

## OPER20525A.A2019 - LOGISTICS

### Warehousing at Avril Supermarché

#### Practical exercises

#### Context:

“Avril Supermarché Santé is an independent Quebecer health food store chain. Just like a garden, Avril is a promise of freshness and abundance, bringing its customers closer to a healthier way of life. Avril stores are designed to be energy efficient and to provide its customers with a unique, satisfying shopping experience.

In Avril stores you will find:

- Natural and organic foods
- Organic vegetables and fruits, certified by Ecocert Canada
- Supplements and vitamins
- Natural cosmetics
- Organic meat products
- Gluten-free products
- Local products
- Fair-trade products
- Ecological products
- Herbal medicine, homeopathy and aromatherapy products
- Esthetics cabin care
- Bistro-type restaurant
- Qualified staff: naturopaths, homeopaths, herborists, cosmeticians
- Private consultations”<sup>1</sup>

Avril has stores in Brossard, Granby, and Longueuil and a distribution center (DC) located a few miles away from the Granby store. Figure 1 shows Avril’s network.

Avril does not accept any direct store delivery (DSD), meaning that every single product goes through the DC on its path between the manufacturers and the stores. Avril recently opened a store in Laval. They now want to move the DC closer to Montréal (but still in the south bank), to better serve the new Laval store. The DC manager wants your help to decide the type of pallet racking, the ideal picking system, and the best picking strategy for the new facility. To help you achieve this goal, the manager has provided you with a data base (file D.AVRIL\_SUPER-MARCHE.XLS) holding information on products, transfers between the DC and the stores, and inventory levels for each product during a year.

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<sup>1</sup> Taken from: <https://www.avril.ca/en/about-us/>. Last access: September 28, 2019.



Category	Category of the product in the Avril classification. There are 9 categories: Canned; Honey, syrup and jam; Inedible; Juices and beverages; Oils, vinegar and seasonings; Pasta, bread and cereals; Snacks and sweets; Soups and broths; and Teas.
Class	The class of the product according to Avril's ABC classification.
Nb units / case	Number of units of the SKU in a case.
Nb case / pallet	Number of cases of the SKU in a pallet.
Nb units / pallet	Number of units of the SKU in a pallet.
Weight	Weight classification: heavy, average, light.
Picking unit	The minimum aggregation unit in which the SKU may appear in an order.
Width (in)	Width of a case in inches.
Length (in)	Length of a case in inches.
Height (in)	Height of a case in inches.
Volume case (ft^3)	Volume of a case in cubic feet.
Volume case (in^3)	Volume of a case in cubic inches.

Figure 2: description of the fields in the product table

Field	Description
Order ID	Unique identifier of the order.
Line ID	Unique identifier of the line.
Customer	The store placing the order: BRD for Brossard, GBY for Granby, and LGL for Longueuil.
Date of TRF	Date of the transfer.
Day TRF	The day of the week corresponding to Date of TRF.
Month TRF	The month of the year corresponding to Date of TRF.
SKU ID	ID of the SKU in the line.
Description	Name of the product associated to the SKU (see Figure 2 for more details).
Qty (units)	Units of SKU shipped.
Qty (case)	Number of cases shipped.
Qty (pallet)	Number of pallets shipped.

Figure 3: description of the fields in the transfers table

Field	Description
SKU ID	ID of the SKU held in inventory.
Description	Name of the product associated to the SKU (see Figure 2 for more details).
Inventory in units	Snapshot of the inventory in units of the SKU the first day of every month between Jul-2018 and Jul-2019. The last two columns contain the average number of units held in inventory during the year and the maximum number of units held in inventory (considering only the values captured by the snapshot).
Inventory in cases	The same information presented in "Inventory in units" but in cases.
Inventory in pallets	The same information presented in "Inventory in units" but in pallets.

Figure 4: description of the fields in the inventory table

## Practical exercises:

### Exercises 1 to 6: basic database queries

1) How many SKUs does Avril handle through the DC?

**Answer:** 657 SKUs.

**Solution:** this question can be answered using a pivot table. Select range **A1:Q658** on the **Product** sheet. Click on the **PivotTable** icon on the **Insert** menu (see Fig. 5). On the popping up menu select **New Worksheet** and click on the **OK** button (see Fig. 6).

