How to calculate present values

Jakob Engardt, 2010-10-22

Case 1

Heating of the property Frigga 100 in Täby, Stockholm

Frigga 100 is a real estate of 5,455 square meters, in 2009 we had to make an investment decision. We had a worn-out oil-fired boiler in Täby. We decided that we had two options. Either upgrade the existing oil-fired boiler, or invest in a new heating system; we looked at a geothermal plant as an option.

We had to choose between the following options:
Alternative 1: Upgrade the oil-fired boiler.
Alternative 2: A new geothermal plant.

Frigga 100	Before	Alt 1	Alt 2
Heating cost in €	120,000	105,000	49,000
Maintenance		2,000	0
Life expectancy		20	20
Rate of interest		6%	6%
Investment		80,000	580,000

Questions for both alternatives

1. What is the discount factor?
2. What is the Present value?
3. What is the Net present value, and which is the best alternative, 1 or 2?
4. In which year would the two alternatives be “paid” off?
5. What answer will you get if you change the rate of interest to 8%?
6. What are my conclusions?

Answers with explanations

1.
The formula to calculate the discount factor in this case is:

$$DF=1/r-1/r\ (1+r)^n$$

DF=1/0.06-1/0.06(1+0.06)^20=11.47

You can also use present value tables, in this case the annuity table, it is easiest. Look at appendix A in Principles of corporate finance. 6% at 20 years gives 11.47

2.
The formula for calculating present value in this case is:

$$PV=C*1/r-1/r\ (1+r)^n=C*DF$$

C is the annual savings.

PV_1=(120,000-105,000-2,000)*11.47=149,110 €

PV_2=(120,000-49,000)*11.47=81,4370 €

All savings have now been converted to today; this is the present value of 20 years of savings. Now we only need to withdraw the investment to see if it is a profitable investment.

3.
The formula to calculate the net present value is:

$$NPV=C_0+PV$$

C_0 is the Investment

NPV_1=-80,000+149,110=69,110 €

NPV_2=-580,000+814,370=233,370 €

An investment is profitable if investment income is positive. The investment options that provide the largest investment gains are most profitable.

Alternative 2 incorporating the geothermal plant is the best option if you look at the net present value.

4.
I put the figures in an excel table and summarised the annual discounted savings until I pass the investment sum!

In alternative 1, the investment is paid off in year 8.

In alternative 2, the investment is paid off in year 12.

5.

NPV_1=
-80,000+13,000* (1/0.08-1/0.08 $(1+0.08)^{20}$)=
47,635 €

NPV_2=
-580,000+71,000* (1/0.08-1/0.08 $(1+0.08)^{20}$)=
117,085 €

The choice of discount rate has a significant impact on the outcome.

6.
My conclusion is:

If you do your maths, calculate the investment and you see it makes a profit. Present the investment to the manager and then hopefully you can start. Often the larger the investment the higher the profit. Do not only think of investments that raise the rent, but consider also investments that reduce costs. Furthermore, we also help the environment.

Case 1 Frigga 100

		acc. savings		acc. savings
	Alt 1		**Alt 2**	
investment	-80000		-580000	
annual savings	13000		71000	
Rate of interest	1,06		1,06	
year 0	-80000		-580000	
year 1	12264	12264	66981	66981
year 2	11570	23834	63190	130171
year 3	10915	34749	59613	189784
year 4	10297	45046	56239	246022
year 5	9714	54761	53055	299078
year 6	9164	63925	50052	349130
year 7	8646	72571	47219	396349
year 8	8156	**80727**	44546	440895
year 9	7695	88422	42025	482920
year 10	7259	95681	39646	522566
year 11	6848	102529	37402	559968
year 12	6461	108990	35285	**595253**
year 13	6095	115085	33288	628540
year 14	5750	120835	31403	659944
year 15	5424	126259	29626	689570
year 16	5117	131377	27949	717519
year 17	4828	136204	26367	743885
year 18	4554	140759	24874	768760
year 19	4297	145056	23466	792226
year 20	4053	149109	22138	814364
PV	**149109**		**814364**	
NPV	**69109**		**234364**	

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Case 2 Group work

Heating of the property of Ymer 2 and Kålroten 2 in Täby, Stockholm

In 2009 we did two more heating projects besides Frigga 100. Ymer 2, a small high house with 40 apartments and two premises at street level, and Kålroten 2 with 84 apartments. All three of the properties had oil-heating. We decided to invest in geothermal plants in all three cases. We made three good investments and we did a lot for the environment. In this Group work you should decide which of the three investment is the best one.

