

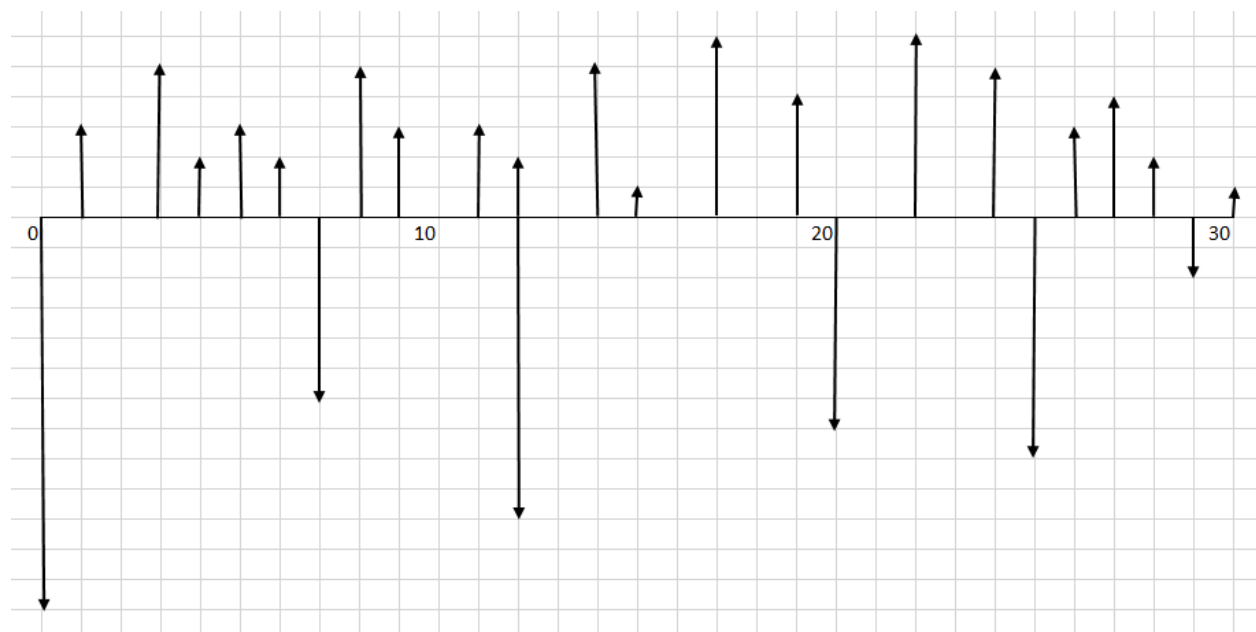
Assignment 1

50 Points

For the cash flow diagram presented below,

(1) Calculate present worth of the project by equivalent present worth for each individual payment using appropriate formulas or values from economic tables. Interest rate is 12% compounded annually.

(2) Develop an EXCEL sheet that perform the same calculations for different values of interest rate from 1 to 20 percent. Use 20 different tabs. Project life is 30 years. Each horizontal grid line represents one year and each vertical grid line represents \$100.



Solution Part 1:

Let's find the present worth of each separate cash flow, adding them together using $(P/F, 12\%, n)$ factor for all individual payments.

One important observation in here is the fact that all payments are made at exact grid sizes. For example, at year one there is a payment equal to 3 grid sizes (or \$300), then instead of multiplying each payment's height by \$100 we can simply use the heights for our calculation and then multiply the final solution by \$100. That is the same as factoring out 100 from calculations.

There are 6 payments (downward direction—thus presented by negative values) at specified end of the years on the cash flow diagram. We also have 18 single payment (upward direction – thus presented by positive values) at specified end of the years on the cash flow diagram. Also note that at the end of year

12 we have two individual payment of +\$200 and -\$1000 which we can replace by on individual payment of -\$800. Table below shows the calculation. The answer is -1.0195 or -\$101.95.

