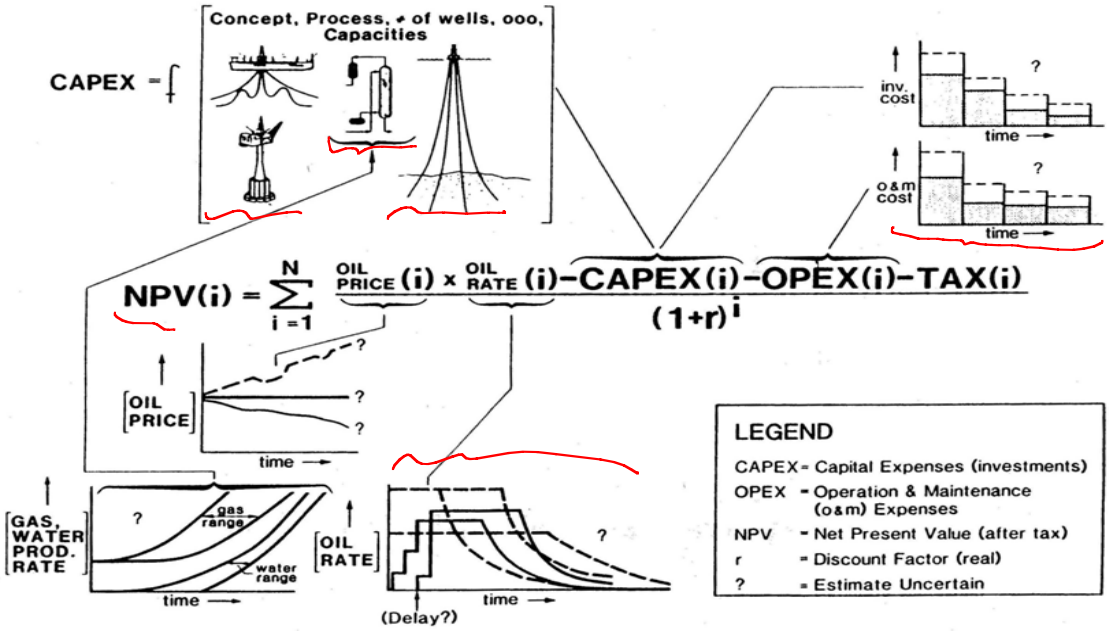
2018 02 06 topics today:
- short comment on NPV calculations
- orientation for excel usage during the course
- Class exercise → estimation of OOIP(N) using Monte Carlo

What can we control?

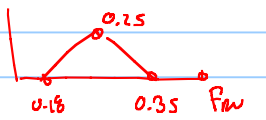
supplementary material article by Halvorsen.



RECOMMENDATIONS WHEN DELIVERING THE EXERCISES

- -Attach all files used to perform your calculations (e.g. Excel files, Hysys files, etc.) to your delivery.
  -Follow the "Excel etiquette" as explained in class. The excel sheets should be legible, understandable and usable for others besides yourself. It is encouraged to include text, sketches and comments to clarify the operations performed in the excel sheet. The plots should have a legible and proper size (e.g. 16 pt), axis titles in bold, depicting the variable name, variable symbol and units. Reservoir pressure, P_R, [bara]
  -OPTIONAL: For clarity purposes, a summary document containing a small description about the methodology, results (on tables and graphs) and short conclusions may be delivered. When converting the word document to pdf make sure to use (in the pdf printer settings) a resolution high enough so figures and plots are still legible.

