UNIVERSITY OF FORT HARE

STD 121/121E

DEGREE EXAMINATIONS

November 2019

Time: 3 HOURS

Subject: BUSINESS STATISTICS

Marks: 100

This paper consists of 10 pages including cover page

Internal Examiners

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Instructions

1. This paper consists of 10 pages (including the cover page).
2. Answer **ALL** Questions.
3. Calculators may be used.
4. Tables and Formula Sheets are attached to this exam paper.
5. Omission of essential working will result in loss of marks.
6. Answers should be rounded off to **two** decimal places.
7. Diagrams or Graphical solutions should be drawn to **scale** on the graph paper/s provided

QUESTION ONE [15 MARKS]

Match each item in Column A with its corresponding definition from Column B. Write down ONLY the correct letter from Column B. e.g. 1.16 F

	Column A	Column B
1.1	Pearson Correlation Coefficient	A. Chance / likelihood of an event occurring.
1.2	Binomial distribution function	B. Asymmetrical and points in the positive direction.
1.3	Standard deviation	C. Used in a two-outcome experiment.
1.4	Scatterplot	D. Statistical measure, which expresses the average deviation about the mean in the original units of the random variable.
1.5	Continuous data	E. Accomplished by dividing the population into groups – usually geographically.
1.6	Variable	F. Difference between the maximum and minimum values in a data set.
1.7	Mutually exclusive	G. Used in prediction.
1.8	Measures of dispersion	H. A random variable whose observation can take on only specific values, usually only an integer (whole numbers) values.
1.9	Standard normal probability distribution function	I. The proportion of variation in the dependent variable that is explained by the independent variable.
1.10	Regression	J. Non-numeric data.
1.11	Quantitative data	K. Asymmetrical and points in the negative direction.
1.12	Cluster sampling	L. Events that cannot occur together.
1.13	Seasonality	M. Manipulation of variables under controlled conditions.
1.14	Coefficient of determination	N. Parameter indicating strength of relationship between 2 variables.
1.15	Positively skewed distribution	O. Spread or dispersion of scores.
		P. A random variable whose observation can take on any value in an interval.
		Q. A graphical plot of the value of the independent and dependent variables.
		R. A numerical value or a characteristic that can differ from individual to individual.
		S. Numeric data.
		T. Events that can occur together.
		U. Mean equal to 0, standard deviation equal to 1.
		V. When a time series exhibits regular fluctuations during the same month (or months) every year.
		W. A summary measure of a sample.

QUESTION TWO [20 MARKS]

The table below is an extract from a descriptive analysis on age of respondents in a survey conducted by Mr Brown on job satisfaction of some selected South African citizens at a certain private company in Durban.

Age

	Intervals	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	11 to < 21 years	40	9.9	9.9	9.9
	21 to < 31 years	112	27.8	27.8	37.7
	31 to < 41 years	136	33.7	33.7	71.5
	41 to < 51 years	68	16.9	16.9	88.3
	51 to < 61 years	34	8.4	8.4	96.8
	61 to < 71 years	13	3.2	3.2	100.0
	Total	403	100.0	100.0	

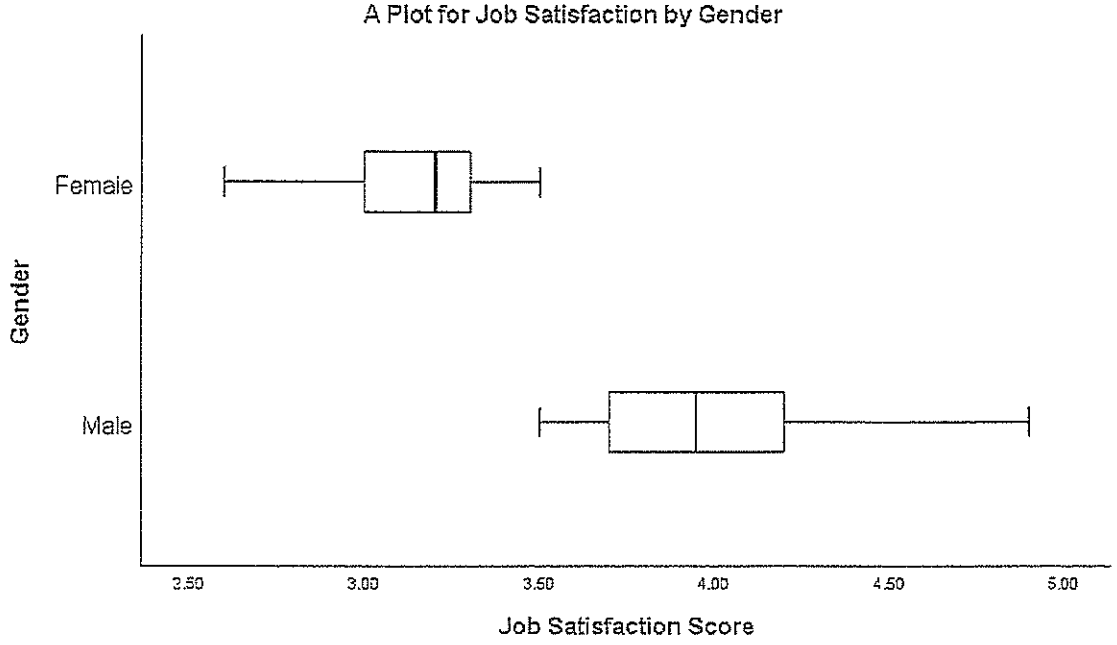
2.1. Using a graph paper, draw a less-than cumulative frequency curve of the data displayed above. [6]