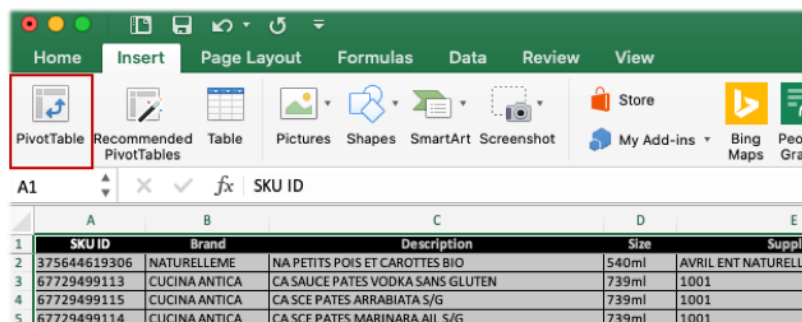


Figure 5: inserting a pivot table

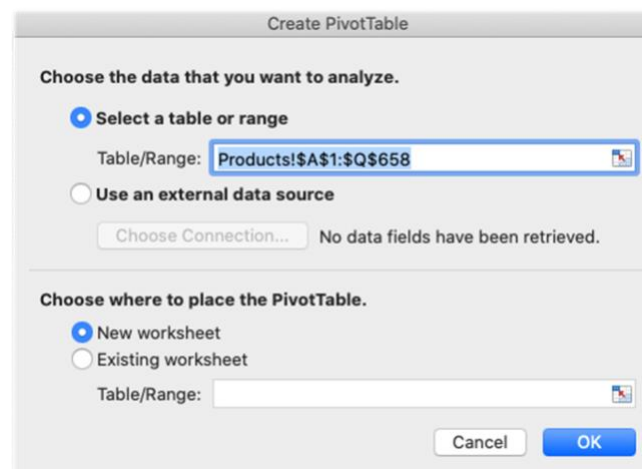


Figure 6: pivot table output parameters

Excel will create a new worksheet. The **PivotTableFields** menu will appear on the right side of the screen<sup>2</sup>. Drag and drop the **Description** field to the **Rows** combo-box and the **SKU ID** to the **Values** combo-box as shown in the right-most part of Figure 7. Right-click on the label **SKU ID** on the **Values** combo-box and select the **Field Settings** option. In the **Summarize by** menu, select **Count** and click on the **OK** button (see Fig. 8). The left-most part of Figure 7 shows the results. For each product (i.e., **Description**), the table

<sup>2</sup> This may change depending on the MS Excel version or operating system platform. The menu should, however, have a similar look in every version.

shows the number of associated SKUs. The value in Cell B612 shows the sum of SKUs. Video [exercise1.mp4](#) shows the whole procedure.

The screenshot shows an Excel spreadsheet with a PivotTable and the 'PivotTable Fields' task pane. The PivotTable has 'Row Labels' in column A and 'Count of SKU ID' in column B. The 'PivotTable Fields' pane on the right shows 'SKU ID' selected under 'FIELD NAME'. The 'Filters' and 'Columns' areas are empty. The 'Rows' area contains 'SKU ID' and the 'Values' area contains 'Count of SKU ID'. The spreadsheet lists 50 items, each with a count of 1, except for 'BR ASSAISONNEMENT TOUT USAGE' which has a count of 2.

Row Labels	Count of SKU ID
AC CROQUANTS H/OLIVE & SDM	1
AC CROQUANTS MULTIGRAIN	1
AC MINI CRISPS AIL ROTI	1
AC MINI CRISPS CHEDDAR FORT	1
AC MINI CRISPS PATATES / CIBOULETTES	1
AC MINI CRISPS RAISINS / NOIX DE GRENoble	1
AC NOUILLE ARACHIDE SESAME	1
AC NOUILLE KUNG PAO	1
AC NOUILLE TERIYAKI	1
AL BOISSON ALOES	1
AL BOISSON ALOES GRENADE ET CANNEBE	1
AL BOISSON ALOES MANGUE ET MANGOUST	1
AL BSN ALOES HERBE BLE	1
AL BSN ALOES POMELO & PAMP ROSE CMD SP #7805	1
AT NETT MULTI SURFACE	1
BA EAU BADOIT	1
BA EAU PETILLANTE 2012	1
BE BIERE SANS ALCOOL	1
BE CREME DE SOYA POUR CUISINER	1
BE POUDING CARAMEL CREMEUX SANS GLU	1
BE POUDING CHOCOLAT BIO	1
BE POUDING CHOCOLAT NOIR SANS GLUTEN	1
BE POUDING VANILLE BIO	1
BE VNG BALSAMIQUE 3 ANS PROMO	1
BF MELANGE FRUIT MANGUE PASSION BANA	1
BF MELANGE FRUIT MULTIFRUIT	1
BF MELANGE FRUIT POMME BANANE	1
BF MELANGE FRUIT POMME CANNELLE	1
BF MELANGE FRUIT POMME FRAISE	1
BF MORCEAUX FRAMBOISE	1
BF MORCEAUX GRENADE & ACAI	1
BF MORCEAUX ORANGE	1
BF MORCEAUX POMME	1
BM EAU COCO + PULPE	1
BO CER 10 GRAINS	1
BR ASSAISONNEMENT TOUT USAGE	2
BS BOISSON GAZ COLA NATUREL	1
BS BOISSON GAZ GINGEMBRE JAMAICAIN	1
BS BOISSON GAZ RACINETTE	1
BV ASSOUPPLISSEUR	1
BV DTG LESSIVE HE COTON FRAIS	1
BV DTG LESSIVE HE S/PARFUM	1
BV DTG LESSIVE ROSEE MATINALE	1
BV LIQUIDE VAISSELLE AGRUME	2
BV LIQUIDE VAISSELLE POMME	1
BV NETT SALLE DE BAIN	1
BV NETT TOUT USAGE	1

Figure 7: selecting fields on a pivot table

The screenshot shows the 'PivotTable Field' task pane with the 'Summarize by' dropdown menu open. The 'Count' option is selected. The 'Field name' is 'Count of SKU ID'. The 'Show data as' button is visible. The 'Number...' button is also visible.

Source field: SKU ID  
Field name: Count of SKU ID  
Summarize by: Count  
Show data as  
Number...  
Cancel  
OK

Figure 8: configuring fields on a pivot table

2) How many products?

**Answer:** 608 products.

**Solution:** There are different ways to find the answer to this question. The simplest one, is just to count the number of rows on the pivot table built to answer to Question 1. Note that each row in this table contains the name (i.e., description) of one product. Select the range **A4:A611** and observe the count on the bottom right part of the screen. Video [exercise2.mp4](#) shows the procedure.

3) How many suppliers deliver products to Avril's DC?

**Answer:** 51 Suppliers.

**Solution:** There are different ways to find the answer to this question. The easiest one is to start from the pivot table built for Exercise 1. Right-click on the **Description** label on the **Rows** combo box and select the **Remove Field** option. Then, drag and drop the **Supplier** field into the **Rows** combo-box. The pivot table should now show the list of suppliers on Column A and the number of SKU supplied by each on Column B. To find the answer to the question, just count the number of suppliers in the table. To do this, select range **A4:A54** and observe the count on the bottom right part of the screen. Video [exercise3.mp4](#) shows the procedure.

