

ISE 307: Engineering Economic Analysis (Term 253)

Major Exam 2 — Practice Set 2

Practice — untimed; try under exam conditions (90 min)

Name: _____ Student ID: _____

Section: _____ Date: _____

Problem 1 (30 pts)

A company is evaluating a single project. It requires **135,000 SAR** now (end of year 0) and returns a net cash inflow of **32,000 SAR** at the end of each year for **6 years**. At the end of year 6 the equipment is sold for **14,000 SAR** (salvage). The MARR is **10.0%**.

- (a) (8 pts) Compute the **net present worth (NPW)** at the MARR and state accept or reject.

- (b) (6 pts) Compute the **annual equivalent (AE)** and the **future worth (FW)**. Confirm all three (PW, AE, FW) give the same decision.

- (c) (10 pts) Compute the **conventional payback period** and the **discounted payback period** (non-rounded and rounded). If the company requires their money back within 4 years, is this project acceptable?

- (d) (6 pts) Find the project's **IRR**. If the president of the company requires a minimum return of 20%, is this project acceptable?

Problem 2 (25 pts)

A company buys a production machine for **105,000 SAR**. It can be sold for **26,000 SAR** after **5 years**. Operating cost is **15,000 SAR/yr** in years 1–2, then **19,000 SAR/yr** in years 3–5. The machine makes **4,500 units/yr**. MARR **10.0%**.

- (a) (7 pts) Compute the **capital recovery cost** $CR(10.0\%)$.

- (b) (10 pts) Compute the total **annual equivalent cost (AEC)** and the **cost per unit**. A supplier offers the same part for **10.50 SAR/unit**; should the company make in-house or buy?

- (c) (8 pts) In the long run the machine is replaced identically *forever*, and a major overhaul of **22,000 SAR** is needed **every 10 years**. Compute the **capitalized (perpetual) cost** of the whole operation.

Problem 3 (25 pts)

A workshop must keep one machine running for a required job (a **service** project, costs only). Two models with **different useful lives** are available. MARR **10.0%**.

	First cost	Operating cost/yr	Life (yr)	Salvage
X (short life)	−22,000	−5,500	3	+4,000
Y (long life)	−35,000	−4,000	6	+5,000

- (a) (15 pts) Compute the **annual equivalent cost** of each model over its life. Which one is cheaper?

- (b) (10 pts) Confirm the choice with a **present-worth comparison over the LCM** of the two lives (replicate the shorter model).

Multiple-Choice Questions (20 pts)

1. (2.5 pts) A nonsimple project turns out to have two rates of return, 9% and 35%. At a MARR of 15% the correct way to decide is to:
 - (A) compute the present worth at 15% and accept if it is positive.
 - (B) average the two rates to 22% and compare with the MARR.
 - (C) reject because $9\% < 15\%$.
 - (D) accept because $35\% > 15\%$.
2. (2.5 pts) A simple project's IRR is 14%. As the MARR rises from 10% to 14%, the accept/reject decision moves from:
 - (A) reject, and stays reject throughout.
 - (B) accept toward indifferent, because PW falls to zero at the IRR.
 - (C) accept toward reject, because PW turns negative at the IRR.
 - (D) reject toward accept.
3. (2.5 pts) For a simple investment, the statement " $IRR \geq MARR$ " is exactly equivalent to:
 - (A) the PW evaluated at the MARR is greater than or equal to zero.
 - (B) the AE evaluated at the MARR is negative.
 - (C) the payback period is shorter than half the life.
 - (D) the salvage value exceeds the first cost.

4. (2.5 pts) By the sign-change (Descartes) rule, a cash flow with exactly two sign changes can have at most:
- (A) one rate of return.
 - (B) no rate of return under any circumstances.
 - (C) three rates of return.
 - (D) two positive real rates of return.
5. (2.5 pts) The incremental rate of return between alternatives B and A is:
- (A) the average of IRR_A and IRR_B .
 - (B) the IRR of the year-by-year difference cash flow $(B - A)$.
 - (C) the difference of the individual rates, $IRR_B - IRR_A$.
 - (D) always equal to the MARR.
6. (2.5 pts) Four mutually exclusive alternatives (do-nothing not allowed) are compared by the champion–challenger incremental method. The number of incremental comparisons performed is:
- (A) one.
 - (B) six.
 - (C) three.
 - (D) four.
7. (2.5 pts) In the champion–challenger tournament with a do-nothing option allowed, the very first duel (smallest alternative versus do-nothing) reduces to:
- (A) checking that alternative's own IRR against the MARR.
 - (B) selecting the alternative with the highest revenue.
 - (C) computing the LCM of all the lives.
 - (D) comparing the two most expensive alternatives.
8. (2.5 pts) After forming an increment $(B - A)$ you find its cash flow changes sign twice. You should:
- (A) reject both alternatives.
 - (B) not trust its IRR; decide by comparing PW at the MARR instead.
 - (C) accept B automatically.
 - (D) use the larger of its two rates of return.

