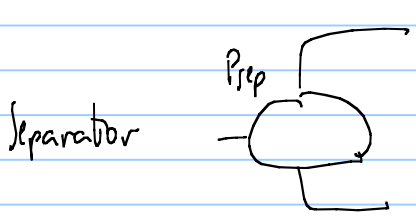
20160118 TPG4230

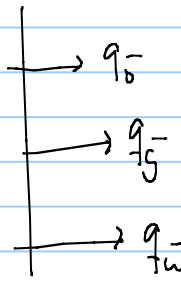
Note Title 18.01.2016

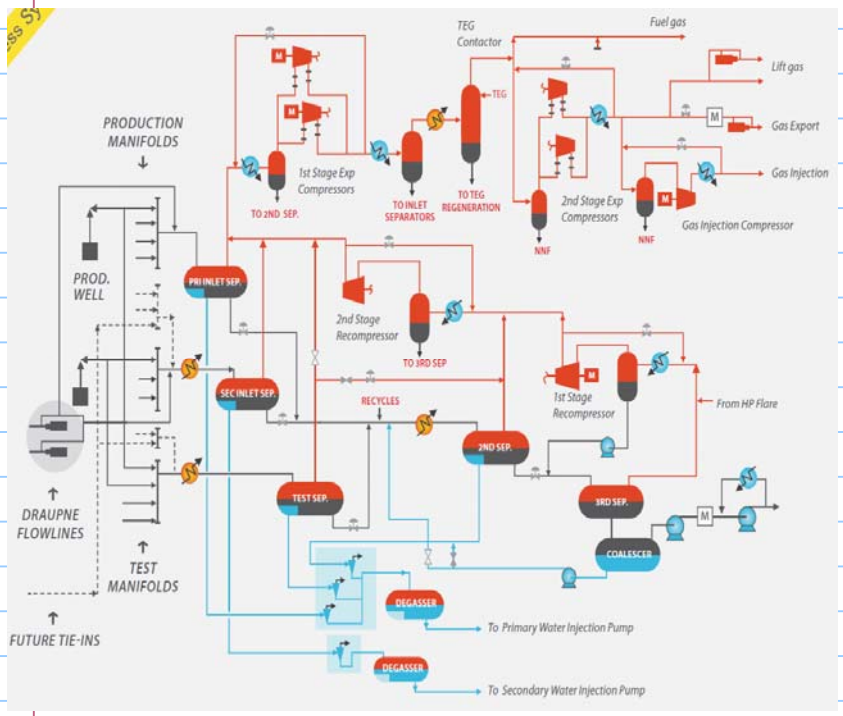
menu: • Production potential : how to estimate production profile from

q_{pp} -s Q_p

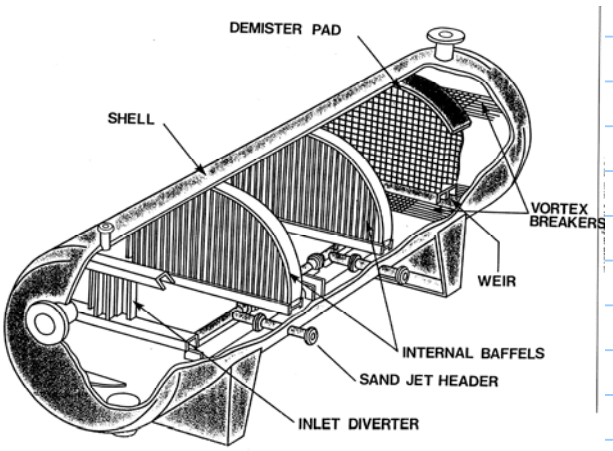
- Excel implementation





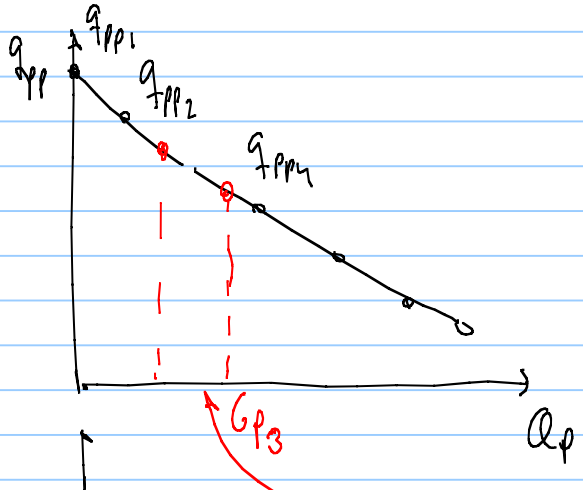


Horizontal separator



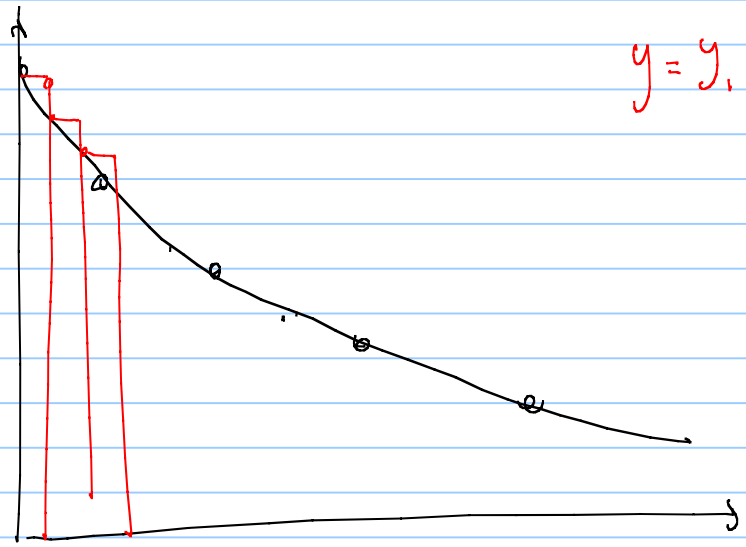
look how the equipment looks like in real life!