2.2. For the grouped data given above, calculate each of the following quantities:

2.2.1 IQR. [6]

2.2.2 Coefficient of variation. Interpret the value obtained. [6]

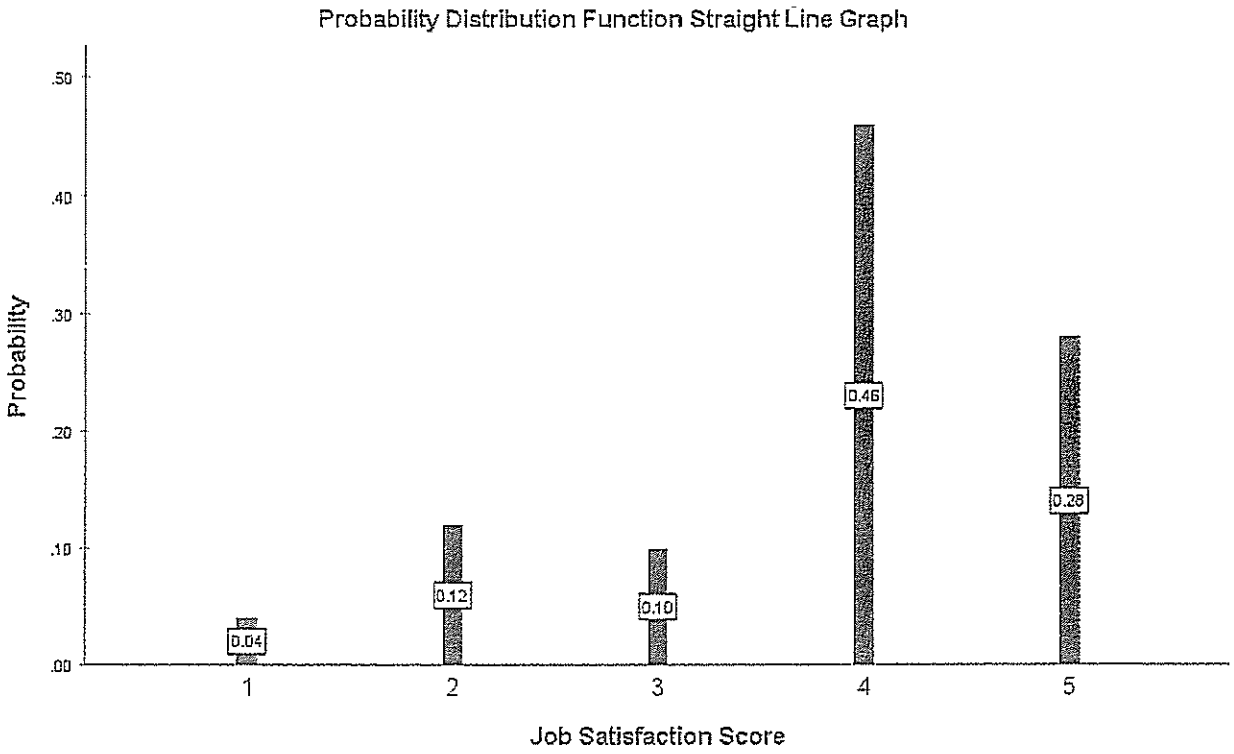
2.3. As one of his objectives for the survey, Mr Brown wanted to make comparisons on job satisfaction by gender of respondents. He then conducted some statistical tests with the aid of the plot below. NB: Job satisfaction was measured from a low of 1 (very dissatisfied) to a high of 5 (very satisfied).