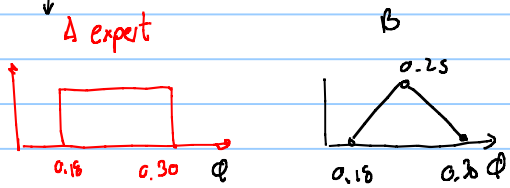
- Problem 3 of exercise set 1



As part of the early development studies and as required by the Norwegian authorities, your first task is to perform a probabilistic estimation of the total recoverable reserves and the original oil in place of the Kobbe reservoir. The subsurface group has provided (in the excel sheet attached) information on the factors needed to calculate hydrocarbon pore volume (rock volume, net to gross, oil saturation, and the reservoir engineering group the formation volume factor (all based on a uniform probability distribution). The ultimate recovery factor is represented by a triangle distribution with a min value of 0.18, a max value of 0.35 and a mode of 0.25

$$N_{PV} = \frac{V_R \cdot \phi \cdot S_o \cdot N_{TG} \cdot F_{RV}}{B_o} \qquad N = \frac{V_R \cdot \phi \cdot S_o \cdot N_{TG}}{B_o}$$

There is disagreement within the company with respect to which porosity values to employ. A senior petrophysicist A says that a uniform porosity distribution should be employed with a min value of 0.18 and a max value of 0.30. Another senior petrophysicist B says that a skewed triangle distribution should be used with a min value of 0.18, a max value of 0.30 and a mode of 0.25.



- Calculate TNR, N for expert A / expert B — In class we are going to solve N for expert A.

Ex. 1, Problem 3. TPG4230, Milan Stanko

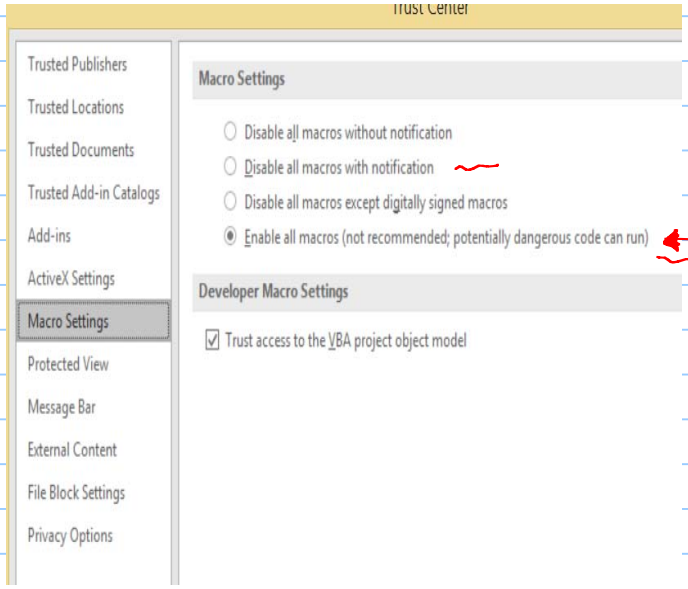
	Rock volume	Porosity	Net to Gross	Oil Saturation	Formation Volume Factor		Ultimate Recovery Factor
	V_R	ϕ	N_{TG}	So	Bo		F_{ru}
	[bbl]	[-]	[-]	[-]	[Res bbl/stb]		[-]
Min	5.00E+09	0.18	0.3	0.8	1.35	Min	0.18
Max	6.25E+09	0.30	0.5	0.9	1.60	Mode	0.25
						Max	0.35

input

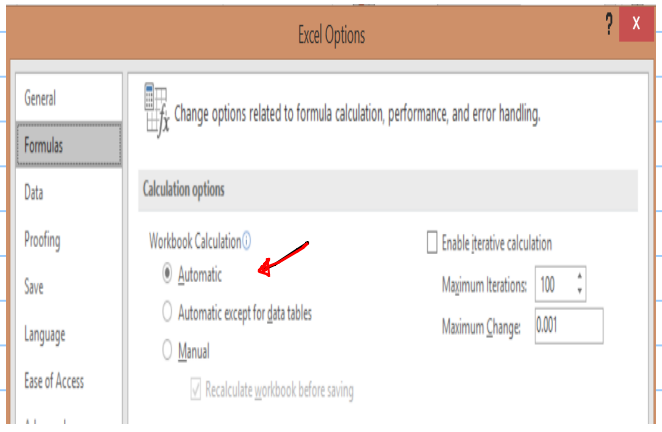
V_R [bbl]	ϕ [-]	N_{TG} [-]	S_o [-]	B_o [bbl/stb]	output N_L [stb]
0	0	0	0	0	0

