KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2017/2018

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF MASTER OF SCIENCE

SCU 801: SCIENTIFIC DATA ANALYSIS

DATE: WEDNESDAY 7TH FEBRUARY 2018 **TIME: 9.00 A.M. - 12.00 P.M.**

INSTRUCTIONS: ANSWER ONE AND ANY OTHER TWO QUESTIONS ONLY.

Q1 (a) Describe the nominal and interval levels of measurements. (4mks)

(b) What is

(i) Accessible population or sampled population? (2mks)

(ii) Independent events? (2mks)

(c) Distinguish between sampling error and standard error. (4mks)

(d) Define skewness of a distribution and give two measures of skewness. (4mks)

(e) Distinguish between descriptive and inferencial statistics. (4mks)

(f) Eight percent (8%) of all elephants in a ranch are found to suffer some lung disease. Suppose seven elephants are randomly captured. Find the probability that

(i) none is infected. (3mks)

(ii) all are infected. (2mks)

(ii) at least two are infected. (3mks)

(g) The average number of new flu infections is 15 in a day. Find the probability that there will be 20 new infections today. (2mks)

Q2. An epidemic of a bovine disease has affected some ranches in a region. The veterinary office made a record of the number of animals affected by the disease in each ranch resulting in the frequency distribution below.

No. of diseased animals	50-59	60-69	70-79	80-89	90-99	100-109
No. of Ranches	23	34	27	20	15	11

(a) Find the median and the mode. (6mks)

(b) Find the first and third quartiles. (4mks)

(c) Determine the arithmetic mean and the standard deviation using assumed mean A=64.5. (4mks)

(d) Find Bowley's coefficient of skewness and comment. (4mks)

(e) Find the coefficient of variation (2mks)

Q3 (a) Eighteen percent (18%) of cows in some region are suffering foot and mouth disease. If 11 cows are selected random, find the probability that the number suffering is

(i) Exactly two (2mks)

(ii) Not more than ten. (3mks)

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(b) The average weight of a rabbit in a farm is known to be 3.8 kg with a standard deviation of 0.6 kg. Determine the probability that a rabbit selected at random has a weight

(i) less than 4 kg (2mks)

(ii) between 3.5 kg and 4.5 kg (2mks)

(iii) more than 5 kg.. (2mks)

(c) It is thought that there is a relationship between the average size of fish bladder and the level of effluent in the river the fish is caught. A study recorded the level of effluent in micrograms per a kilogram of the river water for a sample of rivers and the average size of fish bladder in cubic centimeters for a sample of same fish species and same sizes as follows:

Effluent	220	270	190	250	300
Bladder size	33	31	24	37	40

(i) Find the correlation coefficient between the effluent and bladder sizes. (3mks)

(ii) Assuming bladder size regresses on river effluent, estimate the trend. (4mks)

(iii) Estimate the bladder size of a fish in a river whose effluent is 400 micrograms. (1mks)

(iv) Estimate the level of effluent in a river from which the average bladder size of fish caught from the river is 20. (1mks)

Q4. A study was carried out on the amount of milk produced by a new breed of cows, where a random sample of the cows produced the following amount of milk in a week: 125, 154, 123, 139, 178, 117, 142, 152, 124, 183, 129, 135, 171, 198, 135.

(a) Estimate the average production for a cow in a week. (2mks)

(b) Find the standard error of the estimate. (2mks)

(c) If the population standard deviation of the amount produced in a week is known to be 17 litres,

(i) obtain the 95% confidence interval of the estimate. (3mks)

(ii) test whether the average is 138 litres. (5mks)

(d) If the population standard deviation of the amount produced in a week is unknown

(i) obtain the 95% confidence interval of the estimate. (3mks)

(ii) test whether then average is 138 litres. (5mks)

Q5 (a) A study was done on the effect of some three new fertilizers on some four different soil types in maize production. A record of number of bags of maize produced are as below.

	Soil type 1	Soil type 2	Soil type 3	Soil type 4
Fertilizer 1	26	19	34	21
Fertilizer 2	8	6	17	19
Fertilizer 3	6	5	19	10

Construct the ANOVA table for testing whether feeds have same effect as well as whether breeds have same average milk production. (10mks)

(b) A study was conducted on the extent of spread of worms in sheep in three different regions. A sample of sheep was observed and the number of worms a sheep had in the next droppings recorded as below.

