



ENERGY SAVINGS PERFORMANCE AND MEASUREMENT & VERIFICATION ONLINE TRAINING COURSE

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP
ENERGY SPECIALIST CURRICULUM



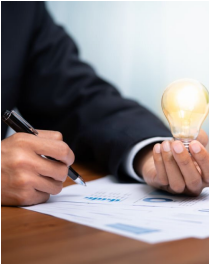


ECONOMIC ANALYSIS AND LIFE CYCLE COSTING FOR ENERGY PROFESSIONALS

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WHAT SHOULD YOU LEARN



- Economic Analysis and Life Cycle Costing
- Terms used in Economic Analysis and Life Cycle Costing
- Economic Evaluation Example
- SIR Decision Criterion
- Interest Tables for Economic Analyses



ECONOMIC ANALYSIS AND LIFE CYCLE COSTING



- ✓ Mandatory section with 20 questions.
- ✓ Useful material for our professional and personal lives.
- ✓ Two hours only, thus brief coverage and simplifying assumptions.
- ✓ Money today is worth more than that same amount at a future date.
- ✓ Example: You win the lottery (congratulations). You are offered \$100,000 today or \$X at the end of every year for the next 10 years. Ignoring taxes, how much would X have to be for you to choose that option? Your investment portfolio is averaging 15% return per year.

ECONOMIC ANALYSIS AND LIFE CYCLE COSTING



- ✓ Engineering Economy and Economics
 1. Several questions on basic economics.
 2. Several problems on simple engineering economy.
 3. Several problems requiring command of engineering economy (internal rate of return, present worth, after tax cash flows, etc.).
- ✓ Simplifying assumptions
 1. Most problems involve an investment now ($T=0$) with annual savings (cost) each and every year for the life of the project.
 2. The life of the project and the equipment life will be given and they will usually be equal.
 3. The cash flow frequency and the compounding periods will match and will usually be annual.

TERMS USED IN THIS COURSE



- ✓ TERMS: For this course, the following terms are important. Some texts may use different terms but these are simplified.
 1. Interest rate, discount rate, minimum attractive rate of return (MARR)—all mean the interest rate to use in the calculation.
 2. Rate of return, return on investment, and internal rate of return—all mean the “interest rate where the present worth of the investment equals the present worth of the savings.”

TERMS USED IN THIS COURSE

- ✓ **Simple Payback (SPB or SPP)** is the number of years before the savings “payback” the investment.

$SPB = \text{Investment} / \text{Net Annual Savings}$ Example: A project has an investment of \$100,000. Savings per year are \$22,000 but added maintenance because of the project is \$2000.

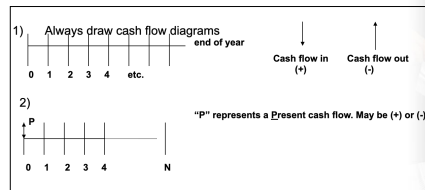
What is the SPB?

Note: SPB does not consider interest and ignores what happens after the payback period. Thus, SPB is not an accurate decision criterion; but everyone understands it (or think they do) and will likely always have it around. Used in proper fashion, SPB is not a bad “first cut” tool.

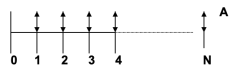
- ✓ **Salvage Value** is the value of the equipment at the end of the project life. Sometimes salvage value is positive and sometimes it is negative. Salvage value is usually ignored in this section.

TERMS USED IN THIS COURSE

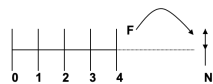
- ✓ **Cash Flow Diagram (CFD).** The CFD is a drawing depicting the cash flows for the life of the project. It is essential for people new to this material to draw the CFD each and every time.



TERMS USED IN THIS COURSE



“A” represents an Annual cash flow. May be (+) or (-). Starts at end of year 1 and Continues through life of project (simplifying assumption).



“F” represents a Future cash flow. May be (+) or (-). Occurs at end of some future year (usually end of project).

TERMS USED IN THIS COURSE

In almost all engineering economy problems, all of the following are known except for one. Solving for it completes the problem.

P, A, I, N Where I is known as the interest rate, discount factor, minimum attractive rate of return, or (in some cases) internal rate of return.

3) Factors are tabulated in all Economy texts

What I want to know

What I do know

$- / -, I, N$
(
 $P/A, I, N$
(

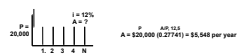
"Find P given that A, I and N are known"

TERMS USED IN THIS COURSE

Find	Given	Factor	Other Title for Factor
F	P	F/P, I, N	SPCA
P	F	P/F, I, N	SPPW
F	A	F/A, I, N	USCA
A	F	A/F, I, N	SFP
A	P	A/P, I, N	CR
P	A	P/A, I, N	USPW

SAMPLE PROBLEMS

a) A boiler economizer will cost \$20,000 installed. How much will it have to save each year (life = 5 years) to return 12%? Here, $P = \$20,000$, $i = 12\%$, $N = 5$, $A = ?$



$A = \$20,000 (0.27745) = \$5,549$ per year

b) A new lighting system will save \$5000 per year. How much can I pay and still get a 15% rate of return? Life = 6 years.
 $A = \$5000/\text{yr}$, $i = 15\%$, $N = 6$, $P = ?$



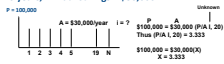
$P = \$5,000 (3.7945) = \$18,972$

SAMPLE PROBLEMS

C) At some interest rate the present worth of the investment (P) is exactly equal to the present worth of the annual savings (P/A, i, N). This is known as the internal rate of return.

Example—What is the internal rate of return for installing a waste heat recovery system, given:

First Cost = \$100,000, Life = 20 years, Annual Savings = \$30,000



Now, search the different interest tables until you find the i where $(P/A, i, N) = 3.333$:
i = IRR = 30% (almost)

Hint: For IRR a good start is try $i = A/P$.

In our example, $i = \$30,000/\$100,000 = 30\%$ which is an upper limit for IRR.

For long periods of time (n = 20 or more) and high i this will be very close. For shorter n and smaller i, it is only a start and IRR will be less than $i = A/P$.

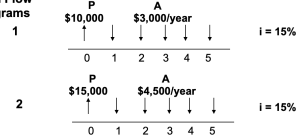
SAMPLE PROBLEMS

Present Worth Analysis

Two insulation thickness are proposed. The cost and savings vary as shown below. Which is better if a return of 15% is required?

Thickness	Cost	Yearly Savings	Life
3 cm	\$10,000	\$3,000	5 years
5 cm	\$15,000	\$4,500	5 years

Cash Flow Diagrams



i: Economic Analysis and Life Cycle Costing - 14

SAMPLE PROBLEMS

Hence, we calculate an equivalent "P" for each. If $P > 0$, it is attractive. If both P's are greater than zero, choose the one that is the maximum. We call that equivalent P the "Present Worth (PW)." $PW(0) = 0$

$$A \quad P/A, 15, 5$$

$$PW(1) = -10,000 + 3,000(3.352) = \$56$$

$$A \quad P/A, 15, 5$$

$$PW(2) = -15,000 + 4,500(3.352) = \$84$$

$P2 > P1$, so, 5 cm is better.