- Excel setup { lower macro security — VBA visual basic for applications

File → options → trust center → trust center settings : on the left menu: "macro settings"

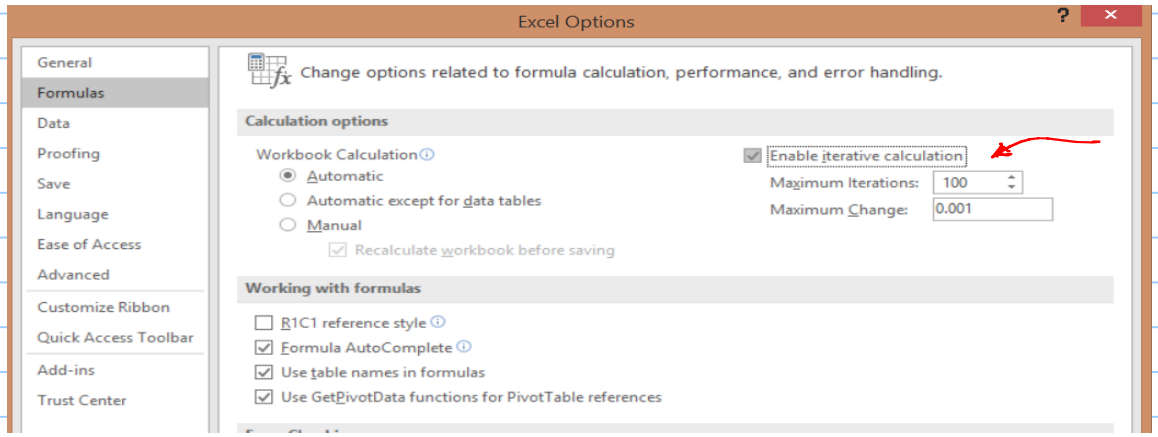


- enable automatic calculations in "file" → "options" → on the left menu → "formulas"



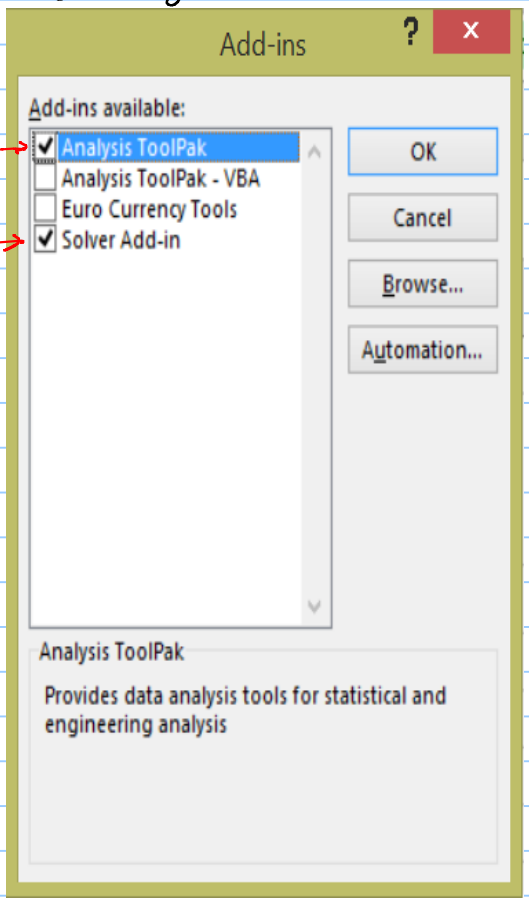
- to execute all calculations on an excel sheet press "F9"

- enable "iterative calculations" (circular references)