2.3.1 What name is given to the plot above? Comment on the differences on job satisfaction. [2]

QUESTION THREE [20 MARKS]

3.1 Mr Brown decided to plot the probability distributions of job satisfaction scores for the sample of respondents who participated in his survey. As in question 1 above, job satisfaction was measured from a low of 1 (very dissatisfied) to a high of 5 (very satisfied).



3.1.1 Is the straight-line graph given above a probability distribution function? State two reasons why you say so.

[2]

3.1.2 What is the expected value of the job satisfaction score?

[3]

3.1.3 Compute the standard deviation of job satisfaction scores.

[4]

3.1.4 Compute $P(X < 5)$

[2]

3.2 An overnight case contains 2 bottles of aspirin and 3 bottles of thyroid tablets. A second case contains 3 bottles of aspirin, 2 bottles of thyroid tablets and 1 bottle of laxative tablets. If 1 bottle of tablets is taken at random from each case,

3.2.1 Draw a tree diagram to represent the above scenario

[4]

3.2.2 Find the probability that both bottles contain thyroid tablets.

[2]

3.2.3 Find the probability that 2 bottles contain different tablets.

[3]

QUESTION FOUR [20 MARKS]

4.1 An auditor is preparing for a physical count of inventory as a means of verifying its value. Items counted are reconciled with a list prepared by the storeroom supervisor. In one particular firm the auditor selected 10 items and found that the probability of exactly 5 items that could not be reconciled without reviewing invoices was 0.026424 and the probability of exactly 6 items that could not be reconciled without reviewing invoices was 0.005505. Calculate the probability that no fewer than 3 items could not be reconciled without reviewing invoices.

[6]

4.2 If the light bulbs in a house fail according to a Poisson law, and over the last 15 weeks there have been 5 failures, find the probability that there will not be more than one failure next week.

[4]

4.3 The management of a large insurance company believes that workers are more productive if they are happy with their jobs. To keep track of workers satisfaction the company regularly conducts surveys. According to a recent survey, the mean job satisfaction score for all workers in this company was 13.10 (on a scale of 1 to 20) and the standard deviation is 1.75. Assume that the job satisfaction scores of workers are normally distributed.

4.3.1 Find the probability that the job satisfaction score for a randomly selected worker from this company is more than 11.50.

[4]

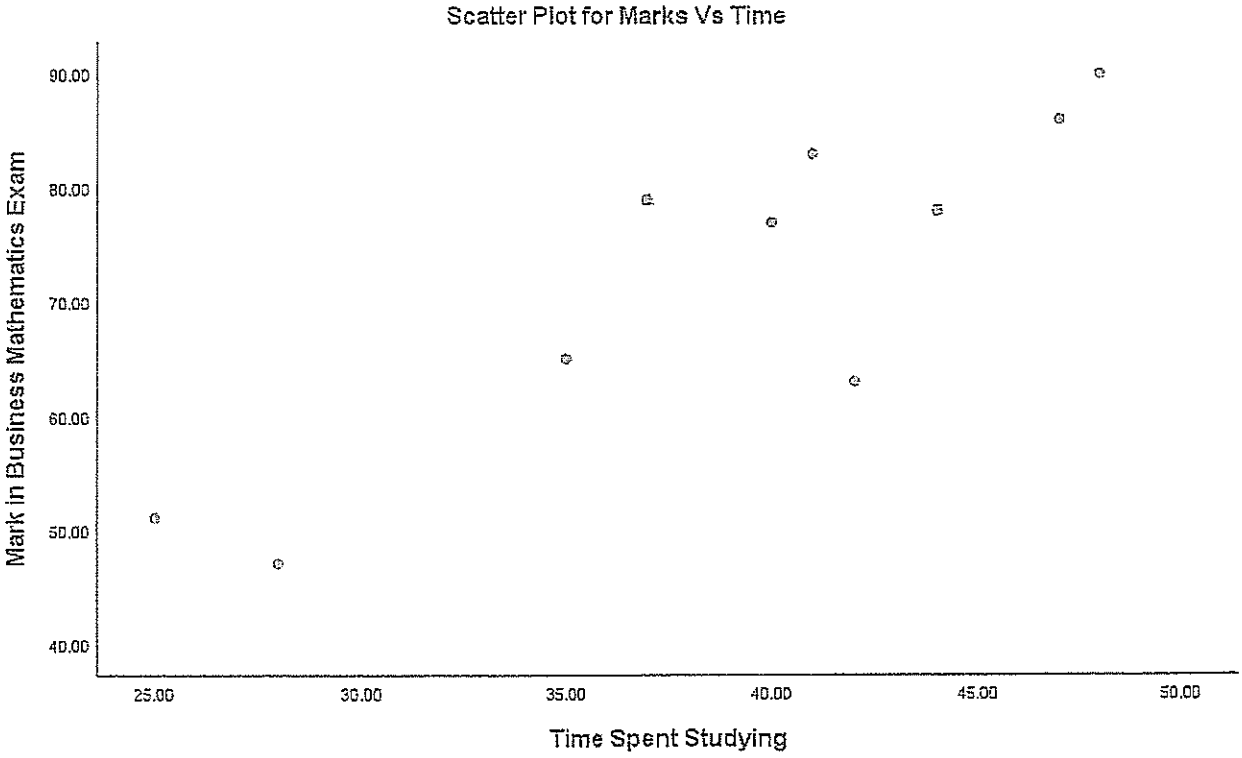
4.3.2 What percentage of the workers has a job satisfaction score outside 12.50 and 18.50?

