

HEC – L3 / M1

Data Modeling with spreadsheets

Exercises

ISOM Department

Contents

Exercise 1.....	3
Model structure, absolute and relative references, names.....	3
Exercise 2.....	4
Model structure, data validation, conditional formatting, IF function, data tables, graphs.	4
Exercise 3.....	6
Match(), Index() Functions, conditional formatting, data validation, date formats.....	6
Exercise 4 (Marks)	7
Functions Rand(), IF, Vlookup, CountIf and Norminv	7
Exercise 5 (Curtains)	8
Elaborate model, data tables, graphs.....	8
Exercise 6.....	10
Financial functions, calculation of a loan, simulation of insolvency.	10
Exercise 7 (Employees)	11
Data lists, Dxx functions	11
Exercise 8 (Pivot tables)	12
Data Lists & Pivot Tables	12
Exercise 9 (Bakery)	15
Time simulation using statistical probabilities, independent periods	15
Exercise 10 (Steelwork Mining and Metal)	16
Probability distribution, simulations	16
Exercise 11 (Golf).....	17
Elaborate model, data tables, graphs.....	17

Exercise 1

Model structure, absolute and relative references, names.

With the following data:

Order:

Products	Quantity	Base Unit price
Asus X5DAF	1	499,00 €
Asus X5DID	2	549,00 €
Ecran Samsung 23" TFT	3	299,00 €
Disque Dur externe 500 Go	1	59,15 €
Imprimante scanner Lexmark	1	99,20 €
Cartouche encre couleur	2	26,05 €
Cartouche encre noire	3	25,15 €
Souris Logitech	1	23,20 €

VAT1 19,6%

VAT2 21,0% (Belgium)

Build and fill the following table :

Products	Total base price	%Total Ex. Tx	Total IncTx1	Total IncTx2
Asus X5DAF	499,00 €	17,80%	596,80 €	603,79 €
Asus X5DID	1 098,00 €	39,17%	1 313,21 €	1 328,58 €
Ecran Samsung 23" TFT	897,00 €	32,00%	1 072,81 €	1 085,37 €
Disque Dur externe 500 Go	59,15 €	2,11%	70,74 €	71,57 €
Imprimante scanner Lexmark	99,20 €	3,54%	118,64 €	120,03 €
Cartouche encre couleur	52,10 €	1,86%	62,31 €	63,04 €
Cartouche encre noire	75,45 €	2,69%	90,24 €	91,29 €
Souris Logitech	23,20 €	0,83%	27,75 €	28,07 €
TOTALS	2 803,10 €	100,00%	3 352,51 €	3 391,75 €

Use parameters, create formulas for the first row only, then use autofill

Exercise 2

Model structure, data validation, conditional formatting, IF function, data tables, graphs.

A company sells electric fans. Its main product is very high tech and has a three-year guarantee, parts and labor included. It is machined in an entirely dedicated workshop.

The CEO has to set the price of the fan for next year, in order to optimize the company margin. Here, the margin is calculated by subtracting production costs (fixed and variable) from turnover excluding taxes.

The information corresponding to monthly data, provided by various executives of the company, are grouped below.

- The Production Manager estimates the fixed production costs will be 200 000 €. Variable costs are 32 € E.T. per unit produced, and we cannot expect productivity gains for increased production.
- The Marketing Manager considers that, with a base price of 100 €, his sellers will be able to place 5,000 units monthly. But he believes this price to be a little high. Indeed, a sensitivity study, achieved by the best market research company in Paris, indicates that, if the selling price falls by 1€ E.T., sales would increase by 90 units. Reports even show that this demand price elasticity can be considered constant, at least down to a floor price of 60 € E.T.

Can you help the CEO to fix his price for the best, in order to obtain the best profit margin possible?

FIST VERSION OF THE MODEL

- 1 **Create model parameters** including all data given in the case. Give a name to each parameter. Control new price input ($>€60$) using data/validation.
- 2 **Calculate your results** using the parameters. Do not put any number in your formula. Assume that you have chosen a new price of €90.

	Results
New price	90€
Quantity	5900
Turnover E.T.	531 000€
Fixed costs	200 000€
Variable costs	188 800€
Total costs	388 800€
Margin	142 200€

What is the margin for a new price of €80, €70 and €60€ ?