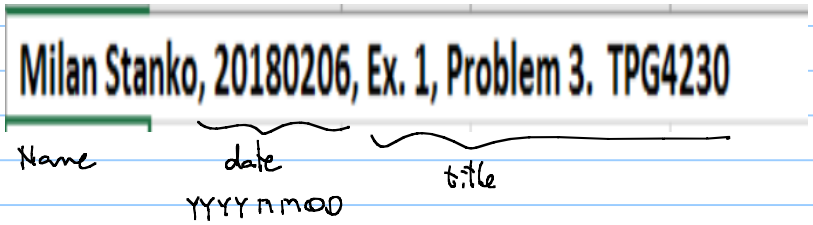
- Enable "solver" { root finding tool } Analysis toolpack

"File" → "options" → "add-ins" → "go"



Excel etiquette:

1: Identify your sheet



2: Use color code for cells:

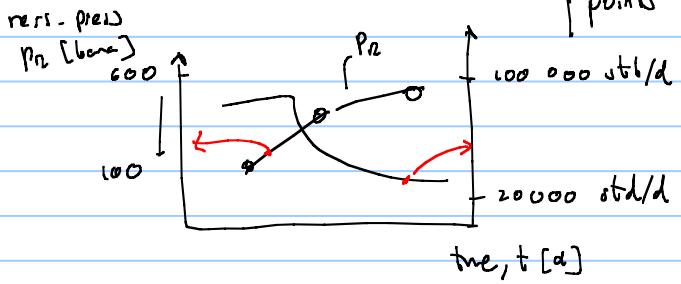
RED ~ user defined input (things that might potentially change)

blue ~ results / product of a calculations

violet ~ constants

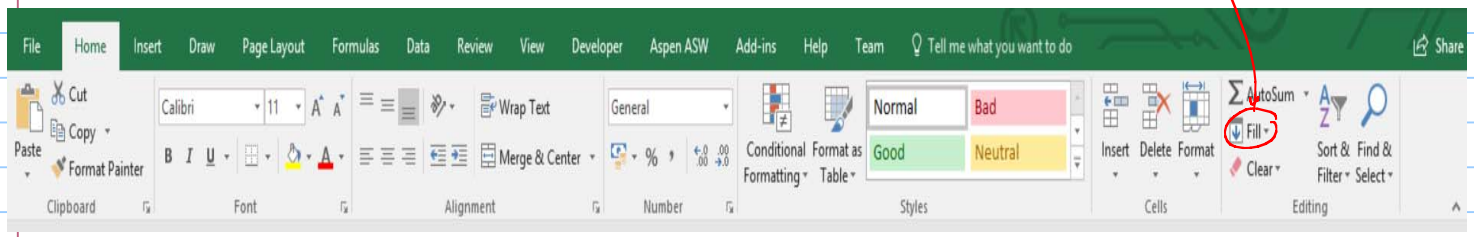
for few input output follow the convention above
for long rows then use black

3: Figures/plots { go in a separate sheet
axis titles variable name, variable symbol, units
font size (16-18 pt)
points should be visible { scatter point with line
bar plot

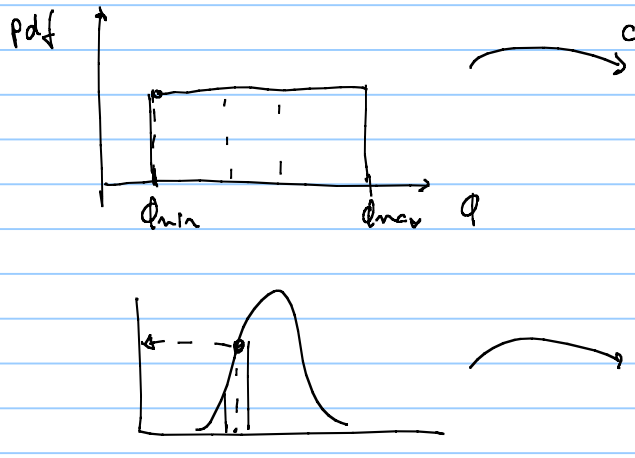


"plot series in secondary axis"