[6]

QUESTION FIVE [25 MARKS]

5.1 Are the marks one receives in an examination related to the amount of time spent studying the subject? To analyze this, a student took a sample of ten (10) students who enrolled in a Business Mathematics class last semester. She asked each of the participants to report his or her mark in the course and the total number of hours spent studying the module. The data are listed in the Table below: (A scatter plot for the data is also given)

Marks	77	63	79	86	51	78	83	90	65	47
Time	40	42	37	47	25	44	41	48	35	28



5.1.1 Identify the independent and dependent variables.

[2]

5.1.2 What does the scatter diagram indicate about the relationship between the two variables?

[2]

5.1.3 Use the least squares method to develop the estimated regression equation.

[8]

5.1.4 Predict the mark a student can obtain who spends 60 hours studying.

[2]

5.1.5 Compute the coefficient of determination and interpret it.

[6]

5.2 The table below shows the number of fire insurance claims from 2003 to 2006, received by Old Mutual Insurance.

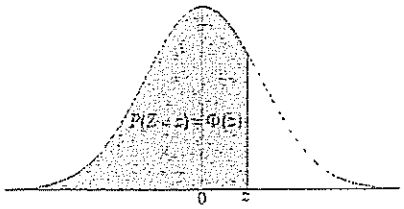
Period		Claims(y)
2003	P_1	7
	P_2	3
	P_3	5
2004	P_1	9
	P_2	7
	P_3	9
2005	P_1	12
	P_2	4
	P_3	10
2006	P_1	13
	P_2	9
	P_3	10

5.2.1 Compute the 3-period moving average values of fire insurance claims received.

[5]

Total: 100

TABLE 1: THE DISTRIBUTION FUNCTION $\Phi(z)$ OF THE NORMAL DISTRIBUTION $N(0, 1)$



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	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
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	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.7	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.8	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Entries in the table are values of $z > 0$

$\Phi(-z) = 1 - \Phi(z)$

TABLE 2: Entries in the table of the inverse function $z = \Phi^{-1}(u)$ for $u \geq 0.5$ where $u = \Phi(z)$ denotes the standard normal distribution function Note that $\Phi(-z) = 1 - \Phi(z)$ when $\Phi(z) < 0.5$ $\Phi(z) < 0.5$