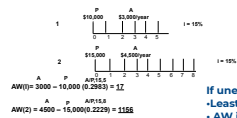
This is called the "Present Worth" Method

SAMPLE PROBLEMS

Find	Given	Factor	Other Title for Factor
F	P	F/P, I, N	SPCA
P	F	P/F, I, N	SPPW
F	A	F/A, I, N	USCA
A	F	A/F, I, N	SFP
A	P	A/P, I, N	CR
P	A	P/A, I, N	USPW

SAMPLE PROBLEMS

What if Alternative 2 lasted 8 years and Alternative 1 lasted 5 years?



If unequal lives, use
 - Least common denominator for planning horizon
 - AW instead of PW

A combined heat and power DG system saves \$10,000 per year. The average life of the project is 7 years. At a discount rate of 10%, what is the NPV of this project? Is this a good project?

$$NPV = PV(\text{savings}) - PV(\text{cost})$$

Solution:

$$NPV = A \cdot [P/A, I, N] - \text{Cost}$$

$$NPV = \$10,000 \cdot [P/A, 10\%, 7] - \$30,000$$

$$= \$10,000 \cdot 4.8684 - \$30,000$$

Solution:

$$NPV = A \cdot [P/A, I, N] - \text{Cost}$$

$$NPV = \$10,000 \cdot [P/A, 10\%, 7] - \$30,000$$

$$= \$10,000 \cdot 4.8684 - \$30,000$$

$$= \$48,684 - \$30,000$$

$$= \$18,684$$

NPV > \$0 so it is a good project.

SIR DECISION CRITERION

- ☒ SIR is the Savings to Investment Ratio
- ☒ The Savings is in Present Value
- ☒ The Investment or Cost is in Present Value (now)
- ☒ If $SIR > 1$, the project is cost effective
- ☒ The bigger the SIR, the better the project
- ☒ SIR and BCR are the same criteria

SIR DECISION CRITERION

Find the SIR for the CHP system example on I-17. Is this a good project?

Use Previous Calculations

SIR =

$$\begin{aligned}\text{SIR} &= \frac{\text{PV}(\text{savings})}{\text{PV}(\text{costs})} \\ &= \frac{\$48,684}{\$30,000} \\ &= 1.623\end{aligned}$$

SIR = This is a good project.



LIFE CYCLE COST EXAMPLE

A Rhino genset costs \$30,000 to buy and costs \$15,000/year to operate over its 10-year life. An Elephant genset costs \$40,000 to buy and costs \$12,000/year to operate. Which genset has the lowest LCC at a 10% discount rate? $\text{LCC} = \text{PV}(\text{purchase cost}) + \text{PV}(\text{operating cost})$

Solution :

$$\text{LCC Rhino} = \$30,000 + \$15,000 [\text{P/A}, 10\%, 10]$$

$$\begin{aligned}\text{LCC Elephant} &= \$40,000 + \$12,000 [\text{P/A}, 10\%, 10] \\ \text{LCC Rhino} &= \$30,000 + \$15,000 [\text{P/A}, 10\%, 10] \\ &= \$30,000 + \$15,000 (6.1446) \\ &= \$122,169\end{aligned}$$

$$\begin{aligned}\text{LCC Elephant} &= \$40,000 + \$12,000 [\text{P/A}, 10\%, 10] \\ &= \$40,000 + \$12,000 (6.1446) \\ &= \$113,735\end{aligned}$$

Elephant DG system has the lowest life cycle cost



RANKING PROJECTS

Note: Ranking Projects by Net Present Worth is more accurate than ranking by IRR (which may yield a different ranking). This is because we assume we "will keep investing as long as we get MARR or greater."



AFTER TAX ANALYSIS

- ✓ Tax policies are very different in various countries. But they are important in the economic analysis of energy projects.
- ✓ Many tax policies are similar, and involve tax deductions for private companies paying interest on borrowed money for projects.
- ✓ For capital projects, the capital cost deductions are usually spread out in time using depreciation. We only look at straight line depreciation here.



AFTER TAX ANALYSIS

✓ Depreciation

- ⇒ It is not a cash flow
- ⇒ Is only used when taxes are involved
- ⇒ Usually straight line depreciation is used

$$ATCF = ATS = S - [(S-D) \times TR]$$

- ✓ S = Before tax annual savings, TR = tax rate
- ✓ D = Depreciation per year, ATS = After tax savings,
- ✓ ATCF = After tax cash flow = ATS



AFTER TAX SAVINGS EXAMPLE

A new absorption chiller costing \$100,000 is installed in a CHP system for a building, and produces savings of \$20,000/year. If the chiller lasts 10 years and the corporate tax rate is 40%, what is the After Tax Savings? Use straight line depreciation.

Solution:

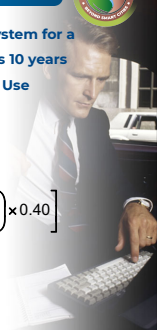
$$ATS = S - [(S - D) \times TR] = ATCF$$

$$ATCF = S - [(S - D) \times TR]$$

$$= \$20,000 / \text{yr} - \left[\left(\frac{\$20,000}{\text{yr}} - \frac{\$100,000}{10 \text{ yrs}} \right) \times 0.40 \right]$$

$$= \$20,000 / \text{yr} - \$4,000 / \text{yr}$$

$$= \$16,000 / \text{yr}$$



TIME VALUE OF MONEY - PROBLEM SESSION

- 1) A vendor proposes a retrofit lighting system. The system will cost \$100,000 installed; but it will save \$15,000 per year for the next 10 years. Your minimum attractive rate of return (interest rate) is 10%. Calculate the present worth of the cash flow. Is this investment desirable? Problem Session
- 2) A heat wheel can be installed on your exhaust air system to preheat the make up air. The installed cost is \$15,000 and the unit has an economic life of 10 years. How much must it save each year to return 15%?
- 3) A desuperheater can be installed on your refrigerator system to obtain free hot water. You estimate you can heat 150,000 litres of water per year from 15°C (city water entering temperature) to 60°C. This will replace a natural gas water heater that operates at 80% efficiency. You pay \$10.00 per GJ for your gas. The unit has an economic life of 5 years. How much can you pay for that unit and obtain a return of 12%?

