Second Semester Examination
2023/2024 Academic Session

July/August 2024

EBS339/3 – Mineral Economics
(Ekonomi Mineral)

Duration : 3 hours
(Masa : 3 jam)

Please check that this examination paper consists of FOURTEEN (14) pages of printed material including THREE (3) APPENDIX before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi EMPAT BELAS (14) muka surat yang bercetak termasuk TIGA (3) LAMPIRAN sebelum anda memulakan peperiksaan ini].

Instructions : Answer **FIVE (5)** questions. **Part A is COMPULSORY**. Answer TWO (2) questions from Section B. All questions carry the same marks.

*[**Arahan :** Jawab **LIMA (5)** soalan. **Bahagian A WAJIB dijawab**. Jawab DUA (2) soalan daripada Bahagian B. Semua soalan membawa jumlah markah yang sama.]*

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai].

PART A / *BAHAGIAN A*

(1). (a). Discuss seven steps in mineral resources estimation starting from drillhole data to ore reserve classification.

Terangkan tujuh langkah didalam pengiraan jumlah sumber mineral bermula daripada data lubang gerudi hingga ke pengkelasan rizab bijih.

(12 marks/*markah)*

(b). Explain the meaning of geostatistic method in mineral resources estimation.

Terangkan maksud kaedah geostatistik di dalam penentuan jumlah sumber mineral.

(3 marks/*markah*)

(c). In what case, non-linear Kriging methods (Kriging of transformed data) is better than linear kriging method. Explain advantages and disadvantages of the kriging method in mineral resources calculation.

Dalam kes yang bagaimana kaedah Kriging tidak linear (Kriging data yang diubah) lebih baik daripada kaedah Kriging linear. Terangkan kelebihan dan kelemahan kaedah kriging di dalam pengiraan sumber mineral.

(5 marks/*markah)*

(2). (a). Differentiate the technical and economic studies in mining operations and determine what kind of studies these cases are:

Bezakan kajian teknikal dan ekonomi di dalam operasi perlombongan dan tentukan jenis kajian kes ini:

(i). Design of the ramp width of an open pit mine
Reka bentuk lebar tanjakan lombong terbuka

(ii). Break even stripping ratio (BESR) determination
Penentuan nisbah pelucutan pulang modal (BESR)

(5 marks/ *markah*)

(b). (i). A copper mine produces 25,000 tons of ore per month. The fixed cost per month is RM300,000, and the cost per ton is RM60. Calculate the production cost per ton at this level.

Sebuah lombong tembaga menghasilkan 25,000 tan bijih sebulan. Kos tetap sebulan ialah RM300,000, dan kos satu tan ialah RM60. Kira kos pengeluaran se-tan pada tahap ini.

(ii). If the company increases the monthly production to 30,000 tons, how does the production cost per ton change?

Jika syarikat meningkatkan pengeluaran bulanan kepada 30,000 tan, bagaimanakah kos pengeluaran se-tan berubah?

(6 marks/ markah)

(c). Compare the meaning of the sunk and recoverable costs. Then determine these costs whether sunk or recoverable.

Bandingkan kos tenggelam dan kos boleh pulih. Kemudian tentukan kos ini sama ada tenggelam atau boleh diperolehi semula.

(i). Exploration and Development Costs
Kos Penerokaan dan Pembangunan

(ii). Depreciation of Equipment
Susut Nilai Peralatan

(iii). Mining area and company properties
Kawasan perlombongan dan hartanah syarikat

(5 marks/*markah*)

(d). A bank gives a mining company RM2,000,000 loan with annual interest rate of 10%. If they agreed that the company can pay back the whole loan in one payment, how much should the company pay after 3 years?

Sebuah bank memberi pinjaman RM2,000,000 kepada syarikat perlombongan dengan kadar faedah tahunan 10%. Jika mereka bersetuju syarikat boleh membayar balik keseluruhan pinjaman dalam satu bayaran, berapakah jumlah yang perlu dibayar oleh syarikat selepas 3 tahun?

(4 marks/*markah*)

(3). (a). (i). What are the key components of mine planning?
Apakah komponen utama perancangan lombong?

(ii). How does geological data influence mine planning decisions?
Bagaimanakah data geologi mempengaruhi keputusan perancangan lombong?

(iii). Discuss the importance of resource estimation in mine planning.
Bincangkan kepentingan anggaran sumber dalam perancangan lombong.

(8 marks/ markah)

(b). A company is considering which of two mutually exclusive projects it should undertake. The finance director thinks that the project with the higher Net Present Value (NPV) should be chosen, whereas the managing director thinks that the one with the higher Internal Rate of Return (IRR) should be undertaken, especially as both projects have the same initial outlay and length of life. The company anticipates a cost of capital of 10%, and the net after tax cashflows of the projects are as follows:

Sebuah syarikat sedang mempertimbangkan dua projek saling menyingkiri untuk dipilih. Pengarah kewangan merasakan projek yang memberikan nilai kini bersih (NPV) lebih tinggi harus dipilih, manakala pengarah urusan merasakan projek yang memberikan kadar pulangan dalaman (IRR) yang tinggi harus dipilih, terutamanya apabila tempoh projek hampir sama. Pihak syarikat menganggarkan kos modal 10% dan aliran tunai bersih seperti berikut:

Year/*Tahun*	Project X/*Projek X*	Project Y/*Projek Y*
	RM000	RM000
0	(200)	(200)
1	35	218
2	80	10
3	90	10
4	75	4
5	20	3

(i). Calculate the NPV and IRR of each project.

