GE 403
Engineering Economy

First Semester 1444 H

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Simple interest VS Compound interest

- Simple interest calculation:

$$F_n = P + P \cdot i \cdot n \quad \Rightarrow \quad F_n = P(1 + i \cdot n)$$

- Compound Interest Calculation:

$$F_n = F_{n-1}(1+i) \qquad F_n = P(1+i)^n$$

Where

- P = present value of single sum of money
- F_n = accumulated value of P over n periods
- i = interest rate per period
- n = number of periods

Ex.1

A friend approaches you and asks to borrow $6,000 at 5 percent simple interest per month. The friend agrees to repay the loan with a single payment after 1 year. How much should you expect to receive?

Solution

Using simple interest formula

$$F_n = P(1 + i \cdot n)$$

$$F = 6000[1 + 0.05(12)] = \$9600$$

You should expect to receive $9600 after 1 year.

Ex.2

Resolve the previous exercise using 5 percent compound interest per month.

Solution

Using compound interest formula

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

$$F = 6000(1 + 0.05)^{12} = \$10775.14$$

Ex.2

Solution

- *Using compound interest tables* in Appendix A for 5 percent and 12 periods, the value of the single sum, future worth factor (F/P 5%,12) is shown to be 1.79586. Thus,

$$F = P(F/P\ 5\%,12)$$

$$F = P(F/P\ 5\%,12)$$

$$F = 6000(1.79586)$$

$$F = \$10775.16$$

TABLE A-a-11

	Single Sums		Uniform Series				Gradient Series	
n	To Find F Given P $(F\|P\ i\%,n)$	To Find P Given F $(P\|F\ i\%,n)$	To Find F Given A $(F\|A\ i\%,n)$	To Find A Given F $(A\|F\ i\%,n)$	To Find P Given A $(P\|A\ i\%,n)$	To Find A Given P $(A\|P\ i\%,n)$	To Find P Given G $(P\|G\ i\%,n)$	To Find A Given G $(A\|G\ i\%,n)$
1	1.05000	0.95238	1.00000	1.00000	0.95238	1.05000	0.00000	0.00000
2	1.10250	0.90703	2.05000	0.48780	1.85941	0.53780	0.90703	0.48780
3	1.15763	0.86384	3.15250	0.31721	2.72325	0.36721	2.63470	0.96749
4	1.21551	0.82270	4.31013	0.23201	3.54595	0.28201	5.10281	1.43905
5	1.27628	0.78353	5.52563	0.18097	4.32948	0.23097	8.23692	1.90252
6	1.34010	0.74622	6.80191	0.14702	5.07569	0.19702	11.96799	2.35790
7	1.40710	0.71068	8.14201	0.12282	5.78637	0.17282	16.23208	2.80523
8	1.47746	0.67684	9.54911	0.10472	6.46321	0.15472	20.96996	3.24451
9	1.55133	0.64461	11.02656	0.09069	7.10782	0.14069	26.12683	3.67579
10	1.62889	0.61391	12.57789	0.07950	7.72173	0.12950	31.65205	4.09909
11	1.71034	0.58468	14.20679	0.07039	8.30641	0.12039	37.49884	4.51444
12	1.79586	0.55684	15.91713	0.06283	8.86325	0.11283	43.62405	4.92190
13	1.88563	0.53032	17.71298	0.05646	9.39357	0.10646	49.98791	5.32150
14	1.97993	0.50507	19.59863	0.05102	9.89864	0.10102	56.55379	5.71329
15	2.07893	0.48102	21.57856	0.04634	10.37966	0.09634	63.28803	6.09731
16	2.18287	0.45811	23.65749	0.04227	10.83777	0.09227	70.15970	6.47363
17	2.29202	0.43630	25.84037	0.03870	11.27407	0.08870	77.14045	6.84229
18	2.40662	0.41552	28.13238	0.03555	11.68959	0.08555	84.20430	7.20336
19	2.52695	0.39573	30.53900	0.03275	12.08532	0.08275	91.32751	7.55690
20	2.65330	0.37689	33.06595	0.03024	12.46221	0.08024	98.48841	7.90297
21	2.78596	0.35894	35.71925	0.02800	12.82115	0.07800	105.66726	8.24164
22	2.92526	0.34185	38.50521	0.02597	13.16300	0.07597	112.84611	8.57298
23	3.07152	0.32557	41.43048	0.02414	13.48857	0.07414	120.00868	8.89706
24	3.22510	0.31007	44.50200	0.02247	13.79864	0.07247	127.14024	9.21397
25	3.38635	0.29530	47.72710	0.02095	14.09394	0.07095	134.22751	9.52377
26	3.55567	0.28124	51.11345	0.01956	14.37519	0.06956	141.25852	9.82655
27	3.73346	0.26785	54.66913	0.01829	14.64303	0.06829	148.22258	10.12240

5.00% Time Value of Money Factors Discrete Compounding

Ex.3

You want to withdraw a single sum of $8,000 from an account at the end of 7 years. This withdrawal will deplete the account. What single sum of money must you deposit today if the account earns 10 percent compound interest?