4) What is the name of the supplier who provides the largest number of SKUs?

**Answer:** 1001 with 160 SKUs.

**Solution:** Select the range **B4:A54** and sort the values on decreasing order. The supplier on the top of the list is the one supplying the largest number of SKUs to Avril. Video [exercise4.mp4](#) shows the procedure.

5) What is the number of A, B, and C class SKUs?

**Answer:** A = 175, B = 210, and C = 272.

**Solution:** The solution to this exercise is quite similar to that shown in Exercise 3. Starting from the current pivot table, right-click on the **Supplier** label on the **Rows** combo-box and select the **Remove Field** option. Then, drag and drop the **Category** field into the **Rows** combo-box. The pivot table will be updated to show for each category (A, B, and C) the number of associated SKUs. Video [exercise5.mp4](#) shows the procedure.



6) How many class-A SKUs are supplied by SATAU?

**Answer:** A = 25.

**Solution:** Starting from the pivot table built in Exercise 5, drag and drop the **Supplier** field into the **Rows** combo-box (place it on top of the **Class** field). The table will be updated to show for each supplier, the number of supplied A, B, and C class products. Video [exercise6.mp4](#) shows the procedure.

## Exercises 7 to 11: Selecting a picking system

7) What is the most common picking unit in Avril's DC?

**Answer:** the case with 656 SKUs.

**Solution:** Starting from the pivot table built in Exercise 5, replace the **Class** field by the **Picking unit** field in the **Rows** combo-box. To achieve this goal, right-click the **Class** label on the **Rows** combo-box and select the **Delete Field** option. Then, drag and drop the **Picking unit** field into the **Rows** combo-box. The table will be updated to show the count of SKUs for each picking unit. As the results show, the most common picking unit is the case. Video [exercise7.mp4](#) shows the procedure.

8) What is the average size of a case (in ft<sup>3</sup>)?

**Answer:** 0.7663ft<sup>3</sup>

**Solution:** Select range [P2:P658](#) on the **Product** sheet and observe the average on the bottom right part of the screen. Video [exercise8.mp4](#) shows the procedure.

9) What is the average and maximum number of orders in one month?

**Answer:** Average = 17.85 and Maximum = 21.

**Solution:** There are several ways to find the answer to this question, but most of them rely on rather advanced data handling functionalities. There is, however, a relatively easy way to dance around this limitation. In Cell [M1](#) of the **Transfers** table, create a header called **Unique**. Set the value of Cell [M2](#) to **TRUE**. Then, insert in Cell [M3](#) the following formula: **=A3<>A2**. Extend the formula from Cell [M3](#) to cell [M5985](#). Figure 9 summarizes the procedure up to this point.

	A	B	C	D	E	F	G	H	I	J	K	L	M
	Order ID	Line ID	Customer	Date of TRF	Day TRF	Month TRF	SKU ID	Description	Nb units / case	Qty (units)	Qty (case)	Qty (pallet)	Unique
1	1	1	BRD	2019/01/03	Thursday	January	2919600761	EN H/OLIVE EXTRA VIERGE BIO	6	6	1	0,01	TRUE
2	1	2	BRD	2019/01/03	Thursday	January	5535831410	ON VNG CIDRE BIO	6	12	2	0,03	FALSE
3	1	3	BRD	2019/01/03	Thursday	January	5557928000	EX DESHYDRATEUR 2400	1	1	1	0,02	FALSE
4	1	4	BRD	2019/01/03	Thursday	January	6366700601	NA BOISSON RIZ ORIGINALE BIO	12	60	5	0,16	FALSE
5	1	5	BRD	2019/01/03	Thursday	January	6366700602	NA BOISSON SOYA VANILLE BIO	12	60	5	0,16	FALSE
6	1	6	BRD	2019/01/03	Thursday	January	6366700140	NA BOISSON SOYA CHOCOLAT BIO	12	60	5	0,16	FALSE
7	1	7	BRD	2019/01/03	Thursday	January	6366730185	KN SPRITZER LIMONADE	24	120	5	0,05	FALSE
8	1	8	BRD	2019/01/03	Thursday	January	7468211383	KN SPRITZER FRAISE	24	48	2	0,02	FALSE
9	1	9	BRD	2019/01/03	Thursday	January	62706202551	ML SUCRE CANNE BLOND BIO	8	80	10	0,17	FALSE
10	1	10	BRD	2019/01/03	Thursday	January	62706220325	ML FLOCONS AVOINE BIO	8	8	1	0,03	FALSE
11	1	11	BRD	2019/01/03	Thursday	January	62706230085	ML MAIS A ECLATER BIO	8	8	1	0,03	FALSE
12	1	12	BRD	2019/01/03	Thursday	January	67178520100	ES EAU NATURELLE	12	84	7	0,14	FALSE
13	1	13	BRD	2019/01/03	Thursday	January	67178576200	ES EAU GAZEIFEE	24	48	2	0,02	FALSE
14	1	14	BRD	2019/01/03	Thursday	January							FALSE

Figure 9: Finding unique order IDs. Steps 1 to 4.

Select column **M**, (see Fig. 10) and press the **CTRL+C** keys. Now right-click and select the **Paste Special** option. On the top menu of the popping up window, select **Values** and click on the **OK** button (see Fig. 11).

