7.6.1. Inventory Planning in General

The formulas below refer to calculation an ordering plan for planning items that are not distributed in DCs. In other words, demand for these planning items is generated by selling activity, not distribution. Ordering plan calculation for planning items that are distributed is described in the Two-echelon planning article.

To calculate the first planned order, Streamline uses the following Excel-like formula:

Order qty$_1$ = MAX(CEILING(MAX(0, D_{OC} + **Safety stock** + $Qty\_to\_ship_{LT,OC}$ - $Remaining$), **Rounding**), **Min lot**) (1),

$Remaining$ = MAX(0, MAX(0, **On hand**) + $Qty\_to\_receive_{LT,OC}$ - D_{LT}),

where:

- D_{OC} – the demand forecast during the **Order cycle** coming after the **Lead time**.

- D_{LT} – the demand forecast for the **Lead time** period.

- $Qty\_to\_ship_{LT,OC}$ and $Qty\_to\_receive_{LT,OC}$ – the quantities that are to be shipped and received correspondingly within the **Lead time** plus **Order cycle** period. Those can be viewed in the In transition details dialog.

- **On hand**, **Order cycle**, **Lead time**, **Rounding**, **Min lot** – replenishment parameters shown in the Inventory planning tab.

The calculated **Order qty$_1$** is shown in the Qty column of the **Current order** section on the **Inventory planning** tab.

To calculate replenishment orders for the next order cycles, the following Excel-like formula is used:

Order qty$_i$ = MAX(CEILING(MAX(0, $D(OC_i)$ + $Safety\ stock_i$ + $Qty\_to\_ship(OC_i)$ - $Qty\_to\_receive(OC_i)$ - $Remaining_{i-1}$), **Rounding**), **Min lot**), `i = 2,…`, (2)

where:

- $D(OC_i)$ – the demand during `i`-th **Order cycle** period.

- $Safety\ stock_i$ – the calculated safety stock for `i`-th **Order cycle** period.

- $Qty\_to\_ship(OC_i)$ and $Qty\_to\_receive(OC_i)$ – the amounts of inventory that are to be shipped and received correspondingly within `i`-th **Order cycle** period.

- $Remaining_{i-1}$ – the remaining on-hand at the end of the previous **Order cycle** period.

- **Order cycle**, **Rounding**, **Min lot** – replenishment parameters shown in the Inventory planning tab.

To demonstrate how Streamline calculates an ordering plan, we will use the built-in example **Inventory Planning by Month**. We have slightly changed the input data of the project:

- added a customer order that is to be shipped on **Jan 4 of 2019**;
- added a line into the **To receive** worksheet of the Excel document used as the data source for this example (see figure below);
- changed the default **Lead time** to **10** days for item **B05465-R** (see figure below); and
- set Streamline to take safety stock as demand for the future month.

	A	B	C	D	E
	Item code	Open date	Delivery date	Qt	
	565405 Beatles L	12/1/2018	1/15/2019	200	
	565405 Beatles M	12/2/2018	1/1/2019	100	
	565405 Beatles M	12/5/2018	3/1/2019	100	
	565405 Beatles M	12/6/2018	2/1/2019	100	
	565405 Beatles S	12/3/2018	1/15/2019	100	
	565405 Beatles XL	12/4/2018	1/15/2019	100	
	B05465-R	12/5/2018	1/15/2019	30	

Transactions | Item info | **To receive** | To ... ⊕

Item code	Description	Supplier	Model type	On hand	Days of supply	To ship	To receive	Lead time, days	Order cycle, months	Min lot
89654-T	Toaster [constan...	3850	Constant...	41	46	0	0	30	1	
VR2156 200	Vital Reds 200g ...	1012	Linear tre...	590	50	0	0	30	1	1000
VB2166 150	Vital Blue 150 g ...	1012	Linear tre...	54	38	0	0	30	1	100
L2010	Lumber [season...	3850	Seasonal ...	54	130	0	0	30	1	
H2510	Nails [seasonal ...	3850	Seasonal ...	69	11	0	0	30	1	1000
C1020	Concrete block [...	3850	Seasonal ...	15	35	0	0	30	1	
B05465-R	Basketball 29.5 (...	3850	Seasonal ...	266	43	30	30	10	1	60
565405 Beatles ...	One Style XL [ex...	4008	Seasonal ...	1456	280	0	30 to be shipped on Jan 4, 2019			100
565405 Beatles S	One Style S [exc...	4008	Seasonal ...	1181	593	0	100	30	1	100

Ordering plan

As we mentioned above, an ordering plan is calculated in two steps. First, the current order quantity is computed.