INTEREST TABLES FOR ECONOMIC ANALYSIS

Time Value of Money Factors - Discrete Compounding
i = 5%

N	Single Cash Flows				Uniform Series			
	To Find P Given F	To Find F Given P	To Find P Given A	To Find A Given P	To Find P Given F	To Find F Given P	To Find P Given A	To Find A Given P
1	0.95238	1.05000	0.95238	0.95238	0.95238	1.05000	0.95238	0.95238
2	0.90696	1.10250	0.90696	0.90696	0.90696	1.10250	0.90696	0.90696
3	0.86261	1.15763	0.86261	0.86261	0.86261	1.15763	0.86261	0.86261
4	0.81928	1.21551	0.81928	0.81928	0.81928	1.21551	0.81928	0.81928
5	0.77643	1.27628	0.77643	0.77643	0.77643	1.27628	0.77643	0.77643
6	0.73495	1.34000	0.73495	0.73495	0.73495	1.34000	0.73495	0.73495
7	0.69483	1.40675	0.69483	0.69483	0.69483	1.40675	0.69483	0.69483
8	0.65600	1.47662	0.65600	0.65600	0.65600	1.47662	0.65600	0.65600
9	0.61839	1.54970	0.61839	0.61839	0.61839	1.54970	0.61839	0.61839
10	0.58201	1.62609	0.58201	0.58201	0.58201	1.62609	0.58201	0.58201
11	0.54683	1.70589	0.54683	0.54683	0.54683	1.70589	0.54683	0.54683
12	0.51281	1.78919	0.51281	0.51281	0.51281	1.78919	0.51281	0.51281
13	0.48000	1.87609	0.48000	0.48000	0.48000	1.87609	0.48000	0.48000
14	0.44837	1.96669	0.44837	0.44837	0.44837	1.96669	0.44837	0.44837
15	0.41790	2.06109	0.41790	0.41790	0.41790	2.06109	0.41790	0.41790
16	0.38857	2.16049	0.38857	0.38857	0.38857	2.16049	0.38857	0.38857
17	0.36037	2.26499	0.36037	0.36037	0.36037	2.26499	0.36037	0.36037
18	0.33329	2.37469	0.33329	0.33329	0.33329	2.37469	0.33329	0.33329
19	0.30731	2.48969	0.30731	0.30731	0.30731	2.48969	0.30731	0.30731
20	0.28241	2.61009	0.28241	0.28241	0.28241	2.61009	0.28241	0.28241
21	0.25857	2.73599	0.25857	0.25857	0.25857	2.73599	0.25857	0.25857
22	0.23577	2.86749	0.23577	0.23577	0.23577	2.86749	0.23577	0.23577
23	0.21399	2.99469	0.21399	0.21399	0.21399	2.99469	0.21399	0.21399
24	0.19321	3.12769	0.19321	0.19321	0.19321	3.12769	0.19321	0.19321
25	0.17343	3.26659	0.17343	0.17343	0.17343	3.26659	0.17343	0.17343
26	0.15463	3.41149	0.15463	0.15463	0.15463	3.41149	0.15463	0.15463
27	0.13681	3.56259	0.13681	0.13681	0.13681	3.56259	0.13681	0.13681
28	0.12000	3.72009	0.12000	0.12000	0.12000	3.72009	0.12000	0.12000
29	0.10420	3.88409	0.10420	0.10420	0.10420	3.88409	0.10420	0.10420
30	0.08940	4.05469	0.08940	0.08940	0.08940	4.05469	0.08940	0.08940
31	0.07560	4.23209	0.07560	0.07560	0.07560	4.23209	0.07560	0.07560
32	0.06279	4.41649	0.06279	0.06279	0.06279	4.41649	0.06279	0.06279
33	0.05097	4.60799	0.05097	0.05097	0.05097	4.60799	0.05097	0.05097
34	0.03915	4.80659	0.03915	0.03915	0.03915	4.80659	0.03915	0.03915
35	0.02833	5.01239	0.02833	0.02833	0.02833	5.01239	0.02833	0.02833
36	0.01851	5.22549	0.01851	0.01851	0.01851	5.22549	0.01851	0.01851
37	0.00969	5.44599	0.00969	0.00969	0.00969	5.44599	0.00969	0.00969
38	0.00087	5.67399	0.00087	0.00087	0.00087	5.67399	0.00087	0.00087
39	0.00005	5.90949	0.00005	0.00005	0.00005	5.90949	0.00005	0.00005
40	0.00000	6.15259	0.00000	0.00000	0.00000	6.15259	0.00000	0.00000

Time Value of Money Factors - Discrete Compounding
i = 10%

N	Single Cash Flows				Uniform Series			
	To Find P Given F	To Find F Given P	To Find P Given A	To Find A Given P	To Find P Given F	To Find F Given P	To Find P Given A	To Find A Given P
1	0.90909	1.10000	0.90909	0.90909	0.90909	1.10000	0.90909	0.90909
2	0.82645	1.21000	0.82645	0.82645	0.82645	1.21000	0.82645	0.82645
3	0.75131	1.33100	0.75131	0.75131	0.75131	1.33100	0.75131	0.75131
4	0.68301	1.46410	0.68301	0.68301	0.68301	1.46410	0.68301	0.68301
5	0.62092	1.61051	0.62092	0.62092	0.62092	1.61051	0.62092	0.62092
6	0.56447	1.77156	0.56447	0.56447	0.56447	1.77156	0.56447	0.56447
7	0.51316	1.94872	0.51316	0.51316	0.51316	1.94872	0.51316	0.51316
8	0.46697	2.14359	0.46697	0.46697	0.46697	2.14359	0.46697	0.46697
9	0.42634	2.35775	0.42634	0.42634	0.42634	2.35775	0.42634	0.42634
10	0.39099	2.59291	0.39099	0.39099	0.39099	2.59291	0.39099	0.39099
11	0.35999	2.85060	0.35999	0.35999	0.35999	2.85060	0.35999	0.35999
12	0.33272	3.13226	0.33272	0.33272	0.33272	3.13226	0.33272	0.33272
13	0.30884	3.43941	0.30884	0.30884	0.30884	3.43941	0.30884	0.30884
14	0.28804	3.77356	0.28804	0.28804	0.28804	3.77356	0.28804	0.28804
15	0.26994	4.13631	0.26994	0.26994	0.26994	4.13631	0.26994	0.26994
16	0.25433	4.53036	0.25433	0.25433	0.25433	4.53036	0.25433	0.25433
17	0.24092	4.95841	0.24092	0.24092	0.24092	4.95841	0.24092	0.24092
18	0.22952	5.42316	0.22952	0.22952	0.22952	5.42316	0.22952	0.22952
19	0.21993	5.92741	0.21993	0.21993	0.21993	5.92741	0.21993	0.21993
20	0.21194	6.47406	0.21194	0.21194	0.21194	6.47406	0.21194	0.21194
21	0.20445	7.06591	0.20445	0.20445	0.20445	7.06591	0.20445	0.20445
22	0.19736	7.70606	0.19736	0.19736	0.19736	7.70606	0.19736	0.19736
23	0.19067	8.39751	0.19067	0.19067	0.19067	8.39751	0.19067	0.19067
24	0.18438	9.14426	0.18438	0.18438	0.18438	9.14426	0.18438	0.18438
25	0.17849	9.95031	0.17849	0.17849	0.17849	9.95031	0.17849	0.17849
26	0.17290	10.82066	0.17290	0.17290	0.17290	10.82066	0.17290	0.17290
27	0.16761	11.76031	0.16761	0.16761	0.16761	11.76031	0.16761	0.16761
28	0.16262	12.77436	0.16262	0.16262	0.16262	12.77436	0.16262	0.16262
29	0.15793	13.86781	0.15793	0.15793	0.15793	13.86781	0.15793	0.15793
30	0.15354	15.04576	0.15354	0.15354	0.15354	15.04576	0.15354	0.15354
31	0.14945	16.31321	0.14945	0.14945	0.14945	16.31321	0.14945	0.14945
32	0.14566	17.67526	0.14566	0.14566	0.14566	17.67526	0.14566	0.14566
33	0.14217	19.13701	0.14217	0.14217	0.14217	19.13701	0.14217	0.14217
34	0.13898	20.70356	0.13898	0.13898	0.13898	20.70356	0.13898	0.13898
35	0.13609	22.38001	0.13609	0.13609	0.13609	22.38001	0.13609	0.13609
36	0.13340	24.17156	0.13340	0.13340	0.13340	24.17156	0.13340	0.13340
37	0.13091	26.08311	0.13091	0.13091	0.13091	26.08311	0.13091	0.13091
38	0.12862	28.12066	0.12862	0.12862	0.12862	28.12066	0.12862	0.12862
39	0.12653	30.29021	0.12653	0.12653	0.12653	30.29021	0.12653	0.12653
40	0.12464	32.59776	0.12464	0.12464	0.12464	32.59776	0.12464	0.12464

