UE 111
FINANCIAL MODELING AND APPLICATIONS
TD #2

Juan Raposo and Fabrice Riva

2015-16

Exercise 1

The constant annuity, denoted a, on a flat loan for which the amount borrowed is denoted K, the term of the loan (in years) is denoted n and the annual interest rate is denoted r, is given by:

$$a = \frac{r \times K}{1 - (1 + r)^{-n}} \tag{1}$$

Write a VBA function whose arguments are K, n and r that returns the value of a.

Exercise 2

The "Exercise 2" worksheet in workbook "TD2 - part 1.xls" contains daily observations on different stocks (see figure 1). For each stock, the information reported is (i) the stock price on each date and (ii) the corresponding trading volume (number of traded shares). The number of trading dates is the same for all stocks, but the number of sample stocks as well as the number of observations per stock are unknown, ex-ante.

A programmer has written the following VBA procedure.

```
1.  Sub Procedure1()
2.   For Each MyCell In Range(Cells(3, 2), Cells(3, 2).End(xlToRight)).Cells
3.     If MyCell.Column Mod 2 = 0 Then
4.      Set Range1 = Range(MyCell, MyCell.End(xlDown))
5.      Set Range2 = Range1.Offset(0, 1)
6.      MyCell.End(xlDown).Offset(1, 0).Value = _
        WorksheetFunction.SumProduct(Range1, Range2) / _
        WorksheetFunction.Sum(Range2)
7.     End If
8.   Next MyCell
9.  End Sub
```

1. What is the set of cells the loop starting in command line 2 loops through?

Figure 1: Snapshot of "Exercise 2" worksheet

	A	B	C	D	E	F	G	H	I	J	K
1	Date	Stock 1		Stock 2		Stock 3		Stock 4		Stock 5	
2		Price	Volume	Price	Volume	Price	Volume	Price	Volume	Price	Volume
3	19/06/2002	29.88	739	48.40	77767	49.43	1276	19.09	2929	9.10	5122
4	20/06/2002	29.03	2722	45.73	58328	48.55	5231	18.60	2819	8.79	4234
5	21/06/2002	30.09	5593	45.77	2791	49.63	2065	18.96	3254	8.74	1098
6	24/06/2002	30.18	1252	45.70	3313	49.36	3813	19.03	2820	8.58	2092
7	25/06/2002	29.91	2171	45.73	17751	49.30	4742	19.24	3062	8.93	1414
8	26/06/2002	30.18	6233	46.50	79843	50.45	2273	19.24	2697	9.00	1274
9	27/06/2002	30.49	3337	44.25	53417	51.27	668	19.39	3370	8.96	6660
10	28/06/2002	29.70	7644	41.73	72867	50.18	5144	18.72	3491	8.70	8550
11	01/07/2002	30.15	8295	41.62	27885	50.79	4619	19.03	3245	8.43	1331
12	02/07/2002	31.37	3501	40.70	75372	53.71	833	19.15	2587	8.23	9278
13	03/07/2002	31.71	1089	40.89	101947	53.58	1632	19.33	2578	8.51	2473
14	04/07/2002	31.86	8809	38.57	5586	53.17	4102	19.48	2808	8.25	6070
15	05/07/2002	30.79	3109	38.11	37556	53.99	264	19.51	2506	8.19	10649
16	08/07/2002	30.34	1175	40.86	26562	53.99	3055	19.82	2576	8.04	3635
17	09/07/2002	30.18	9208	38.19	97372	52.90	2036	19.18	3492	7.76	6221
18	10/07/2002	28.17	1912	38.87	4824	50.86	5059	18.20	2645	6.95	8503
19	11/07/2002	27.38	3951	36.02	29358	47.73	1543	17.47	3438	6.80	1221
20	12/07/2002	25.25	7989	32.40	11335	45.08	4628	16.40	2892	6.39	3314

2. Which cells meet the condition written on command line 3?

3. What are the ranges targeted by command lines 4 and 5, respectively?

4. What is the output of the computation performed by command line 6? Where does the program store this output?

Exercise 3

The "Exercise 3" worksheet in workbook "TD2 - part 1.xls" contains the daily prices of Bouygues over the sample period January 3, 1977 – June 28, 1991 (see figure 2). The number of available stock prices if unknown, ex-ante.

In this exercise, we assume that some of the stock prices are missing. When a stock price is missing on a given date, the reported price is equal to 0. To make the problem simple, it is assumed that there is at most one missing price between two available prices and that neither the first nor the the last price of the sample are missing.

In order to compute unbiased returns when a stock price is missing, the missing price is replaced by the average of the previous price and the next price.

