# 國立臺北大學113學年度碩士班一般入學考試試題

系（所）組別：經濟學系

科　　目：統計學



☑可 ☐不可使用計算機

**I. 選擇題**（每題5分，共30分）

1. Robert has $N = 20$ observations on variables $y$, $x_1$, $x_2$ and $x_3$. He estimates the following equation by OLS method:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + u$$

The estimation outcome is as below:

$$y = 6.0 + 3.0x_1 - 2.0x_2 + 4.0x_3, \quad \text{.....(1)}$$

(1.0)

Explained sum of squares errors (SSE)=100, Total sum of squares=200.

where the numbers in parentheses are standard errors for coefficient $\beta_1$ . What is the true value of $s^2$ ( estimated error variance ) in equation (1)?

(A) 4

(B) 4.76

(C) 4.55

(D) 5

2. Continue Question 1, Robert estimate the other equation by ordinary least squares (OLS) method,

$$y = 6.0 + 3.2x_1, \quad \text{.....(2)}$$

where $SSE = 140$. If Robert tests the following hypothesis: $H_0 : \beta_2 = \beta_3 = 0$, what is the value of F-statistic?

(A) 3

(B) 4.4

(C) 7

(D) 4.2

3. Suppose that the true model of y is $y = \beta_1 x_1 + \beta_2 x_2 + u$, but you estimated an incorrect model by OLS:

$$y = \beta_1 x_1 + v \quad \text{.....(3)}$$

The true parameter $\beta_2 < 0$ , and $E(x_2|x_1)$ has a linear relationship:

$$E(x_2|x_1) = \delta_0 + \delta_1 x_1 \quad \text{.....(4)}$$

If we have the prior information that $\delta_1$ of Equation (4) has negative bias, what is the following condition satisfied for OLS estimator $\hat{\beta}_1$ in equation (3)?

(A) $|\hat{\beta}_1| = |\beta_1|$

(B) $|\hat{\beta}_1| > |\beta_1|$

(C) $|\hat{\beta}_1| < |\beta_1|$

(D) cannot decide

4. Consider the model:

$y_t = \alpha + \rho x_t + \varepsilon_t$,

where $t = 1, \ldots T$. If we want to obtain consistent estimator $\hat{\rho}$ for $T \to \infty$, which necessary condition it must be have?

(A) $cov(\varepsilon_t x_t) = 0$

(B) $Var(\varepsilon_t|1, x_t) = \sigma^2$

(C) $E(\varepsilon_t|1, x_t) = 0$

(D) $E(\varepsilon_t \varepsilon_s|x_t, x_s) = 0$

5. Sample selection bias occurs when

(A) data are collected from a population by simple random sampling.

(B) The choice between two samples is made by the researcher.

(C) Samples are chosen to be small rather than large.

(D) The availability of the data is influenced by a selection process that is related to the value of the dependent variable.

6. The major flaw of the linear probability model is that

(A) the actuals can only be 0 and 1, but the predicted are almost always different from that.

(B) People do not always make clear-cut decisions.

(C) The regression $R^2$ cannot be used as a measure of fit.

(D) The predicted values can lie above 1 and below 0.

**II. 計算問答題** （每題10分，共20分）

Let $y$ , $x_1$ and $x_2$ be observable variables, and let $z^*$ be an unobserved (or latent) variable. Consider the model

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \gamma_1 z^* + \gamma_2 (x_2 z^*) + u \quad \text{.....(5)}$$

$$E(u|x_1, x_2, z^*) = 0 \quad \text{.....(6)}$$

Assume that $z^*$ is normalized so the $E(z^*) = 0$. As a specific example, $y$ might wage (or log wage) of an individual, $x_1$ is education, $x_2$ is education, and $z^*$ is unobserved ability.

1. If $E(z^*|x_1, x_2) = 0$, $\hat{\beta}_0$, $\hat{\beta}_1$, and $\hat{\beta}_2$ be the OLS estimator from the regression $y$ on $(1, x_1, x_2)$.
Whether $\hat{\beta}_0$, $\hat{\beta}_1$, and $\hat{\beta}_2$ are consistent estimators ?
2. Now suppose that there is an observable variable $z$ that is redundant in (5), so that $E(u|x_1, x_2, z^*, z) = 0$, and

$$E(z^*|x_1, x_2, z) = \delta_0 + \delta_1 z \quad \text{.....(7)}$$

How to obtain consistent estimators of $\beta_1$ and $\beta_2$ ?

**III. 計算題** （共50分）

You can find the tables for the t-distribution and the standard normal distribution at the end of the document, specifically in the last two pages, for your reference.

1. (10分)

A test for a certain disease is 90% accurate. If a person has the disease, there's a 90% chance the test will be positive. If a person doesn't have the disease, there's a 10% chance the test will be positive. If 1% of the population has the disease, what is the probability that a person has the disease given they tested positive?

