UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER 2010

TITLE OF PAPER	:	DESCRIPTIVE & INFERENTIAL STATISTICS
COURSE CODE	:	ST 230/IDE-ST 230 (1&2)
TIME ALLOWED	:	THREE (3) HOURS
REQUIREMENTS	:	CALCULATOR, GRAPH PAPER AND STATISTICAL TABLES
INSTRUCTIONS	:	THIS PAPER HAS EIGHT (8) QUESTIONS AND THREE SECTIONS. ANSWER ALL QUESTIONS IN SECTION ONE, ANY TWO (2) QUESTIONS IN SECTION TWO, AND ANY TWO (2) QUESTIONS FROM SECTION THREE

SECTION ONE

(ANSWER ALL QUESTIONS)

Question 1 [10 marks, 1 point each]

Choose the correct answer from the alternatives provided.

1. The government claims that students earn an average of SZL4500 during their summer break from studies. A random sample of students gave a sample average of SZL3975 and a 95% confidence interval was found to be (SZL3525 $< \mu <$ SZL4425). This interval is interpreted to mean that:

   (a) if the study were to be repeated many times, there is a 95% probability that the true average summer earnings is not SZL4500 as the government claims.

   (b) because our specific confidence interval does not contain the value SZL4500 there is a 95% probability that the true average summer earnings is not SZL4500.

   (c) if we were to repeat our survey many times, then about 95% of all the confidence intervals will contain the value SZL4500.

   (d) if we repeat our survey many times, then about 95% of our confidence intervals will contain the true value of the average earnings of students.

   (e) there is a 95% probability that the true average earnings are between SZL3525 and SZL4425 for all students.

2. Which of the following statements about confidence intervals is *incorrect*?

   (a) If we keep the sample size fixed, the confidence interval gets wider as we increase the confidence coefficient.

   (b) A confidence interval for a mean always contains the sample mean.

   (c) If we keep the confidence coefficient fixed, the confidence interval gets narrower as we increase the sample size.

   (d) If the population standard deviation increases, the confidence interval decreases in width.

   (e) If the confidence intervals for two means do not overlap very much, there is evidence that the two population means are different.

3. Data collected at the same, or approximately the same, point in time are

   (a) time series data

   (b) approximate time series data

   (c) cross-sectional data

   (d) approximate data

4. The summaries of data, which may be tabular, graphical, or numerical, are referred to as

   (a) inferential statistics

   (b) descriptive statistics

(c) statistical inference

(d) report generation

5. In a sample of 800 students in a university, 160, or 20%, are Business majors. Based on the above information, the school's paper reported that "20% of all the students at the university are Business majors." This report is an example of

   (a) a sample

   (b) a population

   (c) statistical inference

   (d) descriptive statistics

6. Since a sample is a subset of the population, a percentage that is calculated from the sample data

   (a) is always smaller than the corresponding percentage from the population

   (b) is always larger than the corresponding percentage from the population

   (c) must be equal to the corresponding percentage from the population

   (d) can be larger, smaller, or equal to the corresponding percentage from the population

7. A confidence statement includes what two things?

   (a) margin of error and bias

   (b) bias and variability

   (c) bias and confidence level

   (d) confidence level and margin of error

8. The last time I went to Manzini, I decided to catch a Wanderers game. As I looked throughout the stands, I wondered what proportion of attendees were Wanderers fans. To answer this question, I asked 10 people in the row in front of me if, in fact, they were Wanderers fans. What type of sampling design did I use?

   (a) a probability sample

   (b) simple random sample

   (c) cluster sample

   (d) convenience sample

9. I read an advertisement recently in which a credit card company promised that I could reduce my debt by 150 percent. Which of the following statements is (are) true?

   (a) This is possible if my debt is more than 150 dollars.

   (b) This is possible if my debt has recently increased by at least 150 percent.

   (c) The company's claim makes no sense.

   (d) Both (a) and (b).

10. The diameter of ball bearings are known to be normally distributed with unknown mean and variance. A random sample of size 25 gave a mean 2.5 cm. The 95% confidence interval had length 4 cm. Then

(a) The sample variance is 4.86.

(b) The sample variance is 26.03.

(c) The population variance is 4.84.

(d) The population variance is 23.47.

(e) The sample variance is 23.47.

Question 2 [10 marks, 1 point each]

State TRUE of FALSE.

1. Quota sampling is objective.
2. Nonsampling errors can not occur in a census.
3. A quartile is a measure of location.
4. Putting data into grouped frequency distribution involves a loss of data precision.
5. Other things being equal, larger confidence levels provide a smaller margin of error.
6. The critical region for rejection of H_0 is the area under the curve which contains all the values of the statistic which fail to allow rejection of H_0.
7. The lower quartile is also a decile.
8. Measures of location for a grouped frequency distribution may be determined from the corresponding ogive.
9. If H_0 is false, a high level of power increases the probability we will reject it.
10. Confidence statements are statements applicable only to the sample of individuals measured.