ISE 307: Engineering Economic Analysis (Formula Sheet)

This formula sheet is compiled with the help of GenAI. It has been reviewed and corrected by the instructor, but may still miss some course content or contain mistakes. If you find any issues, please report it so we can correct it for everyone's use. *Current version: v1.2, last updated: 2026-07-05.*

Linear Interest

$$F = P(1 + iN)$$

Single Payment

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

$$P = F(1 + i)^{-N} = P(F/P, i, N)$$

$$N = \frac{\ln(F/P)}{\ln(1+i)}, \quad i = \left(\frac{F}{P}\right)^{1/N} - 1$$

$$N_{\text{double}} \approx 72/i (\%) \quad (\text{Rule of 72})$$

Equal-Payment (Uniform) Series

$$F = A \left[\frac{(1+i)^N - 1}{i} \right] = A(F/A, i, N)$$

$$A = F \left[\frac{i}{(1+i)^N - 1} \right] = A(A/F, i, N)$$

$$P = A \left[\frac{(1+i)^N - 1}{i(1+i)^N} \right] = A(P/A, i, N)$$

$$A = P \left[\frac{i(1+i)^N}{(1+i)^N - 1} \right] = A(A/P, i, N)$$

Linear Gradient Series

$$P = G \left[\frac{(1+i)^N - iN - 1}{i^2(1+i)^N} \right] = G(P/G, i, N)$$

$$A = G \left[\frac{(1+i)^N - iN - 1}{i[(1+i)^N - 1]} \right] = G(A/G, i, N)$$

Geometric Gradient Series

$$P = \begin{cases} A_1 \left[\frac{1 - (1+g)^N(1+i)^{-N}}{i - g} \right], & i \neq g \\ A_1 \left(\frac{N}{1+i} \right), & i = g \end{cases}$$

Useful Relationships

$$(P/F) = 1/(F/P) \quad \text{Reciprocals}$$

$$(A/F) = 1/(F/A)$$

$$(A/P) = 1/(P/A)$$

$$(A/P) = (A/F) + i \quad \text{Sinking/recovery}$$

$$(P/A) = (P/F) \cdot (F/A) \quad \text{Series link}$$

Nominal & Effective Rates

$$i = r/M$$

$$i_a = \left(1 + \frac{r}{M}\right)^M - 1$$

$$i = \left(1 + \frac{r}{M}\right)^C - 1$$

$$i_a = e^r - 1, \quad F = P e^{rN}$$

Inflation

$$i = i' + f + i'f$$

$$i' = \frac{1+i}{1+f} - 1 = \frac{i-f}{1+f}$$

$$A'_n = A_n(1+f)^{-n}$$

$$\bar{f} = \left[\prod_{k=1}^N (1+f_k) \right]^{1/N} - 1$$

Loans

$$B_t = A(P/A, i, N - t + 1)$$

$$I_t = B_t \times i \quad PP_t = A - I_t$$

Perpetuity (Capitalized Cost)

$$P = A/i$$

Worth & Equivalent-Cost Methods

$$PW(i) = \sum_{n=0}^N A_n(1+i)^{-n}$$

$$FW(i) = PW(i)(F/P, i, N)$$

$$AE(i) = PW(i)(A/P, i, N)$$

$$CE(i) = A/i$$

Capital Recovery with Return

$$CR(i) = (I - S)(A/P, i, N) + iS$$

$$AEC = CR + AE \text{ of operating costs}$$

Rate of Return (IRR)

Find i^* (the IRR) that satisfies:

$$PW(i^*) = \sum_{n=0}^N A_n(1+i^*)^{-n} = 0$$

Accept if $i^* \geq \text{MARR}$

Benefit-Cost & Profitability

$$BC(i) = \frac{B}{I+C'}, \quad PI(i) = \frac{B-C'}{I}$$

Depreciation

$$D_n = \frac{I-S}{N} \quad \text{Straight-line}$$

$$D_n = (I - S) \frac{U_n}{U_{\text{total}}} \quad \text{Units of prod.}$$

$$D_n = \alpha B_{n-1} = \alpha I(1 - \alpha)^{n-1} \quad \text{Declining bal.}$$