- Production potential seq vertical calculations open choke

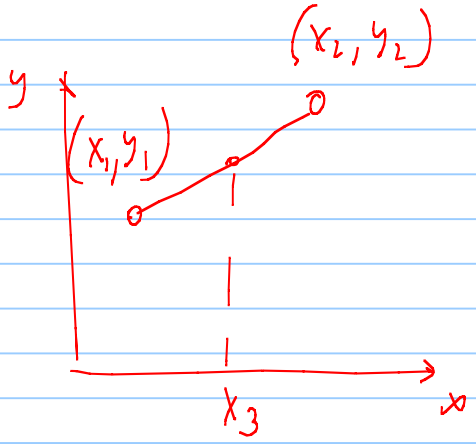


t	q	Qp	q_{pp}
0	q_{pp1}	0	q_{pp1}
0.5	q_{pp2}	$q_{pp1}(0.5-0).355$	q_{pp2}
1	q_{pp3}	$\int + q_{pp2}(1-0.5)355$	q_{pp3}

$0 \rightarrow 0.5$ q_{pp1} operational days in a year = 355



$$y = y_1 + \frac{(y_2 - y_1)}{(x_2 - x_1)}(x_3 - x_1)$$

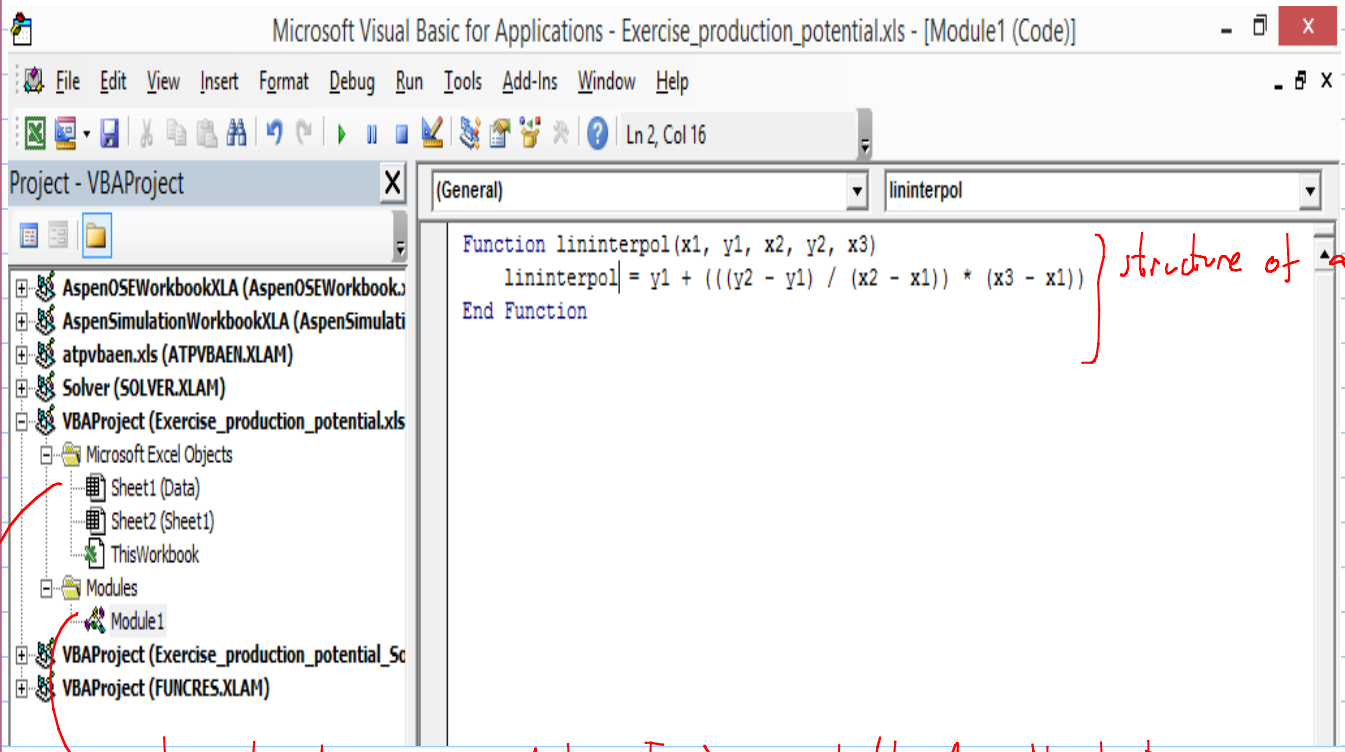


Excel + VBA (visual basic for applications)

