

102106T4COH

Community Health Level 6

AITC/DCH/CC/02/6/C

Apply Statistics in Community Health

July/August 2025



AMREF INTERNATIONAL TRAINING CENTER

CANDIDATE WRITTEN ASSESSMENT

Time: 3 HOURS

INSTRUCTIONS TO CANDIDATE

1. Marks for each question are indicated in the brackets.
2. The paper consists of **TWO** sections: **A** and **B**.
3. Candidates are provided with a separate answer booklet
4. **DO NOT** write on this question paper.

This paper consists of THREE (3) printed pages

Candidates should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing.

SECTION A: (40 MARKS)

Answer *all* questions in this section.

1. Define the following terms
 - i) Health Statistics. (2 Marks)
 - ii) Population. (2 Marks)
2. Differentiate the following terms.
 - i) Descriptive statistics and inferential statistics. (2 Marks)
 - ii) Vital Statistics and Vital Event. (2 Marks)
 - iii) Total Fertility Rate(TFR) and Gross Reproduction Rate.(GRR). (2 Marks)
3. If health measurements in a population are normally distributed with a mean of 10 and variance of 4, what proportion of individuals have values less than 12.5? (3 Marks)
4. Given that in a section of a country, some 54 children were born to 84 women aged 18-27 years during a calendar year. Calculate the Age specific fertility rate (ASFR) for this population. (2 Marks)
5. State without proof the Central Limit Theorem(CLT). (2 Marks)
6. Consider a hospital emergency department where patients arrive according to a Poisson process at an average rate of 2 patients per minute. Determine the probability that in any one-minute interval:
 - a) No patients arrive . (2 Marks)
 - b) Exactly 3 patients arrive. (2 Marks)
7. State and explain the scales of measurements giving an example in each case. (4 Marks)
8. Explain THREE applications of statistics in community health. (3 Marks)
9. Illustrate the graphically positions of mean, median and mode for frequency curve which are skewed to the right and left. (2 Marks)
10. Martin, a community health officer, is assessing the impact of a maternal health education program. She randomly selects a sample of 26 women who participated in the program and records their post-assessment scores. The sample mean score is 48, and the population standard deviation is known to be 5. Compute the 99% confidence interval estimate for the population mean score and interpret your answer. (3 Marks)

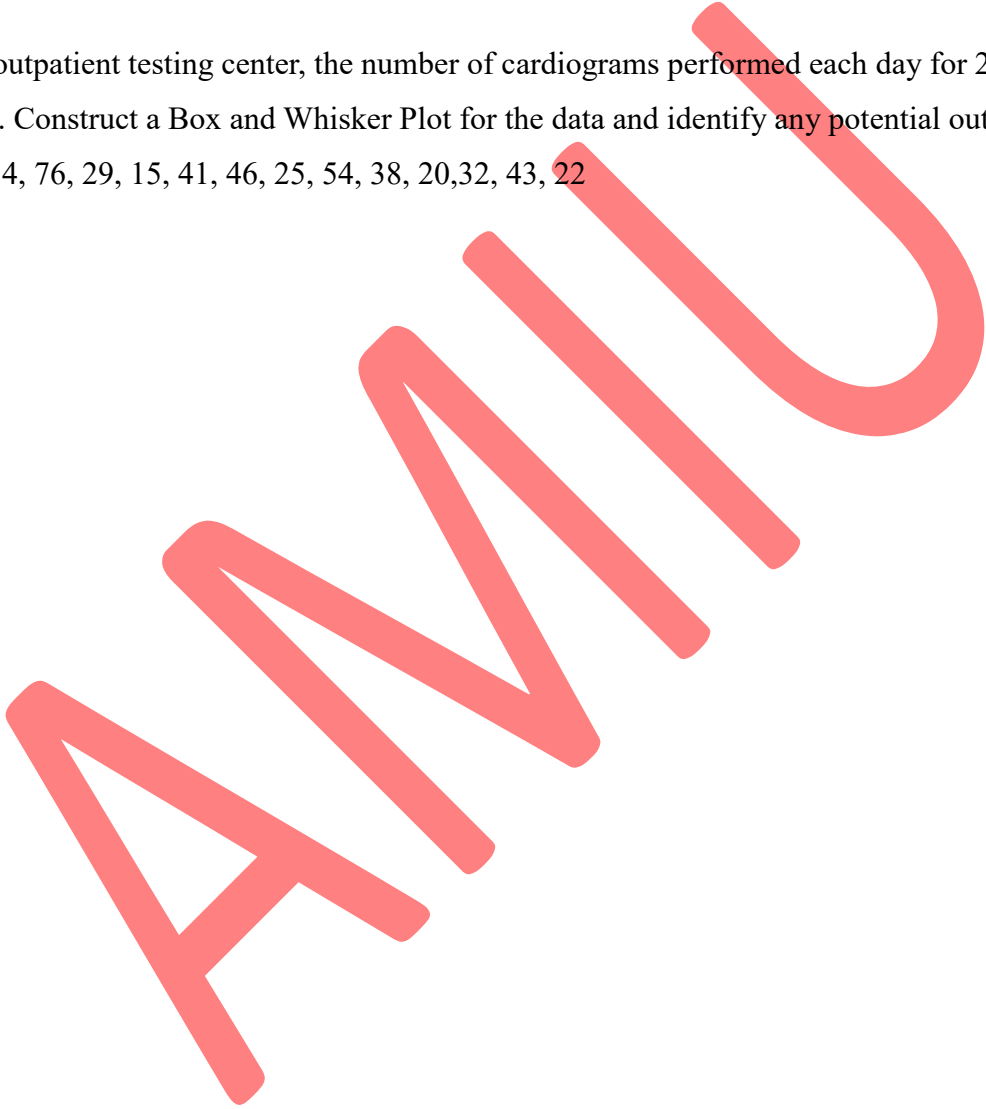
11. Consider the following set; $x = \{11,13,15,16,19,22,13,20\}$

