UNIVERSITY OF SWAZILAND

SUPPLEMENTARY EXAMINATION PAPER

PROGRAMME	**DIPLOMA IN AGRICLTURE** **DIPLOMA IN AGRICULTURAL EDUCATION** **DIPLOMA IN HOME ECONOMICS** **DIPLOMA IN HOME ECONOMICS EDUCATION** **REMEDIAL IN AGRICULTURE**
COURSE CODE:	**AEM 201**
TITLE OF PAPER:	**ELEMENTARY STATISTICS**
TIME ALLOWED:	**TWO HOURS (2HRS)**
REQUIREMENTS:	**CALCULATOR, STATISTICAL TABLES AND GRAPH PAPER**
INSTRUCTIONS:	**ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS.**

DO NOT OPEN THIS PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE CHIEF INVIGILATOR

Question 1

The numbers of heart valve and heart bypass operations performed in a random sample of eight hospitals in the years 2001–2003 are shown in the table.

Hospital	*Number of heart valve operations*	*Number of heart bypass operations*
A	191	1420
B	331	3197
C	231	1721
D	199	1615
E	117	1005
F	247	1993
G	314	1391
H	160	1944

a) Calculate the mean number of heart valve operations performed and the standard deviation. Hence find the coefficient of variation.
b) Calculate the mean number of heart bypass operations performed and the standard deviation. Hence find the coefficient of variation.
c) Compare the results found in (a) and (b).

Question 2

In a particular population, it was of interest whether married men were, on average, younger or older than their respective wives. A random sample of 15 couples was taken, their ages being given in the table below.

Couple number	*Husband's age*	*Wife's age*
1	39	32
2	38	31
3	73	68
4	54	58
5	24	26
6	57	53
7	49	48
8	63	69
9	48	47
10	44	46
11	26	25
12	64	62
13	42	40
14	45	48
15	61	57

Is there evidence that the mean difference in ages between husbands and wives is non-zero? Obtain a 95% confidence interval for the mean difference in ages of the husbands and their respective wives. (20 Marks)

Question 3

A psychologist wished to examine the degree of association between intelligence and the ability to think laterally. An experiment was conducted in which each member of a random sample of 12 subjects was given both an intelligence test and a test of lateral thinking. The scores obtained by each subject on each test are given in the following table. The intelligence test has a maximum score of 150 while the lateral thinking test has a maximum score of 10.

Subject	1	2	3	4	5	6	7	8	9	10	11	12
Intelligence test score	121	148	108	137	141	124	131	115	118	110	132	127
Lateral thinking test score	3	9	6	7	8	2	5	5	6	4	8	7

a) Calculate Pearson's and Spearman's correlation coefficients between these two test scores. What does your result indicate about the association between intelligence and the ability to think laterally?

(12 marks)

b) Which of the two coefficients is appropriate for measuring the relationship between intelligence and lateral thinking?

(8 marks)

Question 4

a) A community in Mbabane has a population 900 economically active people. 460 males and 140 females are employed. 40 males and 260 females are unemployed. One of these individuals is selected at random for a tour throughout the community to publicize the advantages of establishing new industries in the community.
   i) What is the probability of selecting an employed male?
   ii) What is the probability of selecting an unemployed female?

(8 Marks)

b) The prevalence of disease in a population of chicken (i.e. the percentage with the disease) is 10%. If you took a sample of 20 chickens, what is the probability that you would obtain
   (i) 3 diseased cases
   (ii) less than or equal to 5 diseased cases

(6 marks)

c) Suppose 38% of all randomly chosen quadrats of two square metres area contain a particular plant species. If you choose 150 quadrats at random, what is the probability that 50 will contain the species? Or that more than 64 will contain the species?

(6 Marks)