Reduce trust settings to minimum – enable all macros

Alt + F11 to access VBA environment

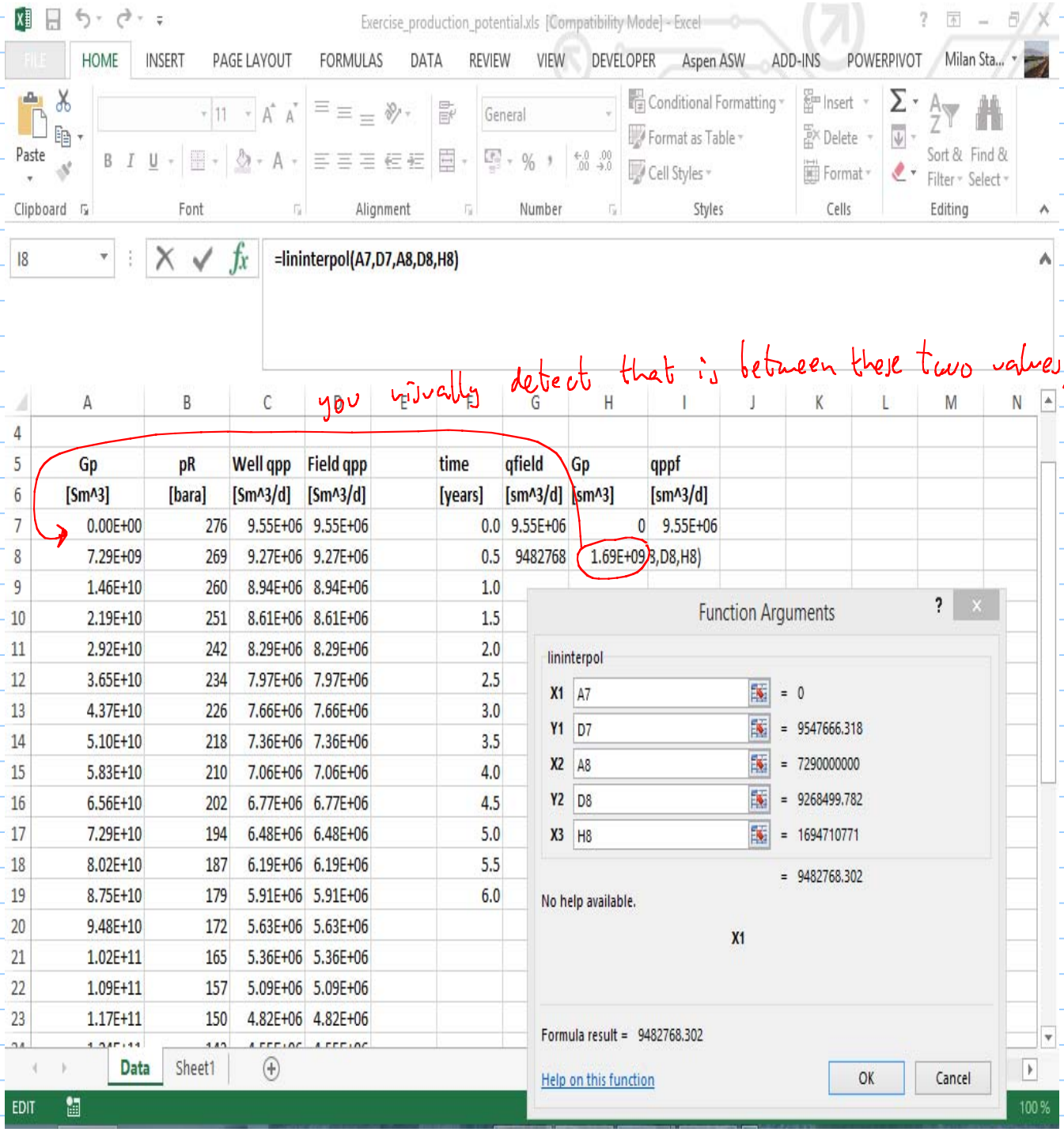
UDF .. User defined function



structure of a UDF

→ when placed in a module, it is available for all sheets in an excel file.

→ when placed in a sheet, it is only available for that sheet.