Region A	7, 4, 6, 11, 9, 8
Region B	5, 2, 3,6, 1
Region C	9, 10,8,12,13

Test by Kruskal-Wallis test if the populations of sheep in the three regions are similarly affected by the worms. (10mks)

SCU 801: Scientific Data Analysis

STATISTICAL FORMULAE

1. Median $$\text{Median} = L_{med} + \frac{c}{f_{med}}\left[\frac{N}{2} - \left(\sum f\right)_{med}\right]$$

2. Mode $$\text{Mode} = L_{mod} + \frac{\Delta_1 c}{\Delta_1 + \Delta_2}$$

3. Quartiles $$Q_1 = L_{Q_1} + \frac{c}{f_{Q_1}}\left[\frac{N}{4} - \left(\sum f\right)_{Q_1}\right]$$

$$Q_3 = L_{Q_3} + \frac{c}{f_{Q_3}}\left[\frac{3N}{4} - \left(\sum f\right)_{Q_3}\right]$$

4. Percentiles $$P_i = L_{P_i} + \frac{c}{f_{P_i}}\left[\frac{iN}{100} - \left(\sum f\right)_{P_i}\right]$$

5. Population Mean $$\overline{X} = \frac{1}{N}\sum_{i=1}^{N} X_i$$

6. Mean Absolute Deviation $$MAD = \frac{\sum_{i=1}^{N}\left|X_i - \overline{X}\right|}{N}$$

7 Population Variance $$\sigma^2 = \frac{\sum_{i=1}^{N}(X_i - \overline{X})^2}{N}$$

8. Sample mean $$\overline{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

9. Sample variance $$s^2 = \frac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n-1}$$

10. Coefficient of variation $$c.v = \frac{\sigma}{\overline{X}} * 100$$

11. Mean of a frequency distribution $$\overline{X} = \frac{c\sum_i f_i u_i}{\sum_i f_i} + A$$

12. Standard deviation of a frequency distribution $$\sigma = c\sqrt{\left[\frac{\sum_i f_i u_i^2}{\sum_i f_i} - \left(\frac{\sum_i f_i u_i}{\sum_i f_i}\right)^2\right]}$$

13	Regression	Intercept in simple linear regression	$\hat{A} = \bar{y} - \hat{B}\bar{x}$
		Regression coefficient	$\hat{B} = \dfrac{\sum x_i y_i - n\bar{x}\bar{y}}{\sum x_i^2 - n\bar{x}^2}$
		Correlation coefficient	$r = \dfrac{\sum_{i=1}^{n} x_i y_i - n\bar{x}\bar{y}}{\sqrt{\left(\sum x_i^2 - n\bar{x}^2\right)\left(\sum y_i^2 - n\bar{y}^2\right)}}$
14	Pearson's coefficients of skewness	(i)	$Sk_{p1} = \dfrac{mean - .Mode}{standard\ deviation}$
		(ii)	$Sk_{p2} = \dfrac{3(mean - .Median)}{standard\ deviation}$
15	Bowley's correlation coefficient		$Sk_B = \dfrac{Q_1 + Q_3 - 2.Median}{Q_3 - Q_1}$
16.	Standard score		$z = \dfrac{x - \mu}{\sigma}$. $z = \dfrac{\lvert \bar{x} - \mu_0 \rvert}{\sigma/\sqrt{n}}$
17	t statistics		$t = \dfrac{\lvert \bar{x} - \mu \rvert}{s / \sqrt{n}}$
18.	Chi-Square statistic		$\chi^2 = \Sigma \dfrac{\left(O_{ij} - E_{ij}\right)^2}{E_{ij}} = \sum \dfrac{O_{ij}^2}{E_{ij}} - n$
19.	The signed rank test statistic T^*		$E\left(T^*\right) = \dfrac{n(n+1)}{4}$
			$V\left(T^*\right) = \dfrac{n(n+1)(2n+1)}{24}$
20.	Run test statistic U		$E\left(U\right) = \dfrac{2n_1n_2}{n_1 + n_2} + 1$
			$V\left(U\right) = \dfrac{2n_1n_2(2n_1n_2 - n_1 - n_2)}{(n_1 + n_2)^2 (n_1 + n_2 - 1)}$
21.	Mann-Whitney U test		$U_1 = n_1n_2 + \dfrac{n_2(n_2 + 1)}{2} - W_2$
			$U_2 = n_1n_2 + \dfrac{n_1(n_1 + 1)}{2} - W_1$
			$E\left(U^*\right) = \dfrac{n_1n_2}{2}$

13	Regression	Intercept in simple linear regression	$\hat{A} = \overline{y} - \hat{B}\overline{x}$
		Regression coefficient	$\hat{B} = \dfrac{\sum x_i y_i - n\overline{xy}}{\sum x_i^2 - n\overline{x}^2}$
		Correlation coefficient	$r = \dfrac{\sum_{i=1}^{n} x_i y_i - n\overline{xy}}{\sqrt{\left(\sum x_i^2 - n\overline{x}^2\right)\left(\sum y_i^2 - n\overline{y}^2\right)}}$
14	Pearson's coefficients of skewness	(i)	$Sk_{p1} = \dfrac{mean - .Mode}{standard\ deviation}$
		(ii)	$Sk_{p2} = \dfrac{3(mean - .Median)}{standard\ deviation}$
15	Bowley's correlation coefficient		$Sk_B = \dfrac{Q_1 + Q_3 - 2.Median}{Q_3 - Q_1}$
16.	Standard score		$z = \dfrac{x - \mu}{\sigma}$. $Z = \dfrac{\lvert \overline{x} - \mu_0 \rvert}{\sigma / \sqrt{n}}$
17	t statistics		$t = \dfrac{\lvert \overline{x} - \mu \rvert}{s / \sqrt{n}}$
18.	Chi-Square statistic		$\chi^2 = \sum \dfrac{\left(O_{ij} - E_{ij}\right)^2}{E_{ij}} = \sum \dfrac{O_{ij}^2}{E_{ij}} - n$
19.	The signed rank test statistic T^*		$E\left(T^*\right) = \dfrac{n(n+1)}{4}$
			$V\left(T^*\right) = \dfrac{n(n+1)(2n+1)}{24}$
20.	Run test statistic U		$E\left(U\right) = \dfrac{2n_1 n_2}{n_1 + n_2} + 1$
			$V\left(U\right) = \dfrac{2n_1 n_2 (2n_1 n_2 - n_1 - n_2)}{(n_1 + n_2)^2 (n_1 + n_2 - 1)}$
21.	Mann-Whitney U test		$U_1 = n_1 n_2 + \dfrac{n_2(n_2 + 1)}{2} - W_2$
			$U_2 = n_1 n_2 + \dfrac{n_1(n_1 + 1)}{2} - W_1$
			$E\left(U^*\right) = \dfrac{n_1 n_2}{2}$

