

國立清華大學 106 學年度碩士班考試入學試題

系所班組別：服務科學研究所 甲組

考試科目（代碼）：統計學（4702）

共 5 頁，第 1 頁 *請在【答案卷、卡】作答

Please answer all 10 questions. In each question, select the correct answer(s).

Below are data for 21 orders of lunch boxes made by a small restaurant. For each order we have the number of lunch boxes (**meals**), the delivery time in minutes (**deliverytime**), and whether the order included drinks (**type=1**) or not (**type=0**).

meals	deliverytime	type
4	45	0
2	38	0
7	48	0
4	41	0
6	45	0
7	47	1
9	49	1
10	48	0
6	50	1
9	50	1
10	51	1
4	44	0
6	44	0
5	52	1
8	50	1
10	51	0
7	48	0
3	40	0
3	42	0
7	49	0
3	42	0

Suppose this sample is representative of orders from this restaurant.

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We wish to test whether the average delivery time for an order with drinks takes longer by more than 5 minutes compared to an order without drinks.

1. [10%] Which of the following set of hypotheses is appropriate for answering this question? We use μ to denote the average delivery time in the population.
 - a. $H_0: \mu_{\text{drinks}} = \mu_{\text{no-drinks}} + 5$ and $H_1: \mu_{\text{drinks}} \neq \mu_{\text{no-drinks}} + 5$
 - b. $H_0: \mu_{\text{drinks}} \geq \mu_{\text{no-drinks}} + 5$ and $H_1: \mu_{\text{drinks}} < \mu_{\text{no-drinks}} + 5$
 - c. $H_0: \mu_{\text{drinks}} \leq \mu_{\text{no-drinks}} + 5$ and $H_1: \mu_{\text{drinks}} > \mu_{\text{no-drinks}} + 5$
 - d. $H_0: \mu_{\text{drinks}} > \mu_{\text{no-drinks}} + 5$ and $H_1: \mu_{\text{drinks}} \leq \mu_{\text{no-drinks}} + 5$
2. [10%] Which of the following sample statistics are **necessary** for computing the test statistic? (choose all that apply)
 - a. average delivery time of all 21 orders
 - b. average number of lunchboxes in the 21 orders
 - c. average delivery time of orders with drinks
 - d. delivery time for each of the 21 orders
 - e. standard deviation of delivery time for orders without drinks
3. [10%] Compute the test statistic (assume equal variances of delivery times for orders with and without drinks). Choose the value of the test statistic that you get:
 - a. lower than -6
 - b. in the interval [-6, -3)
 - c. in the interval [-3, 3)
 - d. in the interval [3, 6]
 - e. higher than 6
4. [10%] A new delivery was just completed in less than 48 minutes. What is the probability that the order included drinks?
 - a. less than 0.1
 - b. in the interval [0.1, 0.4)
 - c. in the interval [0.4, 0.6]
 - d. in the interval [0.6, 0.8]
 - e. higher than 0.8

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Below is a linear regression model estimated for delivery time, with the independent variables meals, type, and their interaction. Use the output to answer the following questions.

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	37.3896	1.0988	34.027	< 2e-16
meals	1.3361	0.1842	7.252	1.35e-06
type	13.3751	3.2409	4.127	0.000704
meals*type	-1.4538	0.4280	-3.397	0.003433

5. [10%] Using the regression model, predict the average delivery time for a new order with 6 lunchboxes that includes drinks. Choose the most appropriate predicted range:
- a. < 40 minutes
 - b. 40-43 minutes
 - c. 44-46 minutes
 - d. 47-50 minutes
 - e. > 50 minutes
6. [10%] The 99% confidence interval for the parameter for **meals*type**
- a. includes the value 0
 - b. includes only positive values
 - c. includes only negative values

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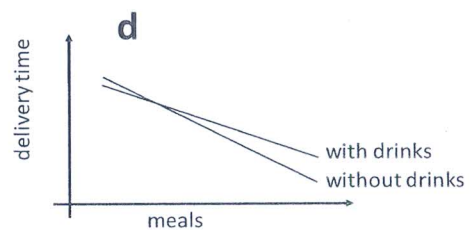
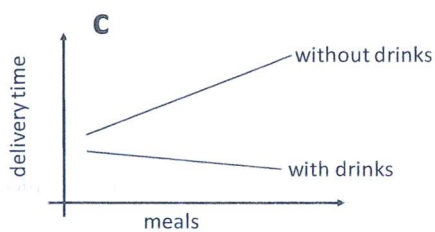
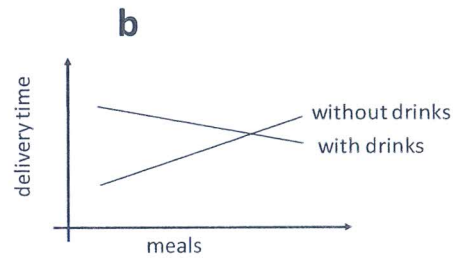
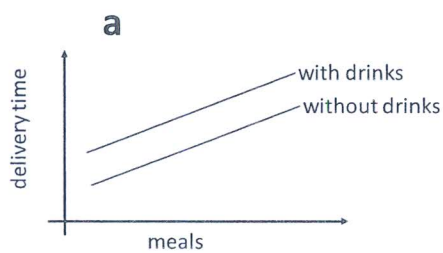
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7. [10%] For an order with drinks, increasing the number of meals by 3 lunchboxes is associated with an average delivery time that is...

- a. longer by less than 1 minute
- b. longer by 1.3 minutes
- c. longer by 4 minutes
- d. shorter by 1.3 minutes
- e. shorter by less than 1 minute

8. [10%] Which of the following four charts best describes the estimated regression model shown in the output?



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9. [10%] Based on the regression output, what can we say about the relationship between delivery time and meals (number of lunchboxes)? Use a 5% significance level. (Choose all that apply)
- a. Delivery time is positively associated with meals
 - b. Delivery time is negatively associated with meals for orders without drinks
 - c. Delivery time is negatively associated with meals for orders with drinks
 - d. Delivery time is positively associated with meals for orders without drinks
 - e. Delivery time is positively associated with meals for orders with drinks
10. [10%] The chart below shows the residuals from the regression model, separately for orders without drinks and orders with drinks. Which of the following statements are correct? (choose all that apply)
- a. A big majority of orders without drinks are over-predicted by the model
 - b. The model cannot generate predicted delivery times above 60 minutes
 - c. The largest error the model makes for these 21 orders is an over-prediction of (approximately) 3 minutes
 - d. The largest error the model makes for these orders is an under-prediction of (approximately) 3 minutes