YR	Payment (100\$)	(P/F,i,n)	Present W (100\$)
0	-13	1.0000	-13.00
1	3	0.8929	2.68
2	0	0.7972	0.00
3	5	0.7118	3.56
4	2	0.6355	1.27
5	3	0.5674	1.70
6	2	0.5066	1.01
7	-6	0.4523	-2.71
8	5	0.4039	2.02
9	3	0.3606	1.08
10	0	0.3220	0.00
11	3	0.2875	0.86
12	-8	0.2567	-2.05
13	0	0.2292	0.00
14	5	0.2046	1.02
15	1	0.1827	0.18
16	0	0.1631	0.00
17	6	0.1456	0.87
18	0	0.1300	0.00
19	4	0.1161	0.46
20	-7	0.1037	-0.73
21	0	0.0926	0.00
22	6	0.0826	0.50
23	0	0.0738	0.00
24	5	0.0659	0.33
25	-8	0.0588	-0.47
26	3	0.0525	0.16
27	4	0.0469	0.19
28	2	0.0419	0.08
29	-2	0.0374	-0.07
30	1	0.0334	0.03
			-1.02

Solution Part 2:

A sample solution is shown in the next pages. Here are some points about the EXCEL sheet:

1. To save the space, I put all calculations on one tab. You needed to do it on separate tabs.
2. For calculating $(P/F, i, n)$ the formula of $1/(1+i)^n$ is used.
3. All values are presented in units of 100\$, thus making it easier to do the calculations. The final answer is multiplied by 100 to present the results in \$ terms.
4. Although for this early assignment it was not required, it is always a good idea to make observations into the problem. For example you may notice that as interest rate increases, the present worth of the overall problem becomes smaller and somewhere between 10% and 11% it actually changes sign from positive to negative. The interest rate at which the overall present worth becomes zero is a significant point (we will talk about it later). It is also useful to find out what functions in EXCEL can be used to solve problems of this nature. I have included additional steps to demonstrate these observations

Assignment #1 Part 2

i	1+i
0.01	1.01

i	1+i
0.02	1.02

i	1+i
0.03	1.03

i	1+i
0.04	1.04

i	1+i
0.05	1.05

Year	Payment	(P/F,i,n)	PW	(P/F,i,n)	PW	(P/F,i,n)	PW	(P/F,i,n)	PW	(P/F,i,n)	PW
0	-13	1.0000	-13.00	1.0000	-13.00	1.0000	-13.00	1.0000	-13.00	1.0000	-13.00
1	3	0.9901	2.97	0.9804	2.94	0.9709	2.91	0.9615	2.88	0.9524	2.86
2	0	0.9803	0.00	0.9612	0.00	0.9426	0.00	0.9246	0.00	0.9070	0.00
3	5	0.9706	4.85	0.9423	4.71	0.9151	4.58	0.8890	4.44	0.8638	4.32
4	2	0.9610	1.92	0.9238	1.85	0.8885	1.78	0.8548	1.71	0.8227	1.65
5	3	0.9515	2.85	0.9057	2.72	0.8626	2.59	0.8219	2.47	0.7835	2.35
6	2	0.9420	1.88	0.8880	1.78	0.8375	1.67	0.7903	1.58	0.7462	1.49
7	-6	0.9327	-5.60	0.8706	-5.22	0.8131	-4.88	0.7599	-4.56	0.7107	-4.26
8	5	0.9235	4.62	0.8535	4.27	0.7894	3.95	0.7307	3.65	0.6768	3.38
9	3	0.9143	2.74	0.8368	2.51	0.7664	2.30	0.7026	2.11	0.6446	1.93
10	0	0.9053	0.00	0.8203	0.00	0.7441	0.00	0.6756	0.00	0.6139	0.00
11	3	0.8963	2.69	0.8043	2.41	0.7224	2.17	0.6496	1.95	0.5847	1.75
12	-8	0.8874	-7.10	0.7885	-6.31	0.7014	-5.61	0.6246	-5.00	0.5568	-4.45
13	0	0.8787	0.00	0.7730	0.00	0.6810	0.00	0.6006	0.00	0.5303	0.00
14	5	0.8700	4.35	0.7579	3.79	0.6611	3.31	0.5775	2.89	0.5051	2.53
15	1	0.8613	0.86	0.7430	0.74	0.6419	0.64	0.5553	0.56	0.4810	0.48
16	0	0.8528	0.00	0.7284	0.00	0.6232	0.00	0.5339	0.00	0.4581	0.00
17	6	0.8444	5.07	0.7142	4.28	0.6050	3.63	0.5134	3.08	0.4363	2.62
18	0	0.8360	0.00	0.7002	0.00	0.5874	0.00	0.4936	0.00	0.4155	0.00
19	4	0.8277	3.31	0.6864	2.75	0.5703	2.28	0.4746	1.90	0.3957	1.58
20	-7	0.8195	-5.74	0.6730	-4.71	0.5537	-3.88	0.4564	-3.19	0.3769	-2.64
21	0	0.8114	0.00	0.6598	0.00	0.5375	0.00	0.4388	0.00	0.3589	0.00
22	6	0.8034	4.82	0.6468	3.88	0.5219	3.13	0.4220	2.53	0.3418	2.05
23	0	0.7954	0.00	0.6342	0.00	0.5067	0.00	0.4057	0.00	0.3256	0.00
24	5	0.7876	3.94	0.6217	3.11	0.4919	2.46	0.3901	1.95	0.3101	1.55
25	-8	0.7798	-6.24	0.6095	-4.88	0.4776	-3.82	0.3751	-3.00	0.2953	-2.36
26	3	0.7720	2.32	0.5976	1.79	0.4637	1.39	0.3607	1.08	0.2812	0.84
27	4	0.7644	3.06	0.5859	2.34	0.4502	1.80	0.3468	1.39	0.2678	1.07
28	2	0.7568	1.51	0.5744	1.15	0.4371	0.87	0.3335	0.67	0.2551	0.51
29	-2	0.7493	-1.50	0.5631	-1.13	0.4243	-0.85	0.3207	-0.64	0.2429	-0.49
30	1	0.7419	0.74	0.5521	0.55	0.4120	0.41	0.3083	0.31	0.2314	0.23
			15.34		12.33		9.83		7.75		6.00

