不得使用計算器

1. (20 pts.) (1) What is the difference between likelihood function $P(x|\theta)$ and conditional probability? (2) Please use an example to explain the method of maximum likelihood estimation. (hint: Albert Einstein said: "God does not play dice with the universe.")

2. (10 pts.) Please use the three axioms of probability to derive and show the probability that the outcome of throwing a fair dice will be "odd" (i.e., 1 or 3 or 5).

3. (20 pts.) DA Lab Technology, Inc. has developed a yield enhancement solution for a Taiwan's semiconductor manufacturer and implemented it in the six scanners of her 300mm fab. The following average yield rates were collected before and after the implementation from these scanners.

scanner	1	2	3	4	5	6
Average yield rate (μ_1) before implementation	87.8	90.5	90.2	87.4	85.9	88.3
Average yield rate (μ_2) after implementation	91.2	90.3	94.6	88.5	86.2	92.8

(1) Please construct a 95% confidence interval on mean difference ($\mu_2-\mu_1$).

(2) Please test the following hypothesis at the 10% level of significance.

H_0: $\mu_2-\mu_1=0$

H_1: $\mu_2-\mu_1>0$

(3) Can the above hypothesis test result be derived directly from the above constructed confidence interval? Why or why not??

4. (20 pts.) A lottery that sells 150,000 tickets has the following prize structure:

(1) first prize of $50,000

(2) five second prizes of $10,000

(3) 25 third prizes of $1,000

(4) 1000 fourth prizes of $10

(a) Let Y be the winning amount of a randomly drawn lottery ticket. Describe the probability distribution of Y.

(b) Compute the mean or expected value of the ticket.

(c) If the ticket costs $1.00, is the purchase of the ticket worthwhile? Explain your answer.

(d) Compute the standard deviation of this distribution. Comment on the usefulness of the standard deviation as a measure of dispersion for this distribution.

5. (15 pts.) Assume that a random sample of size 25 is to be taken from a normal population with $\mu = 10$ and $\sigma = 2$. The value of μ, however, is not known by the person taking the sample.

(a) Suppose that the person taking the sample tests H_0: $\mu = 10.4$ against H_1: $\mu \neq 10.4$. Although this null hypothesis is not true, it may not be rejected, and a type II error may therefore be committed. Compute β if $\alpha = 0.05$.

(b) Suppose the person wanted to test H_0: $\mu = 11.2$ against H_1: $\mu \neq 11.2$. Compute β for $\alpha = 0.05$.

(c) Suppose that the person decided to use H_0: $\mu < 11.2$. Calculate β for $\alpha = 0.05$.

6. (15 pts.) An experimenter is testing a new pressure gauge against a standard (a gauge known to be accurate) by taking three readings each at 50, 100, 150, 200, and 250 pounds per square inch. The purpose of the experiment is to ascertain the precision and accuracy of the new gauge. The data are shown in the following table:

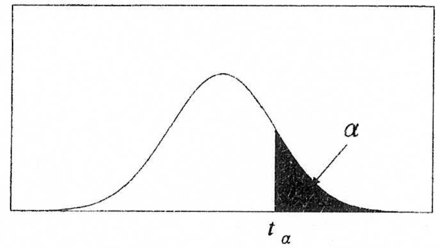
Standard Gauge	**50**	**100**	**150**	**200**	**250**
	48	100	154	201	247
New Gauge	44	100	154	200	245
	46	106	154	205	246

(a) Both precision and accuracy are important factors in determining the effectiveness of a measuring instrument. Perform the appropriate analysis to determine the effectiveness of this instrument.

(b) This device has a shortcoming that is of a slightly different nature. Perform the appropriate analyses to find the shortcoming.

t 分配臨界值表

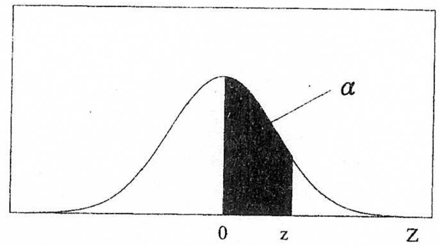
$P(t > t_\alpha) = \alpha$



d.f.	$t_{.100}$	$t_{.050}$	$t_{.025}$	$t_{.010}$	$t_{.005}$	*d.f.*
1	3.078	6.314	12.706	31.821	63.656	1
2	1.886	2.920	4.303	6.965	9.925	2
3	1.638	2.353	3.182	4.541	5.841	3
4	1.533	2.132	2.776	3.747	4.604	4
5	1.476	2.015	2.571	3.365	4.032	5
6	1.440	1.943	2.447	3.143	3.707	6
7	1.415	1.895	2.365	2.998	3.499	7
8	1.397	1.860	2.306	2.896	3.355	8
9	1.383	1.833	2.262	2.821	3.250	9
10	1.372	1.812	2.228	2.764	3.169	10
11	1.363	1.796	2.201	2.718	3.106	11
12	1.356	1.782	2.179	2.681	3.055	12
13	1.350	1.771	2.160	2.650	3.012	13
14	1.345	1.761	2.145	2.624	2.977	14
15	1.341	1.753	2.131	2.602	2.947	15
16	1.337	1.746	2.120	2.583	2.921	16
17	1.333	1.740	2.110	2.567	2.898	17
18	1.330	1.734	2.101	2.552	2.878	18
19	1.328	1.729	2.093	2.539	2.861	19
20	1.325	1.725	2.086	2.528	2.845	20
21	1.323	1.721	2.080	2.518	2.831	21
22	1.321	1.717	2.074	2.508	2.819	22
23	1.319	1.714	2.069	2.500	2.807	23
24	1.318	1.711	2.064	2.492	2.797	24
25	1.316	1.708	2.060	2.485	2.787	25
26	1.315	1.706	2.056	2.479	2.779	26
27	1.314	1.703	2.052	2.473	2.771	27
28	1.313	1.701	2.048	2.467	2.763	28
29	1.311	1.699	2.045	2.462	2.756	29
∞	1.282	1.645	1.960	2.326	2.576	∞

標準常態累加機率值表

$$P(0 < Z < z) = \alpha$$



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990