Question

Write a VBA procedure that reports in column `C`, for each available trading date:

Figure 2: Snapshot of the "Bouygues" worksheet

	A	B
1	DATE	COURSAJUST
2	770103	18.20
3	770104	18.20
4	770105	18.54
5	770106	0.00
6	770107	18.42
7	770110	18.76
8	770111	17.92
9	770112	0.00
10	770113	18.34

- The value of the trading price if the price is not missing;
- The replacement value if the price is missing.

Do you think that replacing stock prices is a good practice? Why?

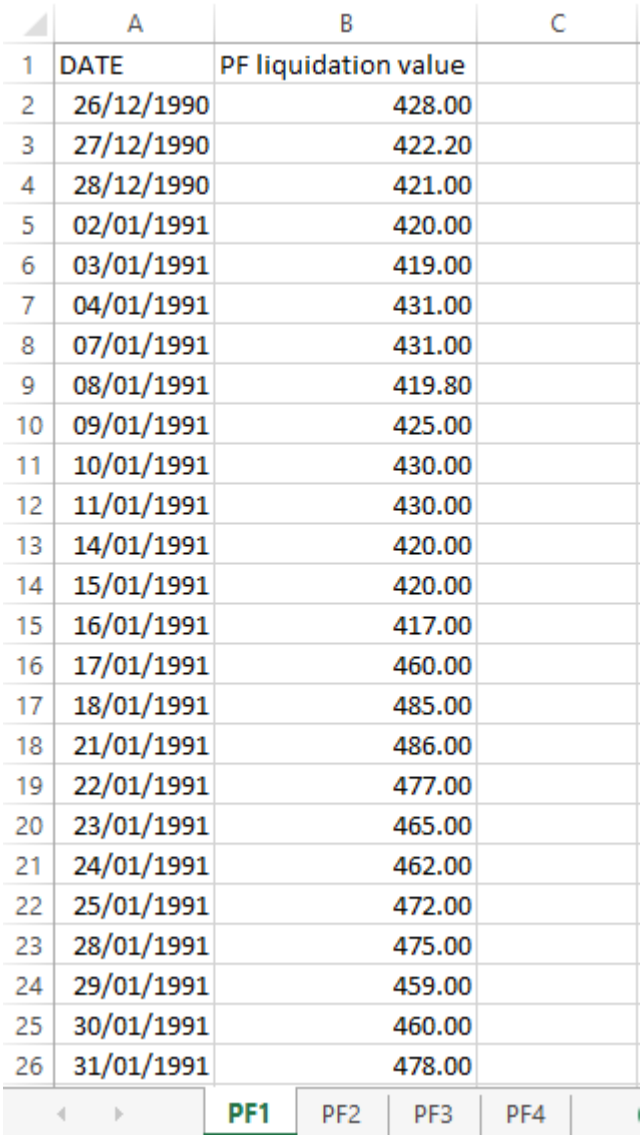
Exercise 4

A fund manager stores the historical liquidation values of its portfolios in a workbook ("TD2 - part 2.xls"). Each worksheet contains information on one portfolio (see figure 3). The investment in the different portfolios has been made at different dates, so that the number of observations in columns A and B is not constant across the different worksheets. Both the number of dates per portfolio and the number of portfolios are unknown, ex-ante.

Questions

1. We first restrict our attention to the worksheet named "PF1". Write a VBA procedure named `Perf_Individual_PF` that stores in cell C1 the portfolio performance, where portfolio performance is computed as the ratio of the last available liquidation value over the first one.
2. We now want to extend this computation to all existing worksheets. We will code two different procedures to perform this task:
   (a) The first procedures relies on the naming convention used by the fund manager to name the worksheets, i.e. "PF1" for the first one, "PF2" for the second one, etc.
      i. What is the VBA command line for counting the number of portfolios managed by the fund manager and storing this number in a variable named `Nb_PF` ?

Figure 3: Snapshot of fund manager's workbook



	A	B	C
1	DATE	PF liquidation value	
2	26/12/1990	428.00	
3	27/12/1990	422.20	
4	28/12/1990	421.00	
5	02/01/1991	420.00	
6	03/01/1991	419.00	
7	04/01/1991	431.00	
8	07/01/1991	431.00	
9	08/01/1991	419.80	
10	09/01/1991	425.00	
11	10/01/1991	430.00	
12	11/01/1991	430.00	
13	14/01/1991	420.00	
14	15/01/1991	420.00	
15	16/01/1991	417.00	
16	17/01/1991	460.00	
17	18/01/1991	485.00	
18	21/01/1991	486.00	
19	22/01/1991	477.00	
20	23/01/1991	465.00	
21	24/01/1991	462.00	
22	25/01/1991	472.00	
23	28/01/1991	475.00	
24	29/01/1991	459.00	
25	30/01/1991	460.00	
26	31/01/1991	478.00	

PF1 PF2 PF3 PF4

ii. Assuming that the portfolio number is stored in variable `i`, what is the command line that builds the character string "PF1" if `i` is equal to 1, "PF2" if `i` is equal to 2, etc.

iii. Write a procedure named `Perf_All_PF_1` that will rely on calls to `Perf_Individual_PF`, which loops through all PF worksheets using a `For...Next` loop, and which stores, at each iteration, the performance of the corresponding portfolio in cell C1.