INTEREST TABLES FOR ECONOMIC ANALYSIS

Time Value of Money Factors - Discrete Compounding
i = 10%

N	Single Cash Flows		Uniform Series				Growing Series	
	To Find P Given F	To Find F Given P	To Find P Given A	To Find A Given P	To Find P Given F	To Find F Given P	To Find P Given A	To Find A Given P
1	0.90909	1.10000	0.90909	0.90909	0.90909	1.10000	0.90909	0.90909
2	0.82645	1.21000	0.82645	0.82645	0.82645	1.21000	0.82645	0.82645
3	0.75131	1.33100	0.75131	0.75131	0.75131	1.33100	0.75131	0.75131
4	0.68301	1.46410	0.68301	0.68301	0.68301	1.46410	0.68301	0.68301
5	0.62092	1.61051	0.62092	0.62092	0.62092	1.61051	0.62092	0.62092
6	0.56447	1.77156	0.56447	0.56447	0.56447	1.77156	0.56447	0.56447
7	0.51316	1.94872	0.51316	0.51316	0.51316	1.94872	0.51316	0.51316
8	0.46697	2.14359	0.46697	0.46697	0.46697	2.14359	0.46697	0.46697
9	0.42634	2.35775	0.42634	0.42634	0.42634	2.35775	0.42634	0.42634
10	0.39099	2.59291	0.39099	0.39099	0.39099	2.59291	0.39099	0.39099
11	0.35999	2.85060	0.35999	0.35999	0.35999	2.85060	0.35999	0.35999
12	0.33272	3.13226	0.33272	0.33272	0.33272	3.13226	0.33272	0.33272
13	0.30884	3.43941	0.30884	0.30884	0.30884	3.43941	0.30884	0.30884
14	0.28804	3.77356	0.28804	0.28804	0.28804	3.77356	0.28804	0.28804
15	0.26994	4.13631	0.26994	0.26994	0.26994	4.13631	0.26994	0.26994
16	0.25433	4.53036	0.25433	0.25433	0.25433	4.53036	0.25433	0.25433
17	0.24092	4.95841	0.24092	0.24092	0.24092	4.95841	0.24092	0.24092
18	0.22952	5.42316	0.22952	0.22952	0.22952	5.42316	0.22952	0.22952
19	0.21993	5.92741	0.21993	0.21993	0.21993	5.92741	0.21993	0.21993
20	0.21194	6.47406	0.21194	0.21194	0.21194	6.47406	0.21194	0.21194
21	0.20445	7.06591	0.20445	0.20445	0.20445	7.06591	0.20445	0.20445
22	0.19736	7.70606	0.19736	0.19736	0.19736	7.70606	0.19736	0.19736
23	0.19067	8.39061	0.19067	0.19067	0.19067	8.39061	0.19067	0.19067
24	0.18438	9.12126	0.18438	0.18438	0.18438	9.12126	0.18438	0.18438
25	0.17848	9.90031	0.17848	0.17848	0.17848	9.90031	0.17848	0.17848
26	0.17296	10.73006	0.17296	0.17296	0.17296	10.73006	0.17296	0.17296
27	0.16781	11.61391	0.16781	0.16781	0.16781	11.61391	0.16781	0.16781
28	0.16292	12.55436	0.16292	0.16292	0.16292	12.55436	0.16292	0.16292
29	0.15828	13.55401	0.15828	0.15828	0.15828	13.55401	0.15828	0.15828
30	0.15389	14.61646	0.15389	0.15389	0.15389	14.61646	0.15389	0.15389
31	0.14964	15.74441	0.14964	0.14964	0.14964	15.74441	0.14964	0.14964
32	0.14553	16.93966	0.14553	0.14553	0.14553	16.93966	0.14553	0.14553
33	0.14156	18.20491	0.14156	0.14156	0.14156	18.20491	0.14156	0.14156
34	0.13772	19.54296	0.13772	0.13772	0.13772	19.54296	0.13772	0.13772
35	0.13401	20.95661	0.13401	0.13401	0.13401	20.95661	0.13401	0.13401
36	0.13042	22.44876	0.13042	0.13042	0.13042	22.44876	0.13042	0.13042
37	0.12695	24.02241	0.12695	0.12695	0.12695	24.02241	0.12695	0.12695
38	0.12359	25.68056	0.12359	0.12359	0.12359	25.68056	0.12359	0.12359
39	0.12034	27.42621	0.12034	0.12034	0.12034	27.42621	0.12034	0.12034
40	0.11719	29.26246	0.11719	0.11719	0.11719	29.26246	0.11719	0.11719
41	0.11414	31.19231	0.11414	0.11414	0.11414	31.19231	0.11414	0.11414
42	0.11118	33.21876	0.11118	0.11118	0.11118	33.21876	0.11118	0.11118
43	0.10831	35.34491	0.10831	0.10831	0.10831	35.34491	0.10831	0.10831
44	0.10553	37.57376	0.10553	0.10553	0.10553	37.57376	0.10553	0.10553
45	0.10283	39.90841	0.10283	0.10283	0.10283	39.90841	0.10283	0.10283
46	0.10021	42.35206	0.10021	0.10021	0.10021	42.35206	0.10021	0.10021
47	0.09767	44.90781	0.09767	0.09767	0.09767	44.90781	0.09767	0.09767
48	0.09520	47.57776	0.09520	0.09520	0.09520	47.57776	0.09520	0.09520
49	0.09279	50.36491	0.09279	0.09279	0.09279	50.36491	0.09279	0.09279