	A	B	C	D	E	F	G	H	I	J	K	L	M
	Order ID	Line ID	Customer	Date of TRF	Day TRF	Month TRF	SKU ID	Description	Nb units / case	Qty (units)	Qty (case)	Qty (pallet)	Unique
1	1	1	BRD	2019/01/03	Thursday	January	2919600761	EN H/OLIVE EXTRA VIERGE BIO	6	6	1	0,01	TRUE
2	1	2	BRD	2019/01/03	Thursday	January	5535831410	ON VNG CIDRE BIO	6	12	2	0,03	FALSE
3	1	3	BRD	2019/01/03	Thursday	January	5557928000	EX DESHYDRATEUR 2400	1	1	1	0,02	FALSE
4	1	4	BRD	2019/01/03	Thursday	January	6366700601	NA BOISSON RIZ ORIGINALE BIO	12	60	5	0,16	FALSE
5	1	5	BRD	2019/01/03	Thursday	January	6366700602	NA BOISSON SOYA VANILLE BIO	12	60	5	0,16	FALSE
6	1	6	BRD	2019/01/03	Thursday	January	6366730140	NA BOISSON SOYA CHOCOLAT BIO	12	60	5	0,16	FALSE
7	1	7	BRD	2019/01/03	Thursday	January	6366730185	KN SPRITZER LIMONADE	24	120	5	0,05	FALSE
8	1	8	BRD	2019/01/03	Thursday	January	7468211383	KN SPRITZER FRAISE	24	48	2	0,02	FALSE
9	1	9	BRD	2019/01/03	Thursday	January	62706202551	ML SUCRE CANNE BLOND BIO	8	80	10	0,17	FALSE
10	1	10	BRD	2019/01/03	Thursday	January	62706220325	ML FLOCONS AVOINE BIO	8	8	1	0,03	FALSE
11	1	11	BRD	2019/01/03	Thursday	January	62706230085	ML MAIS A ECLATER BIO	8	8	1	0,03	FALSE
12	1	12	BRD	2019/01/03	Thursday	January	67178520100	ES EAU NATURELLE	12	84	7	0,14	FALSE
13	1	13	BRD	2019/01/03	Thursday	January	67178576200	ES EAU GAZEIFEE	24	48	2	0,02	FALSE
14	1	14	BRD	2019/01/03	Thursday	January							FALSE

Figure 10: Finding unique order IDs. Steps 5.

Paste Special

**Paste**

- ☒ All
- ☐ Formulas
- ☐ Values
- ☐ Formats
- ☐ Comments
- ☐ Validation
- ☐ All using Source theme
- ☐ All except borders
- ☐ Column widths
- ☐ Formula and number formats
- ☐ Values and number formats
- ☐ All, merge conditional formats

**Operation**

- ☒ None
- ☐ Add
- ☐ Subtract
- ☐ Multiply
- ☐ Divide

☐ Skip Blanks ☐ Transpose

Paste Link Cancel OK

Figure 11: Paste Special window.

Now, select the range **M2:A5985** and sort the range on the decreasing order of the values in Column **M**. Note that now, all the records with a value of **TRUE** in column **M** are at the



top of the list. Note also that each of these records, corresponds to the first line of an order. For instance, Figure 12 shows the 20 first records, corresponding to **Order ID** 1 to 20. In other words, with this procedure we have obtain a sub-table, containing only record for the first line of each order. With this data, we can now proceed to find the answer to the question.

	A	B	C	D	E	F	G	H	I	J	K	L	M
	Order ID	Line ID	Customer	Date of TRF	Day TRF	Month TRF	SKU ID	Description	Nb units / case	Qty (units)	Qty (case)	Qty (pallet)	Unique
1	1	1	BRD	2019/01/03	Thursday	January	2919600761	EN H/OLIVE EXTRA VIERGE BIO	6	6	1	0,01	TRUE
2	2	1	GBY	2019/01/03	Thursday	January	2919600761	EN H/OLIVE EXTRA VIERGE BIO	6	6	1	0,01	TRUE
3	3	1	LGL	2019/01/03	Thursday	January	2919600761	EN H/OLIVE EXTRA VIERGE BIO	6	18	3	0,02	TRUE
4	4	1	BRD	2019/01/13	Sunday	January	5536990171	DE PUREE POMME BIO	12	12	1	0,02	TRUE
5	5	1	GBY	2019/01/13	Sunday	January	5786328233	CY MLG BOUILLON POULET	6	6	1	0,00	TRUE
6	6	1	LGL	2019/01/13	Sunday	January	2919600761	EN H/OLIVE EXTRA VIERGE BIO	6	12	2	0,02	TRUE
7	7	1	BRD	2019/01/17	Thursday	January	2919600761	EN H/OLIVE EXTRA VIERGE BIO	6	6	1	0,01	TRUE
8	8	1	GBY	2019/01/17	Thursday	January	2919600769	EN HUILE DE SESAME VIERGE BIO	6	6	1	0,00	TRUE
9	9	1	LGL	2019/01/17	Thursday	January	2919600761	EN H/OLIVE EXTRA VIERGE BIO	6	12	2	0,02	TRUE
10	10	1	BRD	2019/01/24	Thursday	January	5260305403	PA CREME COURGES BIO	12	60	5	0,08	TRUE
11	11	1	GBY	2019/01/24	Thursday	January	5260305403	PA CREME COURGES BIO	12	96	8	0,13	TRUE
12	12	1	LGL	2019/01/24	Thursday	January	5260305403	PA CREME COURGES BIO	12	60	5	0,08	TRUE
13	13	1	BRD	2019/01/27	Sunday	January	2919600763	EN H/OLIVE FRUITE EXTRA VIERGE BIO	6	6	1	0,01	TRUE
14	14	1	GBY	2019/01/27	Sunday	January	5535831420	ON VNG CIDRE BIO	4	4	1	0,01	TRUE
15	15	1	LGL	2019/01/27	Sunday	January	2919600763	EN H/OLIVE FRUITE EXTRA VIERGE BIO	6	6	1	0,01	TRUE
16	16	1	BRD	2019/01/31	Thursday	January	2639500012	LY GELEE ALOE VERA BIO	1	6	6	0,00	TRUE
17	17	1	GBY	2019/01/31	Thursday	January	2639500004	LY GELEE ALOE VERA BIO	1	6	6	0,01	TRUE
18	18	1	LGL	2019/01/31	Thursday	January	2639500004	LY GELEE ALOE VERA BIO	1	6	6	0,01	TRUE
19	19	1	BRD	2019/02/10	Sunday	February	5557934900	EX DESHYDRATEUR 3900 PLUS	1	1	1	0,05	TRUE
20	20	1	LGL	2019/02/10	Sunday	February	5557934900	EX DESHYDRATEUR 3900 PLUS	1	2	2	0,09	TRUE