You just need to change the value of the new price (decision parameter) to see the results. Save your model.

SECOND VERSION OF THE MODEL

You'd like to test 6 different prices using a chosen step and make manual simulations to find the best price.

1. Create a new parameter, and name it « **step** ».
2. Make sure the new price stays within correct limits, and calculate the margin for 6 different prices at the same time.

New price: €90, step: €1

	Results					
New price	90€	89,00 €	88,00 €	87,00 €	86,00 €	85,00 €
Quantity	5900	5 990	6 080	6 170	6 260	6 350
Turnover E.T.	531 000€	533 110 €	535 040 €	536 790 €	538 360 €	539 750 €
Fixed costs	200 000€	200 000 €	200 000 €	200 000 €	200 000 €	200 000 €
Variable costs	188 800€	191 680 €	194 560 €	197 440 €	200 320 €	203 200 €
Total costs	388 800€	391 680 €	394 560 €	397 440 €	400 320 €	403 200 €
Margin	142 200€	141 430 €	140 480 €	139 350 €	138 040 €	136 550 €

3. Use conditional formatting to highlight the best margin.
4. Use IF function to show the best margin.

Test several values for new price and step. Save your model under another name.

THIRD VERSION OF THE MODEL

Open your first version file.

1. First test all prices from 100 € to 60 € by steps of 1 € and calculate quantity and margin using a one parameter data table. Draw results in a graph.
2. Then test all prices from 100 € to 60 € by steps of 1 € and 4 different elasticity values (110, 100, 90, 80) and calculate margin using a 2 parameters data table. Draw results in a graph.

Exercise 3

Match(), Index() Functions, conditional formatting, data validation, date formats

You have the following table (extract of October products sales table):

	card 1	laptop 1	display 3	display 1	card 2	laptop 2
01-oct	39	23	26	62	60	42
02-oct	57	21	38	67	54	68
03-oct	28	34	20	25	25	66
04-oct	30	26	21	29	48	52
05-oct	48	45	54	36	50	23
06-oct	64	50	54	49	63	65
07-oct	63	19	57	39	21	36
08-oct	20	42	51	60	21	28
09-oct	28	54	39	19	35	62
10-oct	27	42	22	40	27	25
11-oct	56	37	27	70	29	44
12-oct	34	30	32	22	48	49
13-oct	27	54	47	20	61	52

You frequently need to find something specific from this table (sales of a product on a specific date). Tired of looking in the table, you set up an automated procedure in Excel that will work as follows:

- The user will be able to choose a product from the list of products in a “product cell”;
- He’ll select one of the available dates from another cell (“date cell”)
- The matching volume of sales will then be displayed in the “result cell”.

As you are naturally suspicious and you want to be sure not to go wrong, you decide, using the conditional formats, to automatically highlight in the table:

- The line in question (in blue),
- The column in question (in green),
- The corresponding sales value (in yellow)

Exercise 4 (Marks)

Functions Rand(), IF, Vlookup, Countlf and Norminv

You have to rate using A, B, C, D, E, F a group of students for which you have tests results in numbered marks.

Rate rules: mark <8 : F, (>=8 and <10) : E, (>=10 and <12) : D, (>=12 and <14) : C, (>=14 and <16) : B, >=16 : A.

First Name	Name	Mark (numerical)
Amine	AASSI	
Timour	ABO EL EINEIN	
Guillaume	ALRIQ	
Philippe	BARRANDE	
Antoine	BATT	
Raphaël	BONNET	
Mike	BURGAT	
Anton	CHELECHKOV	
Thierry	DE COURREGES	
Jean-Philippe	DESGRANGES	
Emmanuel	DURVILLE	
Alexandre	EL HAGE CHAHINE	
Sébastien	FADOUL	
Patrick	GINDRE	
...	...	

1. Generate random marks on the interval [0, 20] for all of the students, using the RANDBETWEEN() function (). Compute the average, min and max of the marks.
2. Using the Vlookup function, calculate letter grades for all students according to the rate rules above.
3. Using the IF function, show “Remedial” in the Result column when the student got an F .
4. Using the COUNTIF function, compute the number of A, B, C, D, E, and F in the class, and draw the chart.
5. Using COUNTIF(), calculate the number of A, B, C, D, E, and F for the group and draw the histogram of the marks.