2. (10 分)

Given a joint density function $f(x,y)=\frac{1}{2}$ for $0 \le x \le 2$ and $0 \le y \le 2-x$, find the marginal density function of $f_Y(y)$ for $0 \le y \le 2$ to calculate the expected value(mean) of y.

3. (10 分)

A car manufacturer claims that their new electric car model has an average range of at least 300 miles on a single charge. A random sample of 40 cars was tested, and it was found that they had an average range of 295 miles with a standard deviation of 15 miles. At a 5% significance level, calculate the “t value” to test the manufacturer's claim.

4. (5 分)

We have two six-sided dice, one blue and one green. Each die can show a number from 1 to 6 with equal probability. We're interested in two variables: the total (sum) of the numbers that show up, and the difference (blue minus green). Let's call the total 'X = blue + green' and the difference 'Y = blue - green'. We want to find out the covariance between X and Y.

5. (5 分)

Let X and Y be two distinct random variables. The mean of X is given as 10, and its variance is 9. The mean of Y is 0, and its variance is 25. The correlation coefficient between X and Y is established at 0.5. Please compute the variance of the linear combination 3X+2Y .

6. (5 分)

A population has a mean of 500 and a standard deviation of 100. Using Chebyshev's inequality, determine the minimum proportion of the population that lies within the range 300 to 700.

7. (5 分)

Suppose a variable $Z$ follows normal distribution. The mean for $Z$ is 2 and variance is 0.25. We define $Y=e^z$. Suppose the lifetime of a machine component is Y. Find the probability that a randomly chosen component lasts less than $e^3$ hours.

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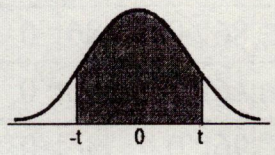
t-distribution table (two-tailed)




| DF | 0.8 | 0.9 | 0.95 | 0.999 |
|---|---|---|---|---|
| **21** | 1.323 | 1.721 | 2.080 | 3.819 |
| **22** | 1.321 | 1.717 | 2.074 | 3.792 |
| **23** | 1.319 | 1.714 | 2.069 | 3.768 |
| **24** | 1.318 | 1.711 | 2.064 | 3.745 |
| **25** | 1.316 | 1.708 | 2.060 | 3.725 |
| **26** | 1.315 | 1.706 | 2.056 | 3.707 |
| **27** | 1.314 | 1.703 | 2.052 | 3.690 |
| **28** | 1.313 | 1.701 | 2.048 | 3.674 |
| **29** | 1.311 | 1.699 | 2.045 | 3.659 |
| **30** | 1.310 | 1.697 | 2.042 | 3.646 |
| **31** | 1.309 | 1.695 | 2.040 | 3.633 |
| **32** | 1.309 | 1.694 | 2.037 | 3.622 |
| **33** | 1.308 | 1.692 | 2.035 | 3.611 |
| **34** | 1.307 | 1.691 | 2.032 | 3.601 |
| **35** | 1.306 | 1.690 | 2.030 | 3.591 |
| **36** | 1.306 | 1.688 | 2.028 | 3.582 |
| **37** | 1.305 | 1.687 | 2.026 | 3.574 |
| **38** | 1.304 | 1.686 | 2.024 | 3.566 |
| **39** | 1.304 | 1.685 | 2.023 | 3.558 |
| **40** | 1.303 | 1.684 | 2.021 | 3.551 |
| **42** | 1.302 | 1.682 | 2.018 | 3.538 |
| **44** | 1.301 | 1.680 | 2.015 | 3.526 |
| **46** | 1.300 | 1.679 | 2.013 | 3.515 |
| **48** | 1.299 | 1.677 | 2.011 | 3.505 |
| **50** | 1.299 | 1.676 | 2.009 | 3.496 |
| **100** | 1.290 | 1.660 | 1.984 | 3.391 |
| **120** | 1.289 | 1.658 | 1.980 | 3.373 |
| **150** | 1.287 | 1.655 | 1.976 | 3.357 |
| **200** | 1.286 | 1.652 | 1.972 | 3.340 |
| **300** | 1.284 | 1.650 | 1.968 | 3.323 |
| **500** | 1.283 | 1.648 | 1.965 | 3.310 |