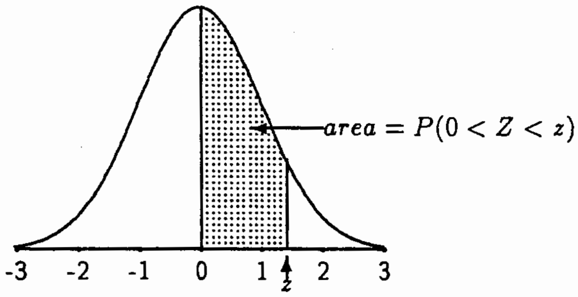
Confidence Intervals

Parameter	Assumptions	Endpoints
μ	$N(\mu, \sigma^2)$ or n large σ^2 known	$\bar{x} \pm z_{\alpha/2} \dfrac{\sigma}{\sqrt{n}}$
μ	$N(\mu, \sigma^2)$ σ^2 unknown	$\bar{x} \pm t_{\alpha/2}(n-1) \dfrac{s}{\sqrt{n}}$
$\mu_X - \mu_Y$	$N(\mu_X, \sigma_X^2)$ $N(\mu_Y, \sigma_Y^2)$ σ_X^2, σ_Y^2 known	$\bar{x} - \bar{y} \pm z_{\alpha/2}\sqrt{\dfrac{\sigma_X^2}{n} + \dfrac{\sigma_Y^2}{m}}$
$\mu_X - \mu_Y$	Variances unknown, large samples	$\bar{x} - \bar{y} \pm z_{\alpha/2}\sqrt{\dfrac{s_x^2}{n} + \dfrac{s_y^2}{m}}$
$\mu_X - \mu_Y$	$N(\mu_X, \sigma_X^2)$ $N(\mu_Y, \sigma_Y^2)$ $\sigma_X^2 = \sigma_Y^2$, unknown	$\bar{x} - \bar{y} \pm t_{\alpha/2}(n+m-2) s_p \sqrt{\dfrac{1}{n} + \dfrac{1}{m}}$, $s_p = \sqrt{\dfrac{(n-1)s_x^2 + (m-1)s_y^2}{n+m-2}}$
$\mu_D = \mu_X - \mu_Y$	X and Y normal, but dependent	$\bar{d} \pm t_{\alpha/2}(n-1) \dfrac{s_d}{\sqrt{n}}$
σ^2	$N(\mu, \sigma^2)$	$\dfrac{(n-1)s^2}{\chi^2_{\alpha/2}(n-1)}, \dfrac{(n-1)s^2}{\chi^2_{1-\alpha/2}(n-1)}$
$\dfrac{\sigma_X^2}{\sigma_Y^2}$	$N(\mu_X, \sigma_X^2)$ $N(\mu_Y, \sigma_Y^2)$	$\dfrac{s_x^2/s_y^2}{F_{\alpha/2}(n-1, m-1)}, \; F_{\alpha/2}(m-1, n-1)\dfrac{s_x^2}{s_y^2}$
p	$b(n, p)$ n is large	$\dfrac{y}{n} \pm z_{\alpha/2}\sqrt{\dfrac{(y/n)(1-y/n)}{n}}$
$p_1 - p_2$	$b(n_1, p_1)$ $b(n_2, p_2)$	$\widehat{p}_1 - \widehat{p}_2 \pm z_{\alpha/2}\sqrt{\dfrac{\widehat{p}_1(1-\widehat{p}_1)}{n_1} + \dfrac{\widehat{p}_2(1-\widehat{p}_2)}{n_2}}$, $\widehat{p}_1 = y_1/n_1, \; \widehat{p}_2 = y_2/n_2$

Tests of Hypotheses

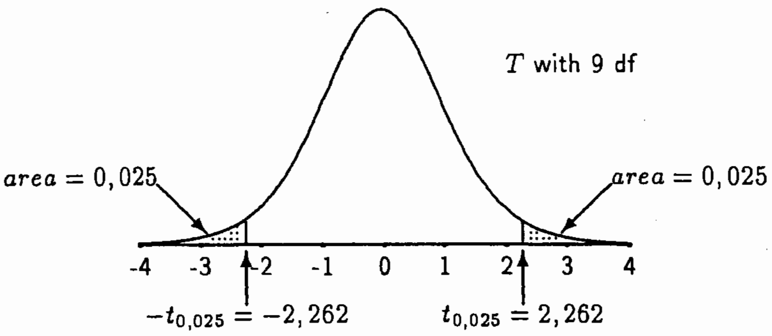
Hypotheses	Critical Region
H_0: $\mu = \mu_0$ H_1: $\mu > \mu_0$ σ^2 known	$z = \dfrac{\bar{x} - \mu_0}{\sigma/\sqrt{n}} \geq z_\alpha$
H_0: $\mu = \mu_0$ H_1: $\mu > \mu_0$ σ^2 unknown	$z = \dfrac{\bar{x} - \mu_0}{s/\sqrt{n}} \geq t_\alpha(n-1)$
H_0: $\mu_X - \mu_Y = 0$ H_1: $\mu_X - \mu_Y > 0$ σ_X^2, σ_Y^2 known	$z = \dfrac{\bar{x} - \bar{y} - 0}{\sqrt{\sigma_X^2/n + \sigma_Y^2/m}} \geq z_\alpha$
H_0: $\mu_X - \mu_Y = 0$ H_1: $\mu_X - \mu_Y > 0$ Variances unknown, large samples	$z = \dfrac{\bar{x} - \bar{y} - 0}{\sqrt{s_x^2/n + s_y^2/m}} \geq z_\alpha$
H_0: $\mu_X - \mu_Y = 0$ H_1: $\mu_X - \mu_Y > 0$ $\sigma_X^2 = \sigma_Y^2$, unknown	$t = \dfrac{\bar{x} - \bar{y} - 0}{s_p\sqrt{1/n + 1/m}} \geq t_\alpha(n+m-2)$ $s_p = \sqrt{\dfrac{(n-1)s_x^2 + (m-1)s_y^2}{n+m-2}}$
H_0: $\mu_D = 0$ H_1: $\mu_D > 0$	$t = \dfrac{\bar{d} - 0}{s_d/\sqrt{n}} \geq t_\alpha(n-1)$
H_0: $\sigma^2 = \sigma_0^2$ H_1: $\sigma^2 > \sigma_0^2$	$\chi^2 = \dfrac{(n-1)s^2}{\sigma_0^2} \geq \chi^2_\alpha(n-1)$
H_0: $\sigma_X^2/\sigma_Y^2 = 1$ H_1: $\sigma_X^2/\sigma_Y^2 > 1$	$F = \dfrac{s_x^2}{s_y^2} \geq F_\alpha(n-1, m-1)$
H_0: $p = p_0$ H_1: $p > p_0$	$z = \dfrac{y/n - p_0}{\sqrt{p_0(1-p_0)/n}} \geq z_\alpha$
H_0: $p_1 - p_2 = 0$ H_1: $p_1 - p_2 > 0$	$z = \dfrac{y_1/n_1 - y_2/n_2 - 0}{\sqrt{\left(\dfrac{y_1+y_2}{n_1+n_2}\right)\left(1 - \dfrac{y_1+y_2}{n_1+n_2}\right)\left(\dfrac{1}{n_1} + \dfrac{1}{n_2}\right)}} \geq z_\alpha$

