國立成功大學

112學年度碩士班招生考試試題

編　號：250

系　所：交通管理科學系

科　目：統計學

日　期：0207

節　次：第 2 節

備　註：不可使用計算機

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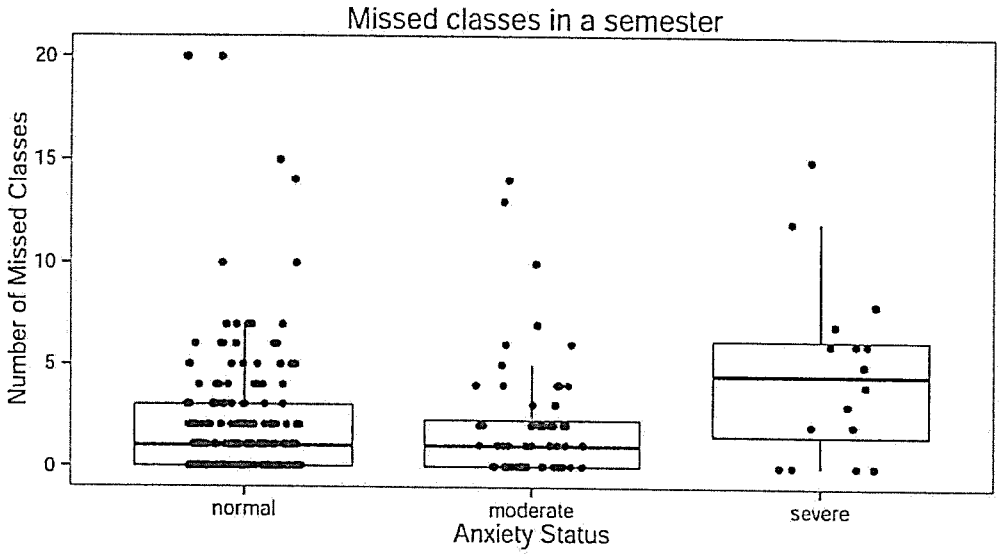
※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

Show all your work. Explain your answers. Partial credit will be given.

1. (30 points) Researchers conducted a study that examined sleep habits of college students and academic performance. Two variables in the study were anxiety, which was scored categorically as one of normal, moderate, or severe, and classes missed which counted the number of classes that the student missed during the semester. The study includes a sample of 253 subjects whom you may consider to be a representative sample from a population of college students. Raw data is plotted below (points jittered horizontally to lessen overlap).



Summary statistics of the number of classes missed are tabulated here.

Anxiety Status	n	$\bar{x}$	s
Normal	181	2.01	3.11
Moderate	56	2.13	3.05
Severe	16	4.75	4.37

The following data may also be useful:

- The grand mean of all observations is $\bar{y}$= 2.21.
- The sum of squares of individual classes missed observations around the grand mean is $\sum_{i=1}^{n}(y_i - \bar{y})^2$= 2645.9 so that the standard deviation of classes missed is $\sqrt{2645.9/252}$= 3.24.
- Ignoring round-off errors in sample standard deviations, the following expression sums the squared deviations of each observation from its sample mean.

$$180 \times (3.11)^2 + 55 \times (3.05)^2 + 15 \times (4.37)^2 \approx 2535.1$$

(a - 9 points) Fill in all missing values in this ANOVA table.

Source	df	SS	MS	F	p-value
Groups					0.0048
Error					
Total					

(b - 5 points) State null and alternative hypotheses tested in the ANOVA table. Assuming a valid test, interpret the results of the test in context.

(c - 5 points) What is the pooled estimate of the common population standard deviation?

(d - 5 points) Fill in the missing parts (①, ②, ③, ④, ⑤) for a 99% confidence interval shown below for the difference in population mean number of classes missed between the severe and normal anxiety groups.

$$\_\_①\_\_ \pm t^* s_e \sqrt{\frac{1}{\_\_②\_\_} + \frac{1}{\_\_③\_\_}}$$

where t^* is from a t distribution with __④__ degrees of freedom and s_e has numerical value __⑤__.

(e - 6 points) ANOVA assumes independent random samples from each group. (1) What additional two assumptions does ANOVA make about the distribution of observations within a group? (2) What about the plot of the data indicates the most serious evidence against one of these two assumptions?

2. (25 points) The director of admissions of a small college selected 120 students at random from the new freshman class in a study to determine whether a student's grade point average (GPA) at the end of the freshman year can be predicted from the ACT test score. Assume that the simple regression model with independent normal error terms is appropriate and its assumptions are satisfied. Regression and analysis of variance output from SAS are below. You can also use the given SAS output for your calculation.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	3.58785	3.58785	(d)	0.0029
Error	(a)	45.81761	(c)		
Corrected Total	119	(b)			

Root MSE	0.62313	R-Square	(e)
Dependent Mean	3.07405	Adj R-Sq	0.0648
Coeff Var	20.27049		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	95% Confidence Limits	
Intercept	1	2.11405	0.32089	6.59	<.0001	1.47859	2.74951
x	1	0.03883	0.01277	3.041	0.0029	(f)	(f)

(a - 5 points) Specify the dependent variable (Y) and independent variable (X) in this study. Write down the statistical model considered in this study.

(b - 6 points) There are 6 blanks in the table. Please fill them all. Show all your work to get full credit.
(c - 6 points) Write down the estimated linear regression function and interpret the estimate of the slope.
(d - 8 points) Does a linear relationship exist between the ACT test score and the GPA at the end of the freshman year? Perform an appropriate test of hypothesis at level α= 0.05. State the hypotheses, the rejection rule, and the conclusion.

3. (15 points) Consider the following data.

