115CM03

國立臺北科技大學115學年度碩士班招生考試

系所組別：4203 經營管理系碩士班

第一節　統計學　試題（選考）

注意事項：

1. 本試題共兩大題，每題 5 分，合計 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

一、選擇題 (單選，每題 5 分，共 10 題，合計 50 分)

Q1. A university reports that 40% of its students are enrolled in business-related programs. Among business students, 30% have taken at least one statistics course, while among non-business students, only 10% have taken a statistics course. If a randomly selected student has taken a statistics course, what is the probability that the student is a business major?

(A) 0.30
(B) 0.40
(C) 0.60
(D) 0.67

Q2. A researcher wants to estimate average weekly study hours of all undergraduate students at a university. She distributes an online survey through a student honors program mailing list and analyzes the responses. Which type of bias is most likely present in this study?

(A) Sampling bias
(B) Nonresponse bias
(C) Measurement bias
(D) Random sampling error

Q3. A company tests whether a new training program improves employee productivity. Employees who voluntarily sign up receive the training, while others do not. Productivity is compared after one month. Which threat to internal validity is most prominent in this study?

(A) History
(B) Maturation
(C) Selection bias
(D) Instrumentation

Q4. A 95% confidence interval for the mean customer satisfaction score is reported as (72, 80). Which of the following interpretations is correct?

(A) 95% of customers scored between 72 and 80
(B) There is a 95% probability that the true mean lies between 72 and 80
(C) 95% of similarly constructed confidence intervals would contain the true mean
(D) The population mean will eventually fall between 72 and 80

Q5. In a hypothesis test, a researcher fails to reject the null hypothesis even though the null hypothesis is false. This outcome is known as:

(A) A Type I error
(B) A Type II error
(C) A power error
(D) A sampling error

Q6. A researcher draws a simple random sample from a population and uses it to estimate the population mean. Which condition is most critical for ensuring the unbiasedness of the estimator?

(A) The sample size is large
(B) Each population element has an equal chance of being selected
(C) The population follows a normal distribution
(D) The variance of the population is known

Q7. In a multiple regression model, the coefficient of variable X is statistically insignificant while the overall model F-test is significant. Which interpretation is most appropriate?

(A) X does not contribute additional explanatory power given other variables
(B) The model is misspecified
(C) The dependent variable is incorrectly measured
(D) Multicollinearity cannot exist in the model

Q8. Holding all else constant, which factor increases the statistical power of a hypothesis test?

(A) Lowering the significance level (α)
(B) Decreasing the sample size
(C) Increasing the effect size

注意：背面尚有試題

(D) Increasing measurement error

Q9. Let X be a discrete random variable with a probability mass function. Which statement is always true?

(A) The expected value of X must be an integer

(B) The variance of X can be negative

(C) X must follow a normal distribution

(D) The sum of all probabilities equals 1

Q10. Which research design provides the strongest basis for causal inference?

(A) Cross-sectional survey

(B) Longitudinal observational study

(C) Randomized controlled experiment

(D) Case study analysis

二、題組題 (單選，每題 5 分，共 10 題，合計 50 分)

Q11-15 Use the following information to answer the questions:

A logistics company tracks the average daily delivery time (in hours) of its express shipping service. Historical data indicate that delivery times are normally distributed with a known population standard deviation $\sigma = 6$ hours. The company claims that the mean delivery time is no more than 48 hours. To evaluate whether deliveries have become slower, a random sample of 64 shipments is collected. The rejection rule for the hypothesis test is:

Reject H_0 if $\bar{x} > 50.94$

Q11. What is the null and alternative hypothesis for this test?

(A) $H_0: \mu = 48, \quad H_1: \mu \neq 48$

(B) $H_0: \mu \geq 48, \quad H_1: \mu < 48$

(C) $H_0: \mu < 48, \quad H_1: \mu \geq 48$

(D) $H_0: \mu \leq 48, \quad H_1: \mu > 48$

Q12. What is the standard error of the sample mean?

(A) 0.75

(B) 1.50

(C) 6.00

(D) 48.00

Q13. What is the significance level α of this test?

(A) 0.0250

(B) 0.0500

(C) 0.0100

(D) 0.0013

Q14. If the true mean delivery time is $\mu = 50$ hours, what is the probability of making a Type II error?

(A) 0.0250

(B) 0.2389

(C) 0.7611

(D) 0.8413

Q15. Which of the following actions would most effectively reduce the probability of a Type II error, holding other factors constant?

(A) Decreasing the sample size

(B) Increasing the population standard deviation

(C) Using a two-tailed test instead of a one-tailed test

(D) Increasing the significance level α

Q16-20 Use the following information to answer the questions:

A researcher investigates factors affecting graduate admission test scores (Y) using the following multiple regression model:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon$$

Where:

X_1= weekly study hours

X_2= number of practice exams taken

From a random sample of n = 40 applicants, the estimated regression results are:

Variable	Coefficient	Standard Error
Intercept	42.0	6.0
X_1	1.2	0.6
X_2	3.0	1.5

Additional information:

$R^2 = 0.52$

Adjusted $R^2 = 0.48$

Correlation between X_1 and X_2: $r_{12} = 0.75$

Significance level: $\alpha = 0.05$

Q16. Which hypothesis test correctly evaluates whether study hours have a statistically significant effect on test scores, controlling for practice exams?

(A) $H_0: \beta_1 = 0$ vs. $H_1: \beta_1 \neq 0$

(B) $H_0: \beta_1 = \beta_2$ vs. $H_1: \beta_1 \neq \beta_2$

(C) $H_0: r_{1Y} = 0$ vs. $H_1: r_{1Y} \neq 0$

(D) $H_0: R^2 = 0$ vs. $H_1: R^2 > 0$

Q17. Based on the output, which statement best explains why the coefficient of X_1 is statistically insignificant at $\alpha = 0.05$?

