

國立清華大學 101 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（4602）

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IMPORTANT: All questions have **multiple-choice** answers. However, if you find that more than one choice is correct, then **please select all correct choices**.

1. You have been asked by Hsinchu city council to estimate demographic information about the population of Hsinchu. Due to cost and time limitations, you can only survey 100 residents. Among other things, you will need to measure the following variables: ORIGIN (which city, township, or village a resident was born in), AGE (the age in years of a resident), EDUCATION (how many years of formal education a resident has), INCOME (yearly income of resident), and GENDER (male or female gender of resident). (10%)
 - 1.1. What kind of measurement scale do we need to use to measure ORIGIN?(5%)

(a) nominal	(c) interval
(b) ordinal	(d) ratio
 - 1.2. Due to legal reasons, you are not permitted to interview residents who are less than 18 years old. How will this restriction affect the measurement of BORN?(5%)

(a) increase bias	(c) increase variance
(b) decrease bias	(d) decrease variance
2. Before interviewing residents of the city, you have pretested your interview instrument on the students of a class you are taking – the class has 10 students in total. The following are the ages (in years) of all students in the class: 19, 20, 21, 20, 20, 19, 20, 21, 19, 21. (35%)
 - 2.1. Approximately, what is the variance of AGE in this class? (10%)

(a) 0.66	(c) 0.60	(e) 0.77
(b) 1.00	(d) 1.50	(f) none of the above
 - 2.2. What should be the units of the variance of AGE? (5%)

(a) no units	(c) years ²
(b) years	(d) $\sqrt{\text{years}}$

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2.3. What are the approximate standardized values of AGE for the 10 students?

(15%)

- (a) -1.00, 0.00, 1.00, 0.00, 0.00, -1.00, 0.00, 1.00, -1.00, 1.00
- (b) -1.67, 0.00, 1.67, 0.00, 0.00, -1.67, 0.00, 1.67, -1.67, 1.67
- (c) -2.36, 0.00, 2.36, 0.00, 0.00, -2.36, 0.00, 2.36, -2.36, 2.36
- (d) -0.36, 0.00, 0.36, 0.00, 0.00, -0.36, 0.00, 0.36, -0.36, 0.36
- (e) none of the above (explain)

2.4. What should be the units for the standardized values of AGE? (5%)

- (a) no units
- (b) years
- (c) years²
- (d) $\sqrt{\text{years}}$

3. After interviewing a sample of 100 residents of Hsinchu, you find that the mean AGE of the sample respondents is 35 years with a standard deviation of 5.0, and that AGE seems fairly normally distributed. However, you are told that the average age of Taiwan is larger than 35 years, and closer to 37 years. *Based on your sample data, you need to test whether the true average age of all Hsinchu residents is at least 37 years, or if it is smaller than 37 years.* (20%)

3.1. What are the most appropriate null and alternative hypotheses for this test?

(5%)

- (a) H_{null} : average age = 37 years
 H_{alt} : average age \neq 37 years
- (b) H_{null} : average age \neq 37 years
 H_{alt} : average age = 37
- (c) H_{null} : average age = 37 years
 H_{alt} : average age < 37 years
- (d) H_{null} : average age \geq 37 years
 H_{alt} : average age < 37 years

3.2. Calculate the t-value for the test to compare the average AGE found in your sample against the claim described above. Use $t = (\text{age}_{\text{ave}} - \mu) / (s / \sqrt{n})$. (10%)

- (a) 1.000
- (b) 2.165
- (c) 4.000
- (d) 3.965
- (e) 2.000
- (f) 1.965

3.3. Based on your t-value and the following excerpt from the t-table, what would you conclude about the claim? (5%)

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.90}$	$t_{.95}$	$t_{.99}$	$t_{.995}$	$t_{.9975}$	$t_{.999}$	$t_{.9995}$	$t_{.9999}$	$t_{.99995}$
one-tail	0.50	0.25	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	1.00	0.50	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.002	0.001
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390

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- (a) Reject H_{null} at 0.001 significance (c) Reject H_{null} at 0.100 significance
(b) Reject H_{null} at 0.050 significance (d) Cannot reject H_{null}

4. A regression analysis is conducted to test whether INCOME is related to AGE and EDUCATION. The output from the regression analysis software is shown below: (35%)

Coefficients:

	Estimate	Std Error	t-value	Pr(> t)
(Intercept)	159979	163075	0.981	0.34972
AGE	13665	5671	2.409	0.03672
EDUCATION	39735	11545	3.442	0.00631

- 4.1. Based on the t-table from problem 3.3, choose the significance level of each of the three coefficients. Choose the range of the significance from options a – d. (15%)

- 4.1.1. The intercept term(5%) (a) Not significant (c) 1%-2.5%
4.1.2. Coefficient of AGE(5%) (b) 2.5% - 5% (d) < 1%
4.1.3. Coefficient of EDUCATION(5%)

- 4.2. How would you interpret the estimate of the intercept: (5%)

- (a) The average income of all residents regardless of age or education
(b) The minimum income of residents regardless of age or education
(c) A random artifact of regression that has no meaning or units
(d) None of the above (explain)

- 4.3. Predict the salary for a 23-year old resident with 18 years of education: (15%)

- (a) NTD 1,189,504 (c) NTD 2,393,428
(b) NTD 1,319,854 (d) NTD 1,029,525