- Fill : fill a column automatically



the random sampling is usually made using the cumulative distribution, NOT the pdf (probability distribution function)



$$\frac{1-0}{q_{max}-q_{min}} = \frac{cp-0}{q^*-q_{min}}$$

rand {0, 1}

X_{max} X_{min}

$$X = X_{min} + (X_{max} - X_{min}) \cdot cp$$

rand (0-1)

SUM | =B$5+(B$6-B$5)*RAND()

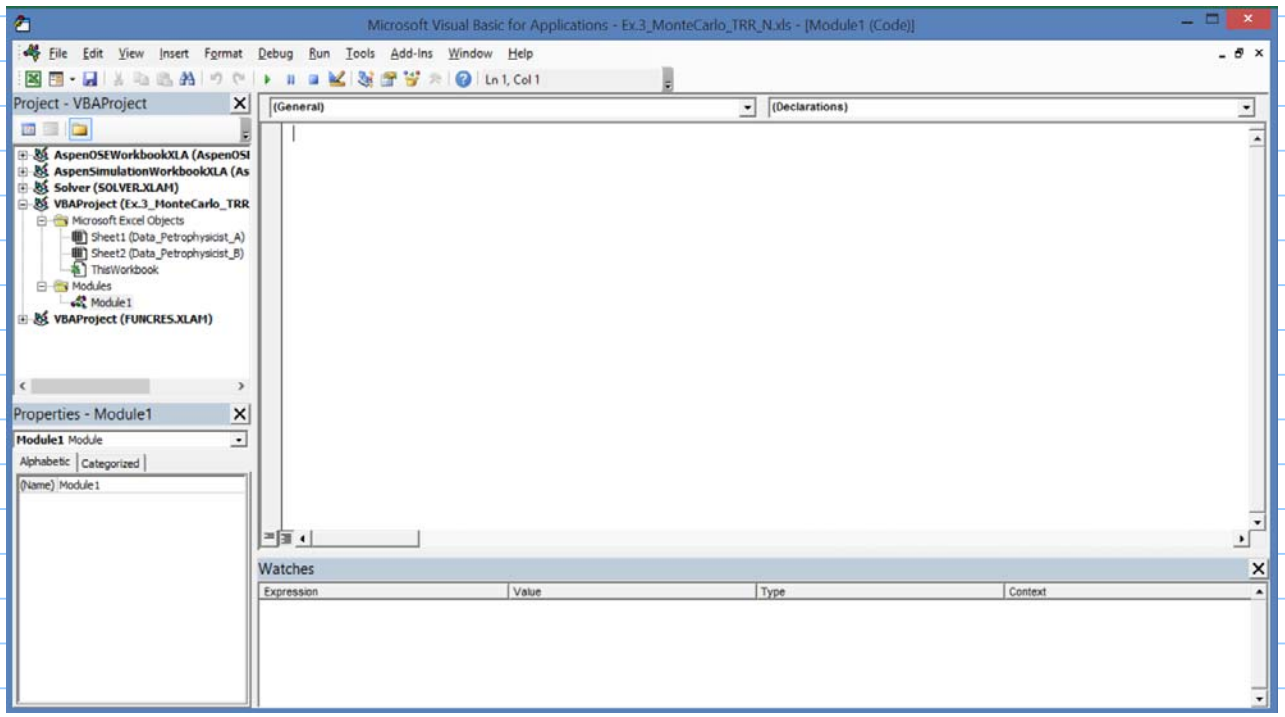
	A	B	C	RAND()	E	F	G	H
1	Milan Stanko, 20180206, Ex. 1, Problem 3. TPG4230							
2		Rock volume	Porosity	Net to Gross	Oil Saturation	Formation Volume Factor		Ultimate Recovery Factor
3		V_R	ϕ	N_{TG}	So	Bo		F_{ru}
4		[bbl]	[-]	[-]	[-]	[Res bbl/stb]		[-]
5	Min	5.00E+09	0.18	0.3	0.8	1.35	Min	0.18
6	Max	6.25E+09	0.30	0.5	0.9	1.60	Mode	0.25
7							Max	0.35
8								
9	Nr. it	V_R	ϕ	N_{TG}	So	Bo	N	
10	[-]	[bbl]	[-]	[-]	[-]	[Res bbl/stb]	[stb]	
11	1	=B$5+(B$6-B$	2.46E-01	3.35E-01	8.22E-01	1.50	2.51E+08	