	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
0.50	0.0000	0.0025	0.0050	0.0075	0.0100	0.0125	0.0150	0.0175	0.0201	0.0226
0.51	0.0251	0.0276	0.0301	0.0326	0.0351	0.0376	0.0401	0.0426	0.0451	0.0476
0.52	0.0502	0.0527	0.0552	0.0577	0.0602	0.0627	0.0652	0.0677	0.0702	0.0728
0.53	0.0753	0.0778	0.0803	0.0828	0.0853	0.0878	0.0904	0.0929	0.0954	0.0979
0.54	0.1004	0.1030	0.1055	0.1080	0.1105	0.1130	0.1156	0.1181	0.1206	0.1231
0.55	0.1257	0.1282	0.1307	0.1332	0.1358	0.1383	0.1408	0.1434	0.1459	0.1484
0.56	0.1510	0.1535	0.1560	0.1586	0.1611	0.1637	0.1662	0.1687	0.1713	0.1738
0.57	0.1764	0.1789	0.1815	0.1840	0.1866	0.1891	0.1917	0.1942	0.1968	0.1993
0.58	0.2019	0.2045	0.2070	0.2096	0.2121	0.2147	0.2173	0.2198	0.2224	0.2250
0.59	0.2275	0.2301	0.2327	0.2353	0.2378	0.2404	0.2430	0.2456	0.2482	0.2508
0.60	0.2533	0.2559	0.2585	0.2611	0.2637	0.2663	0.2689	0.2715	0.2741	0.2767
0.61	0.2793	0.2819	0.2845	0.2871	0.2898	0.2924	0.2950	0.2976	0.3002	0.3029
0.62	0.3055	0.3081	0.3107	0.3134	0.3160	0.3186	0.3213	0.3239	0.3266	0.3292
0.63	0.3319	0.3345	0.3372	0.3398	0.3425	0.3451	0.3478	0.3505	0.3531	0.3558
0.64	0.3585	0.3611	0.3638	0.3665	0.3692	0.3719	0.3745	0.3772	0.3799	0.3826
0.65	0.3853	0.3880	0.3907	0.3934	0.3961	0.3989	0.4016	0.4043	0.4070	0.4097
0.66	0.4125	0.4152	0.4179	0.4207	0.4234	0.4261	0.4289	0.4316	0.4344	0.4372
0.67	0.4399	0.4427	0.4454	0.4482	0.4510	0.4538	0.4565	0.4593	0.4621	0.4649
0.68	0.4677	0.4705	0.4733	0.4761	0.4789	0.4817	0.4845	0.4874	0.4902	0.4930
0.69	0.4959	0.4987	0.5015	0.5044	0.5072	0.5101	0.5129	0.5158	0.5187	0.5215
0.70	0.5244	0.5273	0.5302	0.5330	0.5359	0.5388	0.5417	0.5446	0.5476	0.5505
0.71	0.5534	0.5563	0.5592	0.5622	0.5651	0.5681	0.5710	0.5740	0.5769	0.5799
0.72	0.5828	0.5858	0.5888	0.5918	0.5948	0.5978	0.6008	0.6038	0.6068	0.6098
0.73	0.6128	0.6158	0.6189	0.6219	0.6250	0.6280	0.6311	0.6341	0.6372	0.6403
0.74	0.6433	0.6464	0.6495	0.6526	0.6557	0.6588	0.6620	0.6651	0.6682	0.6713
0.75	0.6745	0.6776	0.6808	0.6840	0.6871	0.6903	0.6935	0.6967	0.6999	0.7031
0.76	0.7063	0.7095	0.7128	0.7160	0.7192	0.7225	0.7257	0.7290	0.7323	0.7356
0.77	0.7388	0.7421	0.7454	0.7488	0.7521	0.7554	0.7588	0.7621	0.7655	0.7688
0.78	0.7722	0.7756	0.7790	0.7824	0.7858	0.7892	0.7926	0.7961	0.7995	0.8030
0.79	0.8064	0.8099	0.8134	0.8169	0.8204	0.8239	0.8274	0.8310	0.8345	0.8381
0.80	0.8416	0.8452	0.8488	0.8524	0.8560	0.8596	0.8633	0.8669	0.8705	0.8742
0.81	0.8779	0.8816	0.8853	0.8890	0.8927	0.8965	0.9002	0.9040	0.9078	0.9116
0.82	0.9154	0.9192	0.9230	0.9269	0.9307	0.9346	0.9385	0.9424	0.9463	0.9502
0.83	0.9542	0.9581	0.9621	0.9661	0.9701	0.9741	0.9782	0.9822	0.9863	0.9904
0.84	0.9945	0.9986	1.0027	1.0069	1.0110	1.0152	1.0194	1.0237	1.0279	1.0322
0.85	1.0364	1.0407	1.0450	1.0494	1.0537	1.0581	1.0625	1.0669	1.0714	1.0758
0.86	1.0803	1.0848	1.0893	1.0939	1.0985	1.1031	1.1077	1.1123	1.1170	1.1217
0.87	1.1264	1.1311	1.1359	1.1407	1.1455	1.1503	1.1552	1.1601	1.1650	1.1700
0.88	1.1750	1.1800	1.1850	1.1901	1.1952	1.2004	1.2055	1.2107	1.2160	1.2212
0.89	1.2265	1.2319	1.2372	1.2426	1.2481	1.2536	1.2591	1.2646	1.2702	1.2759
0.90	1.2816	1.2873	1.2930	1.2988	1.3047	1.3106	1.3165	1.3225	1.3285	1.3346
0.91	1.3408	1.3469	1.3532	1.3595	1.3658	1.3722	1.3787	1.3852	1.3917	1.3984
0.92	1.4051	1.4118	1.4187	1.4255	1.4325	1.4395	1.4466	1.4538	1.4611	1.4684
0.93	1.4758	1.4833	1.4909	1.4985	1.5063	1.5141	1.5220	1.5301	1.5382	1.5464
0.94	1.5548	1.5632	1.5718	1.5805	1.5893	1.5982	1.6072	1.6164	1.6258	1.6352
0.95	1.6449	1.6546	1.6646	1.6747	1.6849	1.6954	1.7060	1.7169	1.7279	1.7392
0.96	1.7507	1.7624	1.7744	1.7866	1.7991	1.8119	1.8250	1.8384	1.8522	1.8663
0.97	1.8808	1.8957	1.9110	1.9268	1.9431	1.9600	1.9774	1.9954	2.0141	2.0335
0.98	2.0537	2.0749	2.0969	2.1201	2.1444	2.1701	2.1973	2.2262	2.2571	2.2904
0.99	2.3263	2.3656	2.4089	2.4573	2.5121	2.5758	2.6521	2.7478	2.8782	3.0902

