



Handout

"Performing Net Present Value (NPV) Calculations"

Introduction

This handout provides instruction and examples for calculating Net Present Value (NPV), an indicator of profitability for an investment project.

A typical Cleaner Production project involves an initial investment (a cash outflow) that will reduce the annual operating costs of existing equipment and processes. This reduction in annual costs provides cash inflows in future years that payback the initial investment. The NPV calculation converts all of a project's expected future cash flows into their "present value", i.e., their value NOW, at the very beginning of the project. Then all of the present values are added together to calculate a single number that can characterise the overall value of the project to the company, i.e., the project's profitability.

NPV typically is calculated over a specific time period of interest, e.g., 3 year or 5 years. If the project NPV is greater than zero, the project is considered to be profitable over that time period. If the project NPV is less than zero, the project is considered to be NOT profitable over that time period.

Calculation Formulas

By definition, NPV = the sum of the present values of all of a project's cash flows, both negative (cash outflows) and positive (cash inflows). For the sake of simplicity, the project cash flows are estimated on an annual basis. The formula for calculating the NPV is:

$$NPV_n = (PV_1 + PV_2 + \dots + PV_n) - \text{Initial Investment Cost}$$

where:

NPV_n = the Net Present Value of the project over n years

PV₁ through PV_n = the cash flows from each project year (positive for cash inflows, negative for cash outflows).

The formula for calculating the Present Value for a cash flow in a particular year is:

$$PV_n = FV_n * PVF_{nd}$$

where:

PV_n = the Present Value of the cash flow from year n

FV_n = the known Future Value of the project cash flow in year n

PVF_{nd} = a Present Value Factor for the year (n) and the project discount rate (d)

Values of PVF have been calculated for various combinations of n and d and are organised on "Present Value Tables", where they can be looked up easily (a version has been included at the end of this instruction guide).

Preparation

Before doing the NPV calculation for a project, you will need the following information:

- 1) The initial investment cost
- 2) The future cash inflows or outflows (FV) expected to occur in each subsequent year of the project. Sometimes the future cash flows will be the same every year, and sometimes they will be irregular. Sometimes they will be all cash inflows, and sometimes a mix of inflows and outflows. It will vary from project to project.
- 3) The discount rate (d) for the company or the project. Some companies use an average discount rate for the analysis of all projects. Other companies may prefer slightly different discount rates for different projects. The discount rate you use should be equal to the required rate of return for the investment project, and should take into account price inflation, project risk, and the real return that you require. At a minimum, this required rate of return should cover the cost of investment capital to the firm.
- 4) The number of years (n) over which you would like to estimate project profitability.

In addition, you will need either a "Present Values Table", on which you can look up Present Value Factors (PVF), or a scientific calculator that will allow you to calculate the Present Value Factors yourself. Both methods are demonstrated below.

Using a "Present Values Table" to determine Present Value Factors

A Present Value Table will allow you to look up Present Value Factors (PVF) for various combinations of n (project year) and d (project discount rate). As an example, look at a CP investment with the following parameters:

1. Initial investment: US\$150,000
2. Future savings (FV): Year 1— US\$45,000
Year 2— US\$45,000
Year 3— US\$77,000
3. Discount rate (d): 10%
4. Number of years (n): 3

Using the Present Value table attached, look up the Present Value Factors (PVF) for a discount rate of 10% and for project years 1, 2, and 3.

Year 1 PVF: 0.9091

Year 2 PVF: 0.8264

Year 3 PVF: 0.7513

Using the PVFs shown above, the future cost savings for each year can be converted to their present value. These values are then added together to estimate the project's Net Present Value. The initial investment (which is already in present-day dollars) is subtracted from the sum. The result is the Net Present Value of the project.

Year	Future Savings	Present Value Factor (10%)	Present Value
1	\$45,000	x 0.9091 =	\$40,910
2	\$45,000	x 0.8264 =	\$37,188
3	\$77,000	x 0.7513 =	\$57,850
			\$135,948
	less: initial investment		- \$150,000
	equals: Net Present Value		-\$14,052

For this example, the NPV is calculated to be -\$14,052 which means that the investment is not profitable within three years. A positive value for NPV would indicate that the investment is profitable within three years.

