

UGANDA MARTYRS UNIVERSITY

UNIVERSITY EXAMINATIONS

FACULTY OF BUSINESS ADMINISTRATION AND MANAGEMENT

DEPARTMENT OF ECONOMICS

YEAR ONE SEMESTER TWO 2023/2024

SUPPLEMENTARY/SPECIAL EXAM

COURSE CODE : MSDE 5105

COURSE UNIT : ECONOMETRICS AND MULTIVARIATE ANALYSIS

PROGRAM : MASTER OF DEVELOPMENT ECONOMICS

DATE: SATURDAY 15/07/24

TIME: 9.30 am – 12.30 pm

DURATION: 3 HOURS

Instructions:

1. This examination consists of **SIX** questions.
 2. Attempt any **FOUR** questions. Each question carries 25 marks.
 3. Do not write anything on the question paper.
 4. Carefully read through ALL the questions before attempting.
 5. No **names** should be written anywhere on the examination booklet.
 6. Any type of examination Malpractice will lead to automatic disqualification.
 7. Ensure that your **Registration number** is indicated on all pages of the examination answer booklet.
 8. Some of the important formulas and statistical tables are attached.
 9. Remember to indicate the question numbers you have attempted.
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QUESTION ONE

- (a) Nature's Way Limited is a small health food company that is trying to break into the highly competitive breakfast cereal market. In order to boost its sales, it is undertaking a national wide advertising campaign and is promoting its product by giving customers a 10% discount on the purchase price of their breakfast cereal. In order to access the impact of this campaign the company has commissioned some research based on evidence from across the country. The resulting ordinary least squares model indicates the following relationship between the sales of its breakfast cereal and three core drivers of sales revenue.

$$\text{Sales} = 33.5 + 25.5 \text{ Advert} + 31.2 \text{ Prom} - 1.10 \text{ Comp}$$

(13.5) (5.3) (12.2) (0.49)

Where:

Sales: sales of breakfast cereal (£ millions)

Advert: Advertising expenditure (£ millions)

Prom: Cost of promotions campaign (£ millions)

Comp: Sales of competitors (£ millions)

Note: The standard errors are in brackets

Multiple Analysis Of Variance (MANOVA)

Source of Variation	Sum of Squares	F-ratio	P-value
Regression	17000	18.3	0.000
Residual	3410		
Total	20410		

- (b) Give a written interpretation of each of the coefficient estimates. (6 marks)
- (c) Which variables are statistically significant at 5% level and which are not? Give reasons for your answers. (4 marks)
- (d) How well is the regression model fitted? Give a reason for your answer. (2 marks)
- (e) Suppose the company had a sample size of 1000, compute the coefficient of determination and give its interpretation. (3 marks)
- (f) Discuss the causes and consequences of multicollinearity in regression analysis. (10 mks)

QUESTION TWO

- (a) Using relevant examples, distinguish between correlation analysis and regression analysis. (6 marks)

- (b) The table below shows Economics marks for a sample of 10 students from the cities of Masaka (X) and Gulu (Y).

Masaka (X)	48	50	30	40	46	74	60	80	88	79
Gulu (Y)	68	54	60	54	62	82	80	66	80	65

- (i) Calculate the Spearman's correlation coefficient. (6 marks)
- (ii) Comment on the association between Economics marks of students from the two cities. (2 marks)
- (c) The following table shows the ages and glucose levels of 6 people who visited Nkozi hospital.

Age (X)	Glucose Level (Y)
43	99
21	65
25	79
42	75
57	87
59	81

- (i) Identify the dependent and independent variables. (2 marks)
- (ii) Determine Pearson's product moment correlation coefficient. (7 marks)
- (iii) Comment on your answer. (2 marks)

QUESTION THREE

- (a) What is meant by the term econometrics? (1 mark)
- (b) Briefly explain any three goals of econometrics? (3 marks)
- (c) Write short notes on the two types of econometrics. (2 marks)
- (d) Discuss the three different types of correlational analysis using relevant diagrams. (6 mks)
- (e) Given the linear stochastic model $Y_i = \beta_0 + \beta_1 X_1 + e_i$.
- (i) Explain the importance of including the stochastic error term e_i . (5 marks)
- (ii) What is the objective of least squares estimation? (1 mark)
- (iii) Use the ordinary least squares method to obtain the estimators of β_0 and β_1 . (7 marks)

QUESTION FOUR

The model $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + U_i$ was used to fit the data in the table below.