$$V\left(U^*\right) = \frac{n_1 n_2 (n_1 + n_2 + 1)}{12}$$

22. Kruskal-Wallis H test statistic

$$H = \frac{12}{n(n+1)}\left[\Sigma \frac{R_i^2}{n_i}\right] - 3(n+1)$$

23. Rank correlation

$$r_c = 1 - \frac{6\Sigma d_i^2}{n(n^2 - 1)}$$

24 Correlation test statistic $t = r_{rk}\sqrt{\frac{n-2}{1-r_{rk}^2}}$

25. Test statistic for difference between two large samples

$$z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

26 Pooled standard deviation

$$s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{(n_1 + n_2 - 2)}$$

27. Test statistic for difference between two small samples

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{s_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

28. Pooled sample proportions

$$p_c = \frac{n_1\bar{x}_1 + n\ \bar{x}_2}{n_1 + n_2}$$

29. Test statistics for equal proportions

$$z = \frac{p_1 - p_2}{\sqrt{\frac{p_c(1-p_c)}{n_1} + \frac{p_c(1-p_c)}{n_2}}}$$

30. Binomial probability

$$P(X = x) = \binom{n}{x} p^x q^{n-x}, \quad where\ x = 0,1,2,\ldots,n$$

$$q = 1 - p$$

31. Poisson Probability

$$P(X = x) = \frac{e^{\lambda}\lambda^x}{x!}, \quad where\ x = 0,1,2\ldots$$

32. 95% confidence interval

$$95\%\ C..I = \begin{cases} (\bar{x} \pm \frac{\sigma}{\sqrt{n}} z_{0.025}), & if\ \sigma\ is\ known \\ (\bar{x} \pm \frac{s}{\sqrt{n}} t_{0.025}(n-1)), & if\ \sigma\ is\ unknown \end{cases}$$

33. The signed test statistic T^{*}

$$E(k) = \frac{n}{2}$$

$$V(k) = \frac{n}{4}$$

34 Analysis of variance statistics: Total sum of squares

$$S_T^2 = \sum y_i^2 - \frac{G^2}{n}$$

Treatment sum of squares

$$S_t^2 = \sum \frac{T_i^2}{b} - \frac{G^2}{n}$$

Blocks sum of squares

$$S_b^2 = \sum \frac{B_j^2}{v} - \frac{G^2}{n}$$

Error sum of squares

$$S_e^2 = S_T^2 - S_t^2 - S_b^2$$

1.

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

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	.3859
-0.1	.46017	.45620	.45224	.44828	.44433	.44038	.43644	.43251	.42858	.4246
-0.0	.50000	.49601	.49202	.48803	.48405	.48006	.47608	.47210	.46812	.4641

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t Table

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
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										

t-table.xls 7/14/2007

Table: Chi-Square Probabilities

The areas given across the top are the areas to the right of the critical value. To look up an area on the left, subtract it from one, and then look it up (ie: 0.05 on the left is 0.95 on the right)

df	0.995	0.99	0.975	0.95	0.90	0.10	0.05	0.025	0.01	0.005
1	---	---	0.001	0.004	0.016	2.706	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.833	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.041	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.559
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.195	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672
40	20.707	22.164	24.433	26.509	29.051	51.805	55.758	59.342	63.691	66.766
50	27.991	29.707	32.357	34.764	37.689	63.167	67.505	71.420	76.154	79.490
60	35.534	37.485	40.482	43.188	46.459	74.397	79.082	83.298	88.379	91.952
70	43.275	45.442	48.758	51.739	55.329	85.527	90.531	95.023	100.425	104.215
80	51.172	53.540	57.153	60.391	64.278	96.578	101.879	106.629	112.329	116.321
90	59.196	61.754	65.647	69.126	73.291	107.565	113.145	118.136	124.116	128.299
100	67.328	70.065	74.222	77.929	82.358	118.498	124.342	129.561	135.807	140.169

*INVOLVEMENT IN ANY **EXAMINATION IRREGULARITY** SHALL LEAD TO **DISCONTINUATION***