50	0.09044	53.27226	0.09044	0.09044	0.09044	53.27226	0.09044	0.09044
51	0.08814	56.30281	0.08814	0.08814	0.08814	56.30281	0.08814	0.08814
52	0.08589	59.45946	0.08589	0.08589	0.08589	59.45946	0.08589	0.08589
53	0.08368	62.74521	0.08368	0.08368	0.08368	62.74521	0.08368	0.08368
54	0.08151	66.16296	0.08151	0.08151	0.08151	66.16296	0.08151	0.08151
55	0.07938	69.71571	0.07938	0.07938	0.07938	69.71571	0.07938	0.07938
56	0.07729	73.40646	0.07729	0.07729	0.07729	73.40646	0.07729	0.07729
57	0.07523	77.23721	0.07523	0.07523	0.07523	77.23721	0.07523	0.07523
58	0.07321	81.21096	0.07321	0.07321	0.07321	81.21096	0.07321	0.07321
59	0.07121	85.33071	0.07121	0.07121	0.07121	85.33071	0.07121	0.07121
60	0.06924	89.59946	0.06924	0.06924	0.06924	89.59946	0.06924	0.06924
61	0.06729	94.01921	0.06729	0.06729	0.06729	94.01921	0.06729	0.06729
62	0.06536	98.59296	0.06536	0.06536	0.06536	98.59296	0.06536	0.06536
63	0.06345	103.32271	0.06345	0.06345	0.06345	103.32271	0.06345	0.06345
64	0.06156	108.21046	0.06156	0.06156	0.06156	108.21046	0.06156	0.06156
65	0.05968	113.25821	0.05968	0.05968	0.05968	113.25821	0.05968	0.05968
66	0.05782	118.46796	0.05782	0.05782	0.05782	118.46796	0.05782	0.05782
67	0.05597	123.84171	0.05597	0.05597	0.05597	123.84171	0.05597	0.05597
68	0.05413	129.38146	0.05413	0.05413	0.05413	129.38146	0.05413	0.05413
69	0.05230	135.08921	0.05230	0.05230	0.05230	135.08921	0.05230	0.05230
70	0.05048	140.96696	0.05048	0.05048	0.05048	140.96696	0.05048	0.05048
71	0.04867	147.01671	0.04867	0.04867	0.04867	147.01671	0.04867	0.04867
72	0.04687	153.24046	0.04687	0.04687	0.04687	153.24046	0.04687	0.04687
73	0.04508	159.64021	0.04508	0.04508	0.04508	159.64021	0.04508	0.04508
74	0.04330	166.21896	0.04330	0.04330	0.04330	166.21896	0.04330	0.04330
75	0.04153	172.97871	0.04153	0.04153	0.04153	172.97871	0.04153	0.04153
76	0.03977	179.92146	0.03977	0.03977	0.03977	179.92146	0.03977	0.03977
77	0.03802	187.04921	0.03802	0.03802	0.03802	187.04921	0.03802	0.03802
78	0.03628	194.36396	0.03628	0.03628	0.03628	194.36396	0.03628	0.03628
79	0.03454	201.86771	0.03454	0.03454	0.03454	201.86771	0.03454	0.03454
80	0.03281	209.56246	0.03281	0.03281	0.03281	209.56246	0.03281	0.03281
81	0.03109	217.45021	0.03109	0.03109	0.03109	217.45021	0.03109	0.03109
82	0.02937	225.53296	0.02937	0.02937	0.02937	225.53296	0.02937	0.02937
83	0.02766	233.81271	0.02766	0.02766	0.02766	233.81271	0.02766	0.02766
84	0.02595	242.29146	0.02595	0.02595	0.02595	242.29146	0.02595	0.02595
85	0.02425	250.97021	0.02425	0.02425	0.02425	250.97021	0.02425	0.02425
86	0.02255	259.85096	0.02255	0.02255	0.02255	259.85096	0.02255	0.02255
87	0.02086	268.93571	0.02086	0.02086	0.02086	268.93571	0.02086	0.02086
88	0.01917	278.22646	0.01917	0.01917	0.01917	278.22646	0.01917	0.01917
89	0.01749	287.72521	0.01749	0.01749	0.01749	287.72521	0.01749	0.01749
90	0.01581	297.43396	0.01581	0.01581	0.01581	297.43396	0.01581	0.01581
91	0.01414	307.35371	0.01414	0.01414	0.01414	307.35371	0.01414	0.01414
92	0.01247	317.48646	0.01247	0.01247	0.01247	317.48646	0.01247	0.01247
93	0.01081	327.83321	0.01081	0.01081	0.01081	327.83321	0.01081	0.01081
94	0.00915	338.39596	0.00915	0.00915	0.00915	338.39596	0.00915	0.00915
95	0.00750	349.17571	0.00750	0.00750	0.00750	349.17571	0.00750	0.00750
96	0.00585	360.17346	0.00585	0.00585	0.00585	360.17346	0.00585	0.00585
97	0.00429	371.39021	0.00429	0.00429	0.00429	371.39021	0.00429	0.00429
98	0.00274	382.82696	0.00274	0.00274	0.00274	382.82696	0.00274	0.00274
99	0.00118	394.48571	0.00118	0.00118	0.00118	394.48571	0.00118	0.00118
100	0.00000	406.36846	0.00000	0.00000	0.00000	406.36846	0.00000	0.00000

