ROP & Safety Stock

Presentation · December 2019

CITATIONS
0

READS
973

1 author:

Huber John
Zhejiang Normal University
22 PUBLICATIONS **2** CITATIONS

SEE PROFILE

REORDER POINT & SAFETY STOCK

Prof. John Huber

Zhejiang Normal University

December 1, 2019

REORDER POINT

The reorder point (ROP) is the level of inventory which triggers an action to replenish a particular inventory stock.

It is a minimum amount of an item which a firm holds in stock, such that, when stock falls to this amount, the item must be reordered.

It is normally calculated as the forecast usage during the replenishment lead time plus safety stock.

REORDER POINT DETERMINATION

- The rate of demand (historical / forecast)
- The lead time
- The extent of demand and/or lead time variability (standard deviation)
- The degree of stockout risk acceptable to management (service level)
- The lifecycle phase
- Seasonality / marketing events

KEY TERMS

Demand is the number of items consumed by customers, usually a succession of independent random variables.

Lead time is the delay between the time the reorder point (inventory level which initiates an order) is reached and renewed availability.

Service level is the desired probability of meeting demand during the lead time without a stockout.

REORDER POINT CALCULATION

$$ROP = E(L) * E(D) + SS$$

E(L) is the mean of lead time
E(D) is the mean of demand in each unit time period
SS is the safety stock

↑ LT = ↑ Inventory = ↓ Cash Flow
↑ $D_{\text{forecast error}}$ = ↑ Inventory = ↓ Cash Flow