Calculate;

- a) Arithmetic mean. (2 Marks)
- b) Harmonic mean. (2 Marks)

12. At an outpatient testing center, the number of cardiograms performed each day for 20 days is shown. Construct a Box and Whisker Plot for the data and identify any potential outlier. (3 Marks)

18, 34, 76, 29, 15, 41, 46, 25, 54, 38, 20,32, 43, 22



SECTION B: (60 MARKS)

Answer any *THREE* questions in this section

13.

- a) At Amref Health Africa Hospital, the medical records department is conducting an analysis of patient recovery times following minor surgical procedures. After collecting data over a three-month period, a biostatistician is tasked with interpreting the distribution of these recovery times. While examining the histogram and statistical summaries, the biostatistician observes that the data shows different patterns of peakedness and tail behavior, suggesting various types of kurtosis. As a student of health statistics, you are required to assist the biostatistician by explaining the meaning of the following terms used to describe the shape (kurtosis) of the data distribution:

- i) Leptokurtic (2 Marks)
- ii) Platykurtic (2 Marks)
- iii) Mesokurtic (2 Marks)

- b) As part of a project evaluating the sustainability of community-based health enterprises (CBHEs), the County Department of Health collected data on the capital size (in millions of Kenyan Shillings) of 285 registered CBHEs. The capital was grouped into classes as shown below:

Capital Range (in millions KSh)	1 - 5	6-10	11-15	16-20	21-25	26-30	31-35
Number of CBHEs	20	27	29	38	48	53	70

Compute Bowley's and Kelly's coefficient of skewness and interpret the results in the context of the capital distribution of CBHEs. (7 Marks)

- c) The following data were collected during a community health study assessing the relationship between Community Health Volunteers' (CHVs) years of service (x) and their health education effectiveness scores (y) based on household feedback. Calculate the Spearman's Rank Correlation Coefficient (R) to evaluate whether there is a relationship between the number of years a CHV has served and their effectiveness in delivering health education.

CHV (Subject)	1	2	3	4	5	6	7	8	9	10
Years of Service (x)	8.3	8.6	9.2	9.8	8.0	7.8	9.4	9.0	7.2	8.6
Effectiveness Score (y)	2300	2250	2380	2400	2000	2100	2360	2350	2000	2260

(7 Marks)

14.

- a) In 2024, Kitale County Referral Hospital had a allocated 92 beds and 57 cots. During the same year, the hospital admitted 3,144 patients and recorded 3,242 discharges and deaths. The total number of inpatient days for the year was 28,600. Using this information, calculate the following for administrative planning and evaluation at Kitale County Referral Hospital.
- i) Available bed days. (2 Marks)
 - ii) Excess or vacant bed days. (2 Marks)
 - iii) Daily bed occupancy rate. (2 Marks)
 - iv) Turnover interval. (2 Marks)
- b) A discrete random variable Y has a PMF (Probability Mass Function) given by the table below:

y	0	1	2	3	4
P(Y=y)	c	2c	5c	10c	17c

Find the value of the constant c hence compute $P(1 \leq Y < 3)$.