Kirakan nilai kini bersih (NPV) dan kadar pulangan dalaman (IRR) bagi setiap projek.

(6 marks/*markah*)

(ii). Recommend, with reasons, which project you would undertake (if either).

Cadangkan, dengan alasan, projek manakah yang akan dipilih.

(6 marks/*markah*)

PART B / *BAHAGIAN B*

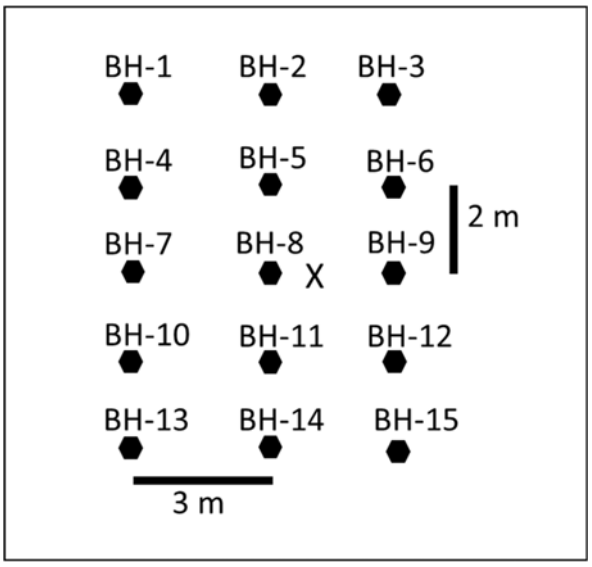
(4). Resources estimation apply various method such as polygonal (local sample mean) and inverse distance method.

Penentuan jumlah sumber mineral menggunakan pelbagai kaedah seperti poligon (purata sampel setempat) dan kaedah jarak songsang.

(a). Calculate the value 'X' in Figure 1 below based on the neighborhood data by using the Inverse Distance method with search radius of 2.5 m. Shows the detail of how you derive the value.

Kira nilai 'X" di dalam Rajah 1 di bawah berdasarkan nilai di sekelilingnya dengan menggunakan kaedah Jarak Songsang dengan jejari carian 2.5 m. Tunjukkan dengan terperinci bagaimana anda memperolehi data tersebut.

(10 marks/*markah*)



Borehole ID	XPT	YPT	Grade (g/t)
BH-1	110	130	0.2
BH-2	113	130	0.3
BH-3	116	130	0.1
BH-4	110	128	0.1
BH-5	113	128	0.7
BH-6	116	128	1.5
BH-7	110	126	0.3
BH-8	113	126	3
BH-9	116	126	1
BH-10	110	124	0.2
BH-11	113	124	2
BH-12	116	124	3.1
BH-13	110	122	0.1
BH-14	113	122	0.66
BH-15	116	122	0.2

Figure 1: Plan view of the bore hole (BH) data and the coordinate of XPT and YPT in meters. The results of gold grade in g/t as in the table. The X value is located at 1m beside BH-8 or at coordinate (XPT - 114, YPT – 126).

Rajah 1: *Pandangan atas data lubang gerudi (BH) dan koordinate XPT dan YPT in meter. Keputusan gred emas dalam g/t seperti dalam jadual. Nilai X terletak 1 m sebelah BH-8 atau pada koordinate (XPT - 114, YPT – 126).*

(b). Based on the Figure 1, calculate the average grade of the ore body outline at cut-off grade (minimum grade) 0.5 g/t and 1.5 g/t grade based on the polygonal (local Sample Mean method).

Berdasarkan kepada Rajah 1, kirakan gred purata jasad bijih pada pada nilai potongan (nilai minimum) 0.4 g/t dan 1.5 g/t berdasarkan kaedah poligon (kaedah Purata Sample Setempat).

(6 marks/*markah*)

(c). Explain the advantages and disadvantages of the Inverse Square Distance method

Terangkan kelebihan dan kekurangan kaedah jarak songsang.

(4 marks/*markah*)

(5). (a). Define “economics” as a science.

Takrifkan "ekonomi" sebagai sains.

(2 marks/*markah*)

(b). Explain the concept of the scarcity of resources and support your answer with two examples.

Terangkan konsep kekurangan sumber dan sokong jawapan anda dengan dua contoh.

(3 marks/*markah*)

(c). What is the definition of Gross Domestic Product (GDP) of a country?

Apakah definisi Keluaran Dalam Negara Kasar (GDP) sesebuah negara?

(3 marks/*markah*)

(d). Analyze the relation between supply, demand and price of substitute goods. Use a graphical model and make at least one example.

Analisa hubungan antara penawaran, permintaan dan harga barang pengganti. Gunakan model grafik dan berikan sekurang-kurangnya satu contoh.

(5 marks/*markah*)

(e). Explain the classes of engineering economic decisions.

Terangkan kelas keputusan ekonomi kejuruteraan.

(4 marks/*markah*)

(f). Explain the relation between risk and return as one of the fundamental principles of engineering economics.

Terangkan hubungan antara risiko dan pulangan sebagai salah satu prinsip asas ekonomi kejuruteraan.

(3 marks/*markah*)

(6). (a). Explain how to determine the Total Capital Cost for a new mining project.