To figure out how the current order of **96** units is obtained, we will address the Explain inventory calculation dialog. To open it, we set the cursor at item **B05465-R** and press **Ctrl + E** (see figure below).

Item code	On hand	To ship	To receive	Lead time, days	Order cycle, months	Min lot	Rounding	Current order		Ordering plan			Demand forecast		
								Qty	Order type	Dec 2018	Jan 2019	Feb 2019	Dec 2018	Jan 2019	Feb 2019
89654-T	41	0	0	30	1			40	Purchase	40	27	27	27	27	27
VR2156 200	590	0	0	30	1	1000	20	1000	Purchase	1000	0	1000	357	358	359
VB2166 150	54	0	0	30	1	100	20	100	Purchase	100	100	0	43	43	43
L2010	54	0	0	30	1		5	0		0	0	15	13	11	12
H2510	69	0	0	30	1	1000	50	1000	Purchase	1000	0	0	181	202	225
C1020	15	0	0	30	1			21	Purchase	21	11	10	13	12	11
B05465-R	266	30	30	10	1	60	12	96	Purchase	96	60	108	197	100	82
565405 Beatles ...	1456	0	100	30	1	100	10	0		0	0	0	176	162	99

Explain inventory calculation

Item: B05465-R — Basketball 29.5 (size 7) [seasonal model]
Location:
Safety stock: 94
Debt received from lower echelon (current/max):   0 / 0, accum. 0
Debt passed to upper echelon (current/max):   0 / 96
Simulation horizon   5 months   ☐ Manufacture details

	Dec 1, 2018	Dec 12, 2018	Dec 31, 2018	Jan 1, 2019	Jan 4, 2019	Jan 12, 2019	Jan 15, 2019	Jan 31, 2019	Feb 1, 2019
Time fraction	0.032	0.366	1	1.032	1.129	1.366	1.484	2	2.032
Events	✉	🛒	⏱	✉	⬆	🛒		⏱	✉
Demand forecast				100					82
+ Manufacture forecast		D(LT)			D(OC)				
= Subperiod consumption		66	125	3	10	24	11	52	3
+ Safety stock			75	2	5	12	-8		
Write-offs									
Orders in transition				-30			30		
Debt after arrivals									
Inventory + in transition	266	200	171	168	128	104	183	131	128
+ Planned order arrivals		96				60			
= Projected inventory	266	296	171	168	128	164	183	131	128
Planned orders	96			60					108
Demand passed to upper echelon	66			60					108

Input / Calculated   +   −   Co-dependent   [Close]

As **Lead time** = **10 days** that ends up on **Dec 12, 2018** and the **Order cycle** is **1 month**, we take the **Subperiod consumption demand** starting from the end of **Dec 12, 2018** to the end of **Jan 12, 2019**. Since the dialog shows the dates the particular subperiod ends, we take the sum for the four subperiods staring from **Dec 31, 2018**.

- Thus, D_{OC} = 125 + 3 + 10 + 24 = 162.

- D_{LT} = Demand_forecast_for_period * **Lead time, days** / 30 = 197 * 10 / 30 = 66. This value is shown in the **Subperiod consumption** row on the date when the first Streamline's planned order arrives.

- Qty to ship = 30, as we have a shipment of 30 units that hit this interval (see figure above).

- **Rounding** = 12, **Min lot** = 60, **On hand** = 266.

Now, let's replace the parameters with the values:

Order qty$_1$ = MAX(CEILING(MAX(0, 162 + 94 + 30 - 200), 12), 60) = 96,

Remaining = MAX(0, MAX(0, 266) + 0 - 66) = 200.

We highlighted the values that are used in the calculation of the **Current order** quantity with positive

and negative signs via green and red borders correspondingly in the figure above.

The values for all of the parameters in the formula (2) can be directly found in the **Explain inventory calculation** dialog as well. The most interesting from them is the *Remaining$_{i-1}$*, i = 2,... . The **Inventory + in transition** row shows these remainings. The figure below highlights the values of the parameters that are used to get the second order.