FORMULA SHEET

$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$	$\bar{x} = \frac{\sum_{i=1}^{n} f_i x_i}{n}$ or $\bar{x} = \frac{\sum_{i=1}^{n} m_i f_i}{n}$
$\mathrm{M}_e = O_{\mathrm{me}} + \frac{c\left[\frac{n}{2} - f(<)\right]}{f_{\mathrm{me}}}$	$\mathrm{Q}_1 = O_{q_1} + \frac{c\left[\frac{n}{4} - f(<)\right]}{f_{q_1}}$
$\mathrm{M}_o = O_{mo} + \frac{c\left[f_m - f_{m-1}\right]}{2f_m - f_{m-1} - f_{m+1}}$	$\mathrm{Q}_3 = O_{q_3} + \frac{c\left[\frac{3n}{4} - f(<)\right]}{f_{q_3}}$
$s^2 = \frac{\sum_i (x_i - \bar{x})^2}{n-1}$ or $s^2 = \frac{\sum_i X_i^2 - \left(\sum_i X_i\right)^2 / n}{n-1}$	$s^2 = \frac{\sum_i f_i (x_i - \bar{x})^2}{n-1}$ or $s^2 = \frac{\sum_i m_i^2 f_i - \left(\sum_i m_i f_i\right)^2 / n}{n-1}$
$\Pr(A) = \frac{r}{n}$	$\Pr(A \mid B) = \frac{\Pr(A \cap B)}{\Pr(B)}$
$\Pr(A \cup B) = \Pr(A) + \Pr(B) - \Pr(A \cap B)$	$\mu = E[X] = \sum_{\text{all } x} x \Pr(X = x)$
$Var[X] = \sum_{\text{all } x} x^2 \Pr(X = x) - \mu^2$	$\Pr(X = x) = \frac{\lambda^x e^{-\lambda}}{x!}$
$\Pr(X = x) = {}^{n}C_x p^x q^{n-x}$	$\hat{y} = b_0 + b_1 x$
$b_0 = \frac{\sum Y_i}{n} - b_1 \frac{\sum X_i}{n}$	$b_1 = \frac{n\sum X_i Y_i - \sum X_i \sum Y_i}{n\sum X_i^2 - \left(\sum X_i\right)^2}$
$r = \frac{n\sum X_i Y_i - \sum X_i \sum Y_i}{\sqrt{n\sum Y_i^2 - \left(\sum Y_i\right)^2}\sqrt{n\sum X_i^2 - \left(\sum X_i\right)^2}}$	$Z = \frac{X - \mu}{\sigma}$

STUDENT NUMBER_____ SURNAME & INITIALS_____
