



**NAMIBIA UNIVERSITY  
OF SCIENCE AND TECHNOLOGY**

**FACULTY OF HEALTH AND APPLIED SCIENCES**

**DEPARTMENT OF MATHEMATICS AND STATISTICS**

<b>QUALIFICATION:</b> BACHELOR OF SCIENCES APPLIED MATHEMATICS AND STATISTICS	
<b>QUALIFICATION CODE:</b> 07BAMS	<b>LEVEL:</b> 7
<b>COURSE CODE:</b> SMS701S	<b>COURSE NAME:</b> SURVEY METHODS AND SAMPLING TECHNIQUES
<b>SESSION:</b> JULY 2022	<b>PAPER:</b> THEORY
<b>DURATION:</b> 3 HOURS	<b>MARKS:</b> 100

<b>SUPPLEMENTARY/SECOND OPPORTUNITY EXAMINATION QUESTION PAPER</b>	
<b>EXAMINER</b>	Mr. J. J. SWARTZ
<b>MODERATOR:</b>	Dr. I. NEEMA

<b>INSTRUCTIONS</b>
<ol style="list-style-type: none"><li>1. Answer ALL the questions in the booklet provided.</li><li>2. Show clearly all the steps used in the calculations.</li><li>3. All written work must be done in blue or black ink and sketches must be done in pencil.</li></ol>

**PERMISSIBLE MATERIALS**

1. Non-programmable calculator without a cover.

**ATTACHMENTS**

1. Normal distribution table
2. T-table

**THIS QUESTION PAPER CONSISTS OF 5 PAGES** (Including this front page)

**QUESTION 1 [25 MARKS]**

1.1 Define the term survey methodology in your own words. [3]

1.2 The Namibia Statistics Agency (NSA) is mandated to conduct annual Labour Force Surveys (NLFS). Describe the basic characteristics of the NLFS in terms of the following:

1.2.1 one of the main objectives of the NLFS

1.2.2 the target population they try to describe

1.2.3 the sources from which they draw samples

1.2.4 the design of the way they sample people

1.2.5 the use of interviewers

1.2.6 the mode of data collection

1.2.7 the use of computers in the collection of responses [7]

1.3 Define the following terms:

1.3.1 A random variable [1]

1.3.2 Sampling unit [1]

1.3.3 Population parameter [1]

1.3.4 Random Sample [1]

1.3.5 Statistical modeling [1]

1.4 Provide a diagrammatically representation of a survey lifecycle from a quality perspective. [10]

**QUESTION 2 [25 MARKS]**

2.1 Provide and explain four basic criteria for the acceptability of a sampling method? [8]

2.2 Write at least 4 properties of the normal probability distribution [4]

2.3 Write a short note on the importance of the normal distribution in sampling theory [3]

2.4 The Ministry of Health and Social Services wants to estimate the rate of incidence of respiratory disorders among the middle aged male and female smokers in Namibia. How large a sample should be taken to be 95% confident that the error of estimation of the proportion of the population with such disorders does not exceed 0.05? The true value of  $p$  is expected to be near 0.20. [4]

2.5 To estimate the percentage of rats that carries a viral infection which produces a certain sickness, 128 rats are examined and 72 of them are found to be infected. Calculate the standard error of the estimated proportion and compute a 95% confidence interval for the population proportion? [6]

**QUESTION 3 [25 MARKS]**

3.1 Distinguish between probability and non-probability sampling in terms of approaches to sampling. [4]

3.2 Consider the population of 32 housing units organised into 8 clusters of 4 housing units in each cluster. A sample of 3 clusters 2, 4, 8 was selected ( $n = 3$ ) and all housing units within these 3 clusters were interviewed. The sample data collected are as follows.

$y_{21} = 9$	$y_{41} = 6$	$y_{81} = 10$
$y_{22} = 7$	$y_{42} = 5$	$y_{82} = 11$
$y_{23} = 6$	$y_{43} = 8$	$y_{83} = 3$
$y_{24} = 4$	$y_{44} = 9$	$y_{84} = 8$
$y_2 = 26$	$y_4 = 28$	$y_8 = 32$

3.2.1 Estimate  $Y$ , population total [4]

3.2.2 Estimate  $\bar{y}$ , average cluster value of the characteristic [3]

3.2.3 Calculate  $\text{Var}(\hat{Y})$  [4]

3.3 Recent census data on the number of cattle per farm are given below: Farms have been stratified based on their total acreage (L=5). The present total number of farms in each stratum is also given in the table.