Normal distribution

1. Let's assume that students' marks follow a normal distribution with mean 12 and standard deviation 3.
2. Generate random marks using NORMINV().
3. Calculate letter grades for all students and draw the histogram of the marks.

Exercise 5 (Curtains)

Elaborate model, data tables, graphs

Curtains shop estimate

A fabrics store manufactures curtains according to the size of its customer's windows. It has 15 fabrics in catalog, which can each be declined in 8 different models of curtains.

Different models are more or less difficult to achieve; for each model, the store has defined the time spent per square meter of fabric, and a code that determines the hourly cost of the employee who works on it.

Each fabric is sold in rolls of a specific width (strip width). The price is set in €/m according to the length of fabric (meterage) necessary for the client:

- For less than 5 meters, we apply price 1
- Between 5 and 10 meters (not included), we apply the price 2
- For more than 10 meters, the price 3 is applied.

To get the estimate, the customer must specify:

- The chosen fabric, model and amplexness (use validation to select fabric and model)
- The window specifications: width, height.

Estimate calculation

The estimate has two elements: the fabric price and the making price.

Fabric pricing

We charge the total meterage (including drops). To determine this meterage, calculate:

- The number of strips (width of fabric) needed:
$$\text{nbstrips} = \text{amplexness} * \text{window width} / \text{fabric width (rounded to the higher whole number)}$$
- The meterage itself = number of strips * window height * hem (coefficient 1.2)

The total fabric surface is calculated by multiplying the meterage by the width of the fabric (in meters).

The total price of the fabric is the meterage multiplied by price 1, 2 or 3 depending on the length to be sold).

Making pricing

To charge the making, we have to calculate:

- The useful surface: $\text{window height} * \text{window width} * \text{amplexness} * \text{hem}$
- Making time (depending on the model and the useful surface)
- The hourly cost (depends on the model making code)
- The total making cost: $\text{hourly cost} * \text{time of work}$.

Questions

1. Design the estimate using the parameters on next page. Be sure to use names, especially for lookup tables.
2. The seller, whose profit-sharing depends on the turnover, would like to get an answer to the following questions:
 - a What models should he or she sell to this customer?
 - b What fabric(s)?
 - c What model/fabric combination should he or she sell?
 - d What impact has the amplexness percentage on the client's estimate?

Present the results to these issues using tables and graphs.

Case Data

Fabric	Width	Price1	Price2	Price3
Corfou	90	15	14	12
Hawai	90	10	10	10
Korogo	90	15	12	12
Majorque	90	9	8	7
Miami	90	12	12	10
Wallis	90	10	8	8
Annaba	120	12	10	8
Tahiti	120	18	15	12
Venise	120	15	12,5	10
Madras	140	20	15	14
Suisse	140	17	15	12
Tabriz	140	26	25	22
Agadir	240	21	18	15
Hébrides	240	26	20	15
Roma	240	25	22	21

Model	Hour/M ²	Making code
Louis XV	2	1
Bonne femme	1,5	2
Régence	1,3	2
Droit	0,8	3
Provençal	1,25	3
Brise Bise	1	4
Campagnard	1,8	4
Empire	2,2	5

Making	Cost/hour
1	12
2	12,5
3	14
4	14,5
5	17,5

Example of calculations on a specific estimate:

Estimate elements	
Number	1
Date	16/06/2013
Window width	2,5
Window height	3,1
Ampleness	1,6
Fabric	Hébrides
Model	Droit

Proposition	1
Date	16/06/2013
Fabric name	Hébrides
Model name	Droit
Number of strips	3
Meterage to be	9
Total surface	21,6
Useful Surface	14,88
Drop Surface	6,72
Making time	11,9
Making cost	14
Total making cost	166,66
Total fabric cost	180
Final Total	346,66

Exercise 6

Financial functions, calculation of a loan, simulation of insolvency.

- Using Excel loan functions based on an interest rate and a constant payment schedule (PV, RATE, NPER, PMT), calculate missing values:

Loan amount	10 000€	10 000€	10 000€	?
Rate	4%	4%	?	4%
Number of periods	5	?	5	5
Payment per period	?	-2 200€	-2 200€	-2 200€

- Build the timetable for repayment of a loan (20 000€, rate 3,5%, 20 periods). It must indicate for each period the amount of payment to interest, payment to principal and left to pay. Use IPMT and PPMT to calculate payments for interest and principal.
- Graph the timetable.