you visually detect that is between these two values, x_1 x_2

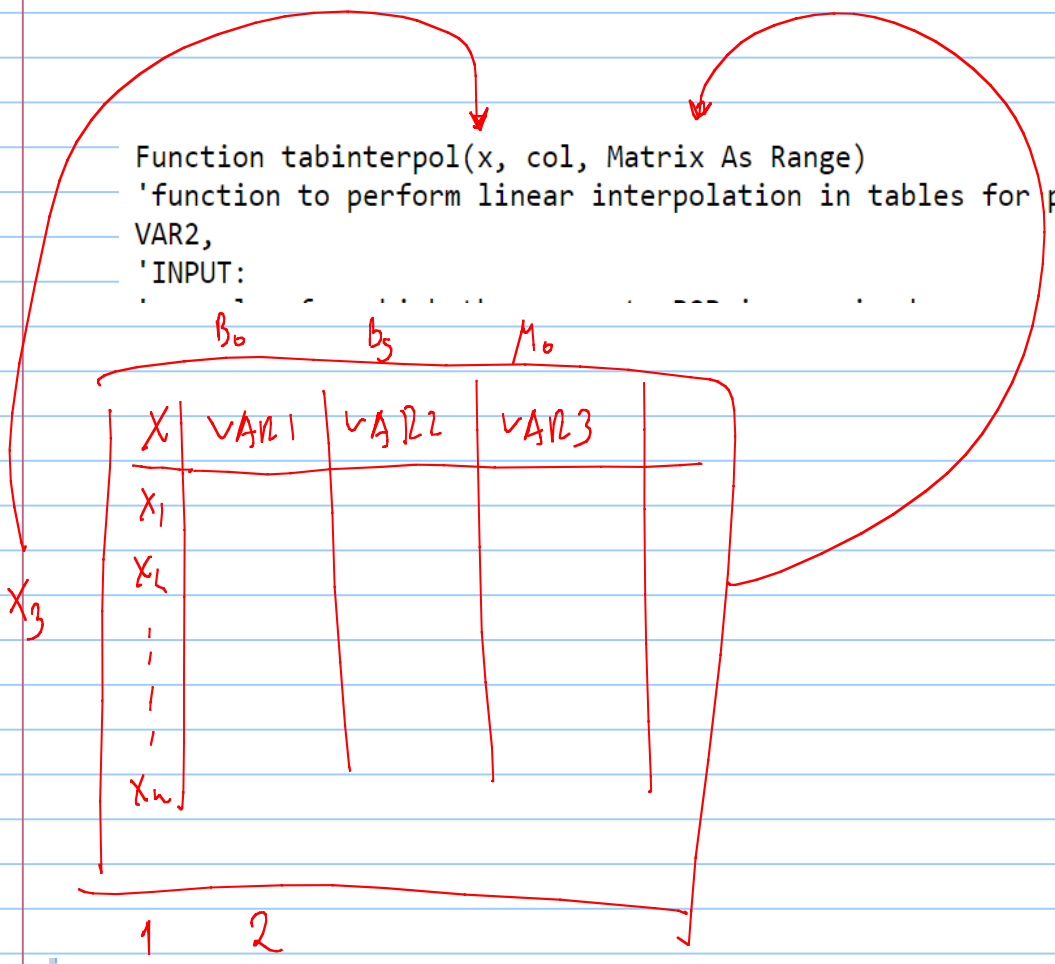
$X = G_p$

$y = q_{pp}$

G_p i want to obtain field with

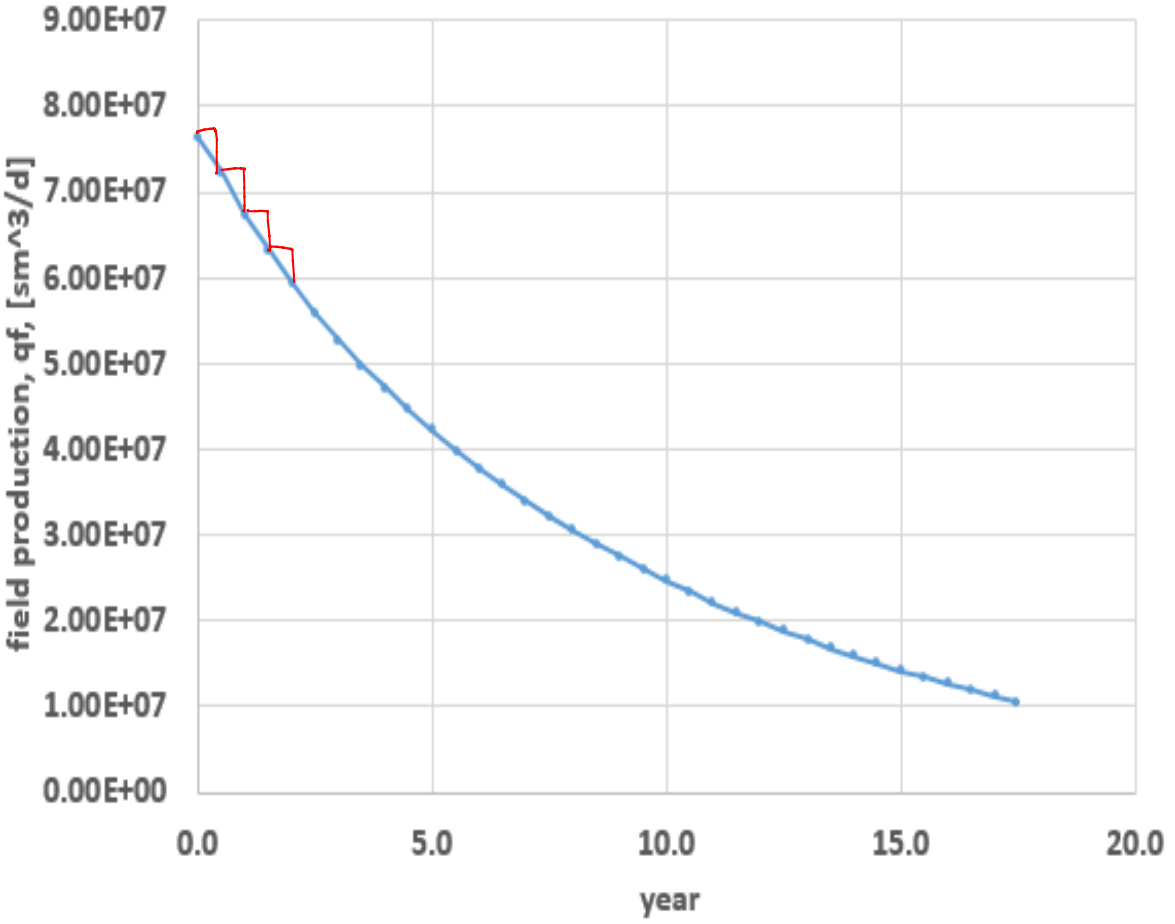
the drawback of this approach is that i have to go manually to each timestep and detect x_1, y_1, x_2, y_2.

```
Function tabinterpol(x, col, Matrix As Range)
'function to perform linear interpolation in tables for properties VAR1,
VAR2,
'INPUT:
```



