UNIVERSITY OF SWAZILAND

FINAL EXAMINATIONS 2005

B.A.S.S. II

TITLE OF PAPER	:	INFERENTIAL STATISTICS
COURSE NUMBER	:	ST 232
TIME ALLOWED	:	TWO (2) HOURS
INSTRUCTIONS	:	1. THIS PAPER CONSISTS OF SEVEN (7) QUESTIONS. 2. ANSWER ALL FOUR QUESTIONS FROM **SECTION A** AND ANY TWO (2) QUESTIONS FROM **SECTION B**.
SPECIAL REQUIREMENTS	:	STATISTICAL TABLES

THIS EXAMINATION PAPER SHOULD NOT BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR.

SECTION A

Answer **ALL** questions in this section.

QUESTION 1

1. If a fair die is rolled five times, use the Binomial distribution formula to find the the probability of rolling

   (a) Exactly two 3's. [3 marks]

   (b) Less than two 3's. [3 marks]

   (c) At least two 3's. [4 marks]

QUESTION 2

2. A manufacturing process produces light bulbs with life expectancies that are normally distributed with a mean of 500 hours and a standard deviation of 100 hours.

   (a) What percantage of the light bulbs can be expected to last between 500 and 760 hours? [5 marks]

   (b) What is the probability of a light bulb chosen at random lasting between 380 and 500 hours? [5 marks]

QUESTION 3

3. (a) Suppose that we are interested in estimating the mean number of unoccupied seats per flight, μ, for a major airline. A random sample of $n = 225$ flights shows that the sample mean is 11.6 and standard deviation is 4.1. Estimate the mean number of unoccupied seats per flight using a 90% confidence interval. [8 marks]

(b) If a public opinion pollster is interested in estimating the proportion of registered voters favouring a candidate (p) with 95% confidence to within 0.05. If p is about 0.5, how large should the sample be? [7 marks]

QUESTION 4

4. A union claims that the average annual wage for their members is E22 000 per year. A random sample of 40 union employees' salary information gave a mean of $\bar{x}$ = E21 250 and $s = 702$. Determine if this data provides sufficient evidence to support the union's claim.(Use $\alpha = 0.05$) [15 marks]

SECTION B

Answer **ANY TWO (2)** questions in this section.

QUESTION 5

5. A manufacturer keeps records of the time interval (in hours) between the breakdown of two machines. A summary of data is shown in the table below,

Number of hours between breakdowns

Machine	Tests	Mean	Standard Deviation
A	64	129	8
B	108	124	17

Test the hypothesis that, on average, machine B has a shorter time between breakdowns than machine A. [25 marks]

QUESTION 6

6. (a) The table below gives weights in grams for a sample of 10 hen eggs. Assume that weights are normally distributed, with a standard deviation of 10 grams. Use this data to construct a 95% confidence interval for the average weight of hen eggs. [10 marks]

36	33	49	59	47
55	54	29	49	66

(b) A researcher wants to determine the average weight of rainbow trout in a particular river. Assuming that weights of rainbow trout have a standard deviation of 300 grams, how many trout would he have to weigh in order to get a margin of error of 50 grams at a 90% confidence level.

7. A certain university's brochure claims that the average amount of money needed for boarding and lodging in the town for a single student is E75 per week. A random sample of nine single students from this university showed the following weekly expenditures:

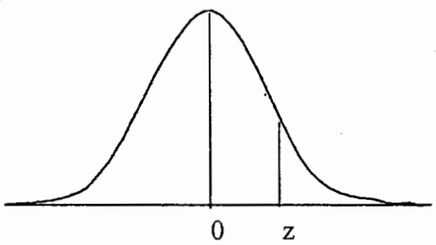
75, 92, 80, 84, 73, 60, 84, 91, 78

Assuming that the distribution of weekly expenditures is symetric and continuous answer the following:

(a) Use the Wolcoxon signed rank test to determine whether the data provides sufficient evidence to suggest that the university's estimate is not correct. 15 marks

(b) Assuming that the weekly expenditure is normal, analyse the same data with two-tailed t-test, and compare with the result obtained in (a).