Figure 12: Finding unique order IDs. Steps 6.

Select range **A2:M125** (i.e., the last record with a value of **TRUE** on Column **M**) on the **Transfers** sheet. Click on the **PivotTable** icon on the **Insert** menu (see Fig. 5). On the popping up menu select **New Worksheet** and click on the **OK** button (see Fig. 6). Excel will create a new worksheet. The **PivotTableFields** menu will appear on the right side of the screen. Drag and drop the **Month TRF** field into the **Rows** combo-box and the **Order ID** field into the **Values** combo-box. Right-click on the **Order ID** label in the **Values** combo-box and select the **Configure Field** option. Select **Count** and click on the **OK** button (see Fig. 8). The resulting pivot table will show the number of orders placed by the stores to the DC in each of the months (see Fig. 13). Select range **B4:A10** and sort the range on decreasing order. The months on the top (May and June) are those with the maximum number of orders (21). Select the range **B4:B10** and observe the metrics on the bottom right part to obtain the average number of orders (17.85). Video [exercise9.mp4](#) shows the whole procedure.

	A	B	C	D	E	F	G	H
1								
2								
3	Row Labels	Count of Order ID						
4	May	21						
5	June	21						
6	January	19						
7	March	18						
8	July	18						
9	April	17						
10	February	11						
11	Grand Total	125						
12	Average	17,857,14286						

Figure 13: orders per month

10) What is the most frequently ordered SKU?

**Answer:** 306832016010 BA EAU BADOIT ordered 57 times.

**Solution:** Select range [A2:L5985](#) on the **Transfers** sheet. Click on the **PivotTable** icon on the **Insert** menu (see Fig. 5). On the popping up menu select **New Worksheet** and click on the **OK** button (see Fig. 6). Excel will create a new worksheet. The **PivotTableFields** menu will appear on the right side of the screen. Drag and drop the **SKU ID** field into the **Rows** combo-box and the **Line ID** field into the **Values** combo-box. Right-click on the **Line ID** label in the **Values** combo-box and select the **Configure Field** option. Select **Count** and click on the **OK** button (see Fig. 8). The resulting pivot table will show for each SKU the number of times it was included in an order. Select range [B4:A660](#) and sort the range in decreasing order. The SKU on the top of the list **306832016010** corresponds to the most frequently ordered SKU. Video [exercise10.mp4](#) shows the procedure.

11) Based on your answers to questions 7, 8, 9, and 10, what picking system (goods-to-man, man-to-goods, or automated system) would you recommend to the DC manager? Why?

**Answer:** Picker to goods.

**Solution:** The first hint comes from the size of the items picked. The most common picking unit is the case (656/657 SKUs) and the size of the boxes is relatively big (an average volume of 0.7663 ft<sup>3</sup>). The second hint comes from the number of orders that are prepared at the DC (an average of 17.85 per month with a maximum of 21). The last hint comes from the picking frequency of the most picking items. With only 57 picks during the year for the fastest moving product, we can safely assume that products in Avril's DC do

not move too fast. Following the picking system selection guidelines discussed in class (see Fig. 14), a picker-to-goods system seems to be the better fit for this situation.

Criterion	Picker-to-goods	Goods-to-picker		A-frame system
		Carrousel	ASRS	
Order volume	Low to medium	Medium to high	Medium to high	High
Product type	All	Small	Small to medium	Small
Product velocity	Low to high	Low	Low to high	High

Figure 14: picking system selection guidelines

## Exercise 12: Selecting a picking strategy

12) According to the data in sheet “Transfers”, what picking strategy (cluster, batch, discrete) would you recommend to the manager?

**Answer:** Discrete Picking

**Solution:** We will answer this question following the guidelines discussed in class (see Fig. 15). To accomplish this goal, we first need to compute the number of orders made up of 1-5; 6-39; and 40+ lines. Starting from the pivot table built in Exercise 11, replace the **SKU ID** field on the **Rows** combo-box by the **Order ID** field. The resulting table shows the number of lines per order. Select range **A3:B127** and copy the values pressing the **CTRL+C** (see Fig. 16). Create a new sheet. Right-click on Cell **A1** and select the **Paste Special** option. On the top part of the popping up window, select **Values** and click on the **OK** button (see Fig. 11).

		Number of lines (products) per order		
		1-5	6-39	40+
Number of items per line	1-5	Cluster (sort-while-pick)	Batch (pick-then-sort)	Discrete (one order at a time)
	6-19	Batch (pick-then-sort)	Batch (pick-then-sort)	Discrete (one order at a time)
	20+	Discrete (one order at a time)	Discrete (one order at a time)	Discrete (one order at a time)

Figure 15: picking strategy selection guidelines

Now we are going to build a frequency table, using the intervals suggested in the guidelines (columns in Figure 15). Build the template for the table as shown in Figure 17. Now, insert the following formula in Cell **F3**: **=FREQUENCY(B2:B125;E3:E5)**. The **frequency()** function takes as input a vector of data and the upper bounds of the frequency intervals and returns the frequency count for each interval. Note that contrary to most Excel functions, the output of the **frequency()** function is not a single value but an array of values (the frequency count for each interval). To deploy the array output,

select the range **F3:F5**, enter the formula bar, and press **CTRL+SHIFT+ENTER** (see Fig. 18). Figure 19 shows the output.