(A) The sample size is too large

(B) Multicollinearity between X_1 and X_2 inflates the standard error

(C) The intercept absorbs most of the explanatory power

(D) The dependent variable is measured with error

Q18: Which interpretation of the adjusted R^2 is most appropriate in this context?

(A) 48% of applicants scored above the mean

(B) The regression model is unbiased

(C) Removing X_1 will increase explanatory power

(D) The model explains 48% of the variance after penalizing for model complexity

Q19: Suppose the researcher removes X_1 from the model. Which outcome is most likely?

(A) R^2 must increase

(B) Adjusted R^2 may increase

(C) The standard error of β_2 must increase

(D) The intercept will become statistically insignificant

Q20: Which conclusion is most statistically defensible based on the regression results?

(A) Study hours have no effect on test scores

(B) Practice exams are the only determinant of test scores

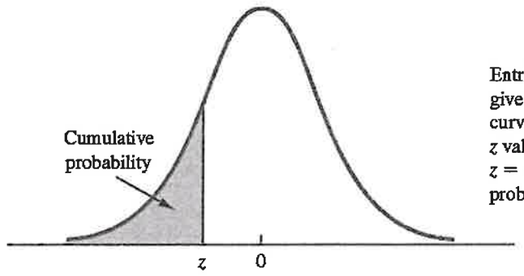
(C) The joint effect of study hours and practice exams is statistically meaningful

(D) Increasing both predictors will guarantee higher test scores for all applicants

注意：背面尚有參考資料

參考資料：第 1 頁 共 2 頁

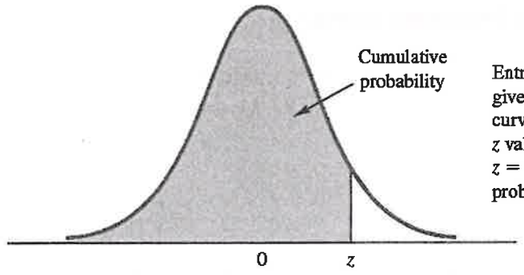
TABLE 1 Cumulative Probabilities for the standard Normal Distribution



Entries in the table give the area under the curve to the left of the z value. For example, for $z = -.85$, the cumulative probability is .1977.

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
−2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
−2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
−2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
−2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
−2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
−2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
−2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
−2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
−2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
−2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
−1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
−1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
−1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
−1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
−1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
−1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
−1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
−1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
−1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
−1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
−.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
−.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
−.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
−.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
−.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
−.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
−.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
−.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
−.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
−.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641

TABLE 1 Cumulative Probabilities for the standard Normal Distribution (*Continued*)

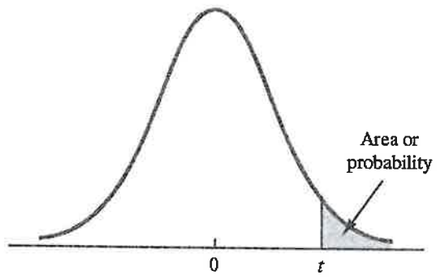


Entries in the table give the area under the curve to the left of the z value. For example, for $z = 1.25$, the cumulative probability is .8944.

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990

參考資料：第 2 頁 共 2 頁

TABLE 2 *t* Distribution



Entries in the table give t values for an area or probability in the upper tail of the t distribution. For example, with 10 degrees of freedom and a .05 area in the upper tail, $t_{.05} = 1.812$.

Degrees of Freedom	Area in Upper Tail					
	.20	.10	.05	.025	.01	.005
1	1.376	3.078	6.314	12.706	31.821	63.656
2	1.061	1.886	2.920	4.303	6.965	9.925
3	.978	1.638	2.353	3.182	4.541	5.841
4	.941	1.533	2.132	2.776	3.747	4.604
5	.920	1.476	2.015	2.571	3.365	4.032
6	.906	1.440	1.943	2.447	3.143	3.707
7	.896	1.415	1.895	2.365	2.998	3.499
8	.889	1.397	1.860	2.306	2.896	3.355
9	.883	1.383	1.833	2.262	2.821	3.250
10	.879	1.372	1.812	2.228	2.764	3.169
11	.876	1.363	1.796	2.201	2.718	3.106
12	.873	1.356	1.782	2.179	2.681	3.055
13	.870	1.350	1.771	2.160	2.650	3.012
14	.868	1.345	1.761	2.145	2.624	2.977
15	.866	1.341	1.753	2.131	2.602	2.947
16	.865	1.337	1.746	2.120	2.583	2.921
17	.863	1.333	1.740	2.110	2.567	2.898
18	.862	1.330	1.734	2.101	2.552	2.878
19	.861	1.328	1.729	2.093	2.539	2.861
20	.860	1.325	1.725	2.086	2.528	2.845
21	.859	1.323	1.721	2.080	2.518	2.831
22	.858	1.321	1.717	2.074	2.508	2.819
23	.858	1.319	1.714	2.069	2.500	2.807
24	.857	1.318	1.711	2.064	2.492	2.797
25	.856	1.316	1.708	2.060	2.485	2.787
26	.856	1.315	1.706	2.056	2.479	2.779
27	.855	1.314	1.703	2.052	2.473	2.771
28	.855	1.313	1.701	2.048	2.467	2.763
29	.854	1.311	1.699	2.045	2.462	2.756
30	.854	1.310	1.697	2.042	2.457	2.750
31	.853	1.309	1.696	2.040	2.453	2.744
32	.853	1.309	1.694	2.037	2.449	2.738
33	.853	1.308	1.692	2.035	2.445	2.733
34	.852	1.307	1.691	2.032	2.441	2.728