Simulation of insolvency

Due to sudden unemployment, the borrower does not have enough money to pay for his loan. He still has a debt of 18561€.

- Choose a new monthly payment from a list of values (500€ to 1400€).
- Define a new timetable for the last 18 periods. The total amount paid must not exceed the chosen value. Depending of the amount, you first pay totally or partially the interest and then whatever amount of the principal you can manage (see the example).
- Graph the new timetable and test several values for monthly payment.

		Monthly payment		600 €
Timetable	Intests	Principal	Left to pay	
1	600 €	-50 €	18 611 €	
2	600 €	-51 €	18 662 €	
3	600 €	-53 €	18 715 €	
4	600 €	-55 €	18 770 €	
5	600 €	-57 €	18 827 €	
6	600 €	-59 €	18 886 €	
7	600 €	-61 €	18 947 €	
8	600 €	-63 €	19 010 €	
9	600 €	-65 €	19 076 €	
10	600 €	-68 €	19 143 €	
11	600 €	-70 €	19 213 €	
12	600 €	-72 €	19 286 €	
13	600 €	-75 €	19 361 €	
14	600 €	-78 €	19 438 €	
15	600 €	-80 €	19 519 €	
16	600 €	-83 €	19 602 €	
17	600 €	-86 €	19 688 €	
18	600 €	-89 €	19 777 €	

Example of calculation for the 10 first periods.

Exercise 7 (Employees)

Data lists, Dxx functions

Open the file Basesal.xlsx:

N°	NAME	SERVICE	SALARY	BONUS	SEX	AGE	YEAR IN C.	TOTAL EARNINGS	AGE GROUP
1	ridaba	Production	2 550,00 €	1 250,00 €	M	36	11		
2	paroda	Finance	2 700,00 €	200,00 €	M	47	13		
3	durezo	HR	1 850,00 €	950,00 €	M	38	0		
4	zuluta	Finance	3 400,00 €	450,00 €	F	48	11		
...		

First, calculate the total salary and age group (20/29, 30/39, 40/49, 50/59, 60/65).

- Sort the list by service and descending salary excluding bonuses then go back to the initial state

Data / Filter

- List the only people in the production department whose total salary is more than 3,000€.
- Do the same for men who have a bonus greater or equal to 1000€ in the 20/29 age group

Dxx Functions

1. Calculate the average, minimum and maximum total pay for all employees
2. Indicate for each service the average, minimum and maximum total pay, as well as the number of employees in that service. (Figure it up to best use autofill on formulas)
3. Using the Dxx functions and a data table, build a table that gives the number of employees who have a total salary exceeds the average of the company, according to their membership service

Data / Advanced filter

4. Extract on the worksheet in separate area the list of employees who have a salary excluding bonuses above the average salaries or a higher premium to the average premium.

Pivot Table

5. Create a pivot table giving the average salary excluding bonuses by service and age group.
6. Create a pivot table giving the average salary by service, age group and sex.

Exercise 8 (Pivot tables)

Data Lists & Pivot Tables

You're working for an international food company and you just asked for an extraction of two years orders from SAP to an Excel workbook (Ordersbase.xlsx). Here is what you got (Orders Sheet). The whole file has 2155 records:

Order	Client Code	Seller code	Order date	Product code	Price	Quantity
10248	VINET	5	02/01/2007	11	11 €	12
10248	VINET	5	02/01/2007	42	8 €	10
10248	VINET	5	02/01/2007	72	28 €	5
10249	TOMSP	6	03/01/2007	14	15 €	9
10249	TOMSP	6	03/01/2007	51	34 €	40
10250	HANAR	4	06/01/2007	41	6 €	10
10250	HANAR	4	06/01/2007	51	34 €	35
10250	HANAR	4	06/01/2007	65	13 €	15
10251	VICTE	3	06/01/2007	22	13 €	6
10251	VICTE	3	06/01/2007	57	12 €	15
10251	VICTE	3	06/01/2007	65	13 €	20
10252	SUPRD	4	07/01/2007	20	53 €	40
10252	SUPRD	4	07/01/2007	33	1 €	25
10252	SUPRD	4	07/01/2007	60	22 €	40

The IT Department provided you with complementary data lists (Sellers, Products and Clients) that you'll find on other sheets of the same workbook.