SUM | =tabinterpol(H10,4,$A$7:$D$37)

	A	B	C	D	E	F	G	H	I
1	N Wells		8						
2	G	[Sm^3]	2.7E+11						
3	Field production	[Sm^3/d]	2.00E+07						
4									
5	Gp	pR	Well qpp	Field qpp		time	qfield	Gp	qppf
6	[Sm^3]	[bara]	[Sm^3/d]	[Sm^3/d]		[years]	[sm^3/d]	[sm^3]	[sm^3/d]
7	0.00E+00	276	9.55E+06	7.64E+07		0.0	7.64E+07	0	7.64E+07
8	7.29E+09	269	9.27E+06	7.41E+07		0.5	7.19E+07	1.36E+10	7.19E+07
9	1.46E+10	260	8.94E+06	7.15E+07		1.0	6.73E+07	2.63E+10	6.73E+07
10	2.19E+10	251	8.61E+06	6.89E+07		1.5	6.32E+07	3.83E+10	=tabinterpo
11	2.92E+10	242	8.29E+06	6.63E+07		2.0	5.94E+07	4.95E+10	5.94E+07
12	3.65E+10	234	7.97E+06	6.38E+07		2.5	5.59E+07	6.00E+10	5.59E+07
13	4.37E+10	226	7.66E+06	6.13E+07		3.0	5.28E+07	7.00E+10	5.28E+07
14	5.10E+10	218	7.36E+06	5.89E+07		3.5	4.98E+07	7.93E+10	4.98E+07
15	5.83E+10	210	7.06E+06	5.65E+07		4.0	4.71E+07	8.82E+10	4.71E+07
16	6.56E+10	202	6.77E+06	5.41E+07		4.5	4.45E+07	9.65E+10	4.45E+07
17	7.29E+10	194	6.48E+06	5.18E+07		5.0	4.22E+07	1.04E+11	4.22E+07
18	8.02E+10	187	6.19E+06	4.95E+07		5.5	3.99E+07	1.12E+11	3.99E+07
19	8.75E+10	179	5.91E+06	4.73E+07		6.0	3.78E+07	1.19E+11	3.78E+07
20	9.48E+10	172	5.63E+06	4.51E+07		6.5	3.58E+07	1.26E+11	3.58E+07
21	1.02E+11	165	5.36E+06	4.29E+07		7.0	3.40E+07	1.32E+11	3.40E+07
22	1.09E+11	157	5.09E+06	4.07E+07		7.5	3.22E+07	1.38E+11	3.22E+07
23	1.17E+11	150	4.82E+06	3.85E+07		8.0	3.05E+07	1.44E+11	3.05E+07
24	1.24E+11	143	4.55E+06	3.64E+07		8.5	2.90E+07	1.49E+11	2.90E+07
25	1.31E+11	136	4.28E+06	3.42E+07		9.0	2.74E+07	1.54E+11	2.74E+07
26	1.39E+11	129	4.01E+06	3.21E+07		9.5	2.60E+07	1.59E+11	2.60E+07
27	1.46E+11	122	3.75E+06	3.00E+07		10.0	2.47E+07	1.64E+11	2.47E+07
28	1.46E+11	122	3.75E+06	3.00E+07		10.5	2.34E+07	1.68E+11	2.34E+07
29	1.53E+11	115	3.48E+06	2.78E+07		11.0	2.21E+07	1.72E+11	2.21E+07
30	1.60E+11	108	3.21E+06	2.57E+07		11.5	2.10E+07	1.76E+11	2.10E+07
31	1.68E+11	101	2.94E+06	2.35E+07		12.0	1.99E+07	1.80E+11	1.99E+07
32	1.75E+11	94	2.67E+06	2.14E+07		12.5	1.88E+07	1.84E+11	1.88E+07
33	1.82E+11	87	2.40E+06	1.92E+07		13.0	1.78E+07	1.87E+11	1.78E+07
34	1.90E+11	80	2.13E+06	1.70E+07		13.5	1.68E+07	1.90E+11	1.68E+07
35	1.97E+11	73	1.85E+06	1.48E+07		14.0	1.59E+07	1.93E+11	1.59E+07
36	2.04E+11	66	1.56E+06	1.25E+07		14.5	1.51E+07	1.96E+11	1.51E+07
37	2.11E+11	59	1.27E+06	1.02E+07		15.0	1.42E+07	1.99E+11	1.42E+07
38						15.5	1.34E+07	2.01E+11	1.34E+07