For a sample of  $n = 500$  farms, compute the sample sizes in each stratum under;

3.3.1 Proportional allocation [5]

3.3.2 Optimal allocation [5]

Stratum	Previous census				Present total number of farms	Estimated cost per unit
	size	Total number of farms	Average number of cattle	Estimated SD per unit		
<b>h</b>	<b>size</b>	$N'_h$	$\bar{y}'_h$	$s'_h$	$N_h$	$c_h$
I	0 – 15	625	3.91	4.5	635	3.50
II	16 – 30	564	10.38	7.3	570	2.75
III	31 – 50	476	14.72	9.6	475	2.25
IV	51 – 75	304	21.99	12.2	303	3.00
V	76 - 100	86	27.38	15.8	89	2.50
All strata		2055			2072	

**QUESTION 4 [25 MARKS]**

4.1 Coding is a process in which questionnaire entries are assigned numeric values. The objective is to prepare the data in a form suitable for entry into a computer. Provide three alternatives that the coding operation may involve. [6]

4.2 You have been approached by a client, Namibia Statistics Agency (NSA) to process the LFS 2012 data and are required to estimate the number of working days you will take to enter 10, 000 questionnaires. The following information is provided:

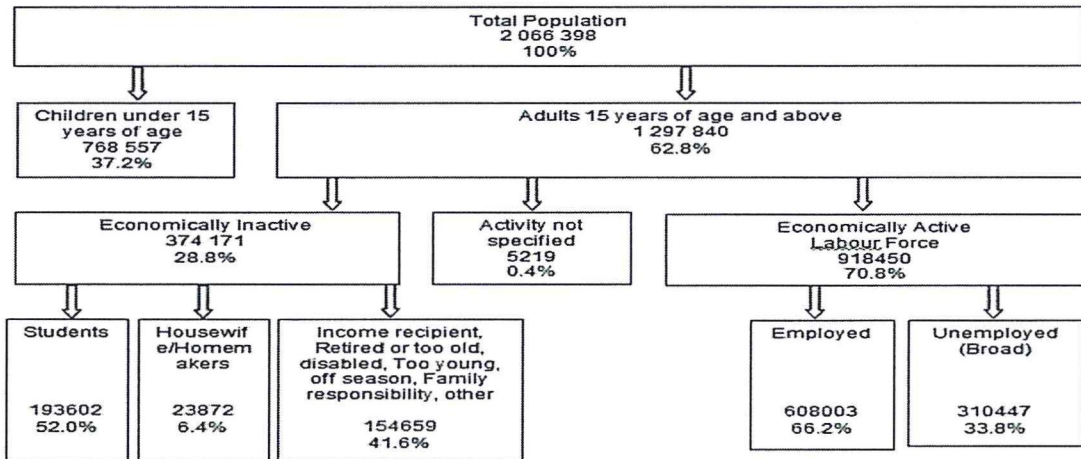
- a. 12 x data entry stations
- b. 2 x shifts of data entry operators
- c. 7 x productive hours per work
- d. 12 x operators
- e. Average of 8,000 strokes per hour
- f. 10,000 questionnaires

- g. 2,500 strokes per questionnaires
- h. 100 percent verification

[9]

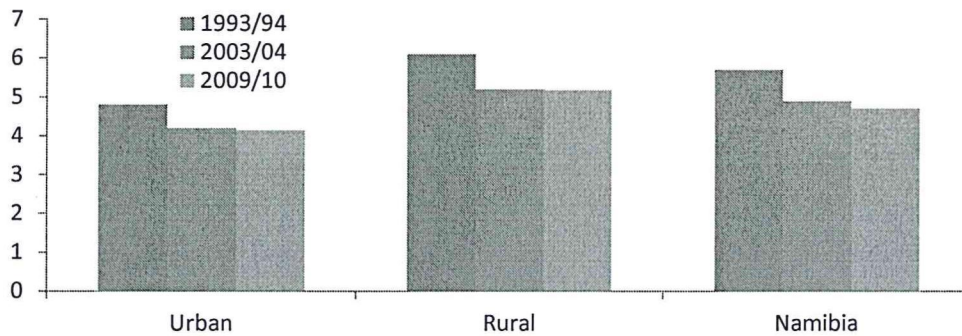
4.3 You were asked by a client to analyze the 2012 Namibia Labour Force Survey data. The following figure and table were produced from the data. Please write a short narrative or interpretation for the figures below on what they are representing.