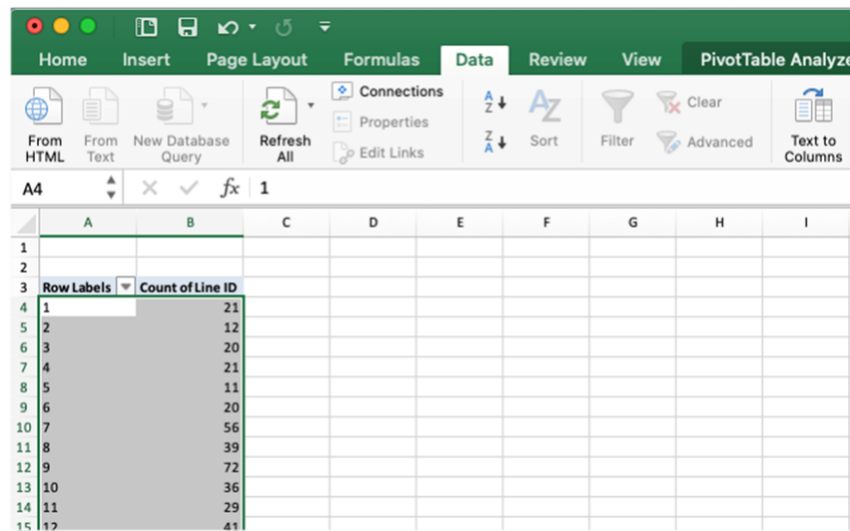


Figure 16: pivot table showing the number of lines per order

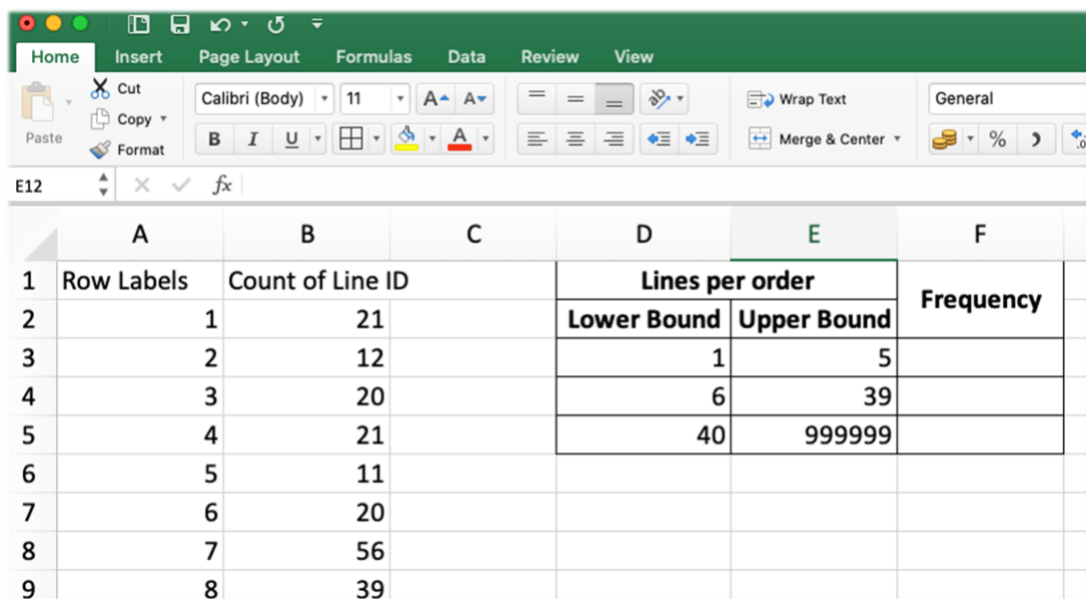


Figure 17: pivot table showing the number of lines per order

As the results in Table 19 show, most of the orders (60 out of 124) are made up of more than 40 lines. Following the guidelines in Figure 15, we select Discrete Picking as the preferred strategy (last column). Video [exercise12a.mp4](#) shows the entire procedure. To confirm our recommendation, we can also compute number of units (cases) per line in the typical order.