TABLE I Normal Curve Areas



	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3196	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3969	.3898	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4136	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4419	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4921	.4826	.4930	.4934	.4839	.4942	.4946	.4950	.4854	.4957
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4979	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

Table 2

Percentage points of the χ^2 distribution

	P(%)											
ν	99.5	99	97.5	95	90	10	5	2.5	1	0.5	0.1	ν
1	0.0000	0.0002	0.0098	0.0039	0.016	2.71	3.84	5.02	6.63	7.88	10.8	1
2	0.010	0.020	0.051	0.103	0.211	4.61	5.99	7.38	9.21	10.6	13.8	2
3	0.02	0.115	0.216	0.352	0.584	6.25	7.81	9.35	11.3	12.8	16.3	3
4	0.207	0.297	0.484	0.711	1.06	7.78	9.49	11.1	13.3	14.9	18.5	4
5	0.412	0.554	0.831	1.15	1.61	9.24	11.1	12.8	15.1	16.7	20.5	5
6	0.676	0.872	1.24	1.64	2.20	10.6	12.6	14.4	16.8	18.5	22.5	6
7	0.989	1.24	1.69	2.17	2.83	12.0	14.1	16.0	18.5	20.3	24.3	7
8	1.34	1.65	2.18	2.73	3.49	13.4	15.5	17.5	20.1	22.0	26.1	8
9	1.73	2.09	2.70	3.33	4.17	14.7	16.9	19.0	21.7	23.6	27.9	9
10	2.16	2.56	3.25	3.94	4.87	16.0	18.3	20.5	23.2	25.2	29.6	10
11	2.60	3.05	3.82	4.57	5.58	17.3	19.7	21.9	24.7	26.8	31.3	11
12	3.07	3.57	4.40	5.23	6.30	18.5	21.0	23.3	26.2	28.3	32.9	12
13	3.57	4.11	5.01	5.89	7.04	19.8	22.4	24.7	27.7	29.8	34.5	13
14	4.07	4.66	5.63	6.57	7.79	21.1	23.7	26.1	29.1	31.3	36.1	14
15	4.60	5.23	6.26	7.26	8.55	22.3	25.0	27.5	30.6	32.8	37.7	15
16	5.14	5.81	6.91	7.96	9.31	23.5	26.3	28.8	32.0	34.3	39.3	16
17	5.70	6.41	7.56	8.67	10.1	24.8	27.6	30.2	33.4	35.7	40.8	17
18	6.26	7.01	8.23	9.39	10.9	26.0	28.9	31.5	34.8	37.2	42.3	18
19	6.84	7.63	8.91	10.1	11.7	27.2	30.1	32.9	36.2	38.6	43.8	19
20	7.43	8.26	9.59	10.9	12.4	28.4	31.4	34.2	37.6	40.0	45.3	20
21	8.03	8.90	10.3	11.6	13.2	29.6	32.7	35.5	38.9	41.4	46.8	21
22	8.64	9.54	11.0	12.3	14.0	30.8	33.9	36.8	40.3	42.8	48.3	22
23	9.26	10.2	11.7	13.1	14.8	32.0	35.2	38.1	41.6	44.2	49.7	23
24	9.89	10.9	12.4	13.8	15.7	33.2	36.4	39.4	43.0	45.6	51.2	24
25	10.5	11.5	13.1	14.6	16.5	34.4	37.7	40.6	44.3	46.9	52.6	25
26	11.2	12.2	13.8	15.4	17.3	35.6	38.9	41.9	45.6	48.3	54.1	26
27	11.8	12.9	14.6	16.2	18.1	36.7	40.1	43.2	47.0	49.6	55.5	27
28	12.5	13.6	15.3	16.9	18.9	37.9	41.3	44.5	48.3	51.0	56.9	28
29	13.1	14.3	16.0	17.7	19.8	39.1	42.6	46.7	49.6	52.3	58.3	29
30	13.8	15.0	16.8	18.5	20.6	40.3	43.8	47.0	50.9	53.7	59.7	30

ν is the number of degrees of freedom

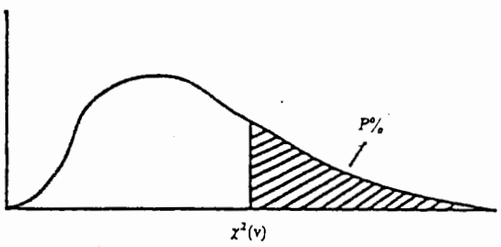


TABLE 3 Cumulative Right Tail Probabilities For Wilcoxon Signed Rank Statistic[a]

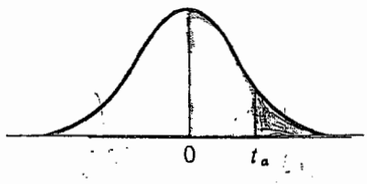
Right tail probabilities $P(W \geq W_0)$ are given for $w_0 \geq n(n+1)/4$. Here W is interpreted as either W_+ or W_-. Left tail probabilities are obtained from the relation $P(W_- \leq n(n+1)/2 - w_0)$.