Terangkan bagaimana anda boleh menentukan Jumlah Kos Modal untuk projek perlombongan baru.

(5 marks/*markah*)

(b). What is “Working Capital” and how you can prepare fund for it?

Apakah “Modal Kerja” dan bagaimana anda membuat peruntukan untuknya?

(5 marks/*markah*)

(c). What is mutually exclusive projects? Explain.

Apakah projek saling menyingkiri? Terangkan.

(5 marks/*markah*)

(d). Explain and discuss the effect of change in metal price on mining operations

Bincangkan kesan perubahan harga logam dalam operasi perlombongan

(5 marks/*markah*)

(7). (a). It is estimated that a copper mine will produce 10000 tons of ore during the coming year.Production is expected to increase by 5% per year thereafter in each of the following four years. Profit per ton will be RM14 for years one through five.

Dianggarkan bahawa lombong tembaga akan menghasilkan 10000 tan bijih pada tahun akan datang. Pengeluaran dijangka meningkat sebanyak 5% setahun selepas itu dalam setiap empat tahun berikutnya. Keuntungan setiap tan ialah RM14 untuk tahun satu hingga lima.

$F=P(1+i)^N$

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(i). Table a cash-flow for this copper mine operation from the company's viewpoint.

Jadualkan aliran tunai untuk operasi lombong tembaga ini dari sudut pandang syarikat.

(ii). If the company can earn 15 % per year on its capital, what is the net future value of the copper mine's cash flows at the end of year five ?

Jika syarikat boleh memperoleh 15% setahun daripada modalnya, apakah nilai masa hadapan bersih aliran tunai lombong tembaga pada akhir tahun lima?

(10 marks/markah)

(b). (i). Draw the feasible space for this problem modeled below.
Lukiskan ruang yang boleh dilaksanakan untuk model masalah ini.

(ii). Find the optimum point which maximizes the objective function.
Cari titik optimum yang memaksimumkan fungsi objektif.

Max Z = 3x+5y

Subject to:

$x \leq 4$

$2y \leq 12$

$3x+2y \leq 18$

$x \geq 0, y \geq 0$

(10 marks/*markah*)

LAMPIRAN I (FAKTOR PENDISKAUNAN)