(3 Marks)

- c) In a clinical trial, a diagnostic test is administered to 6 patients. The probability that the test correctly identifies a disease (i.e., gives a positive result when the disease is present) is 0.3. Let X represent the number of patients who receive a positive result. Calculate: $P(X = 2)$ (3 Marks)
- d) The following table shows the distribution of systolic blood pressure (in mmHg) recorded for a group of patients during a health screening exercise:

Systolic Blood Pressure (mmHg)	100-104	105-109	110-114	115-119	120-124	125-129	130-134
Number of patients.	2	8	18	13	7	1	1

Construct a cumulative frequency curve (ogive) and a histogram to represent this data. (6 Marks)

15.

- a) The following data were collected during a community health survey assessing malaria control in Kakamega County. The table shows the number of mosquito nets owned per household (X) and the corresponding number of malaria cases reported in the household over six months (Y). Develop a regression equation that can be used to predict the number of malaria cases based on the number of mosquito nets in a household. (8 Marks)

Household (ID)	1	2	3	4	5	6	7	8	9	10
Mosquito Nets Owned (x)	98	66	100	96	88	45	76	60	74	82
Malaria Cases in 6 Months (y)	90	74	98	88	80	62	78	74	86	80

- b) As part of a community health survey, Amina, a community health officer, collected data on households' health awareness scores (rated from 0 to 100). The scores were grouped as follows:

Health Score Range	Number of Households (f)
50-59	3
60-69	5
70-79	9
80-89	12

90-100	8
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Using the data, calculate the following measures to assist Amina in evaluating the overall health awareness of the community:

- i) Mean health awareness score. (3 Marks)
- ii) Variance. (4 Marks)
- iii) Standard deviation. (2 Marks)
- iv) Give an R code for calculating mean, variance and standard deviation. (3 Marks)

16.

- a) In a public health study investigating the possible relationship between environmental temperature and the spread of a specific tropical disease, researchers collected the following data:

Mean Temp. (x)	14.2	14.3	14.6	14.9	15.2	15.6	15.9
Pirates (y)	35000	45000	20000	15000	5000	400	17

Using the Pearson Product Moment Correlation Coefficient (developed by Karl Pearson to measure the linear relationship between two continuous variables), calculate the correlation between the mean temperature and the number of reported disease cases. Interpret the results in the context of disease surveillance and public health intervention. (9 Marks)

- b) Ivy, a community health officer, is assessing the impact of a maternal health education program. She randomly selects a sample of 36 women who participated in the program and records their post-assessment scores. The sample mean score is 68, and the population standard deviation is known to be 3. Compute the 95% confidence interval estimate for the population mean score and interpret your answer. (3 Marks)

- c) Five hundred employees were selected from a city's large private companies, and they were asked whether or not they have any retirement benefits provided by their companies. The following table gives the responses.

Gender	Have Benefits	Have no benefits
Men	225	75
Women	150	50

If one employee is selected at random from these 500 employees, find:

- i) $P(\text{woman})$. (2 Marks)
- ii) $P(\text{Has retirement benefits})$. (2 Marks)
- iii) $P(\text{Has retirement benefits given the employee is a man})$. (2 Marks)
- iv) $P(\text{Woman and has benefits})$. (2 Marks)

NOTE: P represents Probability i.e. $p(\text{woman}) = \text{Probability of a woman}$.

STANDARD NORMAL DISTRIBUTION: Table Values Represent AREA to the LEFT of the Z score.