Solution

Using compound interest formula

$$P = F(1+i)^{-n}$$

$$P = 8000(1 + 0.1)^{-7} = \$4105.27$$

Ex.3

Solution

Using compound interest tables in Appendix A for 10 percent and 7 periods, the value of the single sum, present worth factor (P/F 10%, 7) is shown to be 0.51316 . Thus,

$$P = F(P/F\ 10\%,7)$$

$$P = F(P/F\ 10\%,7)$$

$$P = 8000(0.51316)$$

$$P = \$4105.28$$

Time Value of Money Factors Discrete Compounding 10.00%

TABLE A-a-16

	Single Sums		Uniform Series				Gradient Series	
n	To Find F Given P $(F\|P\ i\%,n)$	To Find P Given F $(P\|F\ i\%,n)$	To Find F Given A $(F\|A\ i\%,n)$	To Find A Given F $(A\|F\ i\%,n)$	To Find P Given A $(P\|A\ i\%,n)$	To Find A Given P $(A\|P\ i\%,n)$	To Find P Given G $(P\|G\ i\%,n)$	To Find A Given G $(A\|G\ i\%,n)$
1	1.10000	0.90909	1.00000	1.00000	0.90909	1.10000	0.00000	0.00000
2	1.21000	0.82645	2.10000	0.47619	1.73554	0.57619	0.82645	0.47619
3	1.33100	0.75131	3.31000	0.30211	2.48685	0.40211	2.32908	0.93656
4	1.46410	0.68301	4.64100	0.21547	3.16987	0.31547	4.37812	1.38117
5	1.61051	0.62092	6.10510	0.16380	3.79079	0.26380	6.86180	1.81013
6	1.77156	0.56447	7.71561	0.12961	4.35526	0.22961	9.68417	2.22356
7	1.94872	0.51316	9.48717	0.10541	4.86842	0.20541	12.76312	2.62162
8	2.14359	0.46651	11.43589	0.08744	5.33493	0.18744	16.02867	3.00448
9	2.35795	0.42410	13.57948	0.07364	5.75902	0.17364	19.42145	3.37235
10	2.59374	0.38554	15.93742	0.06275	6.14457	0.16275	22.89134	3.72546
11	2.85312	0.35049	18.53117	0.05396	6.49506	0.15396	26.39628	4.06405
12	3.13843	0.31863	21.38428	0.04676	6.81369	0.14676	29.90122	4.38840
13	3.45227	0.28966	24.52271	0.04078	7.10336	0.14078	33.37719	4.69879
14	3.79750	0.26333	27.97498	0.03575	7.36669	0.13575	36.80050	4.99553
15	4.17725	0.23939	31.77248	0.03147	7.60608	0.13147	40.15199	5.27893
16	4.59497	0.21763	35.94973	0.02782	7.82371	0.12782	43.41642	5.54934
17	5.05447	0.19784	40.54470	0.02466	8.02155	0.12466	46.58194	5.80710
18	5.55992	0.17986	45.59917	0.02193	8.20141	0.12193	49.63954	6.05256
19	6.11591	0.16351	51.15909	0.01955	8.36492	0.11955	52.58268	6.28610
20	6.72750	0.14864	57.27500	0.01746	8.51356	0.11746	55.40691	6.50808
21	7.40025	0.13513	64.00250	0.01562	8.64869	0.11562	58.10952	6.71888
22	8.14027	0.12285	71.40275	0.01401	8.77154	0.11401	60.68929	6.91889
23	8.95430	0.11168	79.54302	0.01257	8.88322	0.11257	63.14621	7.10848
24	9.84973	0.10153	88.49733	0.01130	8.98474	0.11130	65.48130	7.28805
25	10.83471	0.09230	98.34706	0.01017	9.07704	0.11017	67.69640	7.45798
26	11.91818	0.08391	109.18177	9.1590E−03	9.16095	0.10916	69.79404	7.61865
27	13.10999	0.07628	121.09994	8.2576E−03	9.23722	0.10826	71.77726	7.77044
28	14.42099	0.06934	134.20994	7.4510E−03	9.30657	0.10745	73.64953	7.91372

Ex.4

The cash flow profile for an investment is given below, and the interest rate is 6 percent compounded annually.