Assignment #1 Part 2

i	1+i
0.06	1.06

i	1+i
0.07	1.07

i	1+i
0.08	1.08

i	1+i
0.09	1.09

i	1+i
0.1	1.10

Year	Payment	(P/F,i,n)	PW	(P/F,i,n)	PW	(P/F,i,n)	PW	(P/F,i,n)	PW	(P/F,i,n)	PW
0	-13	1.0000	-13.00	1.0000	-13.00	1.0000	-13.00	1.0000	-13.00	1.0000	-13.00
1	3	0.9434	2.83	0.9346	2.80	0.9259	2.78	0.9174	2.75	0.9091	2.73
2	0	0.8900	0.00	0.8734	0.00	0.8573	0.00	0.8417	0.00	0.8264	0.00
3	5	0.8396	4.20	0.8163	4.08	0.7938	3.97	0.7722	3.86	0.7513	3.76
4	2	0.7921	1.58	0.7629	1.53	0.7350	1.47	0.7084	1.42	0.6830	1.37
5	3	0.7473	2.24	0.7130	2.14	0.6806	2.04	0.6499	1.95	0.6209	1.86
6	2	0.7050	1.41	0.6663	1.33	0.6302	1.26	0.5963	1.19	0.5645	1.13
7	-6	0.6651	-3.99	0.6227	-3.74	0.5835	-3.50	0.5470	-3.28	0.5132	-3.08
8	5	0.6274	3.14	0.5820	2.91	0.5403	2.70	0.5019	2.51	0.4665	2.33
9	3	0.5919	1.78	0.5439	1.63	0.5002	1.50	0.4604	1.38	0.4241	1.27
10	0	0.5584	0.00	0.5083	0.00	0.4632	0.00	0.4224	0.00	0.3855	0.00
11	3	0.5268	1.58	0.4751	1.43	0.4289	1.29	0.3875	1.16	0.3505	1.05
12	-8	0.4970	-3.98	0.4440	-3.55	0.3971	-3.18	0.3555	-2.84	0.3186	-2.55
13	0	0.4688	0.00	0.4150	0.00	0.3677	0.00	0.3262	0.00	0.2897	0.00
14	5	0.4423	2.21	0.3878	1.94	0.3405	1.70	0.2992	1.50	0.2633	1.32
15	1	0.4173	0.42	0.3624	0.36	0.3152	0.32	0.2745	0.27	0.2394	0.24
16	0	0.3936	0.00	0.3387	0.00	0.2919	0.00	0.2519	0.00	0.2176	0.00
17	6	0.3714	2.23	0.3166	1.90	0.2703	1.62	0.2311	1.39	0.1978	1.19
18	0	0.3503	0.00	0.2959	0.00	0.2502	0.00	0.2120	0.00	0.1799	0.00
19	4	0.3305	1.32	0.2765	1.11	0.2317	0.93	0.1945	0.78	0.1635	0.65
20	-7	0.3118	-2.18	0.2584	-1.81	0.2145	-1.50	0.1784	-1.25	0.1486	-1.04
21	0	0.2942	0.00	0.2415	0.00	0.1987	0.00	0.1637	0.00	0.1351	0.00
22	6	0.2775	1.67	0.2257	1.35	0.1839	1.10	0.1502	0.90	0.1228	0.74
23	0	0.2618	0.00	0.2109	0.00	0.1703	0.00	0.1378	0.00	0.1117	0.00
24	5	0.2470	1.23	0.1971	0.99	0.1577	0.79	0.1264	0.63	0.1015	0.51
25	-8	0.2330	-1.86	0.1842	-1.47	0.1460	-1.17	0.1160	-0.93	0.0923	-0.74
26	3	0.2198	0.66	0.1722	0.52	0.1352	0.41	0.1064	0.32	0.0839	0.25
27	4	0.2074	0.83	0.1609	0.64	0.1252	0.50	0.0976	0.39	0.0763	0.31
28	2	0.1956	0.39	0.1504	0.30	0.1159	0.23	0.0895	0.18	0.0693	0.14
29	-2	0.1846	-0.37	0.1406	-0.28	0.1073	-0.21	0.0822	-0.16	0.0630	-0.13
30	1	0.1741	0.17	0.1314	0.13	0.0994	0.10	0.0754	0.08	0.0573	0.06
			4.51		3.24		2.14		1.19		0.36