n	w_0	$P(W \geq w_0)$
2	2	.500
	3	.250
3	3	.625
	4	.375
	5	.250
	6	.125
4	5	.562
	6	.438
	7	.312
	8	.188
	9	.125
	10	.062
5	8	.500
	9	.406
	10	.312
	11	.219
	12	.156
	13	.094
	14	.062
	15	.031
6	11	.500
	12	.422
	13	.344
	14	.281
	15	.219
	16	.156
	17	.109
	18	.078
	19	.047
	20	.031
	21	.016
7	14	.531
	15	.469
	16	.406
	17	.344
	18	.289
	19	.234
	20	.188
	21	.148
	22	.109
	23	.078
	24	.055
	25	.039
	26	.023
	27	.016
	28	.008
8	18	.527
	19	.473
	20	.422
	21	.371
	22	.320
	23	.273
	24	.230
	25	.191
	26	.156
	27	.125
	28	.098
	29	.074
	30	.055
	31	.039
	32	.027
	33	.020
	34	.012
	35	.008
	36	.004
9	23	.500
	24	.455
	25	.410
	26	.367
	27	.326
	28	.285
	29	.248
	30	.213
	31	.180
	32	.150
	33	.125
	34	.102
	35	.082
	36	.064
	37	.049
	38	.037
	39	.027
	40	.020
	41	.014
	42	.010
	43	.006
	44	.004
	45	.002
10	28	.500
	29	.461
	30	.423
	31	.385
	32	.348
	33	.312
	34	.278
	35	.246
	36	.216
	37	.188
	38	.161
	39	.138
	40	.116
	41	.097
	42	.080
	43	.065
	44	.053
	45	.042
	46	.032
	47	.024
	48	.019
	49	.014
	50	.010
	51	.007
	52	.005
	53	.003
	54	.002
	55	.001
11	33	.517
	34	.483
	35	.449
	36	.416
	37	.382
	38	.350
	39	.319
	40	.289
	41	.260
	42	.232
	43	.207
	44	.183
	45	.160

TABLE 3 (*Continued*)

n	w_0	$P(W \geq w_0)$
	46	.139
	47	.120
	48	.103
	49	.087
	50	.074
	51	.062
	52	.051
	53	.042
	54	.034
	55	.027
	56	.021
	57	.016
	58	.012
	59	.009
	60	.007
	61	.005
	62	.003
	63	.002
	64	.001
	65	.001
	66	.000
12	39	.515
	40	.485
	41	.455
	42	.425
	43	.396
	44	.367
	45	.339
	46	.311
	47	.285
	48	.259
	49	.235
	50	.212
	51	.190
	52	.170
	53	.151
	54	.133
	55	.117
	56	.102
	57	.088
	58	.076
	59	.065
	60	.055
	61	.046
	62	.039
	63	.032
	64	.026
	65	.021
	66	.017
	67	.013
	68	.010
	69	.008
	70	.006
	71	.005
	72	.003
	73	.002
	74	.002
	75	.001
	76	.001
	77	.000
	78	.000
13	46	.500
	47	.473
	48	.446
	49	.420
	50	.393
	51	.368
	52	.342
	53	.318
	54	.294
	55	.271
	56	.249
	57	.227
	58	.207
	59	.188
	60	.170
	61	.153
	62	.137
	63	.122
	64	.108
	65	.095
	66	.084
	67	.073
	68	.064
	69	.055
	70	.047
	71	.040
	72	.034
	73	.029
	74	.024
	75	.020
	76	.016
	77	.013
	78	.011
	79	.009
	80	.007
	81	.005
	82	.004
	83	.003
	84	.002
	85	.002
	86	.001
	87	.001
	88	.001
	89	.000
	90	.000
	91	.000
14	53	.500
	54	.476
	55	.452
	56	.428
	57	.404
	58	.380
	59	.357
	60	.335
	61	.313
	62	.292
	63	.271
	64	.251
	65	.232
	66	.213
	67	.196
	68	.179
	69	.163
	70	.148
	71	.134
	72	.121
	73	.108
	74	.097
	75	.086
	76	.077
	77	.068
	78	.059
	79	.052
	80	.045
	81	.039
	82	.034
	83	.029

TABLE 4 Percentage points of the t distribution



d.f	$a = .10$	$a = .05$	$a = .025$	$a = .010$	$a = .005$
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
inf.	1.282	1.645	1.960	2.326	2.576

From "Table of Percentage Points of the t-distribution." Computed by Maxine Merrington, *Biometrika*, Vol. 32 (1941), p. 300. Reproduced by permission of the *Biometrika* Trustees.