Using a calculator to calculate Present Value Factors

If you do not have a Present Value table available, you can calculate the necessary Present Value Factors yourself as follows:

$$\text{Present Value Factor (PVF)} = \frac{1}{(1+d)^n}$$

where

d is the discount rate

n is the year number

Using this formula, and a discount rate of 10%, PVFs for years 1, 2, and 3 can be calculated as follows.

$$\text{Year 1 PVF} = \frac{1}{(1+0.1)^1} = 0.9091$$

$$\text{Year 2 PVF} = \frac{1}{(1+0.1)^2} = 0.8264$$

$$\text{Year 3 PVF} = \frac{1}{(1+0.1)^3} = 0.7513$$

These are exactly the same PVFs that you looked up on the table previously. You would use these values to calculate NPV the same way as is illustrated above.

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Present Value Factors

$$PV \text{ Factor} = 1 / (1+d)^n$$

Period	Discount Rate														
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%
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
2	0.9803	0.9612	0.9426	0.9246	0.9070	0.8900	0.8734	0.8573	0.8417	0.8264	0.8116	0.7972	0.7831	0.7695	0.7561
3	0.9706	0.9423	0.9151	0.8890	0.8638	0.8396	0.8163	0.7938	0.7722	0.7513	0.7312	0.7118	0.6931	0.6750	0.6575
4	0.9610	0.9238	0.8885	0.8548	0.8227	0.7921	0.7629	0.7350	0.7084	0.6830	0.6587	0.6355	0.6133	0.5921	0.5718
5	0.9515	0.9328	0.8626	0.8219	0.7835	0.7473	0.7130	0.6806	0.6499	0.6209	0.5935	0.5674	0.5428	0.5194	0.4972
6	0.9416	0.9176	0.8375	0.7903	0.7462	0.7050	0.6663	0.6302	0.5963	0.5645	0.5346	0.5066	0.4803	0.4556	0.4323
7	0.9327	0.9096	0.8131	0.7599	0.7107	0.6651	0.6227	0.5835	0.5470	0.5132	0.4817	0.4523	0.4251	0.3996	0.3759
8	0.9235	0.9053	0.7894	0.7307	0.6768	0.6274	0.5820	0.5403	0.5019	0.4665	0.4339	0.4039	0.3762	0.3506	0.3269
9	0.9143	0.7477	0.7664	0.7026	0.6446	0.5919	0.5439	0.5002	0.4604	0.4241	0.3909	0.3606	0.3329	0.3075	0.2843
10	0.9053	0.8401	0.7441	0.6756	0.6139	0.5584	0.5083	0.4632	0.4224	0.3855	0.3522	0.3220	0.2946	0.2697	0.2472
11	0.8963	0.9004	0.7224	0.6496	0.5847	0.5268	0.4751	0.4289	0.3875	0.3505	0.3173	0.2875	0.2607	0.2366	0.2149
