

國立臺北大學 114 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

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1. (25%) In response to the construction of the Neihu MRT, the Taipei City Department of Transportation hopes to understand the commuting conditions and needs of Neihu residents through a telephone survey. The questionnaire covers basic demographic information, the type of commuting tools used, commuting costs (in NT dollars), and commuting time (in minutes). The basic demographic information includes age (in years), gender, and education level (1 = high school or below; 2 = university; 3 = graduate school or above). 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) Histogram	(D) Line chart (折線圖)
(E) Pie chart	(F) QQ plot	(G) Scatter plot	

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

- Write down the appropriate figures to visualize the type of commuting tools used.
 - Write down the appropriate figures to visualize commuting costs.
 - Write down the appropriate figures to visualize the association between commuting costs and commuting time.
 - Write down the appropriate figures to visualize the association between gender and commuting time.
 - Write down the appropriate figures to visualize the association between gender and the type of commuting tools used.
2. (25%) In response to the construction of the Neihu MRT, the Taipei City Department of Transportation hopes to understand the commuting conditions and needs of Neihu residents through a telephone survey. The questionnaire covers basic demographic information, the type of commuting tools used, commuting costs (in NT dollars), and commuting time (in minutes). The basic demographic information includes age (in years), gender, and education level (1 = high school or below; 2 = university; 3 = graduate school or above). Exploratory data analysis (EDA) is an important statistical analysis procedure. 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.

- Write down the appropriate summary statistics to summarize the type of commuting tools used.
- Write down the appropriate summary statistics to describe the central tendency of commuting costs.
- Write down the appropriate summary statistics to describe the variability of commuting costs.
- Write down the appropriate summary statistics to describe the shape of the distribution of commuting costs.
- Write down the appropriate summary statistics to summarize the association between commuting cost and commuting time.

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3. (15%) In response to the construction of the Neihu MRT, the Taipei City Department of Transportation hopes to understand the commuting conditions and needs of Neihu residents through a telephone survey. The questionnaire covers basic demographic information, the type of commuting tools used, commuting costs (in NT dollars), and commuting time (in minutes). The basic demographic information includes age (in years), gender, and education level (1 = high school or below; 2 = university; 3 = graduate school or above). 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.

- Write down the appropriate test statistics for testing the association between gender and the type of commuting tools used.
 - Write down the appropriate test statistics for testing the association between commuting costs and age.
 - Write down the appropriate test statistics for testing commuting time and gender.
4. (10%) Let X denote commuting costs. Assume that the distribution of X approximately follows a normal distribution with mean 30 NT dollars and standard deviation 2 NT dollars.
- Find the probability that commuting costs exceeds 32 NT dollars.
 - Assume the expert would like to know the average commuting costs for Neihu residents. The expert would like to collect a sample data to estimate the mean commuting costs μ . Assume the standard deviation equals 2 NT dollars. How large a sample is necessary if he want the estimate to be within 0.28 NT dollar of the actual mean value μ , with 95% confidence?
5. (15%) Assume the target commuting costs equals 30 NT dollars. Suppose a sample of size 25 residents are asked and assume the probability that the residents would be willing to pay more than 30 NT dollars equal 0.1. Let X equal the number of residents who pay more than 30 NT dollars to commute.
- Find $P[X = 1]$.
 - Find the probability that no residents pay more than 30 NT dollars for their daily commute.
 - Find mean and variance of X .
6. (10%) The Taipei City Department of Transportation expects that there exists a gender difference in commuting time. Assume that the distributions of the commuting time for female and male are normally distributed. Let the sample mean and sample deviation of commuting time for female and male be
- | | n | Sample mean | Sample variance | Sample standard deviation |
|--------|----|-------------|-----------------|---------------------------|
| Female | 25 | 53.35 | 100.41 | 10.02 |
| Male | 25 | 55.53 | 112.20 | 10.59 |
- Assume that the variance of the commuting time are roughly equal between female and male.
- Write down the hypotheses. The proper notation should be used.
 - Use a 5% significance level to make your inference.

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Table 1: Area under the standard normal curve

z	P[Z ≤ 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

	$P[T \leq t]$				
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