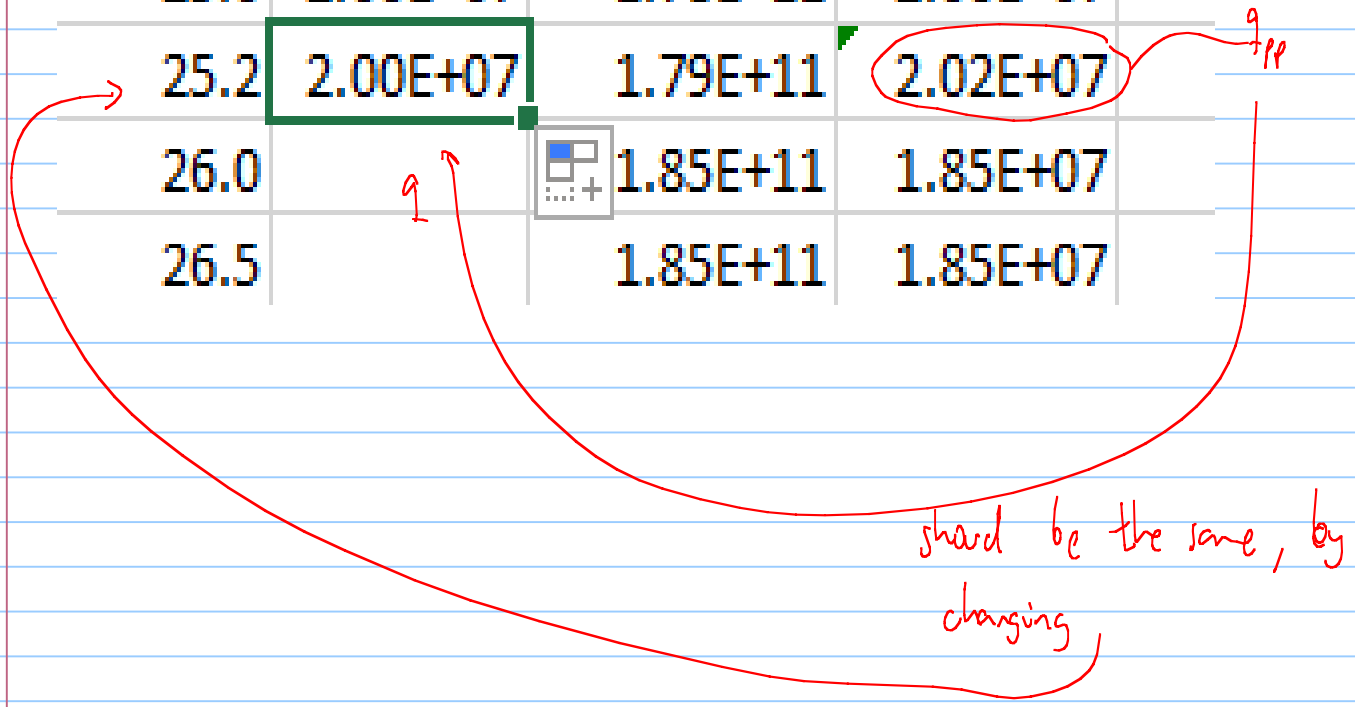
Calculations for plateau mode. Plateau rate of 20 E6 Sm^3/d

time [years]	qfield [sm^3/d]	Gp [sm^3]	qppf [sm^3/d]
0.0	2.00E+07	0	7.64E+07
0.5	2.00E+07	3.55E+09	7.53E+07
1.0	2.00E+07	7.10E+09	7.42E+07
1.5	2.00E+07	1.07E+10	7.29E+07
2.0	2.00E+07	1.42E+10	7.17E+07
2.5	2.00E+07	1.78E+10	7.04E+07
3.0	2.00E+07	2.13E+10	6.91E+07
3.5	2.00E+07	2.49E+10	6.78E+07
4.0	2.00E+07	2.84E+10	6.66E+07
4.5	2.00E+07	3.20E+10	6.54E+07
5.0	2.00E+07	3.55E+10	6.41E+07
5.5	2.00E+07	3.91E+10	6.29E+07
6.0	2.00E+07	4.26E+10	6.17E+07
6.5	2.00E+07	4.62E+10	6.05E+07
7.0	2.00E+07	4.97E+10	5.93E+07
7.5	2.00E+07	5.33E+10	5.82E+07
8.0	2.00E+07	5.68E+10	5.70E+07
8.5	2.00E+07	6.04E+10	5.58E+07
9.0	2.00E+07	6.39E+10	5.47E+07
9.5	2.00E+07	6.75E+10	5.36E+07
10.0	2.00E+07	7.10E+10	5.24E+07
10.5	2.00E+07	7.46E+10	5.13E+07
11.0	2.00E+07	7.81E+10	5.02E+07
11.5	2.00E+07	8.17E+10	4.91E+07