EOY	0	1	2	3	4	5	6
Cash Flow	$0	$500	$200	-$100	$400	$250	$800

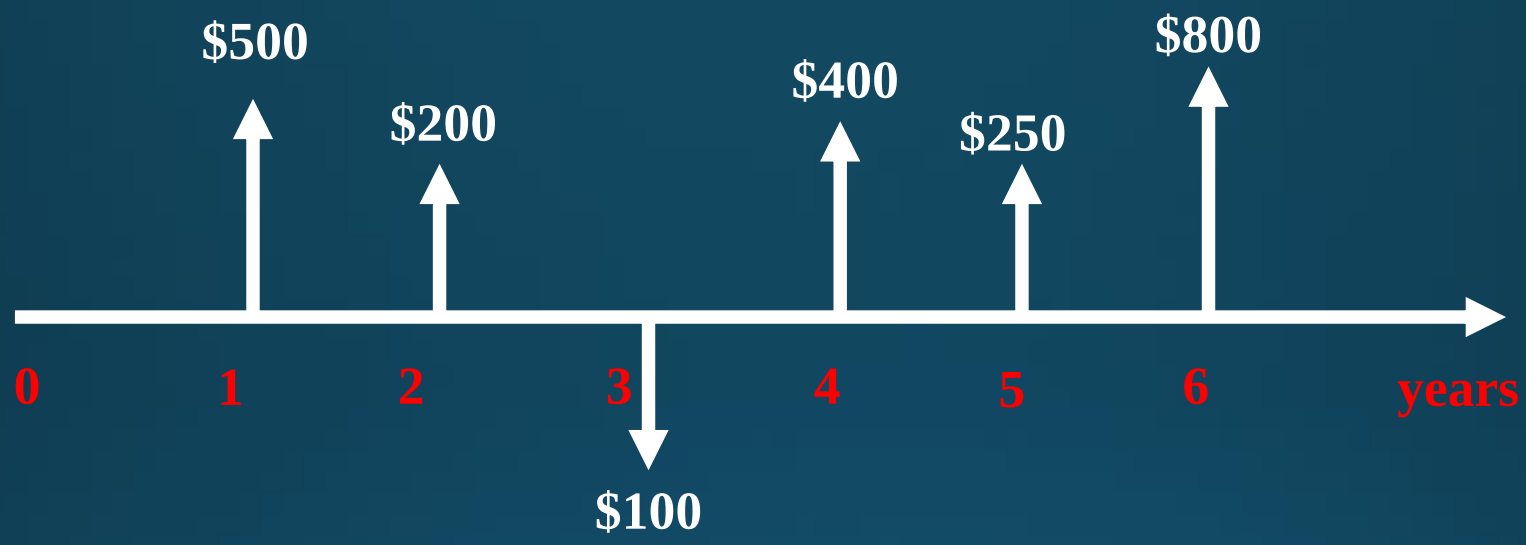
i. Find the future worth of this cash flow series using the actual cash flows.

ii. Find the present worth of this series using the actual cash flows.

iii. Find the present worth using the future worth.

Ex.4

Solution



i- Fw = 500 (F/P 6%, 5) + 200 (F/P 6%, 4) – 100 (F/P 6%, 3) + 400 (F/P 6%, 2)

+ 250 (F/P 6%, 1) + 800 (F/P 6%, 0)

Fw = 500 (1.33823) + 200 (1.26248) – 100 (1.19102) + 400 (1.12360)

+ 250 (1.06) + 800 (1) = $2316.95

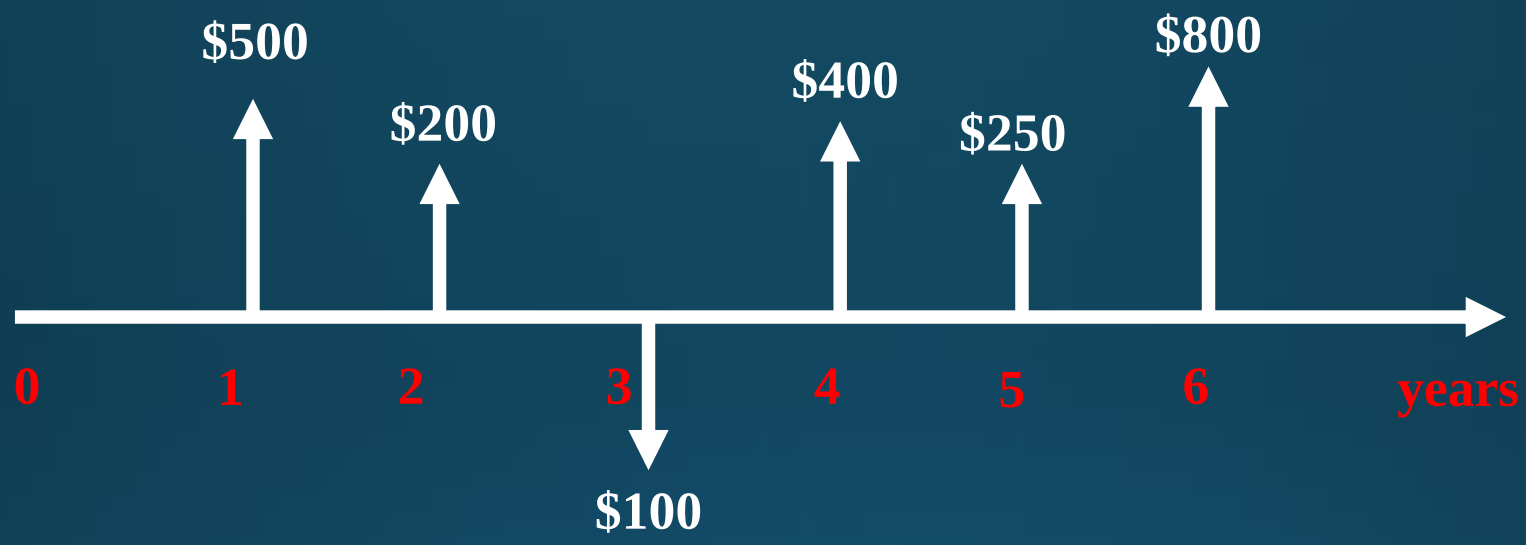
alue of Money Factors Discrete Compounding 6.00%