REORDER POINT: THINGS TO REMEMBER

↑ LT = ↑ ROP = ↑ Inventory = ↓ Cash Flow

↑ $D_{\text{forecast error}}$ = ↑ ROP = ↑ Inventory = ↓ Cash Flow

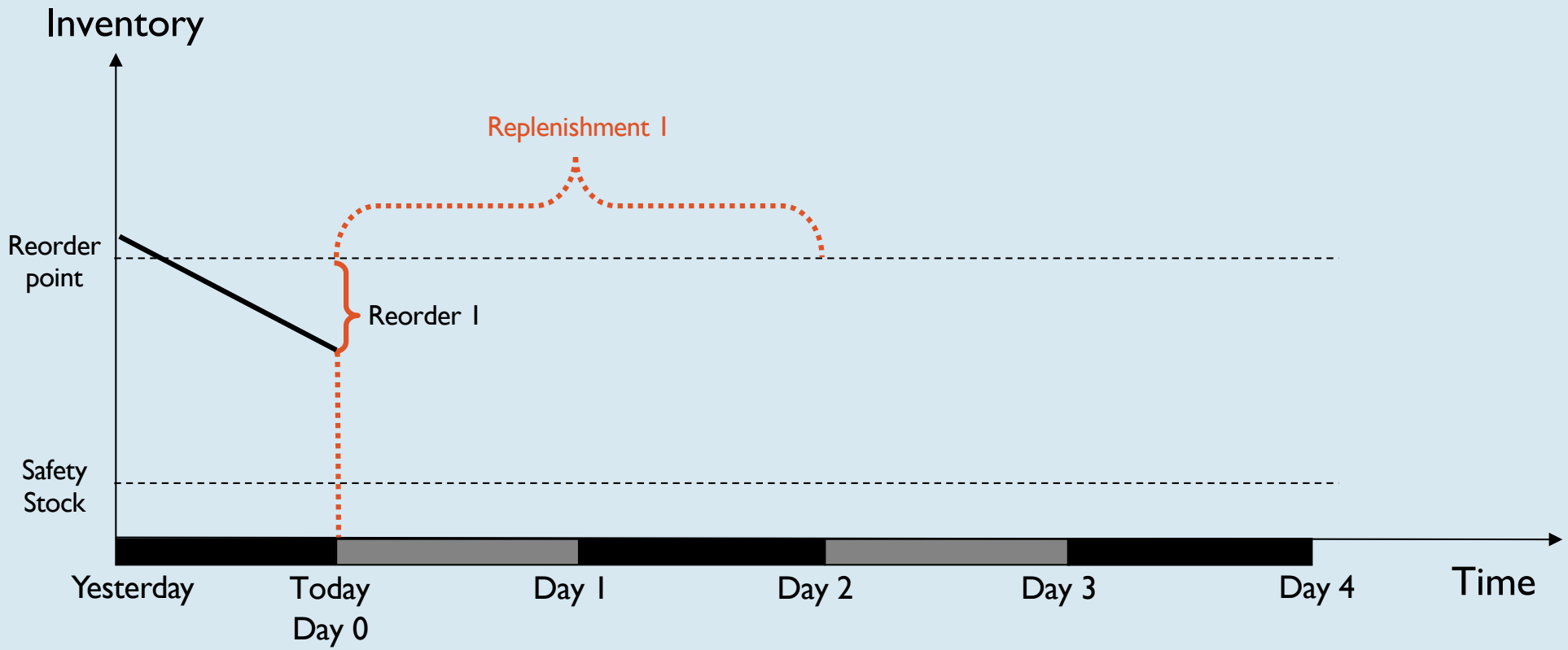
↩

↓ LT = = ↓ ROP = ↓ Inventory = ↑ Cash Flow

↓ $D_{\text{forecast error =}}$ = ↓ ROP = ↓ Inventory = ↑ Cash Flow

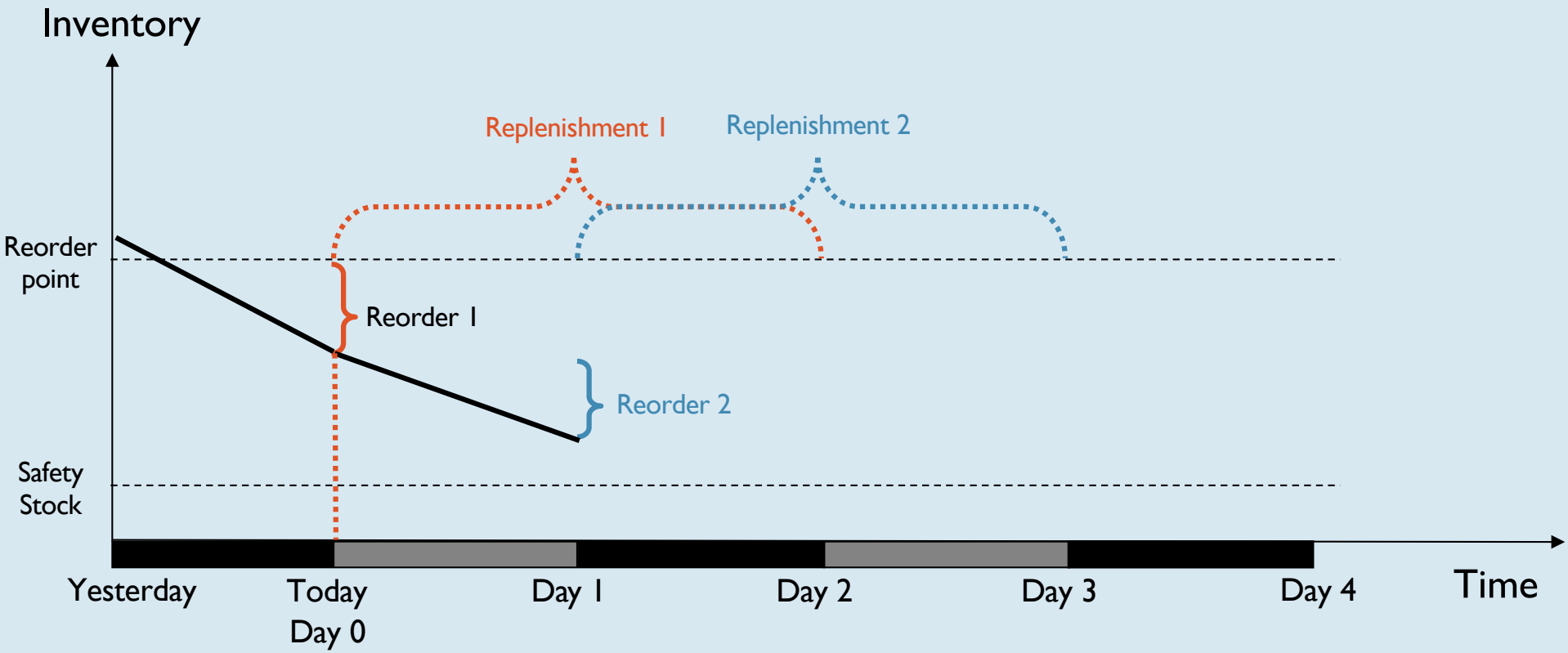
REORDER POINT