Assignment #1 Part 2

i	1+i
0.11	1.11

i	1+i
0.12	1.12

i	1+i
0.13	1.13

i	1+i
0.14	1.14

i	1+i
0.15	1.15

Year	Payment	(P/F,i,n)	PW	(P/F,i,n)	PW	(P/F,i,n)	PW	(P/F,i,n)	PW	(P/F,i,n)	PW
0	-13	1.0000	-13.00	1.0000	-13.00	1.0000	-13.00	1.0000	-13.00	1.0000	-13.00
1	3	0.9009	2.70	0.8929	2.68	0.8850	2.65	0.8772	2.63	0.8696	2.61
2	0	0.8116	0.00	0.7972	0.00	0.7831	0.00	0.7695	0.00	0.7561	0.00
3	5	0.7312	3.66	0.7118	3.56	0.6931	3.47	0.6750	3.37	0.6575	3.29
4	2	0.6587	1.32	0.6355	1.27	0.6133	1.23	0.5921	1.18	0.5718	1.14
5	3	0.5935	1.78	0.5674	1.70	0.5428	1.63	0.5194	1.56	0.4972	1.49
6	2	0.5346	1.07	0.5066	1.01	0.4803	0.96	0.4556	0.91	0.4323	0.86
7	-6	0.4817	-2.89	0.4523	-2.71	0.4251	-2.55	0.3996	-2.40	0.3759	-2.26
8	5	0.4339	2.17	0.4039	2.02	0.3762	1.88	0.3506	1.75	0.3269	1.63
9	3	0.3909	1.17	0.3606	1.08	0.3329	1.00	0.3075	0.92	0.2843	0.85
10	0	0.3522	0.00	0.3220	0.00	0.2946	0.00	0.2697	0.00	0.2472	0.00
11	3	0.3173	0.95	0.2875	0.86	0.2607	0.78	0.2366	0.71	0.2149	0.64
12	-8	0.2858	-2.29	0.2567	-2.05	0.2307	-1.85	0.2076	-1.66	0.1869	-1.50
13	0	0.2575	0.00	0.2292	0.00	0.2042	0.00	0.1821	0.00	0.1625	0.00
14	5	0.2320	1.16	0.2046	1.02	0.1807	0.90	0.1597	0.80	0.1413	0.71
15	1	0.2090	0.21	0.1827	0.18	0.1599	0.16	0.1401	0.14	0.1229	0.12
16	0	0.1883	0.00	0.1631	0.00	0.1415	0.00	0.1229	0.00	0.1069	0.00
17	6	0.1696	1.02	0.1456	0.87	0.1252	0.75	0.1078	0.65	0.0929	0.56
18	0	0.1528	0.00	0.1300	0.00	0.1108	0.00	0.0946	0.00	0.0808	0.00
19	4	0.1377	0.55	0.1161	0.46	0.0981	0.39	0.0829	0.33	0.0703	0.28
20	-7	0.1240	-0.87	0.1037	-0.73	0.0868	-0.61	0.0728	-0.51	0.0611	-0.43
21	0	0.1117	0.00	0.0926	0.00	0.0768	0.00	0.0638	0.00	0.0531	0.00
22	6	0.1007	0.60	0.0826	0.50	0.0680	0.41	0.0560	0.34	0.0462	0.28
23	0	0.0907	0.00	0.0738	0.00	0.0601	0.00	0.0491	0.00	0.0402	0.00
24	5	0.0817	0.41	0.0659	0.33	0.0532	0.27	0.0431	0.22	0.0349	0.17
25	-8	0.0736	-0.59	0.0588	-0.47	0.0471	-0.38	0.0378	-0.30	0.0304	-0.24
26	3	0.0663	0.20	0.0525	0.16	0.0417	0.13	0.0331	0.10	0.0264	0.08
27	4	0.0597	0.24	0.0469	0.19	0.0369	0.15	0.0291	0.12	0.0230	0.09
28	2	0.0538	0.11	0.0419	0.08	0.0326	0.07	0.0255	0.05	0.0200	0.04
29	-2	0.0485	-0.10	0.0374	-0.07	0.0289	-0.06	0.0224	-0.04	0.0174	-0.03
30	1	0.0437	0.04	0.0334	0.03	0.0256	0.03	0.0196	0.02	0.0151	0.02
			-0.37		-1.02		-1.60		-2.11		-2.58

