國立成功大學

115學年度碩士班招生考試試題

編　號：165

系　所：企業管理學系

科　目：統計學

日　期：0204

節　次：第 3 節

注　意：1.不可使用計算機
2.請於答案卷(卡)作答，於試題上作答，不予計分。

Part A: Choice Questions

[Totally 80 points, 5 points of each]

Notice: You do not need to show your work, but please answer in the order of the question numbers.

Q1. _____

The Motor Vehicles Office (MMO) wanted to understand some basic information about people taking the driver's license test. Therefore, the MMO collected some personal information variables, as well as their written and road test scores. The collecting variables are as follows:

Gender (1=male/2=female); Location (1=northern/ 2=central/ 3=southern/ eastern); Height (in cm); Weight (in Kg); Student or not (0=Not/ 1=Yes); Written Test Score (1~100 points); Road Test Score (1~100points).

How many **nominal variables** and how many **rational variables** are there in total?

(a) 5 nominal variables and 2 rational variables; (b) 4 nominal variables and 3 rational variables;

(c) 3 nominal variables and 4 rational variables; (d) 2 nominal variables and 5 rational variables;

Q2. _____

Department of Business Administration of H University has two classes, A and B, with 30 and 20 students, respectively. The following table is statistics of the midterm exam scores of two classes.

Class (n)	Average	Standard Deviation	Mode
A ($n_1 = 30$)	75	8	60
B ($n_2 = 20$)	80	6	62

What are the overall "average score" and "variance" of these 50 students?

(a) average=77 and variance =51.84 (b) average=77 and variance =58.80

(c) average=77 and variance =52.80 (d) average=77.5 and variance = 52.80

Q3. _____

Continuation of Q2. If the coefficients of variation (CV) for the two classes are CV_A and CV_B, and Pearson's first coefficient of skewness are sk_A and sk_B, which of the following statements is correct?

(a) $CV_A = 85.33\%$, $CV_B = 45\%$ (b) $CV_A = 7.5\%$, $CV_B = 10.66\%$

(c) $sk_A = -1.875$, $sk_B = -3.0$, both are left skewness (d) $sk_A = 1.875$, $sk_B = 3.0$, both are right skewness

Q4. _____

Based on data from past flu test strips, the following information was obtained:

Pr(Test positive | Flu) = 0.95; Pr(Test negative | No Flu) = 0.9.

Moreover, it is known that the flu prevalence rate is approximately 0.2 in year 2025. If a flu test indicates that a patient tests positive for flu, what is the probability that he/she in fact has flu?

(a) 0.19 (b) 0.01 (c) 0.27 (d) 0.73

Q5. _____

The following table shows the probability of consumers purchasing flash drives of various memory capacities (X, in GB) according to former selling records from a 3C product store.

X (GB)	2	4	8	16
p(x)	0.1	0.2	0.5	0.2

The expect value of X and variance of X are:

(a) E(X) = 8.2; Var(X) = 19.56;
(b) E(X) = 7.5; Var(X) = 86.80
(c) E(X) = 7.5; Var(X) = 19.56;
(d) E(X) = 8.2; Var(X) = 4.42

Q6. _____

The joint pmf for X and Y is shown as following table:

		Y		
p(x, y)		5	10	50
	1	0.30	0.05	0
X	5	0.15	0.20	0.05
	10	0.10	0.10	0.05

(a) $\mu_x = 5.33$, $\mu_y = 21.67$;
(b) $\mu_x = 4.85$, $\mu_y = 11.25$;
(c) $\mu_x = 4.85$, $\mu_y = 21.67$;
(d) $\mu_x = 5.33$, $\mu_y = 11.25$

Q7. _____

Continuation of Q6. What is the covariance of X and Y? Are X and Y independent?

(a) COV(X, Y) = 68.2500, X and Y are independent;
(b) COV(X, Y) = 68.2500, X and Y are not independent;
(c) COV(X, Y) = 13.6875, X and Y are independent;
(d) COV(X, Y) = 13.6875, X and Y are not independent.

Q8. _____

Suppose X is a random variable of a binomial distribution. Given E(X) = 0.8 and Var(X) = 0.64, what is the binomial distribution of X (sample size (n); probability (p))? Furthermore, if $Y \to B(3, 0.3)$, let Z = X + Y, find P(Z ≥ 1) = ? Assume X and Y are independent.

(a) $X \to B(4, 0.2)$; $P(Z \geq 1)$=0.1405;
(b) $X \to B(3, 0.7)$; $P(Z \geq 1)$=0.8595;
(c) $X \to B(4, 0.2)$; $P(Z \geq 1)$=0.8595;
(d) $X \to B(3, 0.3)$; $P(Z \geq 1)$=0.1405;

Q9. _____

The number of traffic accidents at a certain intersection over the past 8 weeks is 3, 3, 2, 1, 2, 3, 2, 0. If the weekly probability of traffic accidents at this intersection follows a Poisson distribution, what is the probability that the intersection will have more than two (including two) traffic accidents next week? What is the probability that there will be no traffic accidents for two consecutive weeks?