NILAI KINI UNTUK 1 PADA KADAR $r\% = (1+r)^{-n}$

	TAHUN															
r \ n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1%	0.9901	0.9803	0.9706	0.9610	0.9515	0.9420	0.9327	0.9235	0.9143	0.9053	0.8963	0.8874	0.8787	0.8700	0.8613	0.8528
2%	0.9804	0.9612	0.9423	0.9238	0.9057	0.8880	0.8706	0.8535	0.8368	0.8203	0.8043	0.7885	0.7730	0.7579	0.7430	0.7284
3%	0.9709	0.9426	0.9151	0.8885	0.8626	0.8375	0.8131	0.7894	0.7664	0.7441	0.7224	0.7014	0.6810	0.6611	0.6419	0.6232
4%	0.9615	0.9246	0.8890	0.8548	0.8219	0.7903	0.7599	0.7307	0.7026	0.6756	0.6496	0.6246	0.6006	0.5775	0.5553	0.5339
5%	0.9524	0.9070	0.8638	0.8227	0.7835	0.7462	0.7107	0.6768	0.6446	0.6139	0.5847	0.5568	0.5303	0.5051	0.4810	0.4581
6%	0.9434	0.8900	0.8396	0.7921	0.7473	0.7050	0.6651	0.6274	0.5919	0.5584	0.5268	0.4970	0.4688	0.4423	0.4173	0.3936
7%	0.9346	0.8734	0.8163	0.7629	0.7130	0.6663	0.6227	0.5820	0.5439	0.5083	0.4751	0.4440	0.4150	0.3878	0.3624	0.3387
8%	0.9259	0.8573	0.7938	0.7350	0.6806	0.6302	0.5835	0.5403	0.5002	0.4632	0.4289	0.3971	0.3677	0.3405	0.3152	0.2919
9%	0.9174	0.8417	0.7722	0.7084	0.6499	0.5963	0.5470	0.5019	0.4604	0.4224	0.3875	0.3555	0.3262	0.2992	0.2745	0.2519
10%	0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855	0.3505	0.3186	0.2897	0.2633	0.2394	0.2176
11%	0.9009	0.8116	0.7312	0.6587	0.5935	0.5346	0.4817	0.4339	0.3909	0.3522	0.3173	0.2858	0.2575	0.2320	0.2090	0.1883
12%	0.8929	0.7972	0.7118	0.6355	0.5674	0.5066	0.4523	0.4039	0.3606	0.3220	0.2875	0.2567	0.2292	0.2046	0.1827	0.1631
13%	0.8850	0.7831	0.6931	0.6133	0.5428	0.4803	0.4251	0.3762	0.3329	0.2946	0.2607	0.2307	0.2042	0.1807	0.1599	0.1415
14%	0.8772	0.7695	0.6750	0.5921	0.5194	0.4556	0.3996	0.3506	0.3075	0.2697	0.2366	0.2076	0.1821	0.1597	0.1401	0.1229
15%	0.8696	0.7561	0.6575	0.5718	0.4972	0.4323	0.3759	0.3269	0.2843	0.2472	0.2149	0.1869	0.1625	0.1413	0.1229	0.1069
16%	0.8621	0.7432	0.6407	0.5523	0.4761	0.4104	0.3538	0.3050	0.2630	0.2267	0.1954	0.1685	0.1452	0.1252	0.1079	0.0930
17%	0.8547	0.7305	0.6244	0.5337	0.4561	0.3898	0.3332	0.2848	0.2434	0.2080	0.1778	0.1520	0.1299	0.1110	0.0949	0.0811
18%	0.8475	0.7182	0.6086	0.5158	0.4371	0.3704	0.3139	0.2660	0.2255	0.1911	0.1619	0.1372	0.1163	0.0985	0.0835	0.0708
19%	0.8403	0.7062	0.5934	0.4987	0.4190	0.3521	0.2959	0.2487	0.2090	0.1756	0.1476	0.1240	0.1042	0.0876	0.0736	0.0618
20%	0.8333	0.6944	0.5787	0.4823	0.4019	0.3349	0.2791	0.2326	0.1938	0.1615	0.1346	0.1122	0.0935	0.0779	0.0649	0.0541
21%	0.8264	0.6830	0.5645	0.4665	0.3855	0.3186	0.2633	0.2176	0.1799	0.1486	0.1228	0.1015	0.0839	0.0693	0.0573	0.0474
22%	0.8197	0.6719	0.5507	0.4514	0.3700	0.3033	0.2486	0.2038	0.1670	0.1369	0.1122	0.0920	0.0754	0.0618	0.0507	0.0415
23%	0.8130	0.6610	0.5374	0.4369	0.3552	0.2888	0.2348	0.1909	0.1552	0.1262	0.1026	0.0834	0.0678	0.0551	0.0448	0.0364
24%	0.8065	0.6504	0.5245	0.4230	0.3411	0.2751	0.2218	0.1789	0.1443	0.1164	0.0938	0.0757	0.0610	0.0492	0.0397	0.0320
25%	0.8000	0.6400	0.5120	0.4096	0.3277	0.2621	0.2097	0.1678	0.1342	0.1074	0.0859	0.0687	0.0550	0.0440	0.0352	0.0281