Table of Standard Normal Curve Areas



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
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

Table of Critical Values of T



df	$t_{0,05}$	$t_{0,025}$	$t_{0,01}$	$t_{0,005}$
1	6.314	12.706	31.821	63.657
2	2.920	4.303	6.965	9.925
3	2.353	3.182	4.541	5.841
4	2.132	2.776	3.747	4.604
5	2.015	2.571	3.365	4.032
6	1.943	2.447	3.143	3.707
7	1.895	2.365	2.998	3.499
8	1.860	2.306	2.896	3.355
9	1.833	2.262	2.821	3.250
10	1.812	2.228	2.764	3.169
11	1.796	2.201	2.718	3.106
12	1.782	2.179	2.681	3.055
13	1.771	2.160	2.650	3.012
14	1.761	2.145	2.624	2.977
15	1.753	2.131	2.602	2.947
16	1.746	2.120	2.583	2.921
17	1.740	2.110	2.567	2.898
18	1.734	2.101	2.552	2.878
19	1.729	2.093	2.539	2.861
20	1.725	2.086	2.528	2.845
21	1.721	2.080	2.518	2.831
22	1.717	2.074	2.508	2.819
23	1.714	2.069	2.500	2.807
24	1.711	2.064	2.492	2.797
25	1.708	2.060	2.485	2.787
26	1.706	2.056	2.479	2.779
27	1.703	2.052	2.473	2.771
28	1.701	2.048	2.467	2.763
29	1.699	2.045	2.462	2.756
30	1.697	2.042	2.457	2.750

df	$t_{0,05}$	$t_{0,025}$	$t_{0,01}$	$t_{0,005}$
40	1.684	2.021	2.423	2.704
50	1.676	2.009	2.403	2.678
60	1.671	2.000	2.390	2.660
70	1.667	1.994	2.381	2.648
80	1.664	1.990	2.374	2.639
90	1.662	1.987	2.368	2.632
100	1.660	1.984	2.364	2.626
110	1.659	1.982	2.361	2.621
120	1.658	1.980	2.358	2.617
130	1.657	1.978	2.355	2.614
140	1.656	1.977	2.353	2.611
150	1.655	1.976	2.351	2.609
160	1.654	1.975	2.350	2.607
170	1.654	1.974	2.348	2.605
180	1.653	1.973	2.347	2.603
190	1.653	1.973	2.346	2.602
200	1.653	1.972	2.345	2.601
210	1.652	1.971	2.344	2.599
220	1.652	1.971	2.343	2.598
230	1.652	1.970	2.343	2.597
240	1.651	1.970	2.342	2.596
250	1.651	1.969	2.341	2.596
260	1.651	1.969	2.341	2.595
270	1.651	1.969	2.340	2.594
280	1.650	1.968	2.340	2.594
290	1.650	1.968	2.339	2.593
300	1.650	1.968	2.339	2.592
310	1.650	1.968	2.338	2.592
320	1.650	1.967	2.338	2.591
330	1.649	1.967	2.338	2.591
∞	1.645	1.96	2.33	2.58