INTEREST TABLES FOR ECONOMIC ANALYSIS



Time Value of Money Factors - Discrete Compounding
i = 5%

n	Single Cash Flow		Annuity		Future Value		Present Value	
	F/P	P/F	F/A	A/F	F/P	P/F	P/A	
1	1.0500	0.9524	1.0500	0.9524	1.0500	0.9524	1.0000	
2	1.1025	0.9069	2.1025	0.9069	1.1025	0.9069	0.9753	
3	1.1576	0.8638	3.1576	0.8638	1.1576	0.8638	0.9518	
4	1.2167	0.8227	4.3101	0.8227	1.2167	0.8227	0.9297	
5	1.2794	0.7835	5.5276	0.7835	1.2794	0.7835	0.9089	
6	1.3460	0.7462	6.8146	0.7462	1.3460	0.7462	0.8893	
7	1.4167	0.7106	8.1871	0.7106	1.4167	0.7106	0.8709	
8	1.4919	0.6768	9.6445	0.6768	1.4919	0.6768	0.8536	
9	1.5718	0.6447	11.1853	0.6447	1.5718	0.6447	0.8373	
10	1.6567	0.6139	12.8106	0.6139	1.6567	0.6139	0.8219	
11	1.7469	0.5843	14.5219	0.5843	1.7469	0.5843	0.8073	
12	1.8428	0.5560	16.3219	0.5560	1.8428	0.5560	0.7934	
13	1.9447	0.5288	18.2149	0.5288	1.9447	0.5288	0.7801	
14	2.0530	0.5027	20.2049	0.5027	2.0530	0.5027	0.7674	
15	2.1681	0.4776	22.2969	0.4776	2.1681	0.4776	0.7552	
16	2.2905	0.4534	24.4969	0.4534	2.2905	0.4534	0.7435	
17	2.4207	0.4301	26.8119	0.4301	2.4207	0.4301	0.7322	
18	2.5591	0.4076	29.2499	0.4076	2.5591	0.4076	0.7213	
19	2.7062	0.3859	31.8169	0.3859	2.7062	0.3859	0.7107	
20	2.8625	0.3649	34.5199	0.3649	2.8625	0.3649	0.7004	
21	3.0285	0.3445	37.3649	0.3445	3.0285	0.3445	0.6903	
22	3.2047	0.3247	40.3599	0.3247	3.2047	0.3247	0.6805	
23	3.3917	0.3054	43.5119	0.3054	3.3917	0.3054	0.6709	
24	3.5901	0.2866	46.8299	0.2866	3.5901	0.2866	0.6615	
25	3.8005	0.2683	50.3219	0.2683	3.8005	0.2683	0.6523	
26	4.0235	0.2505	53.9999	0.2505	4.0235	0.2505	0.6432	
27	4.2597	0.2332	57.8799	0.2332	4.2597	0.2332	0.6343	
28	4.5097	0.2164	61.9699	0.2164	4.5097	0.2164	0.6255	
29	4.7741	0.1999	66.2899	0.1999	4.7741	0.1999	0.6169	
30	5.0535	0.1839	70.8499	0.1839	5.0535	0.1839	0.6084	
31	5.3485	0.1683	75.6699	0.1683	5.3485	0.1683	0.6000	
32	5.6600	0.1531	80.7599	0.1531	5.6600	0.1531	0.5917	
33	5.9887	0.1383	86.1399	0.1383	5.9887	0.1383	0.5835	
34	6.3354	0.1239	91.8199	0.1239	6.3354	0.1239	0.5753	
35	6.6999	0.1099	97.8199	0.1099	6.6999	0.1099	0.5672	
36	7.0831	0.0962	104.1499	0.0962	7.0831	0.0962	0.5592	
37	7.4859	0.0828	110.8299	0.0828	7.4859	0.0828	0.5513	
38	7.9093	0.0697	117.8799	0.0697	7.9093	0.0697	0.5434	
39	8.3541	0.0568	125.3199	0.0568	8.3541	0.0568	0.5356	
40	8.8213	0.0441	133.1799	0.0441	8.8213	0.0441	0.5278	
41	9.3119	0.0316	141.4899	0.0316	9.3119	0.0316	0.5200	
42	9.8269	0.0193	150.1799	0.0193	9.8269	0.0193	0.5123	
43	10.3673	0.0071	159.2799	0.0071	10.3673	0.0071	0.5046	
44	10.9341	0.0000	168.8199	0.0000	10.9341	0.0000	0.4970	
45	11.5273	0.0000	178.8499	0.0000	11.5273	0.0000	0.4894	
46	12.1489	0.0000	189.4099	0.0000	12.1489	0.0000	0.4818	
47	12.7999	0.0000	200.5499	0.0000	12.7999	0.0000	0.4743	
48	13.4813	0.0000	212.2999	0.0000	13.4813	0.0000	0.4668	
49	14.1941	0.0000	224.6999	0.0000	14.1941	0.0000	0.4593	
50	14.9393	0.0000	237.7799	0.0000	14.9393	0.0000	0.4518	

Time Value of Money Factors - Discrete Compounding
i = 5%

n	Single Cash Flow		Annuity		Future Value		Present Value	
	F/P	P/F	F/A	A/F	F/P	P/F	P/A	
1	1.0500	0.9524	1.0500	0.9524	1.0500	0.9524	1.0000	
2	1.1025	0.9069	2.1025	0.9069	1.1025	0.9069	0.9753	
3	1.1576	0.8638	3.1576	0.8638	1.1576	0.8638	0.9518	
4	1.2167	0.8227	4.3101	0.8227	1.2167	0.8227	0.9297	
5	1.2794	0.7835	5.5276	0.7835	1.2794	0.7835	0.9089	
6	1.3460	0.7462	6.8146	0.7462	1.3460	0.7462	0.8893	
7	1.4167	0.7106	8.1871	0.7106	1.4167	0.7106	0.8709	
8	1.4919	0.6768	9.6445	0.6768	1.4919	0.6768	0.8536	
9	1.5718	0.6447	11.1853	0.6447	1.5718	0.6447	0.8373	
10	1.6567	0.6139	12.8106	0.6139	1.6567	0.6139	0.8219	
11	1.7469	0.5843	14.5219	0.5843	1.7469	0.5843	0.8073	
12	1.8428	0.5560	16.3219	0.5560	1.8428	0.5560	0.7934	
13	1.9447	0.5288	18.2149	0.5288	1.9447	0.5288	0.7801	
14	2.0530	0.5027	20.2049	0.5027	2.0530	0.5027	0.7674	
15	2.1681	0.4776	22.2969	0.4776	2.1681	0.4776	0.7552	
16	2.2905	0.4534	24.4969	0.4534	2.2905	0.4534	0.7435	
17	2.4207	0.4301	26.8119	0.4301	2.4207	0.4301	0.7322	
18	2.5591	0.4076	29.2499	0.4076	2.5591	0.4076	0.7213	
19	2.7062	0.3859	31.8169	0.3859	2.7062	0.3859	0.7107	
20	2.8625	0.3649	34.5199	0.3649	2.8625	0.3649	0.7004	
21	3.0285	0.3445	37.3649	0.3445	3.0285	0.3445	0.6903	
22	3.2047	0.3247	40.3599	0.3247	3.2047	0.3247	0.6805	
23	3.3917	0.3054	43.5119	0.3054	3.3917	0.3054	0.6709	
24	3.5901	0.2866	46.8299	0.2866	3.5901	0.2866	0.6615	
25	3.8005	0.2683	50.3219	0.2683	3.8005	0.2683	0.6523	
26	4.0235	0.2505	53.9999	0.2505	4.0235	0.2505	0.6432	
27	4.2597	0.2332	57.8799	0.2332	4.2597	0.2332	0.6343	
28	4.5097	0.2164	61.9699	0.2164	4.5097	0.2164	0.6255	
29	4.7741	0.1999	66.2899	0.1999	4.7741	0.1999	0.6169	
30	5.0535	0.1839	70.8499	0.1839	5.0535	0.1839	0.6084	
31	5.3485	0.1683	75.6699	0.1683	5.3485	0.1683	0.6000	
32	5.6600	0.1531	80.7599	0.1531	5.6600	0.1531	0.5917	
33	5.9887	0.1383	86.1399	0.1383	5.9887	0.1383	0.5835	
34	6.3354	0.1239	91.8199	0.1239	6.3354	0.1239	0.5753	
35	6.6999	0.1099	97.8199	0.1099	6.6999	0.1099	0.5672	
36	7.0831	0.0962	104.1499	0.0962	7.0831	0.0962	0.5592	
37	7.4859	0.0828	110.8299	0.0828	7.4859	0.0828	0.5513	
38	7.9093	0.0697	117.8799	0.0697	7.9093	0.0697	0.5434	
39	8.3541	0.0568	125.3199	0.0568	8.3541	0.0568	0.5356	
40	8.8213	0.0441	133.1799	0.0441	8.8213	0.0441	0.5278	
41	9.3119	0.0316	141.4899	0.0316	9.3119	0.0316	0.5200	
42	9.8269	0.0193	150.1799	0.0193	9.8269	0.0193	0.5123	
43	10.3673	0.0071	159.2799	0.0071	10.3673	0.0071	0.5046	
44	10.9341	0.0000	168.8199	0.0000	10.9341	0.0000	0.4970	
45	11.5273	0.0000	178.8499	0.0000	11.5273	0.0000	0.4894	
46	12.1489	0.0000	189.4099	0.0000	12.1489	0.0000	0.4818	
47	12.7999	0.0000	200.5499	0.0000	12.7999	0.0000	0.4743	
48	13.4813	0.0000	212.2999	0.0000	13.4813	0.0000	0.4668	
49	14.1941	0.0000	224.6999	0.0000	14.1941	0.0000	0.4593	
50	14.9393	0.0000	237.7799	0.0000	14.9393	0.0000	0.4518	