Assignment #1 Part 2

i	1+i
0.16	1.16

i	1+i
0.17	1.17

i	1+i
0.18	1.18

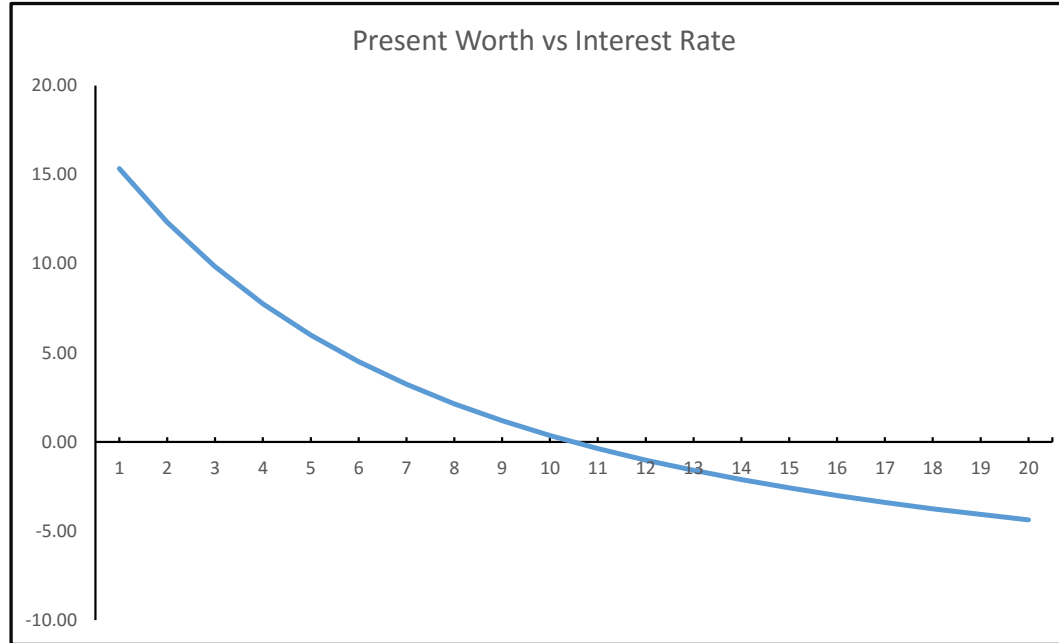
i	1+i
0.19	1.19

i	1+i
0.2	1.20

Year	Payment	(P/F,i,n)	PW	(P/F,i,n)	PW	(P/F,i,n)	PW	(P/F,i,n)	PW	(P/F,i,n)	PW
0	-13	1.0000	-13.00	1.0000	-13.00	1.0000	-13.00	1.0000	-13.00	1.0000	-13.00
1	3	0.8621	2.59	0.8547	2.56	0.8475	2.54	0.8403	2.52	0.8333	2.50
2	0	0.7432	0.00	0.7305	0.00	0.7182	0.00	0.7062	0.00	0.6944	0.00
3	5	0.6407	3.20	0.6244	3.12	0.6086	3.04	0.5934	2.97	0.5787	2.89
4	2	0.5523	1.10	0.5337	1.07	0.5158	1.03	0.4987	1.00	0.4823	0.96
5	3	0.4761	1.43	0.4561	1.37	0.4371	1.31	0.4190	1.26	0.4019	1.21
6	2	0.4104	0.82	0.3898	0.78	0.3704	0.74	0.3521	0.70	0.3349	0.67
7	-6	0.3538	-2.12	0.3332	-2.00	0.3139	-1.88	0.2959	-1.78	0.2791	-1.67
8	5	0.3050	1.53	0.2848	1.42	0.2660	1.33	0.2487	1.24	0.2326	1.16
9	3	0.2630	0.79	0.2434	0.73	0.2255	0.68	0.2090	0.63	0.1938	0.58
10	0	0.2267	0.00	0.2080	0.00	0.1911	0.00	0.1756	0.00	0.1615	0.00
11	3	0.1954	0.59	0.1778	0.53	0.1619	0.49	0.1476	0.44	0.1346	0.40
12	-8	0.1685	-1.35	0.1520	-1.22	0.1372	-1.10	0.1240	-0.99	0.1122	-0.90
13	0	0.1452	0.00	0.1299	0.00	0.1163	0.00	0.1042	0.00	0.0935	0.00
14	5	0.1252	0.63	0.1110	0.56	0.0985	0.49	0.0876	0.44	0.0779	0.39
15	1	0.1079	0.11	0.0949	0.09	0.0835	0.08	0.0736	0.07	0.0649	0.06
16	0	0.0930	0.00	0.0811	0.00	0.0708	0.00	0.0618	0.00	0.0541	0.00
17	6	0.0802	0.48	0.0693	0.42	0.0600	0.36	0.0520	0.31	0.0451	0.27