Seller code	Seller Name
1	Davolio
2	Fuller
3	Leverling
4	Peacock
5	Buchanan
6	Suyama
7	King
8	Callahan
9	Dodsworth

Product code	Product Name	Category
1	Chai	Drinks
2	Chang	Drinks
3	Aniseed Syrup	Seasonings
4	Chef Anton's Hot Seasoning	Seasonings
5	Chef Anton's Gumbo Mix	Seasonings
6	Ma's Boysenberry Spread	Seasonings
7	Bob's Organic Dried Pears	Dry Products
8	Cranberry Sauce	Seasonings
9	Mishi Kobe Niku	Meat

Client Code	Client Name	Country
ALFKI	Alfreds Futterkiste	Allemagne
ANATR	Ana Trujillo Emparedados	Mexique
ANTON	Antonio Moreno Taquería	Mexique
AROUT	Around the Horn	Royaume-Uni
BERGS	Berglunds snabbköp	Suède
BLAUS	Blauer See Delikatessen	Allemagne
BLONP	Blondel père et fils	France
BOLID	Bólido Comidas preparadas	Espagne
BONAP	Bon app'	France

Country	Area
Allemagne	Europe
Mexique	S. America
Royaume-Uni	Europe
Suède	Europe
France	Europe
Espagne	Europe
Canada	N. America
Argentine	S. America
Suisse	Europe

You want to perform sales analysis using Pivot Tables.

1. Data Completion

You first need to add complementary information in the orders data lists:

- Turnover (= Quantity x Price),
- Country, Client's Name, Seller's Name, Category, Product's Name, Geographic Area.

Use VLOOKUP to calculate (on first record row, then copy down):

- Country and Client's Name using Client Code,
- Seller's Name using Seller Code,
- Product's Name and Category using Product Code,
- Geographic Area using Country.

2. Pivot Tables

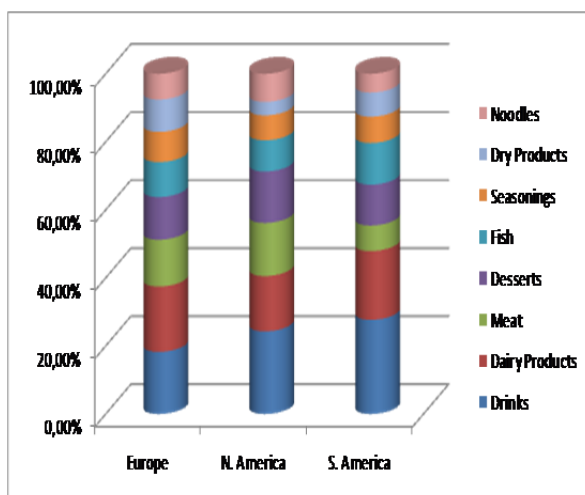
Use Pivot Table to answer these questions.

1. What are our top countries? (globally, and for year 2010 and 2011)

Group orders date by year (Right click on the first Order date of the table and select "Group", then choose grouping by Years)

Sum of Turnover	Étiquettes de colonnes	2010	2011	Total général
Étiquettes de lignes				
États-Unis		66 628 €	144 478 €	211 106 €
Allemagne		76 294 €	117 957 €	194 251 €
Autriche		44 118 €	67 473 €	111 591 €
Brésil		31 823 €	60 093 €	91 916 €
France		34 122 €	34 277 €	68 399 €
Royaume-Uni		20 407 €	28 449 €	48 856 €
Venezuela		18 997 €	29 374 €	48 371 €
Suède		15 279 €	32 372 €	47 651 €
Irlande		16 060 €	30 168 €	46 228 €
Canada		23 868 €	20 520 €	44 388 €
Belgique		11 040 €	17 136 €	28 176 €
Danemark		14 408 €	13 572 €	27 980 €
Suisse		8 535 €	17 332 €	25 867 €
Mexique		13 477 €	5 729 €	19 206 €
Finlande		10 166 €	5 755 €	15 921 €
Espagne		3 432 €	12 117 €	15 549 €
Italie		3 374 €	10 337 €	13 711 €
Portugal		6 281 €	3 605 €	9 886 €
Argentine		874 €	5 629 €	6 503 €
Norvège		1 000 €	4 063 €	5 063 €
Pologne		360 €	2 447 €	2 807 €
Total général		420 543 €	662 883 €	1 083 426 €

2. What is the % of sales in each area for each product category?



First create a Pivot table (Area in row label, Category in column Label).
Show turnover as % of row.