Z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-3.9	.00005	.00005	.00004	.00004	.00004	.00004	.00004	.00004	.00003	.00003
-3.8	.00007	.00007	.00007	.00006	.00006	.00006	.00006	.00005	.00005	.00005
-3.7	.00011	.00010	.00010	.00010	.00009	.00009	.00008	.00008	.00008	.00008
-3.6	.00016	.00015	.00015	.00014	.00014	.00013	.00013	.00012	.00012	.00011
-3.5	.00023	.00022	.00022	.00021	.00020	.00019	.00019	.00018	.00017	.00017
-3.4	.00034	.00032	.00031	.00030	.00029	.00028	.00027	.00026	.00025	.00024
-3.3	.00048	.00047	.00045	.00043	.00042	.00040	.00039	.00038	.00036	.00035
-3.2	.00069	.00066	.00064	.00062	.00060	.00058	.00056	.00054	.00052	.00050
-3.1	.00097	.00094	.00090	.00087	.00084	.00082	.00079	.00076	.00074	.00071
-3.0	.00135	.00131	.00126	.00122	.00118	.00114	.00111	.00107	.00104	.00100
-2.9	.00187	.00181	.00175	.00169	.00164	.00159	.00154	.00149	.00144	.00139
-2.8	.00256	.00248	.00240	.00233	.00226	.00219	.00212	.00205	.00199	.00193
-2.7	.00347	.00336	.00326	.00317	.00307	.00298	.00289	.00280	.00272	.00264
-2.6	.00466	.00453	.00440	.00427	.00415	.00402	.00391	.00379	.00368	.00357
-2.5	.00621	.00604	.00587	.00570	.00554	.00539	.00523	.00508	.00494	.00480
-2.4	.00820	.00798	.00776	.00755	.00734	.00714	.00695	.00676	.00657	.00639
-2.3	.01072	.01044	.01017	.00990	.00964	.00939	.00914	.00889	.00866	.00842
-2.2	.01390	.01355	.01321	.01287	.01255	.01222	.01191	.01160	.01130	.01101
-2.1	.01786	.01743	.01700	.01659	.01618	.01578	.01539	.01500	.01463	.01426
-2.0	.02275	.02222	.02169	.02118	.02068	.02018	.01970	.01923	.01876	.01831
-1.9	.02872	.02807	.02743	.02680	.02619	.02559	.02500	.02442	.02385	.02330
-1.8	.03593	.03515	.03438	.03362	.03288	.03216	.03144	.03074	.03005	.02938
-1.7	.04457	.04363	.04272	.04182	.04093	.04006	.03920	.03836	.03754	.03673
-1.6	.05480	.05370	.05262	.05155	.05050	.04947	.04846	.04746	.04648	.04551
-1.5	.06681	.06552	.06426	.06301	.06178	.06057	.05938	.05821	.05705	.05592
-1.4	.08076	.07927	.07780	.07636	.07493	.07353	.07215	.07078	.06944	.06811
-1.3	.09680	.09510	.09342	.09176	.09012	.08851	.08691	.08534	.08379	.08226
-1.2	.11507	.11314	.11123	.10935	.10749	.10565	.10383	.10204	.10027	.09853
-1.1	.13567	.13350	.13136	.12924	.12714	.12507	.12302	.12100	.11900	.11702
-1.0	.15866	.15625	.15386	.15151	.14917	.14686	.14457	.14231	.14007	.13786
-0.9	.18406	.18141	.17879	.17619	.17361	.17106	.16853	.16602	.16354	.16109
-0.8	.21186	.20897	.20611	.20327	.20045	.19766	.19489	.19215	.18943	.18673
-0.7	.24196	.23885	.23576	.23270	.22965	.22663	.22363	.22065	.21770	.21476
-0.6	.27425	.27093	.26763	.26435	.26109	.25785	.25463	.25143	.24825	.24510
-0.5	.30854	.30503	.30153	.29806	.29460	.29116	.28774	.28434	.28096	.27760
-0.4	.34458	.34090	.33724	.33360	.32997	.32636	.32276	.31918	.31561	.31207
-0.3	.38209	.37828	.37448	.37070	.36693	.36317	.35942	.35569	.35197	.34827
-0.2	.42074	.41683	.41294	.40905	.40517	.40129	.39743	.39358	.38974	.38591
-0.1	.46017	.45620	.45224	.44828	.44433	.44038	.43644	.43251	.42858	.42465
-0.0	.50000	.49601	.49202	.48803	.48405	.48006	.47608	.47210	.46812	.46414

STANDARD NORMAL DISTRIBUTION: Table Values Represent AREA to the LEFT of the Z score.