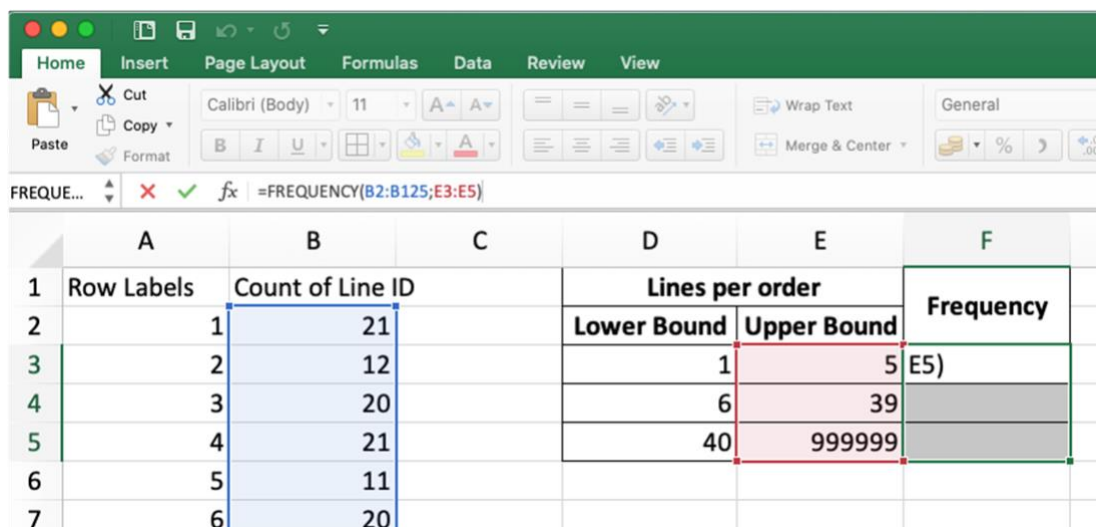


Figure 18 shows a pivot table and a frequency table. The pivot table is on the left, and the frequency table is on the right. The pivot table is set to show the count of line IDs for each order. The frequency table has columns for Lower Bound, Upper Bound, and Frequency. The pivot table is set to show the count of line IDs for each order.

Row Labels	Count of Line ID	Lines per order	Frequency
		Lower Bound	Upper Bound
1	21	1	5
2	12	6	39
3	20	40	999999
4	21		
5	11		
6	20		

Figure 18: pivot table showing the number of lines per order

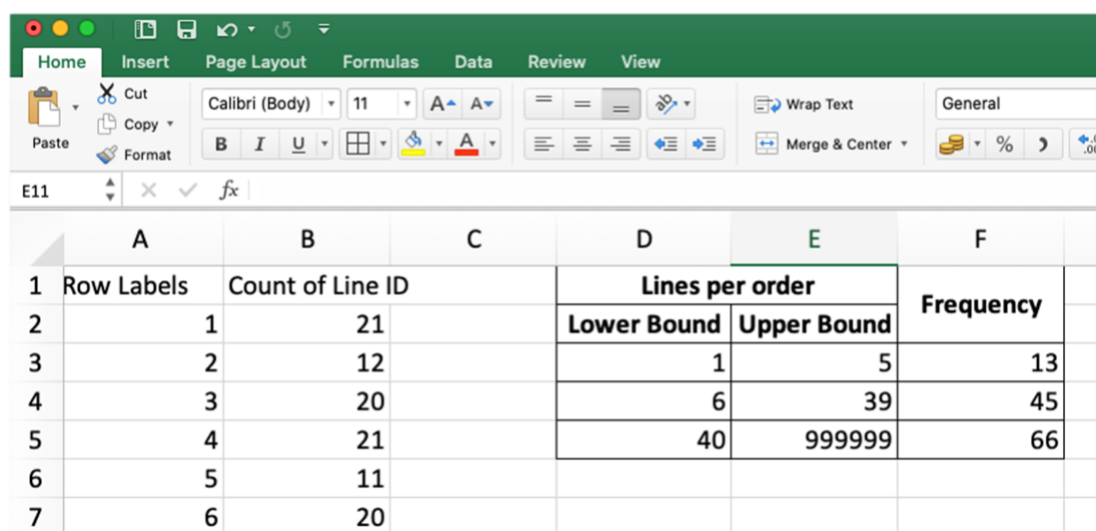


Figure 19 shows a pivot table and a frequency table. The pivot table is on the left, and the frequency table is on the right. The pivot table is set to show the count of line IDs for each order. The frequency table has columns for Lower Bound, Upper Bound, and Frequency. The pivot table is set to show the count of line IDs for each order.

Row Labels	Count of Line ID	Lines per order	Frequency
		Lower Bound	Upper Bound
1	21	1	5
2	12	6	39
3	20	40	999999
4	21		
5	11		
6	20		

Figure 19: number of lines per order – frequency count

Starting from the pivot table built earlier in this exercise, replace the **Count of Line ID** field on the **Values** combo-box by the **Qty (case)** field. Right-click on the **Qty (case)** field on the **Values** combo-box and select the **Field Settings** option. On the top part of the popping up window, select **Average** and click on the **OK** button (see Fig.8). The resulting pivot table shows the average number of cases per line for each order. Select range **A3:B127** and copy the values pressing the **CTRL+C**. Go to the sheet holding the frequency table that you created at the beginning of this exercise, right-click on Cell **A1**, and select the **Paste Special** option. On the top part of the popping up window, select **Values** and click on the **OK** button (see Fig. 11). Update the upper bounds of the frequency intervals in the frequency table and Excel will update the count. Figure 20 shows the resulting table. Video [exercise12b.mp4](#) shows the entire procedure.

	A	B	C	D	E	F
1	1	3,29		<b>Lines per order</b>		<b>Frequency</b>
2	2	2,50		<b>Lower Bound</b>	<b>Upper Bound</b>	
3	3	4,15		1	5	100
4	4	6,38		6	19	24
5	5	2,36		20	999999	0
6	6	6,30				

Figure 20: average number of cases per line – frequency count

### Exercises 13a to 13d: Selecting racking systems

13) According to the data in sheet “Inventory”, what racking systems would you recommend for the following products?

a) 67178550100 – Eska (ES EAU NATURELLE)