$$D_n = I \times r_n \quad \text{MACRS } (r_n \text{ table})$$

$$B_n = I - \sum_{k=1}^n D_k \quad \text{Book value}$$

Gains, Losses & Taxes

$$\text{gain} = S - B_n$$

$$\text{gains tax} = (S - B_n)t$$

$$\text{net salvage} = S - (S - B_n)t$$

$$TI = \text{Rev} - \text{Exp} - D_n$$

$$\text{income tax} = TI \times t$$

$$\text{ATCF} = (\text{Rev} - \text{Exp})(1 - t) + t D_n$$

Replacement Analysis

$$AEC(N) = CR(N) + AEC \text{ of O\&M}(N)$$

Break-Even & Sensitivity

$$Q^* = \frac{\text{Fixed cost}}{\text{Price} - \text{Variable cost}}$$

Standardized Normal (Risk)

$$z = \frac{x - \mu}{\sigma}, \quad \Phi(-z) = 1 - \Phi(z)$$

$i = 5\%$

N	(F/P)	(P/F)	(F/A)	(A/F)	(P/A)	(A/P)	(P/G)
1	1.0500	0.9524	1.0000	1.0000	0.9524	1.0500	0.0000
2	1.1025	0.9070	2.0500	0.4878	1.8594	0.5378	0.9070
3	1.1576	0.8638	3.1525	0.3172	2.7232	0.3672	2.6347
4	1.2155	0.8227	4.3101	0.2320	3.5460	0.2820	5.1028
5	1.2763	0.7835	5.5256	0.1810	4.3295	0.2310	8.2369
6	1.3401	0.7462	6.8019	0.1470	5.0757	0.1970	11.9680
7	1.4071	0.7107	8.1420	0.1228	5.7864	0.1728	16.2321
8	1.4775	0.6768	9.5491	0.1047	6.4632	0.1547	20.9700
9	1.5513	0.6446	11.0266	0.0907	7.1078	0.1407	26.1268
10	1.6289	0.6139	12.5779	0.0795	7.7217	0.1295	31.6520
11	1.7103	0.5847	14.2068	0.0704	8.3064	0.1204	37.4988
12	1.7959	0.5568	15.9171	0.0628	8.8633	0.1128	43.6241
13	1.8856	0.5303	17.7130	0.0565	9.3936	0.1065	49.9879
14	1.9799	0.5051	19.5986	0.0510	9.8986	0.1010	56.5538
15	2.0789	0.4810	21.5786	0.0463	10.3797	0.0963	63.2880
16	2.1829	0.4581	23.6575	0.0423	10.8378	0.0923	70.1597
17	2.2920	0.4363	25.8404	0.0387	11.2741	0.0887	77.1405
18	2.4066	0.4155	28.1324	0.0355	11.6896	0.0855	84.2043
19	2.5270	0.3957	30.5390	0.0327	12.0853	0.0827	91.3275
20	2.6533	0.3769	33.0660	0.0302	12.4622	0.0802	98.4884
21	2.7860	0.3589	35.7193	0.0280	12.8212	0.0780	105.6673
22	2.9253	0.3418	38.5052	0.0260	13.1630	0.0760	112.8461
23	3.0715	0.3256	41.4305	0.0241	13.4886	0.0741	120.0087
24	3.2251	0.3101	44.5020	0.0225	13.7986	0.0725	127.1402
25	3.3864	0.2953	47.7271	0.0210	14.0939	0.0710	134.2275
26	3.5557	0.2812	51.1135	0.0196	14.3752	0.0696	141.2585
27	3.7335	0.2678	54.6691	0.0183	14.6430	0.0683	148.2226
28	3.9201	0.2551	58.4026	0.0171	14.8981	0.0671	155.1101
29	4.1161	0.2429	62.3227	0.0160	15.1411	0.0660	161.9126
30	4.3219	0.2314	66.4388	0.0151	15.3725	0.0651	168.6226
36	5.7918	0.1727	95.8363	0.0104	16.5469	0.0604	206.6237
48	10.4013	0.0961	188.0254	0.0053	18.0772	0.0553	269.2467
60	18.6792	0.0535	353.5837	0.0028	18.9293	0.0528	314.3432
72	33.5451	0.0298	650.9027	0.0015	19.4038	0.0515	345.1485
100	131.5013	0.0076	2610.0252	0.0004	19.8479	0.0504	381.7492