12	0.8874	0.7885	0.7014	0.6246	0.5568	0.4970	0.4440	0.3971	0.3555	0.3186	0.2858	0.2567	0.2307	0.2076	0.1869
13	0.8787	0.7730	0.6810	0.6006	0.5303	0.4688	0.4150	0.3677	0.3262	0.2897	0.2575	0.2292	0.2042	0.1821	0.1625
14	0.8700	0.7579	0.6611	0.5775	0.5051	0.4423	0.3878	0.3405	0.2992	0.2633	0.2320	0.2046	0.1807	0.1597	0.1413
15	0.8613	0.7430	0.6419	0.5553	0.4810	0.4173	0.3624	0.3152	0.2745	0.2394	0.2090	0.1827	0.1599	0.1401	0.1229
16	0.8528	0.7284	0.6232	0.5339	0.4581	0.3936	0.3387	0.2919	0.2519	0.2176	0.1883	0.1631	0.1415	0.1229	0.1069
17	0.8444	0.7142	0.6050	0.5134	0.4363	0.3714	0.3166	0.2703	0.2311	0.1978	0.1696	0.1456	0.1252	0.1078	0.0929
18	0.8360	0.7002	0.5874	0.4936	0.4155	0.3503	0.2959	0.2502	0.2120	0.1799	0.1528	0.1300	0.1108	0.0946	0.0808
19	0.8277	0.6864	0.5703	0.4746	0.3957	0.3305	0.2765	0.2317	0.1945	0.1635	0.1377	0.1161	0.0981	0.0829	0.0703
20	0.8195	0.6730	0.5537	0.4564	0.3769	0.3118	0.2584	0.2145	0.1784	0.1486	0.1240	0.1037	0.0868	0.0728	0.0611
21	0.8114	0.6598	0.5375	0.4388	0.3589	0.2942	0.2415	0.1987	0.1637	0.1351	0.1117	0.0926	0.0768	0.0638	0.0531
22	0.8034	0.6468	0.5219	0.4220	0.3418	0.2775	0.2257	0.1839	0.1502	0.1228	0.1007	0.0826	0.0680	0.0560	0.0462
23	0.7954	0.6342	0.5067	0.4057	0.3256	0.2618	0.2109	0.1703	0.1378	0.1117	0.0907	0.0738	0.0601	0.0491	0.0402
24	0.7876	0.6217	0.4919	0.3901	0.3101	0.2470	0.1971	0.1577	0.1264	0.1015	0.0817	0.0659	0.0532	0.0431	0.0349
25	0.7798	0.6095	0.4776	0.3751	0.2953	0.2330	0.1842	0.1460	0.1160	0.0923	0.0736	0.0588	0.0471	0.0378	0.0304
26	0.7720	0.5976	0.4637	0.3607	0.2812	0.2198	0.1722	0.1352	0.1064	0.0839	0.0663	0.0525	0.0417	0.0331	0.0264
27	0.7644	0.5859	0.4502	0.3468	0.2678	0.2074	0.1609	0.1252	0.0976	0.0763	0.0597	0.0469	0.0369	0.0291	0.0230
28	0.7568	0.5744	0.4371	0.3335	0.2551	0.1956	0.1504	0.1159	0.0895	0.0693	0.0538	0.0419	0.0326	0.0255	0.0200
29	0.7493	0.5631	0.4243	0.3207	0.2429	0.1846	0.1406	0.1073	0.0822	0.0630	0.0485	0.0374	0.0289	0.0224	0.0174
30	0.7419	0.5521	0.4120	0.3083	0.2314	0.1741	0.1314	0.0994	0.0754	0.0573	0.0437	0.0334	0.0256	0.0196	0.0151