4.3.1 Figure 1: Population by activity status



[5]

4.3.2 Figure 2: Average household size by urban/rural areas



[5]

\*\*\*\*\*END OF PAPER\*\*\*\*\*

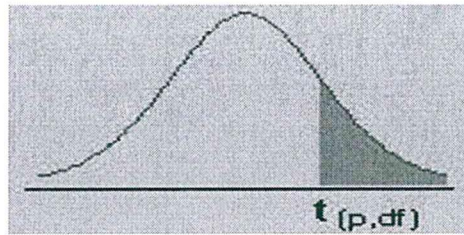
TOTAL MARKS: 100



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

<b>Z</b>	<b>.00</b>	<b>.01</b>	<b>.02</b>	<b>.03</b>	<b>.04</b>	<b>.05</b>	<b>.06</b>	<b>.07</b>	<b>.08</b>	<b>.09</b>
-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

# The t-distribution



df/p	0.40	0.25	0.10	0.05	0.025	0.01	0.005	0.0005
1	0.324920	1.000000	3.077684	6.313752	12.70620	31.82052	63.65674	636.6192
2	0.288675	0.816497	1.885618	2.919986	4.30265	6.96456	9.92484	31.5991
3	0.276671	0.764892	1.637744	2.353363	3.18245	4.54070	5.84091	12.9240
4	0.270722	0.740697	1.533206	2.131847	2.77645	3.74695	4.60409	8.6103
5	0.267181	0.726687	1.475884	2.015048	2.57058	3.36493	4.03214	6.8688
6	0.264835	0.717558	1.439756	1.943180	2.44691	3.14267	3.70743	5.9588
7	0.263167	0.711142	1.414924	1.894579	2.36462	2.99795	3.49948	5.4079
8	0.261921	0.706387	1.396815	1.859548	2.30600	2.89646	3.35539	5.0413
9	0.260955	0.702722	1.383029	1.833113	2.26216	2.82144	3.24984	4.7809
10	0.260185	0.699812	1.372184	1.812461	2.22814	2.76377	3.16927	4.5869
11	0.259556	0.697445	1.363430	1.795885	2.20099	2.71808	3.10581	4.4370
12	0.259033	0.695483	1.356217	1.782288	2.17881	2.68100	3.05454	4.3178
13	0.258591	0.693829	1.350171	1.770933	2.16037	2.65031	3.01228	4.2208
14	0.258213	0.692417	1.345030	1.761310	2.14479	2.62449	2.97684	4.1405
15	0.257885	0.691197	1.340606	1.753050	2.13145	2.60248	2.94671	4.0728
16	0.257599	0.690132	1.336757	1.745884	2.11991	2.58349	2.92078	4.0150
17	0.257347	0.689195	1.333379	1.739607	2.10982	2.56693	2.89823	3.9651
18	0.257123	0.688364	1.330391	1.734064	2.10092	2.55238	2.87844	3.9216
19	0.256923	0.687621	1.327728	1.729133	2.09302	2.53948	2.86093	3.8834
20	0.256743	0.686954	1.325341	1.724718	2.08596	2.52798	2.84534	3.8495
21	0.256580	0.686352	1.323188	1.720743	2.07961	2.51765	2.83136	3.8193
22	0.256432	0.685805	1.321237	1.717144	2.07387	2.50832	2.81876	3.7921
23	0.256297	0.685306	1.319460	1.713872	2.06866	2.49987	2.80734	3.7676
24	0.256173	0.684850	1.317836	1.710882	2.06390	2.49216	2.79694	3.7454
25	0.256060	0.684430	1.316345	1.708141	2.05954	2.48511	2.78744	3.7251
26	0.255955	0.684043	1.314972	1.705618	2.05553	2.47863	2.77871	3.7066
27	0.255858	0.683685	1.313703	1.703288	2.05183	2.47266	2.77068	3.6896
28	0.255768	0.683353	1.312527	1.701131	2.04841	2.46714	2.76326	3.6739
29	0.255684	0.683044	1.311434	1.699127	2.04523	2.46202	2.75639	3.6594
30	0.255605	0.682756	1.310415	1.697261	2.04227	2.45726	2.75000	3.6460
inf	0.253347	0.674490	1.281552	1.644854	1.95996	2.32635	2.57583	3.2905