SECTION TWO

(ANSWER ANY TWO QUESTIONS)

Question 3 [20 marks, 6+3+9+2]

A company is investigating the cost of absenteeism within its production department. Computer records revealed the following data:

Days absent last year	Number of people
0	94
1-5	203
6-10	105
11-20	68
21-30	15
31-40	10
40+	5

(a) Draw an ogive of these data on graph paper and use it to estimate the values of the median, quartile deviation and highest decile. (Do *not* calculate them.)

(b) Explain the meaning of your statistics.

(c) Calculate the coefficient of variation and interpret it.

(d) If each day's absence costs the company SZL150, find the cost of absenteeism in the production department last year.

Question 4 [20 marks, 12+8]

The table below shows the numbers of units sold of a company's products quarter by quarter over a three-and-a-half years.

	Sales in SZL'000			
Year	Q1	Q2	Q3	Q4
1987	100	125	127	102
1988	104	128	130	107
1989	110	131	133	107
1990	109	132		

(a) Use the method of moving averages to construct a deseasonalised series.

(b) Using the rate of change of the trend in 1989, forecast sales for the last two quarters of 1990.

Question 5 [20 marks, 12+4+4]

(a) A company wishes to measure the change in its performance using an index calculated from the data given below on numbers of times sold and their prices in 1990 and 1991.

	1990		1991	
Item	Price	Number	Price	Number
A	2.50	90	2.70	200
B	3.80	150	4.00	160
C	4.10	180	4.50	120

Use 1990 as base and calculate for 1991:

(i) the Laspeyres quantity index;

(ii) the weighted mean of quantity relatives using 1991 prices as weights; and

(iii) the Fisher's price index.

(b) In the UK Index of Retail Prices for December 1986 (January 1974=100) the approximate index for beer was around 500 and that for cheese was 400. Consider the following statements about December 1986:

(i) The price of beer was lower than the price of cheese.

(ii) The price of beer was higher than the price of cheese.

(iii) The change in the price of beer was 20 percent greater than the change in the price of cheese since January 1974.

Which of the statement(s) is/are true?

(c) For a certain product, data is available on last quarter's sales, by value, and on current quarter's prices and sales volume. Which of the following index number types can be calculated, using the last quarter as base?

(i) Laspeyres price index;

(ii) Laspeyres quantity (volume) index;

(iii) Paasche price index;

(iv) Paasche quantity (volume) index; and

(v) Sales value index.

SECTION THREE

(ANSWER ANY TWO QUESTIONS)

Question 6 [20 marks, 10+10]

(a) As part of an investment portfolio analysis, two similar companies which operate in the same market are being compared in terms of their earning per share. The companies' annual results over the last six years have provided the following information:

	Earnings per share (cents)	
Year	Company A	Company B
1980	14.3	13.8
1981	15.6	14.6
1982	17.2	16.4
1983	16.4	16.8
1984	14.9	15.0
1985	17.6	16.4

Perform an appropriate analysis of the data at the 1% level of significance and state your conclusions.

(b) Over a period of time AutoQuest, a car insurance company, monitored the number of car accidents within a certain region. Each accident was classified as slight (minor damage but no personal injuries), or serious (damage to vehicle and personal injury), or fatal (damage to vehicles and loss of life). The size of the car insured by the company was also recorded. The following table summarizes the information collected.

	Size of car		
Type of Accident	Small	Medium	Large
Slight	68	71	51
Serious	46	26	8
Fatal	6	3	1

Does this data indicate that the type of accident is associated with the size of the car insured? Provide a full explanation of your results.

Question 7 [20 marks, 13+7]

(a) It is believed that the price of a house in a certain city may be related to its distance from the centre of the city. These distances (in kilometres) can easily be obtained from a map and are given below for the 12 houses in the sample.

House	A	B	C	D	E	F	G	H	I	J	K	L
Price (SZL 000)	63	75	59	75	100	108	100	90	70	96	84	100
Distance	5.5	5.7	5.2	4.9	3.3	2.1	2.2	3.1	4.2	3.1	3.5	2.8

(i) Using least squares, find the regression coefficients of house price on distance from the city centre. Explain to a manager, with no statistical knowledge the meaning of the terms: slope, intercept and coefficient of determination.

(ii) The overall average distance from the city centre is 4.5 kilometres. Use this information to estimate the population mean house price..

(iii) Comment on the advantages of using linear regression for forecasting and the limitations of the technique.