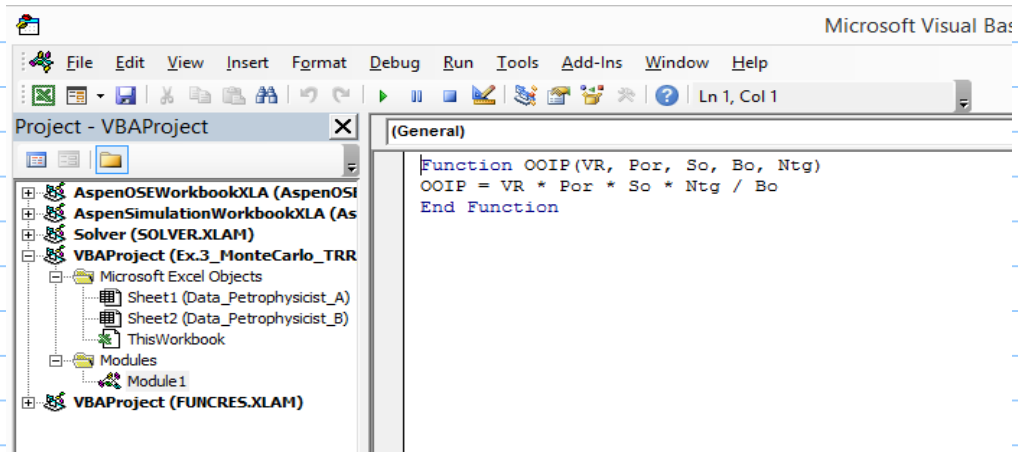
SUM | =B11*C11*D11*E11/F11

	A	B	C	D	E	F	G	H
1	Milan Stanko, 20180206, Ex. 1, Problem 3. TPG4230							
2		Rock volume	Porosity	Net to Gross	Oil Saturation	Formation Volume Factor		Ultimate Recovery Factor
3		V_R	ϕ	N_{TG}	So	Bo		F_{ru}
4		[bbl]	[-]	[-]	[-]	[Res bbl/stb]		[-]
5	Min	5.00E+09	0.18	0.3	0.8	1.35	Min	0.18
6	Max	6.25E+09	0.30	0.5	0.9	1.60	Mode	0.25
7							Max	0.35
8								
9	Nr. it	V_R	ϕ	N_{TG}	So	Bo	N	
10	[-]	[bbl]	[-]	[-]	[-]	[Res bbl/stb]	[stb]	
11	1	5.55E+09	2.46E-01	3.35E-01	8.22E-01	1.50	=B11*C11	
12	2	5.32E+09	2.95E-01	3.81E-01	8.60E-01	1.45	3.54E+08	

VBA Using VBA instead of a formula in Excel:

alt + F11 to access the VBA module:




Microsoft Visual Bas
File Edit View Insert Format Debug Run Tools Add-Ins Window Help
Ln 1, Col 1
Project - VBAProject
AspenOSEWorkbookXLA (AspenOSI
AspenSimulationWorkbookXLA (As
Solver (SOLVER.XLAM)
VBAProject (Ex.3_MonteCarlo_TRR
Microsoft Excel Objects
Sheet1 (Data_Petrophysicist_A)
Sheet2 (Data_Petrophysicist_B)
ThisWorkbook
Modules
Module1
VBAProject (FUNCRES.XLAM)
(General)
Function OOIP(VR, Por, So, Bo, Ntg)
OOIP = VR * Por * So * Ntg / Bo
End Function