R University

Exam 2024-03-13

Personal Data

Family Name:

Given Name:

Signature:

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Registration Number

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1	☐	☐	☐	☐	☐	☐	☐	1
2	☐	☐	☐	☐	☐	☐	☐	2
3	☐	☐	☐	☐	☐	☐	☐	3
4	☐	☐	☐	☐	☐	☐	☐	4
5	☐	☐	☐	☐	☐	☐	☐	5
6	☐	☐	☐	☐	☐	☐	☐	6
7	☐	☐	☐	☐	☐	☐	☐	7
8	☐	☐	☐	☐	☐	☐	☐	8
9	☐	☐	☐	☐	☐	☐	☐	9

In this section **no** changes or modifications must be made!

Scrambling: 0 0

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Exam ID: 24031300003

Please mark the boxes carefully: ☒ Not marked: ☐ or ■

This document is scanned automatically. Please keep clean and do not bend or fold. For filling in the document please use a **blue or black pen**.

Only clearly marked and positionally accurate crosses will be processed!

Answers 1 - 6

	a	b	c	d	e
1	☐	☐	☐	☐	☐
2	☐	☐	☐	☐	☐
3	☐	☐	☐	☐	☐
4	☐	☐	☐	☐	☐
5	☐	☐	☐	☐	☐
6	☐	☐	☐	☐	☐
	a	b	c	d	e

1. *(1 point)* A machine fills milk into 200ml packages. It is suspected that the machine is not working correctly and that the amount of milk filled differs from the setpoint $\mu_0 = 200$. A sample of 214 packages filled by the machine are collected. The sample mean $\bar{y}$ is equal to 196.8 and the sample variance s^2_{n-1} is equal to 39.22.

   Test the hypothesis that the amount filled corresponds on average to the setpoint. What is the value of the *t* test statistic?

   (a) -3.368
   (b) -1.103
   (c) -7.475
   (d) -13.749
   (e) 7.136

2. *(1 point)* The waiting time (in minutes) at the cashier of two supermarket chains with different cashier systems is compared. The following statistical test was performed:

```
        Two Sample t-test

data:  Waiting by Supermarket
t = 3.1905, df = 147, p-value = 0.001737
alternative hypothesis: true difference in means between group Sparag and group Consumo is not e
95 percent confidence interval:
 0.6176644 2.6282316
sample estimates:
 mean in group Sparag mean in group Consumo
             6.935387              5.312439
```

   Which of the following statements are correct? (Significance level 5%)

   (a) The absolute value of the test statistic is larger than 1.96.
   (b) A one-sided alternative was tested.
   (c) The *p* value is larger than 0.05.
   (d) The test shows that the waiting time is longer at Sparag than at Consumo.
   (e) The test shows that the waiting time is shorter at Sparag than at Consumo.

3. *(1 point)* In a small city the satisfaction with the local public transportation is evaluated. One question of interest is whether inhabitants of the city are more satisfied with public transportation compared to those living in the suburbs.

   A survey with 250 respondents gave the following contingency table:

	Location	
Evaluation	City	Suburbs
Very good	24	11
Good	44	25
Bad	25	65
Very bad	7	49

   The following table of percentages was constructed:

	Location	
Evaluation	City	Suburbs
Very good	9.6	4.4
Good	17.6	10.0
Bad	10.0	26.0
Very bad	2.8	19.6

Which of the following statements are correct?

(a) The value in row 4 and column 2 in the percentage table indicates: 19.6 percent of those, who evaluated the public transportation as very bad, live in the suburbs.

(b) The value in row 3 and column 1 in the percentage table indicates: 10 percent of the respondents lived in the city and evaluated the public transportation as bad.

(c) The percentage table provides the location distribution for each level of satisfaction.

(d) The percentage table can be easily constructed from the original contingency table: percentages are calculated for each row.

(e) The percentage table provides total percentages.

4. *(2 points)* A survey with 46 persons was conducted to analyze the design of an advertising campaign. Each respondent was asked to evaluate the overall impression of the advertisement on an eleven-point scale from 0 (bad) to 10 (good). The evaluations are summarized separately with respect to type of occupation of the respondents in the following figure.

To analyze the influence of occupation on the evaluation of the advertisement an analysis of variance was performed:

```
  Res.Df    RSS Df Sum of Sq     F     Pr(>F)
1     45 40.267
2     42 24.875  3    15.392 8.663 0.00013631
```

Which of the following statements are correct?

(a) It can be shown that the evaluation of the respondents depends on their occupation. (Significance level 5%)

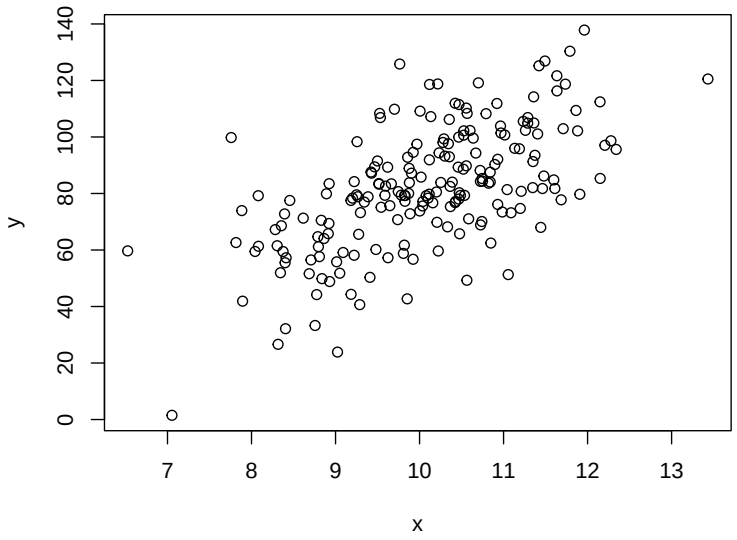
(b) The fraction of explained variance is larger than 26%.

(c) The test statistic is smaller than 20.7.

(d) The fraction of explained variance is smaller than 52%.

(e) A one-sided alternative was tested for the mean values.

5. *(2 points)* The following figure shows a scatterplot. Which of the following statements are correct?



(a) The standard deviation of Y is at least 6.
(b) The mean of Y is at least 30.
(c) For $X = 9.7$, Y can be expected to be about 117 .
(d) The absolute value of the correlation coefficient is at most 0.8.
(e) The scatterplot is standardized.

6. *(3 points)* For the matrix

$$A = \begin{pmatrix} 9 & -3 & -12 & 9 \\ -3 & 26 & 4 & 17 \\ -12 & 4 & 41 & -27 \\ 9 & 17 & -27 & 38 \end{pmatrix}.$$

compute the matrix $L = (\ell_{ij})_{1 \le i,j \le 4}$ from the Cholesky decomposition $A = LL^\top$.
Which of the following statements are true?

(a) $\ell_{21} < -1$
(b) $\ell_{41} \le 3$
(c) $\ell_{32} < -5$
(d) $\ell_{33} \ge 5$
(e) $\ell_{43} < -10$