We have intentionally set Streamline to determine safety stock as the demand for the given number of future periods (1 month in our example) to be able to show you how the order amount is calculated.

- $D(OC_2)$ = 11 + 52 + 3 + 27 = 93;
- *Safety stock$_2$* = *Safety stock$_1$* - 9 = 94 - 8 = 84;

Now, let's replace the parameters with the values:

Order qty$_2$ = MAX(CEILING(MAX(0, 93 + 84 - 30 - 104), 12), 60) = MAX(CEILING(43, 12), 60) = 60.

This example is pretty simplified as it doesn't have imported:

- batches – the Write-offs row of the table is empty; and
- BOMs or distribution centers – Debt after arrivals row of the table is empty.

To calculate the ordered quantities correctly in these more generic cases, the formulas (1) and (2)

should account for the values from the mentioned rows.

Projected Inventory Levels

To find out how the future on-hand levels at the end of each period are calculated, we will use two rows of the dialog table, **Inventory + in transition** and **Planned order arrivals**.

If you set the cursor at any cell of the **Inventory + in transition** row, you'll see the cells taking part in the calculation of the value. This row calculates the remaining on-hand at the end of each subperiod based on the:

- on-hand level at the end of the previous subperiod; and
- item consumption, possible write-off, safety stock debt, and in transition quantity in the currently selected subperiod (see figure below).

	Dec 1, 2018	Dec 12, 2018	Dec 31, 2018
Time fraction	0.032	0.366	1
Events	✉	🛒	⏱
Demand forecast			
+ Manufacture forecast			
= Subperiod consumption		66	125
+ Safety stock			75
Write-offs			
Orders in transition			
Debt after arrivals			
Inventory + in transition	266	200	171
+ Planned order arrivals		96	
= Projected inventory	266	296	171
Planned orders	96		
Demand passed to upper echelon	66		

Input / Calculated   +   −   Co-dependent

In other words, this row shows on-hand remaining at the end of each subperiod without taking into account Streamline's deliveries (the **Planned order arrivals** row). The resulting projected inventory levels, which is the sum of the **Inventory + in transition** and **Planned order arrivals** rows, are indicated in the **Projected inventory** row. Consequently, the amounts at the end of each data aggregation period in this row make up the **Projected inventory levels** report (see figure below).

Item code	On hand	To ship	To receive	Lead time, days	Order cycle, months	Min lot	Rounding	Projected inventory levels		
								Dec 2018	Jan 2019	Feb 2019
89654-T	41	0	0	30	1			15	28	28
VR2156 200	590	0	0	30	1	1000	20	245	887	528
VB2166 150	54	0	0	30	1	100	20	12	69	126
L2010	54	0	0	30	1		5	41	30	18
H2510	69	0	0	30	1	1000	50	0	805	580
C1020	15	0	0	30	1			2	11	11
B05465-R	266	30	30	10	1	60	12	171	131	157
565405 Beatles ...	1456	0	100	30	1	100	10	1286	1224	1125

Explain inventory calculation

Item: B05465-R — Basketball 29.5 (size 7) [seasonal model]

Location:

Safety stock: 94

Debt received from lower echelon (current/max):   0 / 0, accum. 0

Debt passed to upper echelon (current/max):   0 / 96

Simulation horizon   5 months   ☐ Manufacture details

	Dec 1, 2018	Dec 12, 2018	Dec 31, 2018	Jan 1, 2019	Jan 4, 2019	Jan 12, 2019	Jan 15, 2019	Jan 31, 2019	Feb 1, 2019
Time fraction	0.032	0.366	1	1.032	1.129	1.366	1.484	2	2.032
Events	✉	🛒	⏱	✉	⬆	🛒	⏩	⏱	✉
Demand forecast				100					82
+ Manufacture forecast									
= Subperiod consumption		66	125	3	10	24	11	52	3
+ Safety stock			75	2	5	12	-8		
Write-offs									
Orders in transition				-30		30			
Debt after arrivals									
Inventory + in transition	266	200	171	168	128	104	183	131	128
+ Planned order arrivals		96				60			
= Projected inventory	266	296	171	168	128	164	183	131	128
Planned orders	96			60					108
Demand passed to upper echelon	66			60					108

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