26%	0.7937	0.6299	0.4999	0.3968	0.3149	0.2499	0.1983	0.1574	0.1249	0.0992	0.0787	0.0625	0.0496	0.0393	0.0312	0.0248
27%	0.7874	0.6200	0.4882	0.3844	0.3027	0.2383	0.1877	0.1478	0.1164	0.0916	0.0721	0.0568	0.0447	0.0352	0.0277	0.0218
28%	0.7813	0.6104	0.4768	0.3725	0.2910	0.2274	0.1776	0.1388	0.1084	0.0847	0.0662	0.0517	0.0404	0.0316	0.0247	0.0193
29%	0.7752	0.6009	0.4658	0.3611	0.2799	0.2170	0.1682	0.1304	0.1011	0.0784	0.0607	0.0471	0.0365	0.0283	0.0219	0.0170
30%	0.7692	0.5917	0.4552	0.3501	0.2693	0.2072	0.1594	0.1226	0.0943	0.0725	0.0558	0.0429	0.0330	0.0254	0.0195	0.0150
31%	0.7634	0.5827	0.4448	0.3396	0.2592	0.1979	0.1510	0.1153	0.0880	0.0672	0.0513	0.0392	0.0299	0.0228	0.0174	0.0133
32%	0.7576	0.5739	0.4348	0.3294	0.2495	0.1890	0.1432	0.1085	0.0822	0.0623	0.0472	0.0357	0.0271	0.0205	0.0155	0.0118
33%	0.7519	0.5653	0.4251	0.3196	0.2403	0.1807	0.1358	0.1021	0.0768	0.0577	0.0434	0.0326	0.0245	0.0185	0.0139	0.0104
34%	0.7463	0.5569	0.4156	0.3102	0.2315	0.1727	0.1289	0.0962	0.0718	0.0536	0.0400	0.0298	0.0223	0.0166	0.0124	0.0093
35%	0.7407	0.5487	0.4064	0.3011	0.2230	0.1652	0.1224	0.0906	0.0671	0.0497	0.0368	0.0273	0.0202	0.0150	0.0111	0.0082
36%	0.7353	0.5407	0.3975	0.2923	0.2149	0.1580	0.1162	0.0854	0.0628	0.0462	0.0340	0.0250	0.0184	0.0135	0.0099	0.0073
37%	0.7299	0.5328	0.3889	0.2839	0.2072	0.1512	0.1104	0.0806	0.0588	0.0429	0.0313	0.0229	0.0167	0.0122	0.0089	0.0065
38%	0.7246	0.5251	0.3805	0.2757	0.1998	0.1448	0.1049	0.0760	0.0551	0.0399	0.0289	0.0210	0.0152	0.0110	0.0080	0.0058
39%	0.7194	0.5176	0.3724	0.2679	0.1927	0.1386	0.0997	0.0718	0.0516	0.0371	0.0267	0.0192	0.0138	0.0099	0.0072	0.0051
40%	0.7143	0.5102	0.3644	0.2603	0.1859	0.1328	0.0949	0.0678	0.0484	0.0346	0.0247	0.0176	0.0126	0.0090	0.0064	0.0046
41%	0.7092	0.5030	0.3567	0.2530	0.1794	0.1273	0.0903	0.0640	0.0454	0.0322	0.0228	0.0162	0.0115	0.0081	0.0058	0.0041
42%	0.7042	0.4959	0.3492	0.2459	0.1732	0.1220	0.0859	0.0605	0.0426	0.0300	0.0211	0.0149	0.0105	0.0074	0.0052	0.0037
43%	0.6993	0.4890	0.3420	0.2391	0.1672	0.1169	0.0818	0.0572	0.0400	0.0280	0.0196	0.0137	0.0096	0.0067	0.0047	0.0033
44%	0.6944	0.4823	0.3349	0.2326	0.1615	0.1122	0.0779	0.0541	0.0376	0.0261	0.0181	0.0126	0.0087	0.0061	0.0042	0.0029
45%	0.6897	0.4756	0.3280	0.2262	0.1560	0.1076	0.0742	0.0512	0.0353	0.0243	0.0168	0.0116	0.0080	0.0055	0.0038	0.0026
46%	0.6849	0.4691	0.3213	0.2201	0.1507	0.1032	0.0707	0.0484	0.0332	0.0227	0.0156	0.0107	0.0073	0.0050	0.0034	0.0023
47%	0.6803	0.4628	0.3148	0.2142	0.1457	0.0991	0.0674	0.0459	0.0312	0.0212	0.0144	0.0098	0.0067	0.0045	0.0031	0.0021
48%	0.6757	0.4565	0.3085	0.2084	0.1408	0.0952	0.0643	0.0434	0.0294	0.0198	0.0134	0.0091	0.0061	0.0041	0.0028	0.0019
49%	0.6711	0.4504	0.3023	0.2029	0.1362	0.0914	0.0613	0.0412	0.0276	0.0185	0.0124	0.0084	0.0056	0.0038	0.0025	0.0017
50%	0.6667	0.4444	0.2963	0.1975	0.1317	0.0878	0.0585	0.0390	0.0260	0.0173	0.0116	0.0077	0.0051	0.0034	0.0023	0.0015