(b) The second procedure does not require the computation of the number of worksheets since it relies on a `For Each...Next` loop. Write a VBA procedure named `Perf_All_PF_2`

that will also rely on calls to `Perf_Individual_PF` and which performs the same task as `Perf_All_PF_1`.

3. In order to have a clearer view of the performance of its portfolios, the fund manager wants to color in red (`vbRed`) the tabs of the worksheets that contain a portfolio whose performance is strictly negative (ratio stricly lower than 1), and he wants to color in green (`vbGreen`) the tabs of the worksheets that contain a portfolio whose performance is either positive or equal to 0 (ratio greater than or equal to 1). Tabs are accessible through the `Tab` property of a worksheet object and the `Tab` property has a `Color` property which behaves like the `Color` property of a cell. Write a procedure that will color properly the tabs of the various worksheets.

Exercise 5

The objective of this exercise if to code a user-defined NPV function in order to estimate the profitability of an investment project. In step 1 you will be asked to develop a baseline NPV function, while in step 2 you will extend this function to account for the existence of a term structure of discount rates.

Step 1

Excel includes an NPV function (`=NPV` in English / `=VAN` in French). However, as illustrated in figure 4, the Excel NPV has a wrong name as the computed "NPV" is actually the present value, meaning that one has to subtract back the initial investment to get the "true" **Net** present value. To fix this problem, you will code a `MyNPV` function taking 2 arguments as inputs:

- a `CashFlows` argument of type `Range` corresponding to the range that contains the cash flow series associated with the project, including the initial expense (i.e. range `B4:B9` in figure 4);
- a `Rate` argument of type `Range` corresponding to the cell that contains the discount rate (i.e. cell `B1` in figure 4).

NPV computations

Assume that a project involves an initial expense denoted C_0 at date 0 (C_0 is assumed to be negative) and that this project generates a stream of cash flows $C_1, C_2, \ldots, C_T$ at dates $t = 1, 2, \ldots, T$. Then the NPV of the project is compited as:

$$\text{NPV} = C_0 + \sum_{t=1}^{T} \frac{C_t}{(1+r)^t}$$

where r is the (constant) discount rate.

Development of the MyNPV function

1. Instruct VBA that the indexing of all array variables must start from 0.

Figure 4: Excel NPV function

	A	B	C	D
1	Discount rate	10%		
2				
3	Date	Cash-Flow		
4	0	-1000		
5	1	100		
6	2	200		
7	3	300		
8	4	500		
9	5	400		
10				
11	NPV	71.47 €	<- =NPV(B1;B5:B9)+B4	

2. Write a command line that counts the number of cash flows contained in the input variable `CashFlows` and which stores this number in variable `nb_CF`.

3. Declare two array variables named `CF` and `Discount_Factors`, respectively, and whose number of elements is equal to `nb_CF`.

4. Write a VBA procedure that fills all the cells in array variable `CF` with the cash flow values, and which fills each cell `i` in array variable `Discount_Factors` in such a way that `CF(i)` $\times$ `Discount_Factors(i)` returns the discounted value at rate `r` of cash flow `i`.

5. Which (worksheet)function do you have to invoke to compute the NVP of the project based on array variables `CF` and `Discount_Factors`?

6. Write the entire code of the `MyNPV` function.

Step 2: The GenNPV function

We now generalize the former function in order to account for the possibility of non constant discount rates over the lifetime of the project (see figure 5). Denoting r_t the discount rate that applies to cash flow t, the formula to compute the generalized NPV is given by:

$$\text{GenNPV} = C_0 + \sum_{t=1}^{T} \frac{C_t}{(1+r_t)^t} \tag{2}$$

Write a `GenNPV(CashFlows,Rates)` which computes the NPV according to formula (2). In this new function, the `CashFlows` argument still refers to the range that contains the cash flows which have to

Figure 5: Generalized NPV function

	A	B	C
1	Date	Cash-Flow	Discount rate
2	0	-1000	
3	1	100	10%
4	2	200	9%
5	3	300	8%
6	4	500	7%
7	5	400	5%

be discounted, including the initial expense (range `B2:B7` in figure 5) whereas the `Rates` argument now refers to the range that contains the discount rates (range `C3:C7` in figure 5).