(b) A manufacturer claimed that at least 95 percent of the equipment he supplied to a factory conformed to specification. An examination of a sample of 200 pieces of equipment revealed that 18 were faulty. Test his claim at the 1 percent level of significance. State clearly your null and alternative hypothesis, decision rule and present your conclusions.

Question 8 [20 marks, 10+5+5]

(a) A crossword puzzle enthusiast has exactly 30 minutes to complete a puzzle each day during her morning to commute on the train. She knows from experience that the puzzle published in newspaper A takes an average of 25.2 minutes to complete with a standard deviation of 3.9 minutes. The puzzle published in newspaper B also takes an average of 25.2 minutes but it has a standard deviation of 1.9 minutes. What is the probability that she will complete the puzzle if she buys

(i) newspaper A?

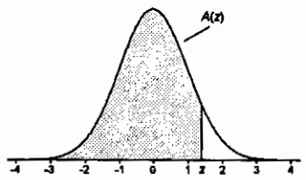
(ii) newspaper B?

(b) One and a half percent of the letters mailed from the mailroom of a company do not have the correct postage. Use the Poisson approximation to the binomial distribution to determine the probability that in a random sample of 200, 2 do not have the correct postage.

(c) A careful analysis of the causes for absences in a certain factory shows that the probability that an employee will be absent because of substance abuse is 0.03; the probability that the factory manager correctly attributes the absence to substance abuse is 0.80, and the probability that the factor manager incorrectly attributes the absence of substance abuse is 0.05. What is the probability that an absence is attributed to substance abuse by the factory manager is actually due to substance abuse?

TABLE A.1

Cumulative Standardized Normal Distribution



$A(z)$ is the integral of the standardized normal distribution from $-\infty$ to z (in other words, the area under the curve to the left of z). It gives the probability of a normal variable not being more than z standard deviations above its mean. Values of z of particular importance:

z	$A(z)$	
1.645	0.9500	Lower limit of right 5% tail
1.960	0.9750	Lower limit of right 2.5% tail
2.326	0.9900	Lower limit of right 1% tail
2.576	0.9950	Lower limit of right 0.5% tail
3.090	0.9990	Lower limit of right 0.1% tail
3.291	0.9995	Lower limit of right 0.05% tail

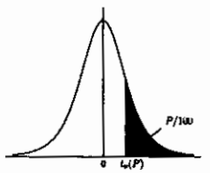
z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.6	0.9998	0.9998	0.9999							

Percentage Points of the t-Distribution

This table gives the percentage points $t_\nu(P)$ for various values of P and degrees of freedom ν, as indicated by the figure to the right.

The lower percentage points are given by symmetry as $-t_\nu(P)$, and the probability that $|t| \geq t_\nu(P)$ is $2P/100$.

The limiting distribution of t as $\nu \to \infty$ is the normal distribution with zero mean and unit variance.



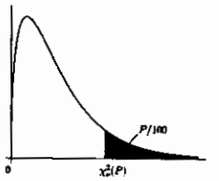
	Percentage points P						
ν	10	5	2.5	1	0.5	0.1	0.05
1	3.078	6.314	12.706	31.821	63.657	318.309	636.619
2	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	1.337	1.746	2.120	2.583	2.921	3.686	4.015
18	1.330	1.734	2.101	2.552	2.878	3.610	3.922
21	1.323	1.721	2.080	2.518	2.831	3.527	3.819
25	1.316	1.708	2.060	2.485	2.787	3.450	3.725
30	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	1.303	1.684	2.021	2.423	2.704	3.307	3.551
50	1.299	1.676	2.009	2.403	2.678	3.261	3.496
70	1.294	1.667	1.994	2.381	2.648	3.211	3.435
100	1.290	1.660	1.984	2.364	2.626	3.174	3.390
∞	1.282	1.645	1.960	2.326	2.576	3.090	3.291

Percentage Points of the χ^2-Distribution

This table gives the percentage points $\chi^2_\nu(P)$ for various values of P and degrees of freedom ν, as indicated by the figure to the right.

If X is a variable distributed as χ^2 with ν degrees of freedom, $P/100$ is the probability that $X \geq \chi^2_\nu(P)$.

For $\nu > 100$, $\sqrt{2X}$ is approximately normally distributed with mean $\sqrt{2\nu - 1}$ and unit variance.