LAMPIRAN II (FAKTOR PENGKOMPAUNAN)

	TAHUN															
r \ n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1%	1.010	1.020	1.030	1.041	1.051	1.062	1.072	1.083	1.094	1.105	1.116	1.127	1.138	1.149	1.161	1.173
2%	1.020	1.040	1.061	1.082	1.104	1.126	1.149	1.172	1.195	1.219	1.243	1.268	1.294	1.319	1.346	1.373
3%	1.030	1.061	1.093	1.126	1.159	1.194	1.230	1.267	1.305	1.344	1.384	1.426	1.469	1.513	1.558	1.605
4%	1.040	1.082	1.125	1.170	1.217	1.265	1.316	1.369	1.423	1.480	1.539	1.601	1.665	1.732	1.801	1.873
5%	1.050	1.103	1.158	1.216	1.276	1.340	1.407	1.477	1.551	1.629	1.710	1.796	1.886	1.980	2.079	2.183
6%	1.060	1.124	1.191	1.262	1.338	1.419	1.504	1.594	1.689	1.791	1.898	2.012	2.133	2.261	2.397	2.540
7%	1.070	1.145	1.225	1.311	1.403	1.501	1.606	1.718	1.838	1.967	2.105	2.252	2.410	2.579	2.759	2.952
8%	1.080	1.166	1.260	1.360	1.469	1.587	1.714	1.851	1.999	2.159	2.332	2.518	2.720	2.937	3.172	3.426
9%	1.090	1.188	1.295	1.412	1.539	1.677	1.828	1.993	2.172	2.367	2.580	2.813	3.066	3.342	3.642	3.970
10%	1.100	1.210	1.331	1.464	1.611	1.772	1.949	2.144	2.358	2.594	2.853	3.138	3.452	3.797	4.177	4.595
11%	1.110	1.232	1.368	1.518	1.685	1.870	2.076	2.305	2.558	2.839	3.152	3.498	3.883	4.310	4.785	5.311
12%	1.120	1.254	1.405	1.574	1.762	1.974	2.211	2.476	2.773	3.106	3.479	3.896	4.363	4.887	5.474	6.130
13%	1.130	1.277	1.443	1.630	1.842	2.082	2.353	2.658	3.004	3.395	3.836	4.335	4.898	5.535	6.254	7.067
14%	1.140	1.300	1.482	1.689	1.925	2.195	2.502	2.853	3.252	3.707	4.226	4.818	5.492	6.261	7.138	8.137
15%	1.150	1.323	1.521	1.749	2.011	2.313	2.660	3.059	3.518	4.046	4.652	5.350	6.153	7.076	8.137	9.358
16%	1.160	1.346	1.561	1.811	2.100	2.436	2.826	3.278	3.803	4.411	5.117	5.936	6.886	7.988	9.266	10.748
17%	1.170	1.369	1.602	1.874	2.192	2.565	3.001	3.511	4.108	4.807	5.624	6.580	7.699	9.007	10.539	12.330
18%	1.180	1.392	1.643	1.939	2.288	2.700	3.185	3.759	4.435	5.234	6.176	7.288	8.599	10.147	11.974	14.129
19%	1.190	1.416	1.685	2.005	2.386	2.840	3.379	4.021	4.785	5.695	6.777	8.064	9.596	11.420	13.590	16.172
20%	1.200	1.440	1.728	2.074	2.488	2.986	3.583	4.300	5.160	6.192	7.430	8.916	10.699	12.839	15.407	18.488
21%	1.210	1.464	1.772	2.144	2.594	3.138	3.797	4.595	5.560	6.727	8.140	9.850	11.918	14.421	17.449	21.114
22%	1.220	1.488	1.816	2.215	2.703	3.297	4.023	4.908	5.987	7.305	8.912	10.872	13.264	16.182	19.742	24.086
23%	1.230	1.513	1.861	2.289	2.815	3.463	4.259	5.239	6.444	7.926	9.749	11.991	14.749	18.141	22.314	27.446
24%	1.240	1.538	1.907	2.364	2.932	3.635	4.508	5.590	6.931	8.594	10.657	13.215	16.386	20.319	25.196	31.243
25%	1.250	1.563	1.953	2.441	3.052	3.815	4.768	5.960	7.451	9.313	11.642	14.552	18.190	22.737	28.422	35.527
26%	1.260	1.588	2.000	2.520	3.176	4.002	5.042	6.353	8.005	10.086	12.708	16.012	20.175	25.421	32.030	40.358
27%	1.270	1.613	2.048	2.601	3.304	4.196	5.329	6.768	8.595	10.915	13.862	17.605	22.359	28.396	36.062	45.799
28%	1.280	1.638	2.097	2.684	3.436	4.398	5.629	7.206	9.223	11.806	15.112	19.343	24.759	31.691	40.565	51.923
29%	1.290	1.664	2.147	2.769	3.572	4.608	5.945	7.669	9.893	12.761	16.462	21.236	27.395	35.339	45.587	58.808
30%	1.300	1.690	2.197	2.856	3.713	4.827	6.275	8.157	10.604	13.786	17.922	23.298	30.288	39.374	51.186	66.542
31%	1.310	1.716	2.248	2.945	3.858	5.054	6.621	8.673	11.362	14.884	19.498	25.542	33.460	43.833	57.421	75.221
32%	1.320	1.742	2.300	3.036	4.007	5.290	6.983	9.217	12.166	16.060	21.199	27.983	36.937	48.757	64.359	84.954
33%	1.330	1.769	2.353	3.129	4.162	5.535	7.361	9.791	13.022	17.319	23.034	30.635	40.745	54.190	72.073	95.858
34%	1.340	1.796	2.406	3.224	4.320	5.789	7.758	10.395	13.930	18.666	25.012	33.516	44.912	60.182	80.644	108.063
35%	1.350	1.823	2.460	3.322	4.484	6.053	8.172	11.032	14.894	20.107	27.144	36.644	49.470	66.784	90.158	121.714
36%	1.360	1.850	2.515	3.421	4.653	6.328	8.605	11.703	15.917	21.647	29.439	40.037	54.451	74.053	100.713	136.969
37%	1.370	1.877	2.571	3.523	4.826	6.612	9.058	12.410	17.001	23.292	31.910	43.717	59.892	82.052	112.411	154.003
38%	1.380	1.904	2.628	3.627	5.005	6.907	9.531	13.153	18.151	25.049	34.568	47.703	65.831	90.846	125.368	173.008
39%	1.390	1.932	2.686	3.733	5.189	7.213	10.025	13.935	19.370	26.925	37.425	52.021	72.309	100.510	139.708	194.194
40%	1.400	1.960	2.744	3.842	5.378	7.530	10.541	14.758	20.661	28.925	40.496	56.694	79.371	111.120	155.568	217.795
41%	1.410	1.988	2.803	3.953	5.573	7.858	11.080	15.623	22.028	31.059	43.794	61.749	87.066	122.763	173.096	244.065
42%	1.420	2.016	2.863	4.066	5.774	8.198	11.642	16.531	23.474	33.334	47.334	67.214	95.444	135.530	192.453	273.284
43%	1.430	2.045	2.924	4.182	5.980	8.551	12.228	17.486	25.005	35.757	51.132	73.119	104.561	149.522	213.816	305.757
44%	1.440	2.074	2.986	4.300	6.192	8.916	12.839	18.488	26.623	38.338	55.206	79.497	114.475	164.845	237.376	341.822
45%	1.450	2.103	3.049	4.421	6.410	9.294	13.476	19.541	28.334	41.085	59.573	86.381	125.252	181.615	263.342	381.846
46%	1.460	2.132	3.112	4.544	6.634	9.685	14.141	20.645	30.142	44.008	64.251	93.807	136.958	199.959	291.939	426.232
47%	1.470	2.161	3.177	4.669	6.864	10.090	14.833	21.804	32.052	47.117	69.261	101.814	149.667	220.010	323.415	475.420
48%	1.480	2.190	3.242	4.798	7.101	10.509	15.554	23.019	34.069	50.422	74.624	110.444	163.457	241.916	358.035	529.892
49%	1.490	2.220	3.308	4.929	7.344	10.943	16.304	24.294	36.197	53.934	80.362	119.739	178.411	265.832	396.090	590.174
50%	1.500	2.250	3.375	5.062	7.594	11.391	17.086	25.629	38.443	57.665	86.498	129.746	194.620	291.929	437.894	656.841

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LAMPIRAN III - NILAI KINI ANUITI $r\%\left[=\frac{1-(1+r)^{-n}}{r}\right]$