Then create a stack cylinder chart from the table.

3. What are the sales of our top 3 dairy products in each country?

Category	Dairy Products			
Sum of Turnover	Column Labels			
Row Labels	Camembert	Pierrot	Mozzarella di Giovanni	Raclette Courvaud
Allemagne	10560		4458	13941
États-Unis	4466		3012	11520
Autriche	4320		528	7470
Brésil	5174		1344	3285
Venezuela	1594		2384	5535
Canada	3915		980	1800
Royaume-Uni	4082		1088	630
Belgique	880		420	4050
Irlande	132			4770
Grand Total				4902

4. Who are our top ten clients, what is their turnover and geographical area?

Sum of Turnover	Column Labels			
Row Labels	Europe	N. America	S. America	Grand Total
QUICK-Stop	94084			94084
Save-a-lot Markets		92085		92085
Ernst Handel	90443			90443
Hungry Owl Grocers	46228			46228
Rattlesnake Canyon Grocery		42081		42081
Hanari Carnes			27489	27489
Folk och få HB	26039			26039
Mère Paillard		25920		25920
Königlich Essen	25626			25626
Queen Cozinha			24271	24271
Grand Total	282420	160086	51760	494266

5. Who are our best sales agents for Year 2011 (globally and for each product category)?

Sum of Turnover	Column Labels									
Row Labels	Dairy Products	Desserts	Drinks	Dry Products	Fish	Meat	Noodles	Seasonings	Grand Total	
Davolio	17907 ✓	13971	26979 ✓	12397	13559 !	7348	5182 ✓	8025	105368	
Leverling	18507 ✓	14676	19710 !	7712	16019 !	11460	9201 !	6375	103660	
Peacock	14188 ✓	12067	17412 !	8264	16274 ✓	12806	11586 ✓	7829	100426	
Fuller	11325 !	8281	30463 ✗	3820	10016 ✓	18199	6361 ✓	9308	97773	
King	18659 !	10358	6234 !	5180	3882 ✓	17448	4330 ✗	4394	70485	
Callahan	11868 ✓	11684	11099 !	7549	6372 ✗	5456	5500 !	6434	65962	
Dodsworth	14139 ✗	5565	14059 ✗	95	4540 !	7880	200 !	5284	51762	
Buchanan	9612 ✗	2531	2110 ✗	2476	3674 !	8838	2873 ✗	1993	34107	
Suyama	6897 ✗	3222	5507 !	5046	3282 ✗	1814	4451 ✗	3121	33340	
Grand Total	123102	82355	133573	52539	77618	91249	49684	52763	662883	

Use conditional formatting to highlight performances.

6. Find the top sales product in year 2011 and create a new table with all detailed information about orders

Exercise 9 (Bakery)

Time simulation using statistical probabilities, independent periods

Suppose that the daily demand for cakes in a bakery follows a normal distribution with a mean of 80 and a standard deviation of 15. The cakes are made all at once at the beginning of each day. Profit is € 4 per cake sold. By late afternoon, the unsold cakes are discarded and the loss is € 2.5 per unit.

How many cakes do you need to make every day to maximize profit?

The sheet “Draws” of the base file contains 365 random numbers of daily demand, corresponding to a year of operation of the bakery.

A. Realization of the model for a production of 80 cakes

You choose to produce 80 cakes per day (parameter area).

1. Compute for each day of operation, using the random numbers for daily demand present on the sheet:
 - the number of sold cakes,
 - the number of unsold cakes
 - and the daily profit.

Calculate also the average daily profit over the year.

2. Make a chart showing the number of sold cakes, the number of unsold cakes and the demand for the first 50 days. What is your conclusion?
3. Make a chart showing the daily profit for the first 50 days.