	Alt 1	Alt 2	Alt 3
	Frigga 100	Kålroten 2	Ymer 2
Heating cost before	120,000	165,000	49,000
Heating cost after	49,000	65,000	23,000
Maintenance	0	0	0
Life expectancy	20	20	20
Rate of interest	7%	7%	7%
Investment	580,000	560,000	240,000

Figure1

Questions for all three alternatives.

1a. What is the discount factor, calculate it?
1b. Get the discount factor from Appendix A, in the book "Principles of Corporate Finance".
2. What is the Present value?
3a. What is the Net present value, and which is the best alternative, 1, 2 or 3?
3b.What is the Net present value if you take into account an inflation of 2% and an interest rate of 7%, is it higher or lower and why?
4. What will happen with the net present value if you change the rate of interest to 9%, and without inflation.
5. In which year are the three alternatives "paid" off, assumptions as in figure 1, do the calculation in excel?

Answers with explanations

1a. DF=1/0.07-1/(0.07 (1+0.07)^{20}=10.59

1b. DF= 10.59, get it from table 3, annuity table.

2. PV_1=(120,000-49,000)*10.59=751,890 €
PV_2=(165,000-65,000)*10.59=1,059,000 €
PV_3=(49,000-230,00)*10.59=275,340 €

3a. NPV_1=-580,000+751,890=171,890 €
NPV_2=-560,000+1,059,000=499,000 €
NPV_3=-240,000+275,340=35,340 €

The investment option that provides the greatest net present value is most profitable. Alternative 2 is best.

3b. PV for Growing annuity.

If the first period´s cash flow is €1 at year 1, and if the cash flow grows at a constant rate of g for t years.

$PV=1/(r-g)-(1/(r-g)*(1+g)^t/(1+r)^t)$

NPV_1=294,725 €
NPV_2=672,000 €
NPV_3=80,320 €

4. NPV_1=-580,000+(120,000-49,000)*9.129=68,159 €
NPV_2=-560,000+(165,000-65,000)*9.129=352,900 €
NPV_3=-240,000+(49,000-23,000)*9.129=-2,646 €

Alternative 3 is no longer a profitable investment.

5. Alternative 1 in year 13
Alternative 2 in year 8
Alternative 3 in year 16

Case 2 Group work

	Frigga 100	acc. savings	**Kålroten 2**	acc. savings	**Ymer 2**	acc. savings
	Alt 1		Alt 2		Alt 3	
invest	-580000		-560000		-240000	
annual saving	71000		100000		26000	
rate of interest	1,07		1,07		1,07	
year 0	-580000		-560000		-240000	
year 1	66355	66355	93458	93458	24299	24299
year 2	62014	128369	87344	180802	22709	47008
year 3	57957	186326	81630	262432	21224	68232
year 4	54166	240492	76290	338721	19835	88067
year 5	50622	291114	71299	410020	18538	106605
year 6	47310	338424	66634	476654	17325	123930
year 7	44215	382640	62275	538929	16191	140122
year 8	41323	423962	58201	**597130**	15132	155254
year 9	38619	462581	54393	651523	14142	169396
year 10	36093	498674	50835	702358	13217	182613
year 11	33732	532406	47509	749867	12352	194966
year 12	31525	563931	44401	794269	11544	206510
year 13	29462	**593393**	41496	835765	10789	217299
year 14	27535	620928	38782	874547	10083	227382
year 15	25734	646662	36245	910791	9424	236806
year 16	24050	670712	33873	944665	8807	**245613**
year 17	22477	693189	31657	976322	8231	253844
year 18	21006	714195	29586	1005909	7692	261536
year 19	19632	733827	27651	1033560	7189	268725
year 20	18348	752175	25842	1059401	6719	275444
PV	**752175**		**1059401**		**275444**	
NPV	**172175**		**499401**		**35444**	