國立臺北大學115學年度碩士班一般入學考試試題

系（所）組別：都市計劃研究所

科　　目：統計學

☑可 ☐不可使用計算機

1. (25%) In response to the construction of the Muzha MRT, the Taipei City Department of Transportation hopes to understand the commuting conditions and needs of Muzha residents through a telephone survey. The questionnaire covers basic demographic information, the type of commuting tools used (bus, car, scooter, bicycle, MRT, walking), ticket type used (single-ride, monthly pass, EasyCard, senior card), commuting cost (in NT dollars), commuting time (in minutes) and distance traveled (in kilometers). The basic demographic information includes age (in years), gender, and employment sector (government, private, self-employed, student, unemployed). Exploratory data analysis (EDA) is an important statistical analysis procedure. Data visualization is one aspect of EDA.

   The commonly used statistical figures include:

(A) Bar chart	(B) Box plot	(C) Stem-leaf plot	(D) Histogram
(E) Line chart (折線圖)	(F) Pie chart	(G) QQ plot	(H) Scatter plot

   Use the letters (A)–(H) to answer the following questions. Multiple figures may be possible for the following questions:

   (i) Provide the appropriate figures to visualize the type of commuting tools used.
   (ii) Provide the appropriate figures to visualize commuting time.
   (iii) Provide the appropriate figures to visualize the association between commuting costs and distance traveled.
   (iv) Provide the appropriate figures to visualize the association between gender and distance traveled.
   (v) Provide the appropriate figures to visualize the association between employment sector and the type of commuting tools used.

2. (25%) In response to the construction of the Muzha MRT, the Taipei City Department of Transportation hopes to understand the commuting conditions and needs of Muzha residents through a telephone survey. The questionnaire covers basic demographic information, the type of commuting tools used (bus, car, scooter, bicycle, MRT, walking), ticket type used (single-ride, monthly pass, EasyCard, senior card), commuting cost (in NT dollars), commuting time (in minutes) and distance traveled (in kilometers). The basic demographic information includes age (in years), gender, and employment sector (government, private, self-employed, student, unemployed). The followings are some commonly used summary statistics:

(A) Correlation	(B) Frequency	(C) Interquartile	(D) Kurtosis
(E) Mean	(F) Medium	(G) Minimum	(H) Mode
(I) Percent	(J) Skewness	(K) Standard deviation	(L) Variance

   Use the letters (A)–(L) to answer the following questions. Multiple summary statistics might be possible for the following questions:

   (i) Provide the appropriate summary statistics to summarize the employment sector.
   (ii) Provide the appropriate summary statistics to describe the central tendency of distance traveled.
   (iii) Provide the appropriate summary statistics to describe the variability of commuting costs.
   (iv) Provide the appropriate summary statistics to describe the shape of the distribution of commuting time.
   (v) Provide the appropriate summary statistics to summarize the association between distance traveled and commuting time.

3. (15%) In response to the construction of the Muzha MRT, the Taipei City Department of Transportation hopes to understand the commuting conditions and needs of Muzha residents through a telephone survey. The questionnaire covers basic demographic information, the type of commuting tools used (bus, car, scooter, bicycle, MRT, walking), ticket type used (single-ride, monthly pass, EasyCard, senior card), commuting cost (in NT dollars), commuting time (in minutes) and distance traveled (in kilometers). The basic demographic information includes age (in years), gender, and employment sector (government, private, self-employed, student, unemployed). Besides EDA, it is also important to identify possible association among variables. The following provides commonly used test statistics:

(A) Chi-square test	(B) Correlation	(C) McNemar test	(D) One-Way Analysis of Variance (ANOVA)
(E) Paired T test	(F) Simple linear regression	(G) Two independent sample T test	(H) Wilcoxon rank sum test

Use the letters (A)–(H) to answer the following questions. Multiple test statistics may be possible for the following questions:

(i) Provide the appropriate test statistics for testing the association between employment sector and commuting costs.

(ii) Provide the appropriate test statistics for testing the association between commuting costs and age.

(iii) Provide the appropriate test statistics for testing the education level and the type of commuting tools used.

4. (10%) Assume that the commuting time (in minutes) in Muzha follows a normal distribution with mean 30 and standard deviation 40.

(i) Find the probability that commuting time exceeds 40 minutes.

(ii) Assume the expert would like to know the average commuting time for Muzha residents. The expert would like to collect a sample data to estimate the mean commuting time μ. Assume the standard deviation equals 40 minutes. How large a sample is necessary if he want the estimate to be within 5 minutes of the actual mean value μ, with 95% confidence?

5. (10%) Assume the target commuting time equals 30 minutes. Suppose a sample of size 25 residents are asked and assume the probability that the residents would be willing to have a commuting time greater than 40 minutes equal 0.1. Let X equal the number of residents who have a commuting time greater than 40 minutes.

(i) Find the probability that no residents is willing to have a commuting time greater than 40 minutes.

(ii) Find mean and variance of X.