INTEREST TABLES FOR ECONOMIC ANALYSIS



Time Value of Money Factors - Discrete Compounding
i = 4%

n	Single Cash Flow		Annuity				Growing Cash Flow	
	F/P	P/F	F/A	A/F	F/P	P/F	P/A	
1	1.0400	0.9615	1.0400	0.9615	1.0400	0.9615	1.0000	
2	1.0816	0.9246	2.0816	0.9246	1.0816	0.9246	0.9733	
3	1.1249	0.8890	3.1249	0.8890	1.1249	0.8890	0.9479	
4	1.1699	0.8548	4.2699	0.8548	1.1699	0.8548	0.9236	
5	1.2167	0.8219	5.5169	0.8219	1.2167	0.8219	0.8995	
6	1.2653	0.7902	6.8679	0.7902	1.2653	0.7902	0.8756	
7	1.3158	0.7596	8.3269	0.7596	1.3158	0.7596	0.8519	
8	1.3683	0.7300	9.8969	0.7300	1.3683	0.7300	0.8284	
9	1.4228	0.7014	11.5819	0.7014	1.4228	0.7014	0.8051	
10	1.4794	0.6737	13.3869	0.6737	1.4794	0.6737	0.7820	
11	1.5381	0.6469	15.3169	0.6469	1.5381	0.6469	0.7591	
12	1.5990	0.6209	17.3769	0.6209	1.5990	0.6209	0.7364	
13	1.6621	0.5957	19.5729	0.5957	1.6621	0.5957	0.7139	
14	1.7275	0.5712	21.9119	0.5712	1.7275	0.5712	0.6916	
15	1.7952	0.5474	24.4009	0.5474	1.7952	0.5474	0.6694	
16	1.8653	0.5243	27.0469	0.5243	1.8653	0.5243	0.6473	
17	1.9379	0.5018	29.8569	0.5018	1.9379	0.5018	0.6254	
18	2.0130	0.4799	32.8369	0.4799	2.0130	0.4799	0.6036	
19	2.0907	0.4586	35.9929	0.4586	2.0907	0.4586	0.5819	
20	2.1711	0.4378	39.3319	0.4378	2.1711	0.4378	0.5603	
21	2.2543	0.4175	42.8609	0.4175	2.2543	0.4175	0.5388	
22	2.3403	0.3977	46.5869	0.3977	2.3403	0.3977	0.5174	
23	2.4292	0.3783	50.5169	0.3783	2.4292	0.3783	0.4961	
24	2.5211	0.3593	54.6569	0.3593	2.5211	0.3593	0.4750	
25	2.6161	0.3406	59.0129	0.3406	2.6161	0.3406	0.4540	
26	2.7142	0.3222	63.5919	0.3222	2.7142	0.3222	0.4332	
27	2.8155	0.3041	69.4019	0.3041	2.8155	0.3041	0.4125	
28	2.9200	0.2862	75.4509	0.2862	2.9200	0.2862	0.3919	
29	3.0278	0.2685	81.7569	0.2685	3.0278	0.2685	0.3714	
30	3.1390	0.2511	88.3269	0.2511	3.1390	0.2511	0.3510	
31	3.2537	0.2340	95.1669	0.2340	3.2537	0.2340	0.3307	
32	3.3720	0.2172	102.2829	0.2172	3.3720	0.2172	0.3105	
33	3.4938	0.2007	109.6809	0.2007	3.4938	0.2007	0.2904	
34	3.6192	0.1845	117.3669	0.1845	3.6192	0.1845	0.2704	
35	3.7482	0.1685	125.3469	0.1685	3.7482	0.1685	0.2505	
36	3.8808	0.1528	133.6269	0.1528	3.8808	0.1528	0.2307	
37	4.0171	0.1374	142.2129	0.1374	4.0171	0.1374	0.2110	
38	4.1571	0.1222	151.1109	0.1222	4.1571	0.1222	0.1915	
39	4.3008	0.1073	160.3269	0.1073	4.3008	0.1073	0.1721	
40	4.4483	0.0926	170.8669	0.0926	4.4483	0.0926	0.1529	
41	4.6000	0.0782	182.7369	0.0782	4.6000	0.0782	0.1338	
42	4.7558	0.0640	195.9529	0.0640	4.7558	0.0640	0.1148	
43	4.9159	0.0500	209.5209	0.0500	4.9159	0.0500	0.0959	
44	5.0804	0.0362	224.4469	0.0362	5.0804	0.0362	0.0771	
45	5.2494	0.0227	240.7369	0.0227	5.2494	0.0227	0.0584	
46	5.4230	0.0094	258.4069	0.0094	5.4230	0.0094	0.0398	
47	5.6013	0.0000	277.4629	0.0000	5.6013	0.0000	0.0213	
48	5.7844	0.0000	297.9109	0.0000	5.7844	0.0000	0.0028	
49	5.9724	0.0000	319.7669	0.0000	5.9724	0.0000	0.0000	
50	6.1654	0.0000	343.0469	0.0000	6.1654	0.0000	0.0000	
51	6.3735	0.0000	368.7669	0.0000	6.3735	0.0000	0.0000	
52	6.5868	0.0000	396.9369	0.0000	6.5868	0.0000	0.0000	
53	6.8054	0.0000	427.5729	0.0000	6.8054	0.0000	0.0000	
54	7.0294	0.0000	460.6929	0.0000	7.0294	0.0000	0.0000	
55	7.2589	0.0000	496.3129	0.0000	7.2589	0.0000	0.0000	
56	7.4940	0.0000	534.4469	0.0000	7.4940	0.0000	0.0000	
57	7.7348	0.0000	575.1969	0.0000	7.7348	0.0000	0.0000	
58	7.9814	0.0000	619.5769	0.0000	7.9814	0.0000	0.0000	
59	8.2339	0.0000	667.6029	0.0000	8.2339	0.0000	0.0000	
60	8.4924	0.0000	719.2909	0.0000	8.4924	0.0000	0.0000	
61	8.7570	0.0000	774.6569	0.0000	8.7570	0.0000	0.0000	
62	9.0278	0.0000	833.7169	0.0000	9.0278	0.0000	0.0000	
63	9.3049	0.0000	896.4869	0.0000	9.3049	0.0000	0.0000	
64	9.5884	0.0000	962.9729	0.0000	9.5884	0.0000	0.0000	
65	9.8784	0.0000	1033.1909	0.0000	9.8784	0.0000	0.0000	
66	10.1750	0.0000	1107.1669	0.0000	10.1750	0.0000	0.0000	
67	10.4782	0.0000	1184.9169	0.0000	10.4782	0.0000	0.0000	
68	10.7881	0.0000	1266.4569	0.0000	10.7881	0.0000	0.0000	