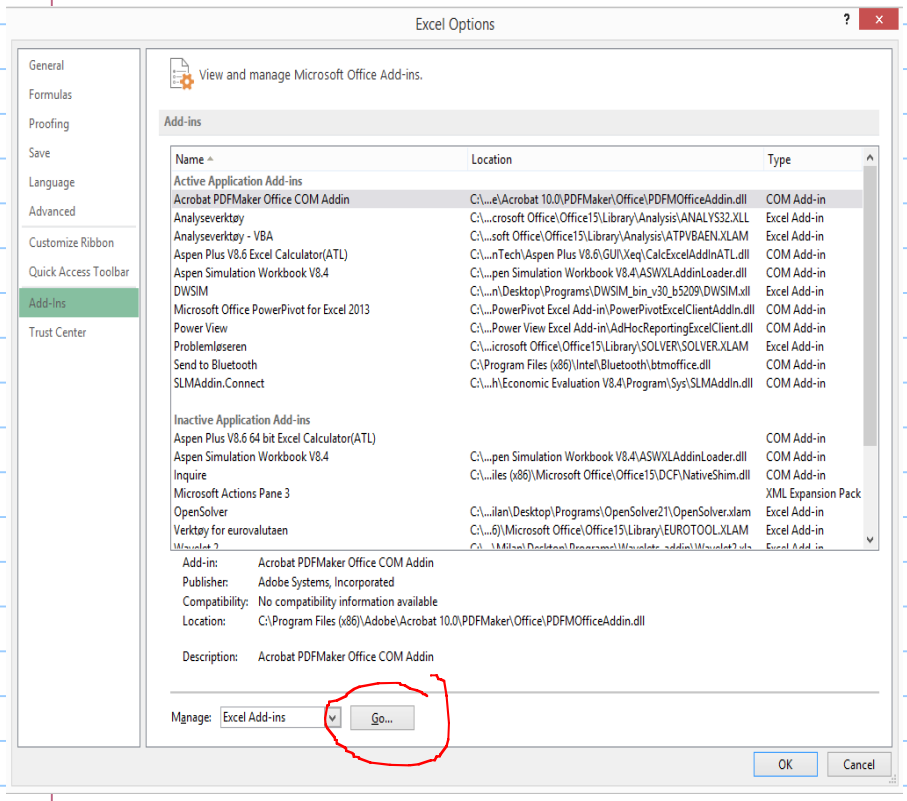
For all these years, production potential is greater than plateau rate, that means that it is feasible to produce it!

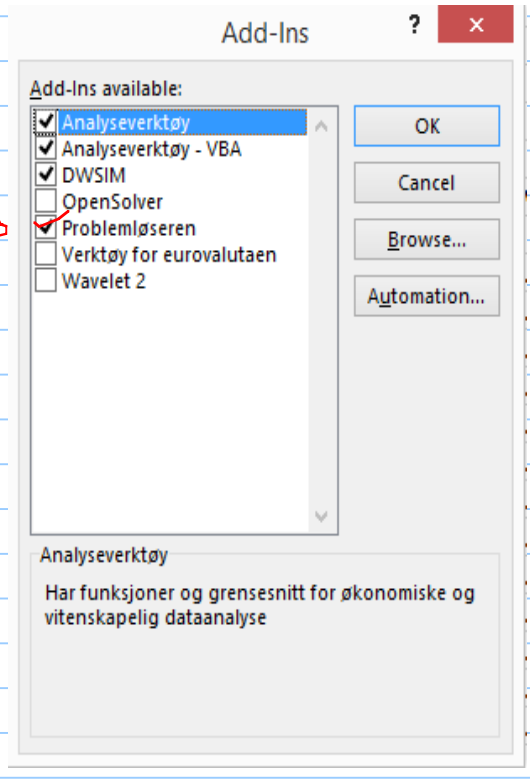
How to find plateau duration with Excel solver?

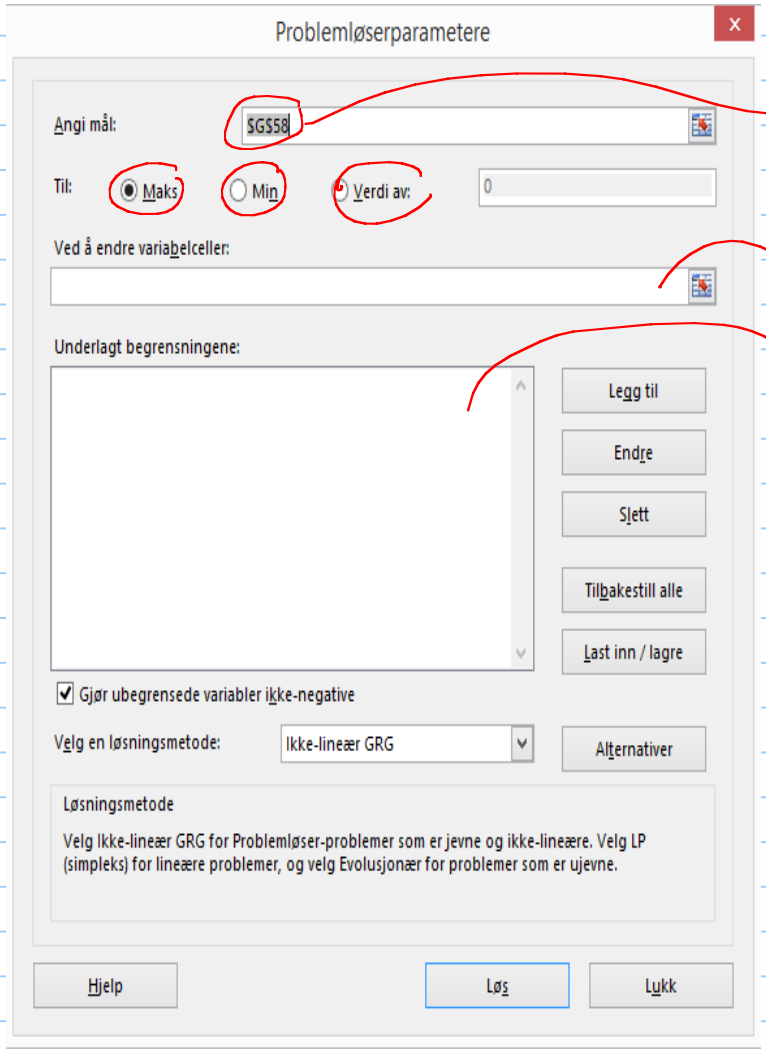
24.0	2.00E+07	1.70E+11	2.27E+07
24.5	2.00E+07	1.74E+11	2.17E+07
25.0	2.00E+07	1.78E+11	2.06E+07
25.2	2.00E+07	1.79E+11	2.02E+07
26.0		1.85E+11	1.85E+07
26.5		1.85E+11	1.85E+07