Y	X_1	X_2
16.7	18.3	20
18.2	19.6	70
22.5	24.8	130
17.3	18.8	40
20.4	22.3	100
17.2	19.1	60
23.4	25.9	140
21.3	23.3	110
15.2	17.7	30
16.3	18.2	80

- (i) Estimate $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2$. (10 marks)
- (ii) Compute the standard errors of the estimates β_1 and β_2 . (5 marks)
- (iii) Compute R^2 and adjusted R^2 . Give their interpretations. (5 marks)
- (iv) Test the hypothesis $H_0 : \beta_1 = \beta_2 = 0$ at 5% level of significance. (5 marks)

QUESTION FIVE

- (i) The regression model below shows the wages of economists working in a given country.

$$Y_i = \beta_0 + \beta_1 D_1 + \beta_2 D_2 + \beta_3 X_i + e.$$

Where Y_i = Monthly wage of an Economist; X_i = Years of schooling

D_1 = If male economist, 0 otherwise; D_2 = If foreigner, 0 otherwise;

Required

- (a) Identify the base categories in the model above. (3 marks)
- (b) Identify the differential intercept coefficients and give their interpretation. (4 marks)
- (c) Write down the expressions for the mean monthly wages of the following:
- (i) A female non-foreign economist. (2 marks)
 - (ii) A male non-foreign economist. (2 marks)
 - (iii) A female foreign economist. (2 marks)
 - (iv) A male foreign economist. (2 marks)
- (ii) Explain the causes and consequences of heteroscedasticity in regression analysis. (10 marks)

QUESTION SIX

- (a) Distinguish between a stochastic model and a deterministic model. (2 marks)
- (b) The following data shows consumer expenditure and income for sample of ten consumers in Kayabwe town.

C	70	65	90	95	110	115	120	140	150	155
Y	80	100	120	140	160	180	200	220	240	260

- (i) Estimate the consumer expenditure function $C_i = \beta_0 + \beta_1 Y_i$ (8 marks)
- (ii) Compute the standard errors of the estimates. (5 marks)
- (iii) Find the 99% confidence intervals for the population parameters. (5 marks)
- (iv) Conduct the tests of hypothesis for the regression estimates at the 1% level of significance. (5 marks)

TABLE OF SOME OF THE IMPORTANT FORMULAS

Mean	$\bar{X} = \frac{\sum f x}{\sum f}$
Simple regression model parameters: $Y = \beta_0 + \beta_1 X$	$\hat{\beta} = \frac{\sum_{i=1}^n (X - \bar{X})(Y - \bar{Y})}{\sum_{i=1}^n (X - \bar{X})^2} ; \hat{\beta}_0 = \bar{Y} - \hat{\beta}_1 \bar{X}$
Coefficient of determination R^2	$R^2 = \frac{ESS}{TSS} = 1 - \frac{RSS}{TSS} ; ESS = \hat{\beta}_1^2 \sum x^2 ;$ $TSS = \sum y_i^2 = \sum (Y - \bar{Y})^2$
Confidence interval (CI)	$\beta_i = \hat{\beta}_i \pm Z_{\frac{\alpha}{2}} \cdot SE(\hat{\beta}_i) \quad \text{or}$ $\beta_i = \hat{\beta}_i \pm t_{\frac{\alpha}{2}, (n-k)} \cdot SE(\hat{\beta}_i)$
Spearman's rank correlation coefficient	$\rho = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$

