


**注意：考試開始鈴響前，不得翻閱試題，
並不得書寫、畫記、作答。**

國立清華大學 108 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(5201)

— 作答注意事項 —

1. 請核對答案卷(卡)上之准考證號、科目名稱是否正確。
2. 作答中如有發現試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記「由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清(含未依範例畫記)致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。
6. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「國立清華大學試場規則及違規處理辦法」，無法因本試題封面作答注意事項中未列明而稱未知悉。

國立清華大學 108 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（服務管理組）

考試科目（代碼）：統計學（5201）

共 6 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).

Gender Discrimination at BoBank

BoBank is a traditional bank that has been in business for nearly 50 years and has employed hundreds of employees. The bank is facing a gender discrimination lawsuit, with claims that women receive lower salaries than men.

A journalist obtained salary and gender data on a random sample of 208 BoBank employees. For each of the employees the journalist has the following information:

Salary = Current monthly salary in thousands of New Taiwan Dollars (NT\$)

Gender = Male or Female

YrsExp = Number of years working at BoBank

Below is the data for the first 6 employees in the journalist's sample:

	<i>Salary</i>	<i>Gender</i>	<i>YrsExp</i>
1	32.00	Male	3
2	39.10	Female	14
3	33.20	Female	12
4	30.60	Female	8
5	29.00	Male	3
6	30.50	Female	3
7	30.00	Female	4
8	27.00	Male	8

Next, the journalist computed and plotted summary statistics of salaries in her sample:

國立清華大學 108 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 (服務管理組)
考試科目 (代碼)：統計學 (5201)

共 6 頁，第 2 頁 *請在【答案卷、卡】作答

The journalist wants to test whether among all BoBank employees, women's average salary is lower than men's average salary.

μ denotes the average salary of all BoBank employees.

\bar{X} denotes the average salary in the journalist's sample (208 employees).

1. [10%] Which of the following set of hypotheses is appropriate for answering the above question?
 - a. $H_0: \mu_{\text{women}} = \mu_{\text{men}}$ and $H_1: \mu_{\text{women}} \neq \mu_{\text{men}}$
 - b. $H_0: \mu_{\text{women}} \geq \mu_{\text{men}}$ and $H_1: \mu_{\text{women}} < \mu_{\text{men}}$
 - c. $H_0: \mu_{\text{women}} > \mu_{\text{men}}$ and $H_1: \mu_{\text{women}} \leq \mu_{\text{men}}$
 - d. $H_0: \bar{X}_{\text{women}} \geq \bar{X}_{\text{men}}$ and $H_1: \bar{X}_{\text{women}} < \bar{X}_{\text{men}}$
 - e. $H_0: \bar{X}_{\text{women}} > \bar{X}_{\text{men}}$ and $H_1: \bar{X}_{\text{women}} \leq \bar{X}_{\text{men}}$

2. [10%] The journalist will use her data to test the hypothesis. Which of the following values are **necessary** for computing the test statistic? (choose all that apply)
 - a. Average salary of all BoBank employees
 - b. Average salary of employees in the journalist's sample
 - c. Average salary of women employees in the journalist's sample
 - d. Standard deviation of women's salary of all BoBank employees
 - e. Standard deviation of women's salary in the journalist's sample

3. [10%] Compute the test statistic (assume equal variances of salary for women and men in the population). The value of the test statistic is:
 - a. lower than -3
 - b. in the interval $[-3, -1)$
 - c. in the interval $[-1, 1)$
 - d. in the interval $[1, 3]$
 - e. higher than 3