8.9	10.2	11.5	7.8	10.0	12.2	13.5	14.1	10.0	12.2
6.8	9.5	11.5	11.2	14.9	7.5	10.0	6.0	15.8	11.5

(a - 3 points) Compute the median, first and third quartiles for these data.
(b - 7 points) Show a box plot for the data.
(c - 5 points) Following the result of (b), would you use Chebyshev's Theorem or Empirical Rule if you want to find an interval centered about the mean in which you would expect around 95% of the data to fall? Justify your answer.

4. (15 points) A shareholders' group claimed that the mean tenure for a chief executive officer (CEO) was at least nine years. A survey found a sample mean tenure of 7.8 years for CEOs with a standard deviation of 6 years.
(a - 5 points) Formulate hypotheses that can be used to challenge the validity of the claim made by the shareholder's group.
(b - 5 points) Assume 25 companies were included in the sample. What is the p-value for your hypothesis test? At α = 0.05, what is your conclusion?
(c - 5 points) Compute a 95% confidence interval for the population mean. Does it support your conclusion in (b)?

5. (15 points) An oil company purchased an option on land in Alaska. Preliminary geologic studies assigned the following prior probabilities.
P(high-quality oil) = .50,
P(medium-quality oil) = .30,
P(no oil) = .20
(a - 5 pts) What is the probability of finding oil?

After 200 feet of drilling on the first well, a soil test is taken. The probabilities of finding the particular type of soil identified by the test follow.
P(soil | high-quality oil) = .30, P(soil | medium-quality oil) = .50, P(soil | no oil) = .20
(b - 10 pts) What are the revised probabilities, and what is the new probability of finding oil? How should the firm interpret the soil test? (You MUST clearly show your work)

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Table of the z distribution

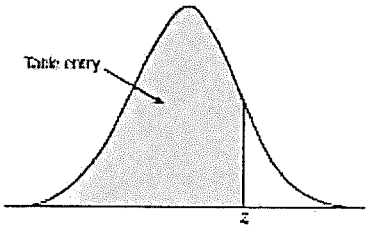

Table entry for z is the area under the standard normal curve to the left of z.

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.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

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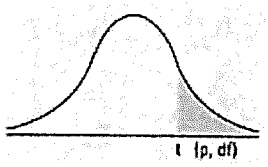
Numbers in each row of the table are values on a *t*-distribution with (*df*) degrees of freedom for selected right-tail (greater-than) probabilities (*p*).



df/p	0.40	0.25	0.10	0.05	0.025	0.01	0.005	0.0005
1	0.324920	1.000000	3.077684	6.313752	12.70620	31.82052	63.65674	636.6192
2	0.288675	0.816497	1.885618	2.919986	4.30265	6.96456	9.92484	31.5991
3	0.276671	0.764892	1.637744	2.353363	3.18245	4.54070	5.84091	12.9240
4	0.270722	0.740697	1.533206	2.131847	2.77645	3.74695	4.60409	8.6103
5	0.267181	0.726687	1.475884	2.015048	2.57058	3.36493	4.03214	6.8688
6	0.264835	0.717558	1.439756	1.943180	2.44691	3.14267	3.70743	5.9588
7	0.263167	0.711142	1.414924	1.894579	2.36462	2.99795	3.49948	5.4079
8	0.261921	0.706387	1.396815	1.859548	2.30600	2.89646	3.35539	5.0413
9	0.260955	0.702722	1.383029	1.833113	2.26216	2.82144	3.24984	4.7809
10	0.260185	0.699812	1.372184	1.812461	2.22814	2.76377	3.16927	4.5869
11	0.259556	0.697445	1.363430	1.795885	2.20099	2.71808	3.10581	4.4370
12	0.259033	0.695483	1.356217	1.782288	2.17881	2.68100	3.05454	43178
13	0.258591	0.693829	1.350171	1.770933	2.16037	2.65031	3.01228	4.2208
14	0.258213	0.692417	1.345030	1.761310	2.14479	2.62449	2.97684	4.1405
15	0.257885	0.691197	1.340606	1.753050	2.13145	2.60248	2.94671	4.0728
16	0.257599	0.690132	1.336757	1.745884	2.11991	2.58349	2.92078	4.0150
17	0.257347	0.689195	1.333379	1.739607	2.10982	2.56693	2.89823	3.9651
18	0.257123	0.688364	1.330391	1.734064	2.10092	2.55238	2.87844	3.9216
19	0.256923	0.687621	1.327728	1.729133	2.09302	2.53948	2.86093	3.8834
20	0.256743	0.686954	1.325341	1.724718	2.08596	2.52798	2.84534	3.8495
21	0.256580	0.686352	1.323188	1.720743	2.07961	2.51765	2.83136	3.8193
22	0.256432	0.685805	1.321237	1.717144	2.07387	2.50832	2.81876	3.7921
23	0.256297	0.685306	1.319460	1.713872	2.06866	2.49987	2.80734	3.7676
24	0.256173	0.684850	1.317836	1.710882	2.06390	2.49216	2.79694	3.7454
25	0.256060	0.684430	1.316345	1.708141	2.05954	2.48511	2.78744	3.7251
26	0.255955	0.684043	1.314972	1.705618	2.05553	2.47863	2.77871	3.7066
27	0.255858	0.683685	1.313703	1.703288	2.05183	2.47266	2.77068	3.6896
28	0.255768	0.683353	1.312527	1.701131	2.04841	2.46714	2.76326	3.6739
29	0.255684	0.683044	1.311434	1.699127	2.04523	2.46202	2.75639	3.6594
30	0.255605	0.682756	1.310415	1.697261	2.04227	2.45726	2.75000	3.6460
z	0.253347	0.674490	1.281552	1.644854	1.95996	2.32635	2.57583	3.2905
CI	———	———	80%	90%	95%	98%	99%	99.9%