Strathmore UNIVERSITY

SCHOOL OF COMPUTING AND ENGINEERING SCIENCES

Master of Science in Sustainable Energy Transitions

MSET8201: Research Methodology

Date: 19th December 2024 **Time: 18:00-20:30 Hours**

Instructions:

1. The Examination Paper consists of **FOUR** Questions.
2. Answer Question #1 (**Compulsory)** and any other **TWO** Questions.
3. Use of Calculators is ALLOWED in this Examination.

Question #1 (Compulsory):

The following metadata for articles is not in APA reference format or style at per Strathmore University's expectations. Organize the references in APA style stating why you think the source is Journal, Book, Newspaper article etc.

(a) MACHADO, J. T. M., and DE ANDRÉS, M. (2023). Implications of offshore wind energy developments in coastal and maritime tourism and recreation areas: An analytical overview. Environmental Impact Assessment Review, 99, 106999. [**3 Marks**]

(b) AKTER, H., HOWLADER, H. O. R., NAKADOMARI, A., ISLAM, M. R., SABER, A. Y., and SENJYU, T. (2022). A short assessment of renewable energy for optimal sizing of 100% renewable energy based microgrids in remote islands of developing countries: A case study in Bangladesh. *Energies*, *15*(3), 1084. [**3 Marks**]

(c) LUCAS, H., FIFITA, S., TALAB, I., MARSCHEL, C., and CABEZA, L. F. (2017). Critical challenges and capacity building needs for renewable energy deployment in Pacific Small Island Developing States (Pacific SIDS). *Renewable energy*, *107*, 42-52. [**3 Marks**]

(d) HOLDMANN, G. P., WIES, R. W., and VANDERMEER, J. B. (2019). Renewable energy integration Alaska's remote islanded microgrids: Economic drivers, technical strategies, technological niche development, and policy implications. Proceedings of the IEEE, 107(9), 1820-1837. [**3 Marks**]

(e) KAYIMA, P., SEMAKULA, H. M., WASSWA, H., MUGAGGA, F., and MUKWAYA, P. I. (2023). Analysis of the socio-economic benefits of on-grid hybrid solar energy system on Bugala island in Uganda. *Energy for Sustainable Development*, *77*, 101332. [**3 Marks**]

(f) CHUANG, E., and SAFAEINILI, N. (2023). Addressing Social Needs in Clinical Settings: Implementation and Impact on Health Care Utilization, Costs, and Integration of Care. *Annual Review of Public Health*, *45*. [**2.5 Marks**]

(g) KUMAR, S. R., GAFARO, F., DAKA, A., and RATURI, A. (2017). Modelling and analysis of grid integration for high shares of solar PV in small isolated systems–A case of Kiribati. *Renewable energy*, *108*, 589-597. [**2.5 Marks**]

Question #2:

(a) What is the purpose of a chi-square in a sample of a given population? What are some important points to note about *chi-square estimation* in the application to sample data? [**3 Marks**]

(b) Table Q2 shows the data of incidences of Renewable Energy Sources in three tropical regions in the World.

Table Q#2: Incidences of Renewable Energy Sources

	India	Ecuador	South America	Total
Wind	31	14	25	70
Geothermal	12	15	33	60
Solar	40	32	28	100
Total	83	61	86	230

i. Calculate the chi-square value of renewable energy sources given in Table Q#2 [**8 Marks**]

ii. What are the degrees of freedom for the data in Table Q#2? Explain your answer. [**2 Marks**]

iii. What conclusion should be made with respect to an experiment when the significance level is 0.005 ($p = 0.005$)? [**2 Marks**]

Question #3:

(a) *"The Scientific Method has been proven to be extremely successful."* Briefly critique the statement using suitable examples and the procedures under the Scientific Method. [**3 Marks**]

(b) *Science is a human activity, and the pursuit of "truth" is subject to all human virtues*. Explain any three cardinal issues you must bear in mind when using the Scientific Method. **[3 Marks**]

(c) Briefly differentiate between a *fact*, *hypothesis*, *theory,* and *law* in Scientific Research. [**4 Marks**]

(d) Is a hypothesis necessary for scientific research? Why? Briefly distinguish the three possible conclusions open to a researcher when one adopts a hypothesis for research. [**2 Marks**].

(e) What would be the basis of choosing a certain methodology for research? Is it important to explain why we choose a methodology? Why? [**3 Marks**]

Question #4:

Real-world energy dataset usages from buildings in a small geographic location and with diverse weather measurements was captured. The dataset characterizes the electricity energy consumption profile for the region inhabitants and correlates consumption habits dependent on weather conditions, such as *temperature, light, or humidity*.

Five households with older adults (over the age of 80) and five with younger adults (between 20 and 30) were given a power consumption satisfaction test. The test scores ranged from 0 to 60 and data obtained for houses with older adults was {45, 39, 52, 42 and 35} while for houses with younger adults it was {28, 26, 16, 26, and 31}

(a) What would the *null hypothesis* for this energy consumption availability satisfaction study? [**2 Marks**]

(b) Using the dataset, compute the appropriate *t-test* for the consumption satisfaction file. [**7 Marks**]

(c) Given the null hypothesis in (a) above, do you *accept or reject the null hypothesis* at 0.025 significance level? Demonstrate why or why not. The appendices contain a t-distribution table for your working convenience. [**6 Marks**]

Appendices:

Chi-Square Right-Tail Probability ($\geq \chi^2$)										
DF	**0.995**	**0.99**	**0.975**	**0.95**	**0.9**	**0.1**	**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

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										