For questions 1 (2 marks) and 38 (2 marks), put your answer below the question.

2	3	4	5	6	7	8	9	10	
C	B	C	A	D	B	C	A	B	
11	12	13	14	15	16	17	18	19	20
A	A	B	B	A	B	A	B	C	B
21	22	23	24	25	26	27	28	29	30
A	C	A	B	B	D	A	B	A	B
31	32	33	34	35	36	37			
D	D	C	D	C	B	D			

Question (1-13): Three types of medium sized cars assembled in New Zealand have been test driven by a motoring magazine and compared on a variety of criteria. In the area of fuel efficiency performance, five cars of each brand were each test driven 1000 km; the km per liter data are obtained as follows:

	Kilometres per liter					Total
Brand A	7.6	8.4	8	7.6	8.4	40
Brand B	7.8	8	9.1	8.5	9.6	43
Brand C	9.6	10.4	9.2	9.7	10.6	49.5

Let the one way ANOVA tabulated as follows:

Source of variation	Sum of squares	Degrees of freedom	Mean Squares	Test Statistics
Treatments	SSA	df_{trt}	MSA	
Errors	SSE	df_{er}	MSE	f
Total	SST	df_{tot}		

At a significance level of $\alpha = 0.05$, we want to compare the means of the three groups.

1. Write the hypotheses H_0 and H_1. Explain (2 marks).

2. The grand mean $\bar{y}_{..}$ is

(A) (40+30+49.5)/3	(B) (40+30+49.5)/5	(C) (40+30+49.5)/15

3. The value of SSA is

(A) 18.5	(B) 9.43	(C) 29.5	(D) 38.75

$$SST = \sum_i \sum_j (y_{ij} - \bar{y}_{..})^2 = \sum_i \sum_j y_{ij}^2 - 15\bar{y}_{..}^2 \text{ and } \sum_i \sum_j y_{ij}^2 = 1184.11$$

4. Then SST is

(A) 4.26	(B) 24.75	(C) 13.69	(D) 0.28

5. The value of SSE is

(A) 4.26	(B) 14.75	(C) 25.23	(D)34.28

6. The degrees of freedom of the treatments (df_{trt}) is

(A) 4	(B) 3	(C) 14	(D) 2

7. The degrees of freedom of the error (df_{er}) is

(A) 10	(B) 12	(C) 14	(D) 8

8. The degrees of freedom of the total (df_{tot}) is

(A) 15	(B) 16	(C) 14	(D) 17

9. The Mean Squares of the treatments (MSA) is

(A) 4.72	(B) 9.25	(C) 14.75	(D) 19.37

10. The Mean Squares of the errors (MSE) is

(A) 1.229	(B) 0.355	(C) 0.227	(D) 2.102

11. The value of the test statistic f is

(A) 13.29	(B) 7.53	(C) 64.98	(D) 85.35

12. The rejection region (R.R) of H_0 is

(A) $(3.89, +\infty)$	(B) $(3.49, +\infty)$	(C) $(3.34, +\infty)$	(D) $(19.41. +\infty)$

13. The decision about the doctor's claim is

(A) Not Reject H_0	(B) Reject H_0

Questions (14-18): A doctor believes that the proportions of births in this country on each day of the week are equal. A simple random sample of 700 births from a recent year is selected, and the results are below.

Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Frequency	65	103	114	116	115	112	75
Expected frequency (E_i)	$E_1 = 100$	$E_2 = \cdots$	$E_3 = \cdots$	$E_4 = 100$	$E_5 = 100$	$E_6 = 100$	$E_7 = 100$

At a significance level of $\alpha = 0.01$, we want to test the hypothesis if there is enough evidence to support the doctor's claim .