69	11.1048	0.0000	1351.8029	0.0000	11.1048	0.0000	0.0000	
70	11.4284	0.0000	1441.0709	0.0000	11.4284	0.0000	0.0000	
71	11.7589	0.0000	1534.2769	0.0000	11.7589	0.0000	0.0000	
72	12.0964	0.0000	1631.4369	0.0000	12.0964	0.0000	0.0000	
73	12.4409	0.0000	1732.5669	0.0000	12.4409	0.0000	0.0000	
74	12.7926	0.0000	1837.6829	0.0000	12.7926	0.0000	0.0000	
75	13.1515	0.0000	1946.8009	0.0000	13.1515	0.0000	0.0000	
76	13.5177	0.0000	2060.0369	0.0000	13.5177	0.0000	0.0000	
77	13.8914	0.0000	2177.4069	0.0000	13.8914	0.0000	0.0000	
78	14.2726	0.0000	2298.9269	0.0000	14.2726	0.0000	0.0000	
79	14.6614	0.0000	2424.6129	0.0000	14.6614	0.0000	0.0000	
80	15.0579	0.0000	2554.4809	0.0000	15.0579	0.0000	0.0000	
81	15.4622	0.0000	2688.5469	0.0000	15.4622	0.0000	0.0000	
82	15.8744	0.0000	2826.8269	0.0000	15.8744	0.0000	0.0000	
83	16.2946	0.0000	2969.3369	0.0000	16.2946	0.0000	0.0000	
84	16.7228	0.0000	3116.0929	0.0000	16.7228	0.0000	0.0000	
85	17.1591	0.0000	3267.1109	0.0000	17.1591	0.0000	0.0000	
86	17.6035	0.0000	3422.4069	0.0000	17.6035	0.0000	0.0000	
87	18.0561	0.0000	3582.0009	0.0000	18.0561	0.0000	0.0000	
88	18.5169	0.0000	3745.9069	0.0000	18.5169	0.0000	0.0000	
89	18.9860	0.0000	3914.1469	0.0000	18.9860	0.0000	0.0000	
90	19.4634	0.0000	4086.7369	0.0000	19.4634	0.0000	0.0000	
91	19.9492	0.0000	4263.6929	0.0000	19.9492	0.0000	0.0000	
92	20.4435	0.0000	4445.0369	0.0000	20.4435	0.0000	0.0000	
93	20.9464	0.0000	4630.7869	0.0000	20.9464	0.0000	0.0000	
94	21.4579	0.0000	4820.9669	0.0000	21.4579	0.0000	0.0000	
95	21.9781	0.0000	5015.5969	0.0000	21.9781	0.0000	0.0000	
96	22.5070	0.0000	5214.6969	0.0000	22.5070	0.0000	0.0000	
97	23.0447	0.0000	5418.2869	0.0000	23.0447	0.0000	0.0000	
98	23.5912	0.0000	5626.3869	0.0000	23.5912	0.0000	0.0000	
99	24.1466	0.0000	5839.0269	0.0000	24.1466	0.0000	0.0000	
100	24.7109	0.0000	6056.2369	0.0000	24.7109	0.0000	0.0000	
101	25.2842	0.0000	6278.0469	0.0000	25.2842	0.0000	0.0000	
102	25.8665	0.0000	6504.4869	0.0000	25.8665	0.0000	0.0000	
103	26.4579	0.0000	6735.5869	0.0000	26.4579	0.0000	0.0000	
104	27.0584	0.0000	6971.3769	0.0000	27.0584	0.0000	0.0000	
105	27.6680	0.0000	7211.8869	0.0000	27.6680	0.0000	0.0000	
106	28.2868	0.0000	7457.1469	0.0000	28.2868	0.0000	0.0000	
107	28.9148	0.0000	7707.1869	0.0000	28.9148	0.0000	0.0000	
108	29.5521	0.0000	7962.0469	0.0000	29.5521	0.0000	0.0000	
109	30.1987	0.0000	8221.7669	0.0000	30.1987	0.0000	0.0000	
110	30.8547	0.0000	8486.3769	0.0000	30.8547	0.0000	0.0000	
111	31.5201	0.0000	8755.8969	0.0000	31.5201	0.0000	0.0000	
112	32.1950	0.0000	9030.3669	0.0000	32.1950	0.0000	0.0000	
113	32.8794	0.0000	9309.8269	0.0000	32.8794	0.0000	0.0000	
114	33.5734	0.0000	9594.3169	0.0000	33.5734	0.0000	0.0000	
115	34.2770	0.0000	9883.8769	0.0000	34.2770	0.0000	0.0000	
116	34.9902	0.0000	10178.5469	0.0000	34.9902	0.0000	0.0000	
117	35.7130	0.0000	10478.3669	0.0000	35.7130	0.0000	0.0000	
118	36.4455	0.0000	10783.3769	0.0000	36.4455	0.0000	0.0000	
119	37.1877	0.0000	11093.6169	0.0000	37.1877	0.0000	0.0000	
120	37.9397	0.0000	11409.1269	0.0000	37.9397	0.0000	0.0000	
121	38.7015	0.0000	11729.9469	0.0000	38.7015	0.0000	0.0000	
122	39.4731	0.0000	12056.1169	0.0000	39.4731	0.0000	0.0000	
123	40.2546	0.0000	12387.6869	0.0000	40.2546	0.0000	0.0000	
124	41.0460	0.0000	12724.6969	0.0000	41.0460	0.0000	0.0000	
125	41.8474	0.0000	13067.1869	0.0000	41.8474	0.0000	0.0000	
126	42.6588	0.0000	13415.2969	0.0000	42.6588	0.0000	0.0000	
127	43.4802	0.0000	13769.0669	0.0000	43.4802	0.0000	0.0000	
128	44.3117	0.0000	14128.5369	0.0000	44.3117	0.0000	0.0000	
129	45.1532	0.0000	14493.7469	0.0000	45.1532	0.0000	0.0000	
130	46.0048	0.0000	14864.7469	0.0000	46.0048	0.0000	0.0000	
131	46.8665	0.0000	15241.5869	0.0000	46.8665	0.0000	0.0000	
132	47.7383	0.0000	15624.3069	0.0000	47.7383	0.0000	0.0000	
133	48.6202	0.0000	16012.8469	0.0000	48.6202	0.0000	0.0000	
134	49.5122	0.0000	16407.2569	0.0000	49.5122	0.0000	0.0000	
135	50.4							