國立臺灣科技大學
八十七學年度碩士班招生考試試題

所　別：管理技術研究所　　組別：乙組　　科目：應用統計
學程別：資訊管理學程

1.(25%) When using *estimator* $\hat{\theta}$ to estimate *parameter* θ, why is it so important to assess the variability of $\hat{\theta}$? How would you assess the *error* $|\hat{\theta}-\theta|$? What is the role played by *sampling distribution* of $\hat{\theta}$ in *statistics*? Why do we need to learn *probability* before *statistics*?

2.(25%) Assume that the following regression model holds

$$Y_i = \beta_0 + \beta_1 x_i^2 + \epsilon_i, \qquad i = 1, 2, \ldots, n,$$

where $\epsilon_i \overset{i.i.d.}{\sim} N(0, \sigma^2)$.
(a) Find the least-squares estimators of β_0 and β_1.
(b) Find the distributions of $\hat{\beta}_0$ and $\hat{\beta}_1$.
(c) When there are more than one inedependent variable in the model, what is the problem of *multicollinearity*?

3. (20%) A health insurer gathers data on the length of hospitalization (in days) of patients operated on for appendicitis. Random samples from two different hospitals yielded the following results:

	Hospital 1	Hospital 2
Sample mean	8.2	9.4
Sample standard deviation	3.6	2.9
Sample size	56	38

(a) Find a 90% confidence interval for $\mu_1 - \mu_2$, the difference in long-run average lengths of hospitalization.
(b) Test the null hypothesis of equal long-run average stay against a general (two-sided) alternative; use $\alpha = 0.10$.

4. (30%) A tasting panel of 15 people is asked to rate two new kinds of tea on a scale ranging from 0 to 100;
0 means "I would never try it again,"
25 means "I would try to finish it only to be polite,"
50 means "I would drink it but not buy it,"
75 means "It's about as good as any tea I know,"
100 means "It's superb; I would drink nothing else."
The ratings are as follows:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Tea A	85	40	75	81	42	50	60	15	65	40	60	40	65	75	80
Tea B	65	50	43	65	20	65	35	38	60	47	60	43	53	61	63

s_d=16.08
(a) Calculate a 95% confidence interval for the population difference in mean ratings.
(b) Test the null hypothesis of no difference against a two-sided alternative using $\alpha = 0.05$.
(c) What advantage does the pair-sample method have in this situation?

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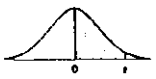
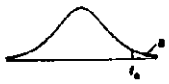
Normal curve areas



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.00	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.10	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.20	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.30	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.40	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.50	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.60	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.70	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.80	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.90	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.00	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.10	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.20	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.30	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.40	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.50	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.60	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.70	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.80	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.90	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.00	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.10	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.20	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.30	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.40	.4918	.4920	.4922	.4925	.4927	.4928	.4931	.4932	.4934	.4936
2.50	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.60	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.70	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.80	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.90	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.00	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

z	area
3.50	.49976737
4.00	.49996833
4.50	.49999660
5.00	.49999971

Percentage points of the *t* distribution



df	α=.1	α=.05	α=.025	α=.01	α=.005	α=.001
1	3.078	6.314	12.706	31.821	63.657	318.309
2	1.886	2.920	4.303	6.965	9.925	22.327
3	1.638	2.353	3.182	4.541	5.841	10.215
4	1.533	2.132	2.776	3.747	4.604	7.173
5	1.476	2.015	2.571	3.365	4.032	5.893
6	1.440	1.943	2.447	3.143	3.707	5.208
7	1.415	1.895	2.365	2.998	3.499	4.785
8	1.397	1.860	2.306	2.896	3.355	4.501
9	1.383	1.833	2.262	2.821	3.250	4.297
10	1.372	1.812	2.228	2.764	3.169	4.144
11	1.363	1.796	2.201	2.718	3.106	4.025
12	1.356	1.782	2.179	2.681	3.055	3.930
13	1.350	1.771	2.160	2.650	3.012	3.852
14	1.345	1.761	2.145	2.624	2.977	3.787
15	1.341	1.753	2.131	2.602	2.947	3.733
16	1.337	1.746	2.120	2.583	2.921	3.686
17	1.333	1.740	2.110	2.567	2.898	3.646
18	1.330	1.734	2.101	2.552	2.878	3.610
19	1.328	1.729	2.093	2.539	2.861	3.579
20	1.325	1.725	2.086	2.528	2.845	3.552
21	1.323	1.721	2.080	2.518	2.831	3.527
22	1.321	1.717	2.074	2.508	2.819	3.505
23	1.319	1.714	2.069	2.500	2.807	3.485
24	1.318	1.711	2.064	2.492	2.797	3.467
25	1.316	1.708	2.060	2.485	2.787	3.450
26	1.315	1.706	2.056	2.479	2.779	3.435
27	1.314	1.703	2.052	2.473	2.771	3.421
28	1.313	1.701	2.048	2.467	2.763	3.408
29	1.311	1.699	2.045	2.462	2.756	3.396
30	1.310	1.697	2.042	2.457	2.750	3.385
40	1.303	1.684	2.021	2.423	2.704	3.307
60	1.296	1.671	2.000	2.390	2.660	3.232
120	1.289	1.658	1.980	2.358	2.617	3.160
240	1.285	1.651	1.970	2.342	2.596	3.125
∞	1.282	1.645	1.960	2.326	2.576	3.090