Activate the solver in Excel: File, options---Add-ins







objective cell, max, min, drive to a certain value

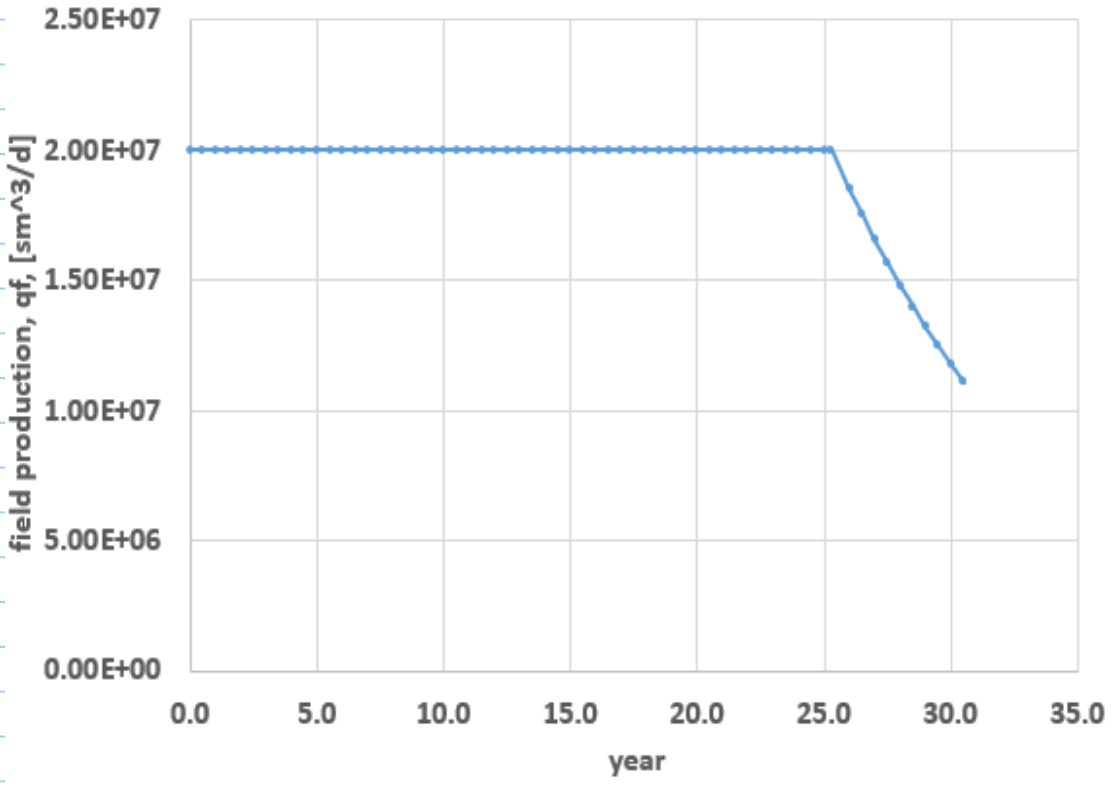
cells to change, variables

constraints:
- operational constraints
- variable bounds to help the solver

	22.5	2.00E+07	1.60E+11	2.59E+07	
	23.0	2.00E+07	1.63E+11	2.48E+07	
	23.5	2.00E+07	1.67E+11	2.38E+07	
	24.0	2.00E+07	1.70E+11	2.27E+07	
	24.5	2.00E+07	1.74E+11	2.17E+07	
	25.0	2.00E+07	1.78E+11	2.06E+07	Error
End of plateau	25.291	2.00E+07	1.80E+11	2.00E+07	=(I58-G58)^2
	26.0	1.85E+07	1.85E+11	1.85E+07	
	26.5	1.75E+07	1.88E+11	1.75E+07	

After plateau, the field its producing at is production potential

End of plateau	25.291	2.00E+07	1.80E+11	2.00E+07	1.38778E-17
	26.0	1.85E+07	1.85E+11	1.85E+07	
	26.5	1.75E+07	1.88E+11	1.75E+07	
	27.0	1.66E+07	1.91E+11	1.66E+07	
	27.5	1.57E+07	1.94E+11	1.57E+07	
	28.0	1.48E+07	1.97E+11	1.48E+07	
	28.5	1.40E+07	1.99E+11	1.40E+07	
	29.0	1.32E+07	2.02E+11	1.32E+07	
	29.5	1.25E+07	2.04E+11	1.25E+07	
	30.0	1.18E+07	2.06E+11	1.18E+07	
	30.5	1.11E+07	2.08E+11	1.11E+07	



it might not be possible to produce at the production potential (specially for early times)
- damage to the formation (sand production)
- gas coning, water coning
- erosion problems
- Critical flow ⇝ limitation in the maximum rate

But it is important to estimate the behavior of the production potential to estimate plateau duration.