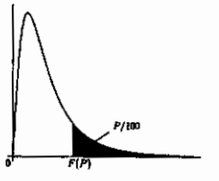
	Percentage points P						
ν	10	5	2.5	1	0.5	0.1	0.05
1	2.706	3.841	5.024	6.635	7.879	10.828	12.116
2	4.605	5.991	7.378	9.210	10.597	13.816	15.202
3	6.251	7.815	9.348	11.345	12.838	16.266	17.730
4	7.779	9.488	11.143	13.277	14.860	18.467	19.997
5	9.236	11.070	12.833	15.086	16.750	20.515	22.105
6	10.645	12.592	14.449	16.812	18.548	22.458	24.103
7	12.017	14.067	16.013	18.475	20.278	24.322	26.018
8	13.362	15.507	17.535	20.090	21.955	26.124	27.868
9	14.684	16.919	19.023	21.666	23.589	27.877	29.666
10	15.987	18.307	20.483	23.209	25.188	29.588	31.420
11	17.275	19.675	21.920	24.725	26.757	31.264	33.137
12	18.549	21.026	23.337	26.217	28.300	32.909	34.821
13	19.812	22.362	24.736	27.688	29.819	34.528	36.478
14	21.064	23.685	26.119	29.141	31.319	36.123	38.109
15	22.307	24.996	27.488	30.578	32.801	37.697	39.719
16	23.542	26.296	28.845	32.000	34.267	39.252	41.308
17	24.769	27.587	30.191	33.409	35.718	40.790	42.879
18	25.989	28.869	31.526	34.805	37.156	42.312	44.434
19	27.204	30.144	32.852	36.191	38.582	43.820	45.973
20	28.412	31.410	34.170	37.566	39.997	45.315	47.498
25	34.382	37.652	40.646	44.314	46.928	52.620	54.947
30	40.256	43.773	46.979	50.892	53.672	59.703	62.162
40	51.805	55.758	59.342	63.691	66.766	73.402	76.095
50	63.167	67.505	71.420	76.154	79.490	86.661	89.561
80	96.578	101.879	106.629	112.329	116.321	124.839	128.261

5 Percent Points of the F-Distribution

This table gives the percentage points $F_{\nu_1,\nu_2}(P)$ for $P = 0.05$ and degrees of freedom ν_1, ν_2, as indicated by the figure to the right.

The lower percentage points, that is the values $F'_{\nu_1,\nu_2}(P)$ such that the probability that $F \leq F'_{\nu_1,\nu_2}(P)$ is equal to $P/100$, may be found using the formula

$$F'_{\nu_1,\nu_2}(P) = 1/F_{\nu_1,\nu_2}(P)$$



	ν_1								
ν_2	1	2	3	4	5	6	12	24	∞
2	18.513	19.000	19.164	19.247	19.296	19.330	19.413	19.454	19.496
3	10.128	9.552	9.277	9.117	9.013	8.941	8.745	8.639	8.526
4	7.709	6.944	6.591	6.388	6.256	6.163	5.912	5.774	5.628
5	6.608	5.786	5.409	5.192	5.050	4.950	4.678	4.527	4.365
6	5.987	5.143	4.757	4.534	4.387	4.284	4.000	3.841	3.669
7	5.591	4.737	4.347	4.120	3.972	3.866	3.575	3.410	3.230
8	5.318	4.459	4.066	3.838	3.687	3.581	3.284	3.115	2.928
9	5.117	4.256	3.863	3.633	3.482	3.374	3.073	2.900	2.707
10	4.965	4.103	3.708	3.478	3.326	3.217	2.913	2.737	2.538
11	4.844	3.982	3.587	3.357	3.204	3.095	2.788	2.609	2.404
12	4.747	3.885	3.490	3.259	3.106	2.996	2.687	2.505	2.296
13	4.667	3.806	3.411	3.179	3.025	2.915	2.604	2.420	2.206
14	4.600	3.739	3.344	3.112	2.958	2.848	2.534	2.349	2.131
15	4.543	3.682	3.287	3.056	2.901	2.790	2.475	2.288	2.066
16	4.494	3.634	3.239	3.007	2.852	2.741	2.425	2.235	2.010
17	4.451	3.592	3.197	2.965	2.810	2.699	2.381	2.190	1.960
18	4.414	3.555	3.160	2.928	2.773	2.661	2.342	2.150	1.917
19	4.381	3.522	3.127	2.895	2.740	2.628	2.308	2.114	1.878
20	4.351	3.493	3.098	2.866	2.711	2.599	2.278	2.082	1.843
25	4.242	3.385	2.991	2.759	2.603	2.490	2.165	1.964	1.711
30	4.171	3.316	2.922	2.690	2.534	2.421	2.092	1.887	1.622
40	4.085	3.232	2.839	2.606	2.449	2.336	2.003	1.793	1.509
50	4.034	3.183	2.790	2.557	2.400	2.286	1.952	1.737	1.438
100	3.936	3.087	2.696	2.463	2.305	2.191	1.850	1.627	1.283
∞	3.841	2.996	2.605	2.372	2.214	2.099	1.752	1.517	1.002