SUCCESS

STATISTICAL TABLES

Student's -t Distribution Table

	t-Distribution Critical Values											
df, ν	0.25	0.20	0.15	0.10	0.05	0.025	0.02	0.01	0.005	0.0025	0.001	0.0005
1	1.000	1.376	1.963	3.078	6.314	12.71	15.89	31.82	63.66	127.3	318.3	636.6
2	0.816	1.061	1.386	1.886	2.920	4.303	4.849	6.965	9.925	14.09	22.33	31.60
3	0.765	0.978	1.250	1.638	2.353	3.182	3.482	4.541	5.841	7.453	10.21	12.92
4	0.741	0.941	1.190	1.533	2.132	2.776	2.999	3.747	4.604	5.598	7.173	8.610
5	0.727	0.920	1.156	1.476	2.015	2.571	2.757	3.365	4.032	4.773	5.893	6.869
6	0.718	0.906	1.134	1.440	1.943	2.447	2.612	3.143	3.707	4.317	5.208	5.959
7	0.711	0.896	1.119	1.415	1.895	2.365	2.517	2.998	3.499	4.029	4.785	5.408
8	0.706	0.889	1.108	1.397	1.860	2.306	2.449	2.896	3.355	3.833	4.501	5.041
9	0.703	0.883	1.100	1.383	1.833	2.262	2.398	2.821	3.250	3.690	4.297	4.781
10	0.700	0.879	1.093	1.372	1.812	2.228	2.359	2.764	3.169	3.581	4.144	4.587
11	0.697	0.876	1.088	1.363	1.796	2.201	2.328	2.718	3.106	3.497	4.025	4.437
12	0.695	0.873	1.083	1.356	1.782	2.179	2.303	2.681	3.055	3.428	3.930	4.318
13	0.694	0.870	1.079	1.350	1.771	2.160	2.282	2.650	3.012	3.372	3.852	4.221
14	0.692	0.868	1.076	1.345	1.761	2.145	2.264	2.624	2.977	3.326	3.787	4.140
15	0.691	0.866	1.074	1.341	1.753	2.131	2.249	2.602	2.947	3.286	3.733	4.073
16	0.690	0.865	1.071	1.337	1.746	2.120	2.235	2.583	2.921	3.252	3.686	4.015
17	0.689	0.863	1.069	1.333	1.740	2.110	2.224	2.567	2.898	3.222	3.646	3.965
18	0.688	0.862	1.067	1.330	1.734	2.101	2.214	2.552	2.878	3.197	3.611	3.922
19	0.688	0.861	1.066	1.328	1.729	2.093	2.205	2.539	2.861	3.174	3.579	3.883
20	0.687	0.860	1.064	1.325	1.725	2.086	2.197	2.528	2.845	3.153	3.552	3.850
21	0.686	0.859	1.063	1.323	1.721	2.080	2.189	2.518	2.831	3.135	3.527	3.819
22	0.686	0.858	1.061	1.321	1.717	2.074	2.183	2.508	2.819	3.119	3.505	3.792
23	0.685	0.858	1.060	1.319	1.714	2.069	2.177	2.500	2.807	3.104	3.485	3.768
24	0.685	0.857	1.059	1.318	1.711	2.064	2.172	2.492	2.797	3.091	3.467	3.745
25	0.684	0.856	1.058	1.316	1.708	2.060	2.167	2.485	2.787	3.078	3.450	3.725
26	0.684	0.856	1.058	1.315	1.706	2.056	2.162	2.479	2.779	3.067	3.435	3.707
27	0.684	0.855	1.057	1.314	1.703	2.052	2.158	2.473	2.771	3.057	3.421	3.690
28	0.683	0.855	1.056	1.313	1.701	2.048	2.154	2.467	2.763	3.047	3.408	3.674
29	0.683	0.854	1.055	1.311	1.699	2.045	2.150	2.462	2.756	3.038	3.396	3.659
30	0.683	0.854	1.055	1.310	1.697	2.042	2.147	2.457	2.750	3.030	3.385	3.646
40	0.681	0.851	1.050	1.303	1.684	2.021	2.123	2.423	2.704	2.971	3.307	3.551
50	0.679	0.849	1.047	1.299	1.676	2.009	2.109	2.403	2.678	2.937	3.261	3.496
60	0.679	0.848	1.045	1.296	1.671	2.000	2.099	2.390	2.660	2.915	3.232	3.460
80	0.678	0.846	1.043	1.292	1.664	1.990	2.088	2.374	2.639	2.887	3.195	3.416
100	0.677	0.845	1.042	1.290	1.660	1.984	2.081	2.364	2.626	2.871	3.174	3.390
1000	0.675	0.842	1.037	1.282	1.646	1.962	2.056	2.330	2.581	2.813	3.098	3.300
z^*	0.674	0.841	1.036	1.282	1.645	1.960	2.054	2.326	2.576	2.807	3.091	3.291
	50%	60%	70%	80%	90%	95%	96%	98%	99%	99.5%	99.8%	99.9%
	Confidence level C											