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Present Value Factors

Period	Discount Rate															Period
	16%	17%	18%	19%	20%	25%	30%	35%	40%	45%	50%	60%	70%	80%	90%	
1	0.8621	0.8547	0.8475	0.8403	0.8333	0.8000	0.7692	0.7407	0.7143	0.6897	0.6667	0.6250	0.5882	0.5556	0.5263	1
2	0.7432	0.7305	0.7182	0.7062	0.6944	0.6400	0.5917	0.5487	0.5102	0.4756	0.4444	0.3906	0.3460	0.3086	0.2770	2
3	0.6407	0.6244	0.6086	0.5934	0.5787	0.5120	0.4552	0.4064	0.3644	0.3280	0.2963	0.2441	0.2035	0.1715	0.1458	3
4	0.5523	0.5337	0.5158	0.4987	0.4823	0.4096	0.3501	0.3011	0.2603	0.2262	0.1975	0.1526	0.1197	0.0953	0.0767	4
5	0.4761	0.4561	0.4371	0.4190	0.4019	0.3277	0.2693	0.2230	0.1859	0.1560	0.1317	0.0954	0.0704	0.0529	0.0404	5
6	0.4104	0.3898	0.3704	0.3521	0.3349	0.2621	0.2072	0.1652	0.1328	0.1076	0.0878	0.0596	0.0414	0.0294	0.0213	6
7	0.3538	0.3332	0.3139	0.2959	0.2791	0.2097	0.1594	0.1224	0.0949	0.0742	0.0585	0.0373	0.0244	0.0163	0.0112	7
8	0.3050	0.2848	0.2660	0.2487	0.2326	0.1678	0.1226	0.0906	0.0678	0.0512	0.0390	0.0233	0.0143	0.0091	0.0059	8
9	0.2630	0.2434	0.2255	0.2090	0.1938	0.1342	0.0943	0.0671	0.0484	0.0353	0.0260	0.0146	0.0084	0.0050	0.0031	9
10	0.2267	0.2080	0.1911	0.1756	0.1615	0.1074	0.0725	0.0497	0.0346	0.0243	0.0173	0.0091	0.0050	0.0028	0.0016	10
11	0.1954	0.1778	0.1619	0.1476	0.1346	0.0859	0.0558	0.0368	0.0247	0.0168	0.0116	0.0057	0.0029	0.0016	0.0009	11
12	0.1685	0.1520	0.1372	0.1240	0.1122	0.0687	0.0429	0.0273	0.0176	0.0116	0.0077	0.0036	0.0017	0.0009	0.0005	12
13	0.1452	0.1299	0.1163	0.1042	0.0935	0.0550	0.0330	0.0202	0.0126	0.0080	0.0051	0.0022	0.0010	0.0005	0.0002	13
14	0.1252	0.1110	0.0985	0.0876	0.0779	0.0440	0.0254	0.0150	0.0090	0.0055	0.0034	0.0014	0.0006	0.0003	0.0001	14
15	0.1079	0.0949	0.0835	0.0736	0.0649	0.0352	0.0195	0.0111	0.0064	0.0038	0.0023	0.0009	0.0003	0.0001	0.0001	15
16	0.0930	0.0811	0.0708	0.0618	0.0541	0.0281	0.0150	0.0082	0.0046	0.0026	0.0015	0.0005	0.0002	0.0001	0.0000	16
17	0.0802	0.0693	0.0600	0.0520	0.0451	0.0225	0.0116	0.0061	0.0033	0.0018	0.0010	0.0003	0.0001	0.0000	0.0000	17
18	0.0691	0.0592	0.0508	0.0437	0.0376	0.0180	0.0089	0.0045	0.0023	0.0012	0.0007	0.0002	0.0001	0.0000	0.0000	18
19	0.0596	0.0506	0.0431	0.0367	0.0313	0.0144	0.0068	0.0033	0.0017	0.0009	0.0005	0.0001	0.0000	0.0000	0.0000	19
20	0.0514	0.0433	0.0365	0.0308	0.0261	0.0115	0.0053	0.0025	0.0012	0.0006	0.0003	0.0001	0.0000	0.0000	0.0000	20
21	0.0443	0.0370	0.0309	0.0259	0.0217	0.0092	0.0040	0.0018	0.0009	0.0004	0.0002	0.0001	0.0000	0.0000	0.0000	21
22	0.0382	0.0316	0.0262	0.0218	0.0181	0.0074	0.0031	0.0014	0.0006	0.0003	0.0001	0.0000	0.0000	0.0000	0.0000	22
23	0.0329	0.0270	0.0222	0.0183	0.0151	0.0059	0.0024	0.0010	0.0004	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000	23
24	0.0284	0.0231	0.0188	0.0154	0.0126	0.0047	0.0018	0.0007	0.0003	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	24
25	0.0245	0.0197	0.0160	0.0129	0.0105	0.0038	0.0014	0.0006	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	25
26	0.0211	0.0169	0.0135	0.0109	0.0087	0.0030	0.0011	0.0004	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	26
27	0.0182	0.0144	0.0115	0.0091	0.0073	0.0024	0.0008	0.0003	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	27
28	0.0157	0.0123	0.0097	0.0077	0.0061	0.0019	0.0006	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	28
29	0.0135	0.0105	0.0082	0.0064	0.0051	0.0015	0.0005	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	29
30	0.0116	0.0090	0.0070	0.0054	0.0042	0.0012	0.0004	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	30

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