TABLE A-a-12

	Single Sums		Uniform Series				Gradient Series	
n	To Find F Given P $(F\|P\ i\%,n)$	To Find P Given F $(P\|F\ i\%,n)$	To Find F Given A $(F\|A\ i\%,n)$	To Find A Given F $(A\|F\ i\%,n)$	To Find P Given A $(P\|A\ i\%,n)$	To Find A Given P $(A\|P\ i\%,n)$	To Find P Given G $(P\|G\ i\%,n)$	To Find A Given G $(A\|G\ i\%,n)$
1	1.06000	0.94340	1.00000	1.00000	0.94340	1.06000	0.00000	0.00000
2	1.12360	0.89000	2.06000	0.48544	1.83339	0.54544	0.89000	0.48544
3	1.19102	0.83962	3.18360	0.31411	2.67301	0.37411	2.56924	0.96118
4	1.26248	0.79209	4.37462	0.22859	3.46511	0.28859	4.94552	1.42723
5	1.33823	0.74726	5.63709	0.17740	4.21236	0.23740	7.93455	1.88363
6	1.41852	0.70496	6.97532	0.14336	4.91732	0.20336	11.45935	2.33040
7	1.50363	0.66506	8.39384	0.11914	5.58238	0.17914	15.44969	2.76758
8	1.59385	0.62741	9.89747	0.10104	6.20979	0.16104	19.84158	3.19521
9	1.68948	0.59190	11.49132	0.08702	6.80169	0.14702	24.57677	3.61333
10	1.79085	0.55839	13.18079	0.07587	7.36009	0.13587	29.60232	4.02201
11	1.89830	0.52679	14.97164	0.06679	7.88687	0.12679	34.87020	4.42129
12	2.01220	0.49697	16.86994	0.05928	8.38384	0.11928	40.33686	4.81126
13	2.13293	0.46884	18.88214	0.05296	8.85268	0.11296	45.96293	5.19198
14	2.26090	0.44230	21.01507	0.04758	9.29498	0.10758	51.71284	5.56352
15	2.39656	0.41727	23.27597	0.04296	9.71225	0.10296	57.55455	5.92598
16	2.54035	0.39365	25.67253	0.03895	10.10590	0.09895	63.45925	6.27943
17	2.69277	0.37136	28.21288	0.03544	10.47726	0.09544	69.40108	6.62397
18	2.85434	0.35034	30.90565	0.03236	10.82760	0.09236	75.35692	6.95970
19	3.02560	0.33051	33.75999	0.02962	11.15812	0.08962	81.30615	7.28673
20	3.20714	0.31180	36.78559	0.02718	11.46992	0.08718	87.23044	7.60515
21	3.39956	0.29416	39.99273	0.02500	11.76408	0.08500	93.11355	7.91508
22	3.60354	0.27751	43.39229	0.02305	12.04158	0.08305	98.94116	8.21662
23	3.81975	0.26180	46.99583	0.02128	12.30338	0.08128	104.70070	8.50991

Ex.4

Solution



ii- Pw = 500 (P/F 6%, 1) + 200 (P/F 6%, 2) – 100 (P/F 6%, 3) + 400 (P/F 6%, 4)

+ 250 (P/F 6%, 5) + 800 (P/F 6%, 6)

Pw = 500 (0.94340) + 200 (0.8900) – 100 (0.83962) + 400 (0.79209)

+ 250 (0.74726) + 800 (0.70496) = $1633.36

Ex.4

Solution

iii- Pw = Fw (P/F 6%, 6)

Pw = 2316.95 (P/F 6%, 6)

Pw = 2316.95 (0.70496) = $1633.36