 $i = 7\%$

N	(F/P)	(P/F)	(F/A)	(A/F)	(P/A)	(A/P)	(P/G)
1	1.0700	0.9346	1.0000	1.0000	0.9346	1.0700	0.0000
2	1.1449	0.8734	2.0700	0.4831	1.8080	0.5531	0.8734
3	1.2250	0.8163	3.2149	0.3111	2.6243	0.3811	2.5060
4	1.3108	0.7629	4.4399	0.2252	3.3872	0.2952	4.7947
5	1.4026	0.7130	5.7507	0.1739	4.1002	0.2439	7.6467
6	1.5007	0.6663	7.1533	0.1398	4.7665	0.2098	10.9784
7	1.6058	0.6227	8.6540	0.1156	5.3893	0.1856	14.7149
8	1.7182	0.5820	10.2598	0.0975	5.9713	0.1675	18.7889
9	1.8385	0.5439	11.9780	0.0835	6.5152	0.1535	23.1404
10	1.9672	0.5083	13.8164	0.0724	7.0236	0.1424	27.7156
11	2.1049	0.4751	15.7836	0.0634	7.4987	0.1334	32.4665
12	2.2522	0.4440	17.8885	0.0559	7.9427	0.1259	37.3506
13	2.4098	0.4150	20.1406	0.0497	8.3577	0.1197	42.3302
14	2.5785	0.3878	22.5505	0.0443	8.7455	0.1143	47.3718
15	2.7590	0.3624	25.1290	0.0398	9.1079	0.1098	52.4461
16	2.9522	0.3387	27.8881	0.0359	9.4466	0.1059	57.5271
17	3.1588	0.3166	30.8402	0.0324	9.7632	0.1024	62.5923
18	3.3799	0.2959	33.9990	0.0294	10.0591	0.0994	67.6219
19	3.6165	0.2765	37.3790	0.0268	10.3356	0.0968	72.5991
20	3.8697	0.2584	40.9955	0.0244	10.5940	0.0944	77.5091
21	4.1406	0.2415	44.8652	0.0223	10.8355	0.0923	82.3393
22	4.4304	0.2257	49.0057	0.0204	11.0612	0.0904	87.0793
23	4.7405	0.2109	53.4361	0.0187	11.2722	0.0887	91.7201
24	5.0724	0.1971	58.1767	0.0172	11.4693	0.0872	96.2545
25	5.4274	0.1842	63.2490	0.0158	11.6536	0.0858	100.6765
26	5.8074	0.1722	68.6765	0.0146	11.8258	0.0846	104.9814
27	6.2139	0.1609	74.4838	0.0134	11.9867	0.0834	109.1656
28	6.6488	0.1504	80.6977	0.0124	12.1371	0.0824	113.2264
29	7.1143	0.1406	87.3465	0.0114	12.2777	0.0814	117.1622
30	7.6123	0.1314	94.4608	0.0106	12.4090	0.0806	120.9718
36	11.4239	0.0875	148.9135	0.0067	13.0352	0.0767	141.1990
48	25.7289	0.0389	353.2701	0.0028	13.7305	0.0728	169.4981
60	57.9464	0.0173	813.5204	0.0012	14.0392	0.0712	185.7677
72	130.5065	0.0077	1850.0922	0.0005	14.1763	0.0705	194.6365
100	867.7163	0.0012	12382	0.0001	14.2693	0.0701	202.2001

 $i = 6\%$

N	(F/P)	(P/F)	(F/A)	(A/F)	(P/A)	(A/P)	(P/G)
1	1.0600	0.9434	1.0000	1.0000	0.9434	1.0600	0.0000
2	1.1236	0.8900	2.0600	0.4854	1.8334	0.5454	0.8900
3	1.1910	0.8396	3.1836	0.3141	2.6730	0.3741	2.5692
4	1.2625	0.7921	4.3746	0.2286	3.4651	0.2886	4.9455
5	1.3382	0.7473	5.6371	0.1774	4.2124	0.2374	7.9345
6	1.4185	0.7050	6.9753	0.1434	4.9173	0.2034	11.4594
7	1.5036	0.6651	8.3938	0.1191	5.5824	0.1791	15.4497
8	1.5938	0.6274	9.8975	0.1010	6.2098	0.1610	19.8416
9	1.6895	0.5919	11.4913	0.0870	6.8017	0.1470	24.5768
10	1.7908	0.5584	13.1808	0.0759	7.3601	0.1359	29.6023
11	1.8983	0.5268	14.9716	0.0668	7.8869	0.1268	34.8702
12	2.0122	0.4970	16.8699	0.0593	8.3838	0.1193	40.3369
13	2.1329	0.4688	18.8821	0.0530	8.8527	0.1130	45.9629
14	2.2609	0.4423	21.0151	0.0476	9.2950	0.1076	51.7128
15	2.3966	0.4173	23.2760	0.0430	9.7122	0.1030	57.5546
16	2.5404	0.3936	25.6725	0.0390	10.1059	0.0990	63.4592
17	2.6928	0.3714	28.2129	0.0354	10.4773	0.0954	69.4011
18	2.8543	0.3503	30.9057	0.0324	10.8276	0.0924	75.3569
19	3.0256	0.3305	33.7600	0.0296	11.1581	0.0896	81.3062
20	3.2071	0.3118	36.7856	0.0272	11.4699	0.0872	87.2304
21	3.3996	0.2942	39.9927	0.0250	11.7641	0.0850	93.1136
22	3.6035	0.2775	43.3923	0.0230	12.0416	0.0830	98.9412
23	3.8197	0.2618	46.9958	0.0213	12.3034	0.0813	104.7007
24	4.0489	0.2470	50.8156	0.0197	12.5504	0.0797	110.3812
25	4.2919	0.2330	54.8645	0.0182	12.7834	0.0782	115.9732
26	4.5494	0.2198	59.1564	0.0169	13.0032	0.0769	121.4684
27	4.8223	0.2074	63.7058	0.0157	13.2105	0.0757	126.8600
28	5.1117	0.1956	68.5281	0.0146	13.4062	0.0746	132.1420
29	5.4184	0.1846	73.6398	0.0136	13.5907	0.0736	137.3096
30	5.7435	0.1741	79.0582	0.0126	13.7648	0.0726	142.3588
36	8.1473	0.1227	119.1209	0.0084	14.6210	0.0684	170.0387
48	16.3939	0.0610	256.5645	0.0039	15.6500	0.0639	212.0351
60	32.9877	0.0303	533.1282	0.0019	16.1614	0.0619	239.0428
72	66.3777	0.0151	1089.6286	0.0009	16.4156	0.0609	255.5146
100	339.3021	0.0029	5638.3681	0.0002	16.6175	0.0602	272.0471