(a) $1 - 3e^{-2}$; e^{-4}
(b) $1 - e^{-2}$; e^{4}
(c) $2e^{-2}$; $1 - e^{-4}$
(d) $1 - 2e^{2}$; e^{-4}

Q10. _____

The output voltage of a power supply is normally distributed with mean 5 V and standard deviation 0.02 V. If the lower and upper specifications for voltage are 4.95 V and 5.05 V, respectively, what is the probability that a power supply selected at random will conform to the specifications on voltage? [See the **Appendix I**.]

(a) 0.9938 (b) 0.9876 (c) 0.0062 (d) 0.0124

Q11. _____

Continuation of Q10. Suppose we wanted to improve the process. How much would the process variability need to be reduced in order to have all but one out of 1000 units conform to the specifications?

(a) $\sigma = 0.018$; (b) $\sigma = 0.015$ (c) $\sigma = 0.010$ (d) $\sigma = 0.005$

Q12. _____

If X is uniformly distributed over (0, 15), then the $P(X^2 + 32 > 12X)$= ?

(a) $\frac{3}{5}$ (b) $\frac{1}{3}$ (c) $\frac{11}{15}$ (d) $\frac{7}{15}$

Q13. _____

The following tables are the ANOVA Table and coefficients Table for a simple linear regression. In this regression model, Y represents Satisfaction, and X represents Product Quality. From these two tables, what are the values of R^2 (coefficient of determination) of this regression model and r (correlation coefficient) of X and Y?

(a) $R^2 = 23.651\%$, r = 0.415; (b) $R^2 = 76.349\%$, r = 0.415;

(c) $R^2 = 23.651\%$, r = 0.486; (d) $R^2 = 76.349\%$, r = 0.598;

ANOVA Table

Source	Sum of Squares	df	Mean Square	F	P-value
Regression	33.260	1	33.260	30.358	0.000
Residual	107.367	98	1.096		
Total	140.628	99			

Dependent Variable: Y (Satisfaction); Predictors: (Constant), X (Product Quality)

Coefficients Table

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	P-value
(Constant)	3.676	0.598		6.151	0.000
X	0.415	(Blank A)	0.486	5.510	0.000

Q14. _____

Continuation of Q13, what is the value of **Blank A** in Coefficients Table?

(a) 0.075 (b) 0.088 (c) 0.107 (d) 0.895

Q15. _____

Let $X_1, X_2, X_3, \ldots, X_n$ be a random sample from the population which is following Uniform [0, 5θ]. Which of the following can be considered the maximum likelihood estimator of θ?

(a) $5\min\{x_1, x_2, x_3, \ldots, x_n\}$ (b) $5\max\{x_1, x_2, x_3, \ldots, x_n\}$

(c) $\frac{1}{5}\min\{x_1, x_2, x_3, \ldots, x_n\}$ (d) $\frac{1}{5}\max\{x_1, x_2, x_3, \ldots, x_n\}$

Q16. _____

Let X_1 and X_2 be independent. If X_1 and X_2 both follow $N(0, \sigma^2)$, what the distribution should be of $\frac{(X_1+X_2)^2}{2\sigma^2}$?

(a) t(2) (b) $\chi^2(1)$ (c) F(1, 2) (d) $\chi^2(2)$

Part B: Calculation

[Totally 20 points]

Notice: Please show the details and answer in order.

Students in a class argued with their teacher, believing the grades were too low. However, the teacher felt the grades were within a reasonable range. Finally, the department chairman proposed the following rule: A sample of average grades from this teacher's past courses would be taken. If the average grade was lower than the department's overall student average of 75, then the teacher would be asked to adjust the grade by adding points. Therefore, the department sampled 64 of this teacher's past courses, with an average of 77 and a standard deviation of 8. Please answer the following questions based on the above description:

(a) [2 points] List the null hypothesis(H_0) and alternative hypothesis (H_1).

(b) [b-1; 3 points] If we consider n=64 as a large sample, what is the test statistic for part (a)?

[b-2; 2 points] Please conduct the test of hypothesis at level of significance = 0.05 by the test statistic and show your conclusion?

(c) [c-1; 3 points] What is the corresponding (1−α)% confidence interval?

[c-2; 2 points] Please conduct the test of hypothesis with the confidence interval, and what is your conclusion?

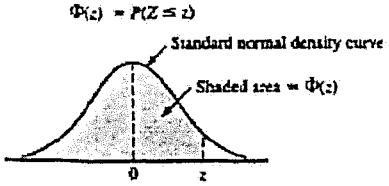
(d) [d-1; 2 points] What is the p-value for this test?

[d-2; 2 points] Based on the p-value, what is your conclusion?

(e) [4 points] Suppose that the actual mean score of all students in the department is 78, what is the value of Type II Error?

Please see the Appendix I.

Appendix I. Z Table



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
−3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
−3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
−3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
−3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
−2.9	.0019	.0018	.0017	.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	.0352	.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	.0722	.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
−0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
−0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
−0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
−0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
−0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
−0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
−0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3482
−0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
−0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
−0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641