B. Simulation (test of different production levels)

1. Compute using a data table the average daily profit for a daily production ranging from 75 to 95 cakes by step of 1.
2. Make a chart of your results.

C. Simulation (new random draws)

1. Create, in the Draws sheet, ten set of statistical values for daily sales with the same law.
2. Adjust your model to use these new values and compare the obtained results.

3.

Exercise 10 (Steelwork Mining and Metal)

Probability distribution, simulations

SteelworkChina is a company operating in a Chinese port. The port facility consists in a wharf able to load or unload two 50.000 tons ore carriers at the same time. Each loading / unloading operation lasts one day. The wharf facility is available 24 hours a day and 7 days a week.

Today's number of cargo ships coming to SteelworkChina facilities is 250 per year. But this should increase within 2 years to 500 ships per year. Each ship should be loaded/unloaded the day of its arrival and SteelworkChina is subject to €7000 penalties per day for late completion.

In order to avoid substantial penalties, two projects are under review:

- Expansion of the existing wharf, which should enable to load 3 ships at the same time. The investment cost is €3 000 000, amortized over 6 years.
- Construction of a second wharf, which will double the capacity (4 ships). The investment cost is €7 500 000, amortized over 6 years.

Statistical surveys seem to indicate that the number of ships arriving each day is best approximated using a Poisson distribution.

Questions

1. Simulate ships arrivals for 365 days using a Poisson law (Expected value 500/365). Calculate the average cost (e.g. penalties + annual depreciation charge) of each solution (status quo, expansion, second wharf) for one year.

You'll find in the second sheet of the workbook 365 values of `alea()`, which you'll use to generate the daily number of incoming ships.

3. Test these results for different numbers of incoming ships (from 350 to 800 by steps of 50).

Exercise 11 (Golf)

Elaborate model, data tables, graphs

A golf club offers two formulas to its customers.

- A yearly subscription, which allows you to play a given number of times.
- A green fee that you have to pay each time you want to play a round of golf.

The subscription depends on how many rounds you expect to play in the year. There are five possible subscriptions:

Subscription	# of rounds	Yearly amount	Cost per round
Discovery	1-4 rounds	240,00 €	30,00 €
Leisure	5-9 rounds	300,00 €	20,00 €
Regular	10-19 rounds	400,00 €	12,00 €
Intensive	20-39 rounds	500,00 €	8,00 €
Professional	40 rounds or more	700,00 €	3,00 €

Part I : Subscriptions only

Question 1

You are analysing the situation of a player who intends to play 15 rounds during the year. Calculate his cost, which should correspond to the following table:

# of rounds	15
Subscription	400,00 €
Unit Cost	12,00 €
Cost of rounds	180,00 €
Total cost	580,00 €
Average cost per round	38,67 €

The yearly subscription chosen depends on the number of rounds the player expects to have in one year

Question 2

Create a table with which you can evaluate the total yearly cost and the average cost per round as a function of the number of rounds played (from 1 to 50), for each type of subscription.

Question 3

Create a graph representing this table, on the same sheet.

Part II : Comparison of subscriptions with additional rounds

Question 4

If the member plays more than the maximum # of rounds allowed by his subscription, he has to pay a fee of 25 € per additional round.

For a given subscription (e.g. "Regular") and for a given number of rounds (e.g. 22), build the following model:

Subscription # of rounds played	Regular 22
Subscription cost	400,00 €
Max # of rounds allowed within the subscription	19
Unit cost of the subscription rounds	12,00 €
Total cost of subscription rounds played	228,00 €
Total subscription cost	628,00 €
# of additional rounds played	3
Cost of additional rounds	75,00 €
Total cost	703,00 €
Average cost per round	31,95 €

Question 5

Build a two-dimensional table depending on the subscription (from Discovery to Professional) and on the number of rounds played (from 1 to 50) and showing the total cost. Illustrate this with a graph on a graph sheet (not a worksheet).

Question 6

Add a column to the preceding table and calculate – for each number of rounds played from 1 to 50 – the name of the cheapest subscription (including possible additional rounds).

Question 7

Show, for each of the five subscription types, the lower and the upper number of rounds for which this subscription is the cheapest.