 $i = 8\%$

N	(F/P)	(P/F)	(F/A)	(A/F)	(P/A)	(A/P)	(P/G)
1	1.0800	0.9259	1.0000	1.0000	0.9259	1.0800	0.0000
2	1.1664	0.8573	2.0800	0.4808	1.7833	0.5608	0.8573
3	1.2597	0.7938	3.2464	0.3080	2.5771	0.3880	2.4450
4	1.3605	0.7350	4.5061	0.2219	3.3121	0.3019	4.6501
5	1.4693	0.6806	5.8666	0.1705	3.9927	0.2505	7.3724
6	1.5869	0.6302	7.3359	0.1363	4.6229	0.2163	10.5233
7	1.7138	0.5835	8.9228	0.1121	5.2064	0.1921	14.0242
8	1.8509	0.5403	10.6366	0.0940	5.7466	0.1740	17.8061
9	1.9990	0.5002	12.4876	0.0801	6.2469	0.1601	21.8081
10	2.1589	0.4632	14.4866	0.0690	6.7101	0.1490	25.9768
11	2.3316	0.4289	16.6455	0.0601	7.1390	0.1401	30.2657
12	2.5182	0.3971	18.9771	0.0527	7.5361	0.1327	34.6339
13	2.7196	0.3677	21.4953	0.0465	7.9038	0.1265	39.0463
14	2.9372	0.3405	24.2149	0.0413	8.2442	0.1213	43.4723
15	3.1722	0.3152	27.1521	0.0368	8.5595	0.1168	47.8857
16	3.4259	0.2919	30.3243	0.0330	8.8514	0.1130	52.2640
17	3.7000	0.2703	33.7502	0.0296	9.1216	0.1096	56.5883
18	3.9960	0.2502	37.4502	0.0267	9.3719	0.1067	60.8426
19	4.3157	0.2317	41.4463	0.0241	9.6036	0.1041	65.0134
20	4.6610	0.2145	45.7620	0.0219	9.8181	0.1019	69.0898
21	5.0338	0.1987	50.4229	0.0198	10.0168	0.0998	73.0629
22	5.4365	0.1839	55.4568	0.0180	10.2007	0.0980	76.9257
23	5.8715	0.1703	60.8933	0.0164	10.3711	0.0964	80.6726
24	6.3412	0.1577	66.7648	0.0150	10.5288	0.0950	84.2997
25	6.8485	0.1460	73.1059	0.0137	10.6748	0.0937	87.8041
26	7.3964	0.1352	79.9544	0.0125	10.8100	0.0925	91.1842
27	7.9881	0.1252	87.3508	0.0114	10.9352	0.0914	94.4390
28	8.6271	0.1159	95.3388	0.0105	11.0511	0.0905	97.5687
29	9.3173	0.1073	103.9659	0.0096	11.1584	0.0896	100.5738
30	10.0627	0.0994	113.2832	0.0088	11.2578	0.0888	103.4558
36	15.9682	0.0626	187.1021	0.0053	11.7172	0.0853	118.2839
48	40.2106	0.0249	490.1322	0.0020	12.1891	0.0820	137.4428
60	101.2571	0.0099	1253.2133	0.0008	12.3766	0.0808	147.3000
72	254.9825	0.0039	3174.7814	0.0003	12.4510	0.0803	152.1076
100	2199.7613	0.0005	27485	0.0000	12.4943	0.0800	155.6107