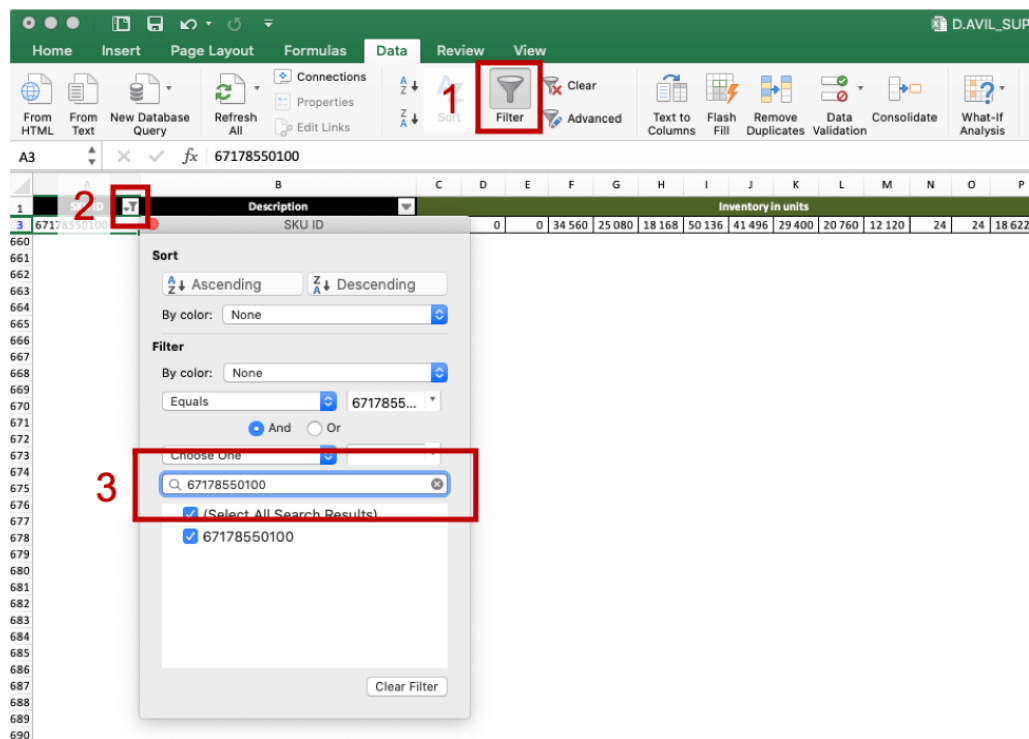
**Answer:** Double Deep

**Solution:** We will answer the question based on the racking system selection guidelines discussed in class and presented in Figure 20. We will first compute the frequency (i.e., number of months) at which the inventory (for this product) laid within the bounds of each of the intervals defined in the guidelines. Select and copy range **AG2:AS2** in the **Inventory** sheet. Now, create a new worksheet and right-click on range **A2**. Select the **Paste Special** option. Select the **Values** and **Transpose** options in the top and bottom parts of the popping up window (see Fig. 11). Click on the **OK** button. Now return to the Inventory sheet and look for the row holding the information for product 67178550100 – Eska (ES EAU NATURELLE). An easy way to accomplish this task is to set a filter on the rows. Select the **Data** toolbar and click on the **Filter** icon (see Fig. 22 – Step 1). Click on the down arrow in Cell **A1** (see Fig. 22 – Step 2). Use the search bar in the pop up menu to write the **SKU ID** of the product (i.e., 6717855010). Excel will filter out all the rows for which the value of **Column A** is not equal to the **SKU ID**. Select and copy range **AG3:AS3**. In the worksheet where you previously pasted the months, right-click on Cell **B2** and select the **Paste Special** option. Select the **Values** and **Transpose** options in the top and bottom parts of the popping up window (see Fig. 11) and click on the **OK** button. The resulting table shows the number of pallets of the product held in inventory the first day of the month. Following the same procedure used to answer Question 12, build a frequency table using this time the intervals defined by the guidelines in Figure 21. Figure 23 shows the result. Video [exercise13.mp4](#) shows the procedure.



Racking systems					
Number of pallets per product	Racking system				
	Single deep	Double deep	Drive-in	Push back	Flow
0.25 to 1					
2 to 5					
6 to 10					
11 to 20					
21 to 50					
51 to 100					
> 100					

Figure 21: pallet racking selection guidelines.  
Dark-grey indicates preferred options, light-grey indicates possible options, and white boxes indicate misadvised options



As the frequency table shows, during most of the months (5 out of 12) the number of pallets in inventory laid between 11 and 20. A quick look at the value in Cell B14 in Figure 23, reveals that the average number of stored pallets, also falls within this interval. Following the guidelines, the candidate racking systems are then Double Deep, Push Back, and Pallet Flow. The typical number of pallets is close to the lower bound of the interval. Therefore, the higher density of the Pushback over the Double Deep is not needed. The former is also more expensive. Based on these two observations, we can

safely eliminate the Pushback option. The product is perishable but usually has long expiration days (going from semesters to years). The FIFO property provided by the Pallet Flow system is therefore not needed. The latter is also more expensive than the Double Deep rack. Based on these two observations, we can also discard this option.

	A	B	C	D	E	F
1	Jul-18	6		<b>Palets per month</b>		<b>Frequency</b>
2	Aug-18	0		<b>Lower Bound</b>	<b>Upper Bound</b>	
3	Sep-18	0		0,25	1,00	4
4	Oct-18	20		2,00	5,00	0
5	Nov-18	15		6,00	10,00	2
6	Dec-18	11		11,00	20,00	5
7	Jan-19	29		21,00	50,00	2
8	Feb-19	24		51,00	100,00	0
9	Mar-19	17		100,00	99999,00	0
10	Apr-19	12				
11	May-19	7				
12	Jun-19	0				
13	Jul-19	0				
14	Avg.	11				
15						

Figure 23: frequency count for the number of pallets in stock

The procedure to answer to questions 13b to 13d is exactly the same. These exercises are therefore leaved as an assignment for the reader.

- b) 6366751100 – Boisson Soya non sucrée
- c) 3619212784 – Limonade à la mangue
- d) 62123490560 – Cubes bouillon de Poulet