14. The expected frequency E_2 is

(A) 75	(B) 100	(C) 103	(D) 75

15. The degree of freedom of the χ^2 test statistic is

(A) 6	(B) 7	(C) 5	(D) 4

16. The value of the χ^2 test statistic is

(A) 14.3	(B) 26.8	(C) 39.5	(D) 55.7

17. The critical value is

(A) 16.812	(B) 20.090	(C) 18.475	(D) 18.548

18. The decision about the doctor's claim is

(A) Not Reject H_0	(B) Reject H_0

Questions (19-25): The results of a random sample of children with pain from musculoskeletal injuries treated with acetaminophen, ibuprofen, or codeine are shown in the table. At $\alpha = 0.10$, we want to test the hypothesis that the treatment and result are independent

	Acetaminophen	Ibuprofen	Codeine
Significant Improvement	58 (E_{11}=66.7)	81 (E_{12}=…)	61 (E_{13}=66.6)
Slight Improvement	42 (E_{21}=…)	19 (E_{22}=33.3)	39 (E_{23}=33.4)

19. The distribution of the test statistic is

(A) t	(B) Binomial	(C) Chi squares	(D) Normal

20. The value of the expectation E_{12} is :

| (A) 33.3 | (B) 66.7 | (C) 70.6 | (D) 60.1 |

21. The value of the expectation E_{21} is

| (A) 33.3 | (B) 23.5 | (C) 66.7 | (D) 30.5 |

22. The mathematical expression of the test statistic is :

(A)	(B)	(C)	(D)
$\displaystyle\sum_{1}^{C} \frac{(O_j - E_j)^2}{E_j}$	$\displaystyle\sum_{1}^{C} \frac{(O_j - E_j)^2}{O_j}$	$\displaystyle\sum_{i=1}^{r}\sum_{j=1}^{C} \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$	$\displaystyle\sum_{i=1}^{r}\sum_{j=1}^{C} \frac{(O_{ij} - E_{ij})^2}{O_{ij}}$

23. The value of the χ^2 test statistic is

| (A) 14.02 | (B) 20.3 | (C) 22.6 | (D) 18.26 |

24. The critical value is

| (A) 9.348 | (B) 4.605 | (C) 5.991 | (D) 7.815 |

25. The decision about the independence is

| (A) Not Reject H_0 | (B) Reject H_0 |

Question (25-35): The shear resistance of soil, Y , is determined by measurements as a function of the normal stress, X . We assume that the errors ε_i are normally distributed. The data are as shown below:

x_i	10	11	12	13	14	15	16	17	18	19	20	21
y_i	14.08	15.57	16.94	17.68	18.49	19.55	20.68	21.72	22.8	23.84	24.79	25.67

We have $\sum_i x_i = 186$, $\sum_i y_i = 241.81$, $\sum_i x_i^2 = 3026$, $\sum_i y_i^2 = 5025.399$, $\sum_i x_i y_i = 3895.65$

26. The coefficient S_{xx} is

| (A) 345 | (B) 230 | (C) 80 | (D) 143 |

27. The coefficient S_{yy} is

| (A) 152.726 | (B) 258.126 | (C) 345.652 | (D) 430.584 |

28. The coefficient S_{xy} is

| (A) 50.156 | (B) 147.595 | (C) 245.123 | (D) 349.245 |

29. The sample linear correlation coefficient r is

| (A) 0.9987 | (B) 0.5642 | (C) 0.4893 | (D) 0.3359 |

- If the estimate of the linear regression line is $\hat{y} = a + bx$, then

30. The value of b is :

| (A) 0.842 | (B) 1.032 | (C) 0.586 | (D) 0.351 |

31. The value of a is

| (A) 1.34 | (B) 2.53 | (C) 3.98 | (D) 4.15 |

-We want to test the hypothesis that b= 1 against the alternative that b> 1 at the 0.05 level of significance. The residuals e_i are

-0.394 0.064 0.402 0.109 -0.113 -0.085 0.013 0.021 0.069 0.077 -0.005 -0.158

32. Deduce that the value of SSE is

| (A) 3.145 | (B) 2.232 | (C) 1.962 | (D) 0.389 |

33. The unbiased estimate of σ^2 is

| (A) 0.3145 | (B) 0.1232 | (C) 0.0389 | (D) 0.1962 |

34. The value of the test statistic is

| (A) 5.14 | (B) 4.23 | (C) 3.14 | (D) 1.94 |

35. The critical value is

| (A) 2.228 | (B) 2.796 | (C) 1.812 | (D) 1.782 |

36. The decision is

| (A) Not Reject H_0 | (B)   Reject H_0 |

37. The coefficient of determination R^2 is

| (A) 0.228 | (B) 0.796 | (C) 0.612 | (D) 0.997 |

38. Determine the 90% confidence interval for the parameter β_1 (2 marks).