$i = 9\%$

N	(F/P)	(P/F)	(F/A)	(A/F)	(P/A)	(A/P)	(P/G)
1	1.0900	0.9174	1.0000	1.0000	0.9174	1.0900	0.0000
2	1.1881	0.8417	2.0900	0.4785	1.7591	0.5685	0.8417
3	1.2950	0.7722	3.2781	0.3051	2.5313	0.3951	2.3860
4	1.4116	0.7084	4.5731	0.2187	3.2397	0.3087	4.5113
5	1.5386	0.6499	5.9847	0.1671	3.8897	0.2571	7.1110
6	1.6771	0.5963	7.5233	0.1329	4.4859	0.2229	10.0924
7	1.8280	0.5470	9.2004	0.1087	5.0330	0.1987	13.3746
8	1.9926	0.5019	11.0285	0.0907	5.5348	0.1807	16.8877
9	2.1719	0.4604	13.0210	0.0768	5.9952	0.1668	20.5711
10	2.3674	0.4224	15.1929	0.0658	6.4177	0.1558	24.3728
11	2.5804	0.3875	17.5603	0.0569	6.8052	0.1469	28.2481
12	2.8127	0.3555	20.1407	0.0497	7.1607	0.1397	32.1590
13	3.0658	0.3262	22.9534	0.0436	7.4869	0.1336	36.0731
14	3.3417	0.2992	26.0192	0.0384	7.7862	0.1284	39.9633
15	3.6425	0.2745	29.3609	0.0341	8.0607	0.1241	43.8069
16	3.9703	0.2519	33.0034	0.0303	8.3126	0.1203	47.5849
17	4.3276	0.2311	36.9737	0.0270	8.5436	0.1170	51.2821
18	4.7171	0.2120	41.3013	0.0242	8.7556	0.1142	54.8860
19	5.1417	0.1945	46.0185	0.0217	8.9501	0.1117	58.3868
20	5.6044	0.1784	51.1601	0.0195	9.1285	0.1095	61.7770
21	6.1088	0.1637	56.7645	0.0176	9.2922	0.1076	65.0509
22	6.6586	0.1502	62.8733	0.0159	9.4424	0.1059	68.2048
23	7.2579	0.1378	69.5319	0.0144	9.5802	0.1044	71.2359
24	7.9111	0.1264	76.7898	0.0130	9.7066	0.1030	74.1433
25	8.6231	0.1160	84.7009	0.0118	9.8226	0.1018	76.9265
26	9.3992	0.1064	93.3240	0.0107	9.9290	0.1007	79.5863
27	10.2451	0.0976	102.7231	0.0097	10.0266	0.0997	82.1241
28	11.1671	0.0895	112.9682	0.0089	10.1161	0.0989	84.5419
29	12.1722	0.0822	124.1354	0.0081	10.1983	0.0981	86.8422
30	13.2677	0.0754	136.3075	0.0073	10.2737	0.0973	89.0280
36	22.2512	0.0449	236.1247	0.0042	10.6118	0.0942	99.9319
48	62.5852	0.0160	684.2804	0.0015	10.9336	0.0915	112.9625
60	176.0313	0.0057	1944.7921	0.0005	11.0480	0.0905	118.9683
72	495.1170	0.0020	5490.1891	0.0002	11.0887	0.0902	121.5917
100	5529.0408	0.0002	61423	0.0000	11.1091	0.0900	123.2335