NILAI KINI ANUITI UNTUK 1 PADA KADAR

	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.8850	0.8772	0.8696	0.8621	0.8547
2	1.9704	1.9416	1.9135	1.8861	1.8594	1.8334	1.8080	1.7833	1.7591	1.7355	1.7125	1.6901	1.6681	1.6467	1.6257	1.6052	1.5852
3	2.9410	2.8839	2.8286	2.7751	2.7232	2.6730	2.6243	2.5771	2.5313	2.4869	2.4437	2.4018	2.3612	2.3216	2.2832	2.2459	2.2096
4	3.9020	3.8077	3.7171	3.6299	3.5460	3.4651	3.3872	3.3121	3.2397	3.1699	3.1024	3.0373	2.9745	2.9137	2.8550	2.7982	2.7432
5	4.8534	4.7135	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927	3.8897	3.7908	3.6959	3.6048	3.5172	3.4331	3.3522	3.2743	3.1993
6	5.7955	5.6014	5.4172	5.2421	5.0757	4.9173	4.7665	4.6229	4.4859	4.3553	4.2305	4.1114	3.9975	3.8887	3.7845	3.6847	3.5892
7	6.7282	6.4720	6.2303	6.0021	5.7864	5.5824	5.3893	5.2064	5.0330	4.8684	4.7122	4.5638	4.4226	4.2883	4.1604	4.0386	3.9224
8	7.6517	7.3255	7.0197	6.7327	6.4632	6.2098	5.9713	5.7466	5.5348	5.3349	5.1461	4.9676	4.7988	4.6389	4.4873	4.3436	4.2072
9	8.5660	8.1622	7.7861	7.4353	7.1078	6.8017	6.5152	6.2469	5.9952	5.7590	5.5370	5.3282	5.1317	4.9464	4.7716	4.6065	4.4506
10	9.4713	8.9826	8.5302	8.1109	7.7217	7.3601	7.0236	6.7101	6.4177	6.1446	5.8892	5.6502	5.4262	5.2161	5.0188	4.8332	4.6586
11	10.3676	9.7868	9.2526	8.7605	8.3064	7.8869	7.4987	7.1390	6.8052	6.4951	6.2065	5.9377	5.6869	5.4527	5.2337	5.0286	4.8364
12	11.2551	10.5753	9.9540	9.3851	8.8633	8.3838	7.9427	7.5361	7.1607	6.8137	6.4924	6.1944	5.9176	5.6603	5.4206	5.1971	4.9884
13	12.1337	11.3484	10.6350	9.9856	9.3936	8.8527	8.3577	7.9038	7.4869	7.1034	6.7499	6.4235	6.1218	5.8424	5.5831	5.3423	5.1183
14	13.0037	12.1062	11.2961	10.5631	9.8986	9.2950	8.7455	8.2442	7.7862	7.3667	6.9819	6.6282	6.3025	6.0021	5.7245	5.4675	5.2293
15	13.8651	12.8493	11.9379	11.1184	10.3797	9.7122	9.1079	8.5595	8.0607	7.6061	7.1909	6.8109	6.4624	6.1422	5.8474	5.5755	5.3242
16	14.7179	13.5777	12.5611	11.6523	10.8378	10.1059	9.4466	8.8514	8.3126	7.8237	7.3792	6.9740	6.6039	6.2651	5.9542	5.6685	5.4053
17	15.5623	14.2919	13.1661	12.1657	11.2741	10.4773	9.7632	9.1216	8.5436	8.0216	7.5488	7.1196	6.7291	6.3729	6.0472	5.7487	5.4746
18	16.3983	14.9920	13.7535	12.6593	11.6896	10.8276	10.0591	9.3719	8.7556	8.2014	7.7016	7.2497	6.8399	6.4674	6.1280	5.8178	5.5339
19	17.2260	15.6785	14.3238	13.1339	12.0853	11.1581	10.3356	9.6036	8.9501	8.3649	7.8393	7.3658	6.9380	6.5504	6.1982	5.8775	5.5845
20	18.0456	16.3514	14.8775	13.5903	12.4622	11.4699	10.5940	9.8181	9.1285	8.5136	7.9633	7.4694	7.0248	6.6231	6.2593	5.9288	5.6278
21	18.8570	17.0112	15.4150	14.0292	12.8212	11.7641	10.8355	10.0168	9.2922	8.6487	8.0751	7.5620	7.1016	6.6870	6.3125	5.9731	5.6648
22	19.6604	17.6580	15.9369	14.4511	13.1630	12.0416	11.0612	10.2007	9.4424	8.7715	8.1757	7.6446	7.1695	6.7429	6.3587	6.0113	5.6964
23	20.4558	18.2922	16.4436	14.8568	13.4886	12.3034	11.2722	10.3711	9.5802	8.8832	8.2664	7.7184	7.2297	6.7921	6.3988	6.0442	5.7234
24	21.2434	18.9139	16.9355	15.2470	13.7986	12.5504	11.4693	10.5288	9.7066	8.9847	8.3481	7.7843	7.2829	6.8351	6.4338	6.0726	5.7465
25	22.0232	19.5235	17.4131	15.6221	14.0939	12.7834	11.6536	10.6748	9.8226	9.0770	8.4217	7.8431	7.3300	6.8729	6.4641	6.0971	5.7662
26	22.7952	20.1210	17.8768	15.9828	14.3752	13.0032	11.8258	10.8100	9.9290	9.1609	8.4881	7.8957	7.3717	6.9061	6.4906	6.1182	5.7831