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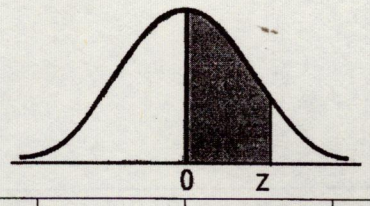
**標準常態分配表**




| Z | 0 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 0.000 | 0.004 | 0.008 | 0.012 | 0.016 | 0.020 | 0.024 | 0.028 | 0.032 | 0.036 |
| **0.1** | 0.040 | 0.044 | 0.048 | 0.052 | 0.056 | 0.060 | 0.064 | 0.068 | 0.071 | 0.075 |
| **0.2** | 0.079 | 0.083 | 0.087 | 0.091 | 0.095 | 0.099 | 0.103 | 0.106 | 0.110 | 0.114 |
| **0.3** | 0.118 | 0.122 | 0.126 | 0.129 | 0.133 | 0.137 | 0.141 | 0.144 | 0.148 | 0.152 |
| **0.4** | 0.155 | 0.159 | 0.163 | 0.166 | 0.170 | 0.174 | 0.177 | 0.181 | 0.184 | 0.188 |
| **0.5** | 0.192 | 0.195 | 0.199 | 0.202 | 0.205 | 0.209 | 0.212 | 0.216 | 0.219 | 0.222 |
| **0.6** | 0.226 | 0.229 | 0.232 | 0.236 | 0.239 | 0.242 | 0.245 | 0.249 | 0.252 | 0.255 |
| **0.7** | 0.258 | 0.261 | 0.264 | 0.267 | 0.270 | 0.273 | 0.276 | 0.279 | 0.282 | 0.285 |
| **0.8** | 0.288 | 0.291 | 0.294 | 0.297 | 0.300 | 0.302 | 0.305 | 0.308 | 0.311 | 0.313 |
| **0.9** | 0.316 | 0.319 | 0.321 | 0.324 | 0.326 | 0.329 | 0.332 | 0.334 | 0.337 | 0.339 |
| **1** | 0.341 | 0.344 | 0.346 | 0.349 | 0.351 | 0.353 | 0.355 | 0.358 | 0.360 | 0.362 |
| **1.1** | 0.364 | 0.367 | 0.369 | 0.371 | 0.373 | 0.375 | 0.377 | 0.379 | 0.381 | 0.383 |
| **1.2** | 0.385 | 0.387 | 0.389 | 0.391 | 0.393 | 0.394 | 0.396 | 0.398 | 0.400 | 0.402 |
| **1.3** | 0.403 | 0.405 | 0.407 | 0.408 | 0.410 | 0.412 | 0.413 | 0.415 | 0.416 | 0.418 |
| **1.4** | 0.419 | 0.421 | 0.422 | 0.424 | 0.425 | 0.427 | 0.428 | 0.429 | 0.431 | 0.432 |
| **1.5** | 0.433 | 0.435 | 0.436 | 0.437 | 0.438 | 0.439 | 0.441 | 0.442 | 0.443 | 0.444 |
| **1.6** | 0.445 | 0.446 | 0.447 | 0.448 | 0.450 | 0.451 | 0.452 | 0.453 | 0.454 | 0.455 |
| **1.7** | 0.455 | 0.456 | 0.457 | 0.458 | 0.459 | 0.460 | 0.461 | 0.462 | 0.463 | 0.463 |
| **1.8** | 0.464 | 0.465 | 0.466 | 0.466 | 0.467 | 0.468 | 0.469 | 0.469 | 0.470 | 0.471 |
| **1.9** | 0.471 | 0.472 | 0.473 | 0.473 | 0.474 | 0.474 | 0.475 | 0.476 | 0.476 | 0.477 |
| **2** | 0.477 | 0.478 | 0.478 | 0.479 | 0.479 | 0.480 | 0.480 | 0.481 | 0.481 | 0.482 |
| **2.1** | 0.482 | 0.483 | 0.483 | 0.483 | 0.484 | 0.484 | 0.485 | 0.485 | 0.485 | 0.486 |
| **2.2** | 0.486 | 0.486 | 0.487 | 0.487 | 0.488 | 0.488 | 0.488 | 0.488 | 0.489 | 0.489 |
| **2.3** | 0.489 | 0.490 | 0.490 | 0.490 | 0.490 | 0.491 | 0.491 | 0.491 | 0.491 | 0.492 |
| **2.4** | 0.492 | 0.492 | 0.492 | 0.493 | 0.493 | 0.493 | 0.493 | 0.493 | 0.493 | 0.494 |
| **2.5** | 0.494 | 0.494 | 0.494 | 0.494 | 0.495 | 0.495 | 0.495 | 0.495 | 0.495 | 0.495 |
| **2.6** | 0.495 | 0.496 | 0.496 | 0.496 | 0.496 | 0.496 | 0.496 | 0.496 | 0.496 | 0.496 |
| **2.7** | 0.497 | 0.497 | 0.497 | 0.497 | 0.497 | 0.497 | 0.497 | 0.497 | 0.497 | 0.497 |
| **2.8** | 0.497 | 0.498 | 0.498 | 0.498 | 0.498 | 0.498 | 0.498 | 0.498 | 0.498 | 0.498 |
| **2.9** | 0.498 | 0.498 | 0.498 | 0.498 | 0.498 | 0.498 | 0.499 | 0.499 | 0.499 | 0.499 |

試題隨卷繳交