6. (15%) The Taipei City Department of Transportation expects that there exists a gender difference in commuting time in response to the construction of the Muzha MRT. Assume that the commuting time for female and male residents follow normal distributions. A telephone survey was conducted, and the summary statistics are shown below:

	n	Sample mean	Sample variance
Female	64	50.00	64.00
Male	64	54.00	64.00

Assume that the variance of the commuting time are roughly equal between female and male. Answer each of the following questions:

(i) Hypotheses: State the null and alternative hypotheses for testing whether there is a gender difference in commuting time among Muzha residents.

(ii) Test selection: Identify the appropriate statistical test to compare the two groups.

(iii) Computation: Compute the test statistic using the given sample means and variances.

(iv) Decision: At a 5% significance level, determine whether the difference in commuting time is statistically significant.

(v) Interpretation: Explain the result in the context of transportation planning for the Muzha MRT.

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Table 1: Area under the standard normal curve

z	$P[Z \le z]$									
	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	0.500	0.504	0.508	0.512	0.516	0.520	0.524	0.528	0.532	0.536
0.10	0.540	0.544	0.548	0.552	0.556	0.560	0.564	0.567	0.571	0.575
0.20	0.579	0.583	0.587	0.591	0.595	0.599	0.603	0.606	0.610	0.614
0.30	0.618	0.622	0.626	0.629	0.633	0.637	0.641	0.644	0.648	0.652
0.40	0.655	0.659	0.663	0.666	0.670	0.674	0.677	0.681	0.684	0.688
0.50	0.691	0.695	0.698	0.702	0.705	0.709	0.712	0.716	0.719	0.722
0.60	0.726	0.729	0.732	0.736	0.739	0.742	0.745	0.749	0.752	0.755
0.70	0.758	0.761	0.764	0.767	0.770	0.773	0.776	0.779	0.782	0.785
0.80	0.788	0.791	0.794	0.797	0.800	0.802	0.805	0.808	0.811	0.813
0.90	0.816	0.819	0.821	0.824	0.826	0.829	0.831	0.834	0.836	0.839
1.00	0.841	0.844	0.846	0.848	0.851	0.853	0.855	0.858	0.860	0.862
1.10	0.864	0.867	0.869	0.871	0.873	0.875	0.877	0.879	0.881	0.883
1.20	0.885	0.887	0.889	0.891	0.893	0.894	0.896	0.898	0.900	0.901
1.30	0.903	0.905	0.907	0.908	0.910	0.911	0.913	0.915	0.916	0.918
1.40	0.919	0.921	0.922	0.924	0.925	0.926	0.928	0.929	0.931	0.932
1.50	0.933	0.934	0.936	0.937	0.938	0.939	0.941	0.942	0.943	0.944
1.60	0.945	0.946	0.947	0.948	0.949	0.951	0.952	0.953	0.954	0.954
1.70	0.955	0.956	0.957	0.958	0.959	0.960	0.961	0.962	0.962	0.963
1.80	0.964	0.965	0.966	0.966	0.967	0.968	0.969	0.969	0.970	0.971
1.90	0.971	0.972	0.973	0.973	0.974	0.974	0.975	0.976	0.976	0.977
2.00	0.977	0.978	0.978	0.979	0.979	0.980	0.980	0.981	0.981	0.982
2.10	0.982	0.983	0.983	0.983	0.984	0.984	0.985	0.985	0.985	0.986
2.20	0.986	0.986	0.987	0.987	0.987	0.988	0.988	0.988	0.989	0.989
2.30	0.989	0.990	0.990	0.990	0.990	0.991	0.991	0.991	0.991	0.992
2.40	0.992	0.992	0.992	0.992	0.993	0.993	0.993	0.993	0.993	0.994
2.50	0.994	0.994	0.994	0.994	0.994	0.995	0.995	0.995	0.995	0.995
2.60	0.995	0.995	0.996	0.996	0.996	0.996	0.996	0.996	0.996	0.996
2.70	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997
2.80	0.997	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.998
2.90	0.998	0.998	0.998	0.998	0.998	0.998	0.998	0.999	0.999	0.999
3.00	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999

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Table 2: Selected quantiles of the t distribution

	$P[T \le t]$				
r	0.900	0.950	0.975	0.99	0.995
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.228	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2.518	2.831
22	1.321	1.717	2.074	2.508	2.819
23	1.319	1.714	2.069	2.500	2.807
24	1.318	1.711	2.064	2.492	2.797
25	1.316	1.708	2.060	2.485	2.787
26	1.315	1.706	2.056	2.479	2.779
27	1.314	1.703	2.052	2.473	2.771
28	1.313	1.701	2.048	2.467	2.763
29	1.311	1.699	2.045	2.462	2.756
30	1.310	1.697	2.042	2.457	2.750
40	1.303	1.684	2.021	2.423	2.704
50	1.299	1.676	2.009	2.403	2.678
60	1.296	1.671	2.000	2.390	2.660
∞	1.282	1.645	1.960	2.326	2.576

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