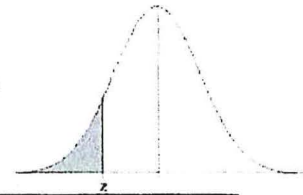
JNN & DDW, Elements of Probability & Statistics: Lecture 293

Notes

7.1 Normal Distribution Table

7.1.1 Negative Z-values Table

Cumulative probabilities for **NEGATIVE** Z-values are shown in the following table:



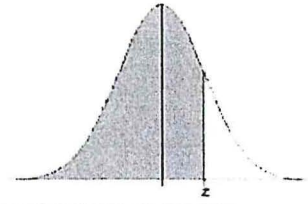
Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
-3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
-3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
-3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
-3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
-2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
-2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
-2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
-2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
-2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
-2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
-2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
-2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
-2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
-2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
-1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
-1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
-1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
-1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
-0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
-0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
-0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
-0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
-0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
-0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

JNN & DDW, Elements of Probability & Statistics: Lecture 291
Notes

CHAPTER 7. PROBABILITY TABLES

7.1.2 Positive Z-values Table

Cumulative probabilities for **POSITIVE** Z-values are shown in the following table:

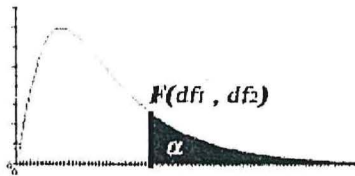


Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	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	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

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Notes

F-Distribution Table

F-Distribution Critical Values $\alpha = 0.05$								
\	df1=1	2	3	4	5	6	7	8
df2=1	161.4476	199.5000	215.7073	224.5832	230.1619	233.9860	236.7684	238.8827
2	18.5128	19.0000	19.1643	19.2468	19.2964	19.3295	19.3532	19.3710
3	10.1280	9.5521	9.2766	9.1172	9.0135	8.9406	8.8867	8.8452
4	7.7086	6.9443	6.5914	6.3882	6.2561	6.1631	6.0942	6.0410
5	6.6079	5.7861	5.4095	5.1922	5.0503	4.9503	4.8759	4.8183
6	5.9874	5.1433	4.7571	4.5337	4.3874	4.2839	4.2067	4.1468
7	5.5914	4.7374	4.3468	4.1203	3.9715	3.8660	3.7870	3.7257
8	5.3177	4.4590	4.0662	3.8379	3.6875	3.5806	3.5005	3.4381
9	5.1174	4.2565	3.8625	3.6331	3.4817	3.3738	3.2927	3.2296
10	4.9646	4.1028	3.7083	3.4780	3.3258	3.2172	3.1355	3.0717
11	4.8443	3.9823	3.5874	3.3567	3.2039	3.0946	3.0123	2.9480
12	4.7472	3.8853	3.4903	3.2592	3.1059	2.9961	2.9134	2.8486
13	4.6672	3.8056	3.4105	3.1791	3.0254	2.9153	2.8321	2.7669
14	4.6001	3.7389	3.3439	3.1122	2.9582	2.8477	2.7642	2.6987
15	4.5431	3.6823	3.2874	3.0556	2.9013	2.7905	2.7066	2.6408



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Notes