18	0	0.0691	0.00	0.0592	0.00	0.0508	0.00	0.0437	0.00	0.0376	0.00
19	4	0.0596	0.24	0.0506	0.20	0.0431	0.17	0.0367	0.15	0.0313	0.13
20	-7	0.0514	-0.36	0.0433	-0.30	0.0365	-0.26	0.0308	-0.22	0.0261	-0.18
21	0	0.0443	0.00	0.0370	0.00	0.0309	0.00	0.0259	0.00	0.0217	0.00
22	6	0.0382	0.23	0.0316	0.19	0.0262	0.16	0.0218	0.13	0.0181	0.11
23	0	0.0329	0.00	0.0270	0.00	0.0222	0.00	0.0183	0.00	0.0151	0.00
24	5	0.0284	0.14	0.0231	0.12	0.0188	0.09	0.0154	0.08	0.0126	0.06
25	-8	0.0245	-0.20	0.0197	-0.16	0.0160	-0.13	0.0129	-0.10	0.0105	-0.08
26	3	0.0211	0.06	0.0169	0.05	0.0135	0.04	0.0109	0.03	0.0087	0.03
27	4	0.0182	0.07	0.0144	0.06	0.0115	0.05	0.0091	0.04	0.0073	0.03
28	2	0.0157	0.03	0.0123	0.02	0.0097	0.02	0.0077	0.02	0.0061	0.01
29	-2	0.0135	-0.03	0.0105	-0.02	0.0082	-0.02	0.0064	-0.01	0.0051	-0.01
30	1	0.0116	0.01	0.0090	0.01	0.0070	0.01	0.0054	0.01	0.0042	0.00
			-3.01		-3.39		-3.75		-4.07		-4.37

Assignment #1 Part 2

Interest Rate	PW
1	15.34
2	12.33
3	9.83
4	7.75
5	6.00
6	4.51
7	3.24
8	2.14
9	1.19
10	0.36
11	-0.37
12	-1.02
13	-1.60
14	-2.11
15	-2.58
16	-3.01
17	-3.39
18	-3.75
19	-4.07
20	-4.37



Assignment #1 Part 2

Year	Payment
0	-13
1	3
2	0
3	5
4	2
5	3
6	2
7	-6
8	5
9	3
10	0
11	3
12	-8
13	0
14	5
15	1
16	0
17	6
18	0
19	4
20	-7
21	0
22	6
23	0
24	5
25	-8
26	3
27	4
28	2
29	-2
30	0

-4.38



Calculating the Present Worth
Using NPV Function
for 20% Interest Rate
Compounded Annually
 $=NPV(0.2, B179:B208) + B178$