 $i = 12\%$

N	(F/P)	(P/F)	(F/A)	(A/F)	(P/A)	(A/P)	(P/G)
1	1.1200	0.8929	1.0000	1.0000	0.8929	1.1200	0.0000
2	1.2544	0.7972	2.1200	0.4717	1.6901	0.5917	0.7972
3	1.4049	0.7118	3.3744	0.2963	2.4018	0.4163	2.2208
4	1.5735	0.6355	4.7793	0.2092	3.0373	0.3292	4.1273
5	1.7623	0.5674	6.3528	0.1574	3.6048	0.2774	6.3970
6	1.9738	0.5066	8.1152	0.1232	4.1114	0.2432	8.9302
7	2.2107	0.4523	10.0890	0.0991	4.5638	0.2191	11.6443
8	2.4760	0.4039	12.2997	0.0813	4.9676	0.2013	14.4714
9	2.7731	0.3606	14.7757	0.0677	5.3282	0.1877	17.3563
10	3.1058	0.3220	17.5487	0.0570	5.6502	0.1770	20.2541
11	3.4785	0.2875	20.6546	0.0484	5.9377	0.1684	23.1288
12	3.8960	0.2567	24.1331	0.0414	6.1944	0.1614	25.9523
13	4.3635	0.2292	28.0291	0.0357	6.4235	0.1557	28.7024
14	4.8871	0.2046	32.3926	0.0309	6.6282	0.1509	31.3624
15	5.4736	0.1827	37.2797	0.0268	6.8109	0.1468	33.9202
16	6.1304	0.1631	42.7533	0.0234	6.9740	0.1434	36.3670
17	6.8660	0.1456	48.8837	0.0205	7.1196	0.1405	38.6973
18	7.6900	0.1300	55.7497	0.0179	7.2497	0.1379	40.9080
19	8.6128	0.1161	63.4397	0.0158	7.3658	0.1358	42.9979
20	9.6463	0.1037	72.0524	0.0139	7.4694	0.1339	44.9676
21	10.8038	0.0926	81.6987	0.0122	7.5620	0.1322	46.8188
22	12.1003	0.0826	92.5026	0.0108	7.6446	0.1308	48.5543
23	13.5523	0.0738	104.6029	0.0096	7.7184	0.1296	50.1776
24	15.1786	0.0659	118.1552	0.0085	7.7843	0.1285	51.6929
25	17.0001	0.0588	133.3339	0.0075	7.8431	0.1275	53.1046
26	19.0401	0.0525	150.3339	0.0067	7.8957	0.1267	54.4177
27	21.3249	0.0469	169.3740	0.0059	7.9426	0.1259	55.6369
28	23.8839	0.0419	190.6989	0.0052	7.9844	0.1252	56.7674
29	26.7499	0.0374	214.5828	0.0047	8.0218	0.1247	57.8141
30	29.9599	0.0334	241.3327	0.0041	8.0552	0.1241	58.7821
36	59.1356	0.0169	484.4631	0.0021	8.1924	0.1221	63.1970
48	230.3908	0.0043	1911.5898	0.0005	8.2972	0.1205	67.4068
60	897.5969	0.0011	7471.6411	0.0001	8.3240	0.1201	68.8100
72	3497.0161	0.0003	29133	0.0000	8.3310	0.1200	69.2530
100	83522	0.0000	696011	0.0000	8.3332	0.1200	69.4336

 $i = 10\%$

N	(F/P)	(P/F)	(F/A)	(A/F)	(P/A)	(A/P)	(P/G)
1	1.1000	0.9091	1.0000	1.0000	0.9091	1.1000	0.0000
2	1.2100	0.8264	2.1000	0.4762	1.7355	0.5762	0.8264
3	1.3310	0.7513	3.3100	0.3021	2.4869	0.4021	2.3291
4	1.4641	0.6830	4.6410	0.2155	3.1699	0.3155	4.3781
5	1.6105	0.6209	6.1051	0.1638	3.7908	0.2638	6.8618
6	1.7716	0.5645	7.7156	0.1296	4.3553	0.2296	9.6842
7	1.9487	0.5132	9.4872	0.1054	4.8684	0.2054	12.7631
8	2.1436	0.4665	11.4359	0.0874	5.3349	0.1874	16.0287
9	2.3579	0.4241	13.5795	0.0736	5.7590	0.1736	19.4215
10	2.5937	0.3855	15.9374	0.0627	6.1446	0.1627	22.8913
11	2.8531	0.3505	18.5312	0.0540	6.4951	0.1540	26.3963
12	3.1384	0.3186	21.3843	0.0468	6.8137	0.1468	29.9012
13	3.4523	0.2897	24.5227	0.0408	7.1034	0.1408	33.3772
14	3.7975	0.2633	27.9750	0.0357	7.3667	0.1357	36.8005
15	4.1772	0.2394	31.7725	0.0315	7.6061	0.1315	40.1520
16	4.5950	0.2176	35.9497	0.0278	7.8237	0.1278	43.4164
17	5.0545	0.1978	40.5447	0.0247	8.0216	0.1247	46.5819
18	5.5599	0.1799	45.5992	0.0219	8.2014	0.1219	49.6395
19	6.1159	0.1635	51.1591	0.0195	8.3649	0.1195	52.5827
20	6.7275	0.1486	57.2750	0.0175	8.5136	0.1175	55.4069
21	7.4002	0.1351	64.0025	0.0156	8.6487	0.1156	58.1095
22	8.1403	0.1228	71.4027	0.0140	8.7715	0.1140	60.6893
23	8.9543	0.1117	79.5430	0.0126	8.8832	0.1126	63.1462
24	9.8497	0.1015	88.4973	0.0113	8.9847	0.1113	65.4813
25	10.8347	0.0923	98.3471	0.0102	9.0770	0.1102	67.6964
26	11.9182	0.0839	109.1818	0.0092	9.1609	0.1092	69.7940
27	13.1100	0.0763	121.0999	0.0083	9.2372	0.1083	71.7773
28	14.4210	0.0693	134.2099	0.0075	9.3066	0.1075	73.6495
29	15.8631	0.0630	148.6309	0.0067	9.3696	0.1067	75.4146
30	17.4494	0.0573	164.4940	0.0061	9.4269	0.1061	77.0766
36	30.9127	0.0323	299.1268	0.0033	9.6765	0.1033	85.1194
48	97.0172	0.0103	960.1723	0.0010	9.8969	0.1010	94.0217
60	304.4816	0.0033	3034.8164	0.0003	9.9672	0.1003	97.7010
72	955.5938	0.0010	9545.9382	0.0001	9.9895	0.1001	99.1419
100	13781	0.0001	137796	0.0000	9.9993	0.1000	99.9202