國立清華大學 108 學年度碩士班考試入學試題

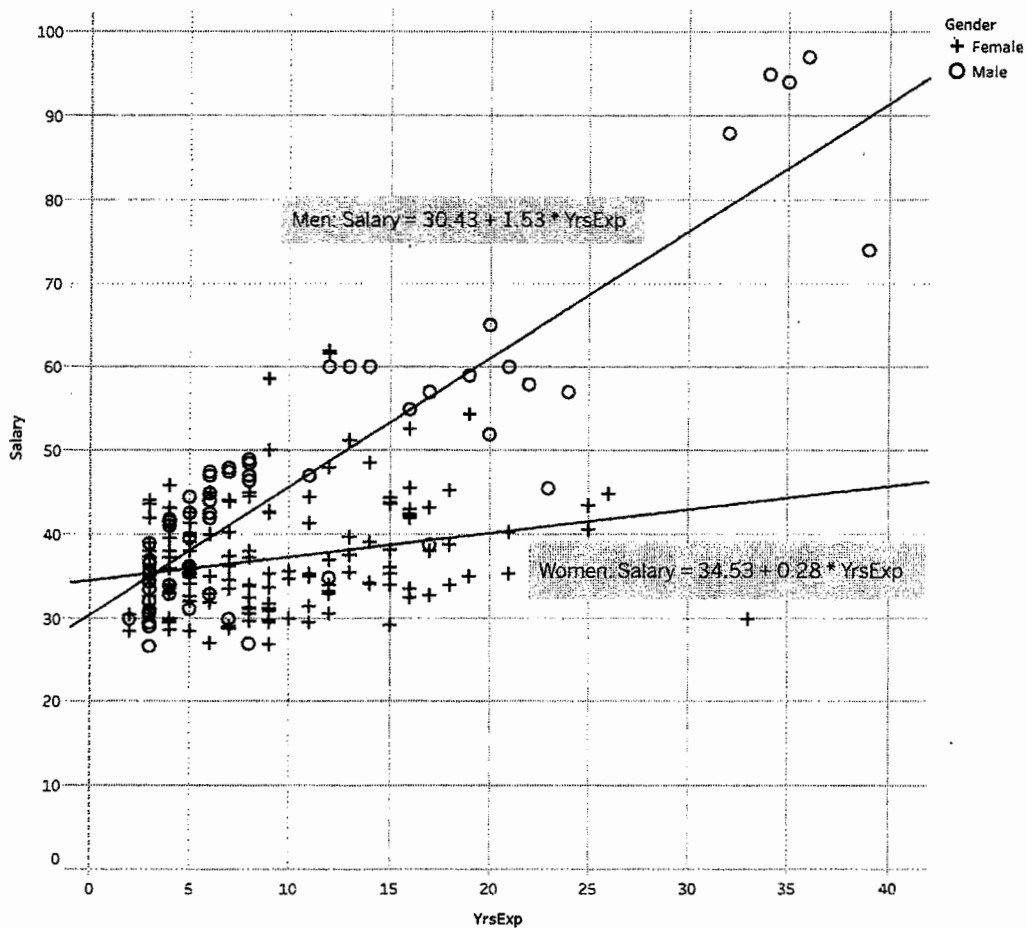
系所班組別：服務科學研究所 甲組（服務管理組）

考試科目（代碼）：統計學（5201）

共 6 頁，第 3 頁 *請在【答案卷、卡】作答

The journalist wanted to take into account the employee's experience at BoBank. She plotted *Salary* vs. *YrsExp* by *Gender* and fitted two regression lines (one for men and one for women).

Salary vs Experience



國立清華大學 108 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（服務管理組）

考試科目（代碼）：統計學（5201）

共 6 頁，第 4 頁 *請在【答案卷、卡】作答

4. [10%] What does the scatter plot show about work experience? (Choose all correct statements)
- a. Salaries increase as employees work longer at the bank
 - b. Women with more experience always earn higher salaries than less-experienced women
 - c. Men with more experience earn higher average salaries than less-experienced men
 - d. The top 5 highest salaries in the sample belong to the employees with the longest experience
 - e. The difference between the regression line intercepts for men and for women is statistically significant
5. [10%] What does the plot show about gender? (Choose all correct statements)
- a. Comparing men and women with the same experience, the average salaries are higher for men.
 - b. Comparing employees with 30+ years of experience to employees with shorter experience, salary gender gaps look different
 - c. Women are rare among the top salary employees in the sample
 - d. The difference between the regression line slope for men and for women is statistically significant
6. [10%] Using the regression models shown inside the chart, predict the average salary expected for a **woman working 10 years** at BoBank. Choose the appropriate predicted range:
- a. < NT\$30,000
 - b. NT\$30,000 to NT\$40,000
 - c. NT\$40,001 to NT\$50,000
 - d. NT\$50,001 to NT\$60,000
 - e. > NT\$60,000

國立清華大學 108 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（服務管理組）

考試科目（代碼）：統計學（5201）

共 6 頁，第 5 頁 *請在【答案卷、卡】作答

The journalist realized she cannot test the hypothesis about men vs. women's average salary with two separate models. So she ran a single linear regression model for all 208 employees, with *Salary* as a function of *Gender*, *YrsExp*, and their interaction *Gender x YrsExp*. Here is the output:

	Coefficient	Std. Error	t value	Pr(> t)
(Intercept)	34.5283	1.1380	30.342	< 2e-16
GenderMale	-4.0983	1.6658	-2.460	0.01472
YrsExp	0.2800	0.1025	2.733	0.00684
GenderMale xYrsExp	1.2478	0.1367	9.130	< 2e-16

Note: *GenderMale* = 1 for men and 0 for women

Use the regression output to answer the following questions (\$ are rounded)

7. [10%] Using the regression model, predict the average salary expected for a woman working 10 years at BoBank. Choose the appropriate predicted range:
 - a. < NT\$30,000
 - b. NT\$30,000 to NT\$40,000
 - c. NT\$40,001 to NT\$50,000
 - d. NT\$50,001 to NT\$60,000
 - e. > NT\$60,000

8. [10%] For a woman and man who joined BoBank 3 years ago, how will their salaries differ today? Choose the correct answer:
 - a. The woman will earn NT\$4098 less than the man
 - b. The woman will earn on average NT\$4000 less than the man
 - c. The woman will earn on average NT\$4000 more than the man
 - d. The woman will earn on average NT\$350 less than the man
 - e. The woman will earn on average NT\$350 more than the man

國立清華大學 108 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（服務管理組）

考試科目（代碼）：統計學（5201）

共6頁，第_6_頁 *請在【答案卷、卡】作答

9. [10%] The regression model coefficients indicate that (choose all the correct statements)
- for each year of experience, men's average salary increases by NT\$280
 - for each year of experience, women's average salary increases by NT\$280
 - for each year of experience, the average salary for men increases by NT\$1528
 - for each year of experience, the average salary for women increases by NT\$1528
 - the average starting salary for women is NT\$34,528
10. [10%] Which of the regression coefficients should the journalist use to test the hypothesis that **the effect of years of experience at BoBank on average salary is different across the two genders?** (Choose all the correct answers)
- The intercept
 - GenderMale
 - YrsExp
 - Gender x YrsExp