27	23.5596	20.7069	18.3270	16.3296	14.6430	13.2105	11.9867	10.9352	10.0266	9.2372	8.5478	7.9426	7.4086	6.9352	6.5135	6.1364	5.7975
28	24.3164	21.2813	18.7641	16.6631	14.8981	13.4062	12.1371	11.0511	10.1161	9.3066	8.6016	7.9844	7.4412	6.9607	6.5335	6.1520	5.8099
29	25.0658	21.8444	19.1885	16.9837	15.1411	13.5907	12.2777	11.1584	10.1983	9.3696	8.6501	8.0218	7.4701	6.9830	6.5509	6.1656	5.8204
30	25.8077	22.3965	19.6004	17.2920	15.3725	13.7648	12.4090	11.2578	10.2737	9.4269	8.6938	8.0552	7.4957	7.0027	6.5660	6.1772	5.8294
31	26.5423	22.9377	20.0004	17.5885	15.5928	13.9291	12.5318	11.3498	10.3428	9.4790	8.7331	8.0850	7.5183	7.0199	6.5791	6.1872	5.8371
32	27.2696	23.4683	20.3888	17.8736	15.8027	14.0840	12.6466	11.4350	10.4062	9.5264	8.7686	8.1116	7.5383	7.0350	6.5905	6.1959	5.8437
33	27.9897	23.9886	20.7658	18.1476	16.0025	14.2302	12.7538	11.5139	10.4644	9.5694	8.8005	8.1354	7.5560	7.0482	6.6005	6.2034	5.8493
34	28.7027	24.4986	21.1318	18.4112	16.1929	14.3681	12.8540	11.5869	10.5178	9.6086	8.8293	8.1566	7.5717	7.0599	6.6091	6.2098	5.8541
35	29.4086	24.9986	21.4872	18.6646	16.3742	14.4982	12.9477	11.6546	10.5668	9.6442	8.8552	8.1755	7.5856	7.0700	6.6166	6.2153	5.8582
36	30.1075	25.4888	21.8323	18.9083	16.5469	14.6210	13.0352	11.7172	10.6118	9.6765	8.8786	8.1924	7.5979	7.0790	6.6231	6.2201	5.8617
37	30.7995	25.9695	22.1672	19.1426	16.7113	14.7368	13.1170	11.7752	10.6530	9.7059	8.8996	8.2075	7.6087	7.0868	6.6288	6.2242	5.8647
38	31.4847	26.4406	22.4925	19.3679	16.8679	14.8460	13.1935	11.8289	10.6908	9.7327	8.9186	8.2210	7.6183	7.0937	6.6338	6.2278	5.8673
39	32.1630	26.9026	22.8082	19.5845	17.0170	14.9491	13.2649	11.8786	10.7255	9.7570	8.9357	8.2330	7.6268	7.0997	6.6380	6.2309	5.8695
40	32.8347	27.3555	23.1148	19.7928	17.1591	15.0463	13.3317	11.9246	10.7574	9.7791	8.9511	8.2438	7.6344	7.1050	6.6418	6.2335	5.8713
41	33.4997	27.7995	23.4124	19.9931	17.2944	15.1380	13.3941	11.9672	10.7866	9.7991	8.9649	8.2534	7.6410	7.1097	6.6450	6.2358	5.8729
42	34.1581	28.2348	23.7014	20.1856	17.4232	15.2245	13.4524	12.0067	10.8134	9.8174	8.9774	8.2619	7.6469	7.1138	6.6478	6.2377	5.8743
43	34.8100	28.6616	23.9819	20.3708	17.5459	15.3062	13.5070	12.0432	10.8380	9.8340	8.9886	8.2696	7.6522	7.1173	6.6503	6.2394	5.8755
44	35.4555	29.0800	24.2543	20.5488	17.6628	15.3832	13.5579	12.0771	10.8605	9.8491	8.9988	8.2764	7.6568	7.1205	6.6524	6.2409	5.8765
45	36.0945	29.4902	24.5187	20.7200	17.7741	15.4558	13.6055	12.1084	10.8812	9.8628	9.0079	8.2825	7.6609	7.1232	6.6543	6.2421	5.8773
46	36.7272	29.8923	24.7754	20.8847	17.8801	15.5244	13.6500	12.1374	10.9002	9.8753	9.0161	8.2880	7.6645	7.1256	6.6559	6.2432	5.8781
47	37.3537	30.2866	25.0247	21.0429	17.9810	15.5890	13.6916	12.1643	10.9176	9.8866	9.0235	8.2928	7.6677	7.1277	6.6573	6.2442	5.8787
48	37.9740	30.6731	25.2667	21.1951	18.0772	15.6500	13.7305	12.1891	10.9336	9.8969	9.0302	8.2972	7.6705	7.1296	6.6585	6.2450	5.8792
49	38.5881	31.0521	25.5017	21.3415	18.1687	15.7076	13.7668	12.2122	10.9482	9.9063	9.0362	8.3010	7.6730	7.1312	6.6596	6.2457	5.8797
50	39.1961	31.4236	25.7298	21.4822	18.2559	15.7619	13.8007	12.2335	10.9617	9.9148	9.0417	8.3045	7.6752	7.1327	6.6605	6.2463	5.8801

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