 $i = 15\%$

N	(F/P)	(P/F)	(F/A)	(A/F)	(P/A)	(A/P)	(P/G)
1	1.1500	0.8696	1.0000	1.0000	0.8696	1.1500	0.0000
2	1.3225	0.7561	2.1500	0.4651	1.6257	0.6151	0.7561
3	1.5209	0.6575	3.4725	0.2880	2.2832	0.4380	2.0712
4	1.7490	0.5718	4.9934	0.2003	2.8550	0.3503	3.7864
5	2.0114	0.4972	6.7424	0.1483	3.3522	0.2983	5.7751
6	2.3131	0.4323	8.7537	0.1142	3.7845	0.2642	7.9368
7	2.6600	0.3759	11.0668	0.0904	4.1604	0.2404	10.1924
8	3.0590	0.3269	13.7268	0.0729	4.4873	0.2229	12.4807
9	3.5179	0.2843	16.7858	0.0596	4.7716	0.2096	14.7548
10	4.0456	0.2472	20.3037	0.0493	5.0188	0.1993	16.9795
11	4.6524	0.2149	24.3493	0.0411	5.2337	0.1911	19.1289
12	5.3503	0.1869	29.0017	0.0345	5.4206	0.1845	21.1849
13	6.1528	0.1625	34.3519	0.0291	5.5831	0.1791	23.1352
14	7.0757	0.1413	40.5047	0.0247	5.7245	0.1747	24.9725
15	8.1371	0.1229	47.5804	0.0210	5.8474	0.1710	26.6930
16	9.3576	0.1069	55.7175	0.0179	5.9542	0.1679	28.2960
17	10.7613	0.0929	65.0751	0.0154	6.0472	0.1654	29.7828
18	12.3755	0.0808	75.8364	0.0132	6.1280	0.1632	31.1565
19	14.2318	0.0703	88.2118	0.0113	6.1982	0.1613	32.4213
20	16.3665	0.0611	102.4436	0.0098	6.2593	0.1598	33.5822
21	18.8215	0.0531	118.8101	0.0084	6.3125	0.1584	34.6448
22	21.6447	0.0462	137.6316	0.0073	6.3587	0.1573	35.6150
23	24.8915	0.0402	159.2764	0.0063	6.3988	0.1563	36.4988
24	28.6252	0.0349	184.1678	0.0054	6.4338	0.1554	37.3023
25	32.9190	0.0304	212.7930	0.0047	6.4641	0.1547	38.0314
26	37.8568	0.0264	245.7120	0.0041	6.4906	0.1541	38.6918
27	43.5353	0.0230	283.5688	0.0035	6.5135	0.1535	39.2890
28	50.0656	0.0200	327.1041	0.0031	6.5335	0.1531	39.8283
29	57.5755	0.0174	377.1697	0.0027	6.5509	0.1527	40.3146
30	66.2118	0.0151	434.7451	0.0023	6.5660	0.1523	40.7526
36	153.1519	0.0065	1014.3457	0.0010	6.6231	0.1510	42.5872
48	819.4007	0.0012	5456.0047	0.0002	6.6585	0.1502	43.9997
60	4383.9987	0.0002	29220	0.0000	6.6651	0.1500	44.3431
72	23455	0.0000	156363	0.0000	6.6664	0.1500	44.4221
100	1174313	0.0000	7828750	0.0000	6.6667	0.1500	44.4438