Z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.50000	.50399	.50798	.51197	.51595	.51994	.52392	.52790	.53188	.53586
0.1	.53983	.54380	.54776	.55172	.55567	.55962	.56356	.56749	.57142	.57535
0.2	.57926	.58317	.58706	.59095	.59483	.59871	.60257	.60642	.61026	.61409
0.3	.61791	.62172	.62552	.62930	.63307	.63683	.64058	.64431	.64803	.65173
0.4	.65542	.65910	.66276	.66640	.67003	.67364	.67724	.68082	.68439	.68793
0.5	.69146	.69497	.69847	.70194	.70540	.70884	.71226	.71566	.71904	.72240
0.6	.72575	.72907	.73237	.73565	.73891	.74215	.74537	.74857	.75175	.75490
0.7	.75804	.76115	.76424	.76730	.77035	.77337	.77637	.77935	.78230	.78524
0.8	.78814	.79103	.79389	.79673	.79955	.80234	.80511	.80785	.81057	.81327
0.9	.81594	.81859	.82121	.82381	.82639	.82894	.83147	.83398	.83646	.83891
1.0	.84134	.84375	.84614	.84849	.85083	.85314	.85543	.85769	.85993	.86214
1.1	.86433	.86650	.86864	.87076	.87286	.87493	.87698	.87900	.88100	.88298
1.2	.88493	.88686	.88877	.89065	.89251	.89435	.89617	.89796	.89973	.90147
1.3	.90320	.90490	.90658	.90824	.90988	.91149	.91309	.91466	.91621	.91774
1.4	.91924	.92073	.92220	.92364	.92507	.92647	.92785	.92922	.93056	.93189
1.5	.93319	.93448	.93574	.93699	.93822	.93943	.94062	.94179	.94295	.94408
1.6	.94520	.94630	.94738	.94845	.94950	.95053	.95154	.95254	.95352	.95449
1.7	.95543	.95637	.95728	.95818	.95907	.95994	.96080	.96164	.96246	.96327
1.8	.96407	.96485	.96562	.96638	.96712	.96784	.96856	.96926	.96995	.97062
1.9	.97128	.97193	.97257	.97320	.97381	.97441	.97500	.97558	.97615	.97670
2.0	.97725	.97778	.97831	.97882	.97932	.97982	.98030	.98077	.98124	.98169
2.1	.98214	.98257	.98300	.98341	.98382	.98422	.98461	.98500	.98537	.98574
2.2	.98610	.98645	.98679	.98713	.98745	.98778	.98809	.98840	.98870	.98899
2.3	.98928	.98956	.98983	.99010	.99036	.99061	.99086	.99111	.99134	.99158
2.4	.99180	.99202	.99224	.99245	.99266	.99286	.99305	.99324	.99343	.99361
2.5	.99379	.99396	.99413	.99430	.99446	.99461	.99477	.99492	.99506	.99520
2.6	.99534	.99547	.99560	.99573	.99585	.99598	.99609	.99621	.99632	.99643
2.7	.99653	.99664	.99674	.99683	.99693	.99702	.99711	.99720	.99728	.99736
2.8	.99744	.99752	.99760	.99767	.99774	.99781	.99788	.99795	.99801	.99807
2.9	.99813	.99819	.99825	.99831	.99836	.99841	.99846	.99851	.99856	.99861
3.0	.99865	.99869	.99874	.99878	.99882	.99886	.99889	.99893	.99896	.99900
3.1	.99903	.99906	.99910	.99913	.99916	.99918	.99921	.99924	.99926	.99929
3.2	.99931	.99934	.99936	.99938	.99940	.99942	.99944	.99946	.99948	.99950
3.3	.99952	.99953	.99955	.99957	.99958	.99960	.99961	.99962	.99964	.99965
3.4	.99966	.99968	.99969	.99970	.99971	.99972	.99973	.99974	.99975	.99976
3.5	.99977	.99978	.99978	.99979	.99980	.99981	.99981	.99982	.99983	.99983
3.6	.99984	.99985	.99985	.99986	.99986	.99987	.99987	.99988	.99988	.99989
3.7	.99989	.99990	.99990	.99990	.99991	.99991	.99992	.99992	.99992	.99992
3.8	.99993	.99993	.99993	.99994	.99994	.99994	.99994	.99995	.99995	.99995
3.9	.99995	.99995	.99996	.99996	.99996	.99996	.99996	.99996	.99997	.99997

t Table

cum. prob	<i>t</i> _{.50}	<i>t</i> _{.75}	<i>t</i> _{.80}	<i>t</i> _{.85}	<i>t</i> _{.90}	<i>t</i> _{.95}	<i>t</i> _{.975}	<i>t</i> _{.99}	<i>t</i> _{.995}	<i>t</i> _{.999}	<i>t</i> _{.9995}
one-tail	0.50	0.25	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	1.00	0.50	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.002	0.001
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.000	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.000	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.000	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.000	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.000	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.000	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.000	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.000	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.000	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	Confidence Level										