During the day (Day 0), inventory is consumed below the reorder point. An order is placed to take the inventory back to the reorder point, "Reorder 1." Replenishment lead time for orders are 2 days.



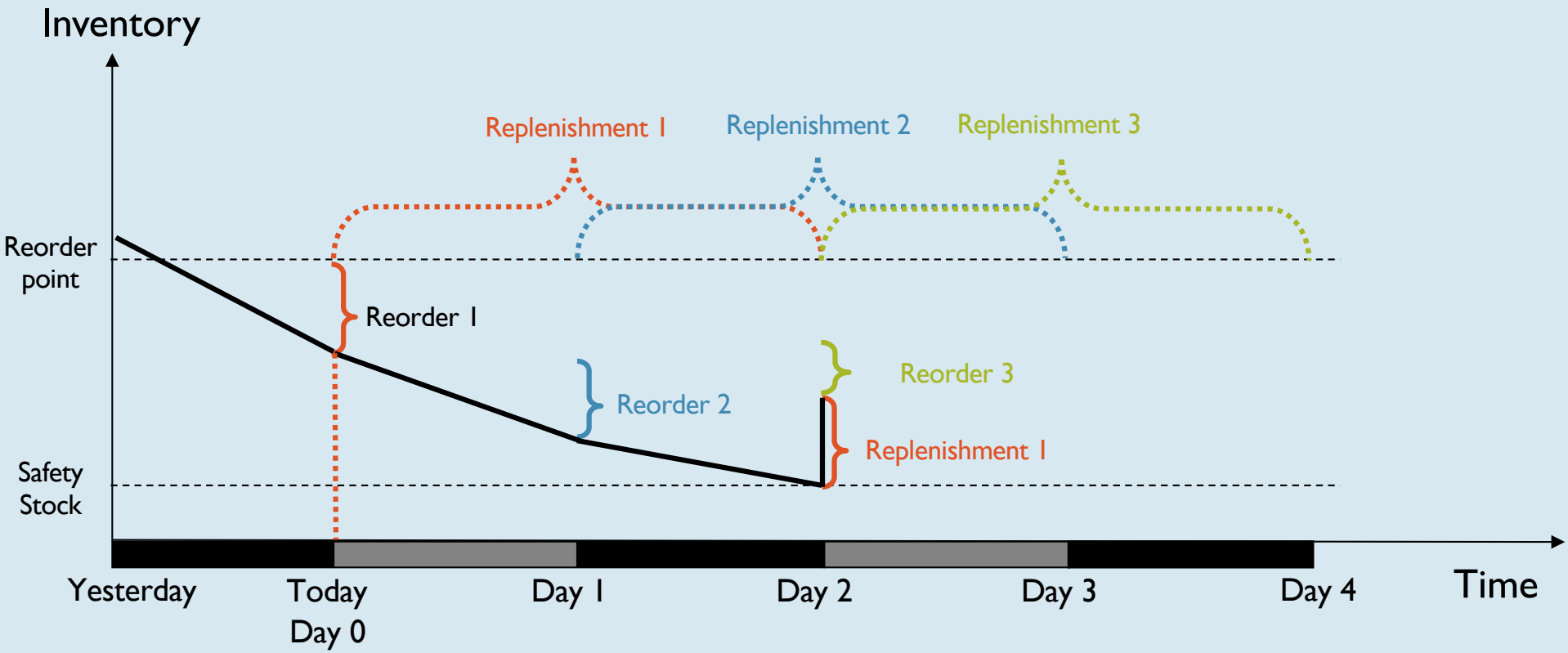
REORDER POINT

During Day 1, inventory is further consumed, and a second order, Reorder 2, is made to replace the days orders



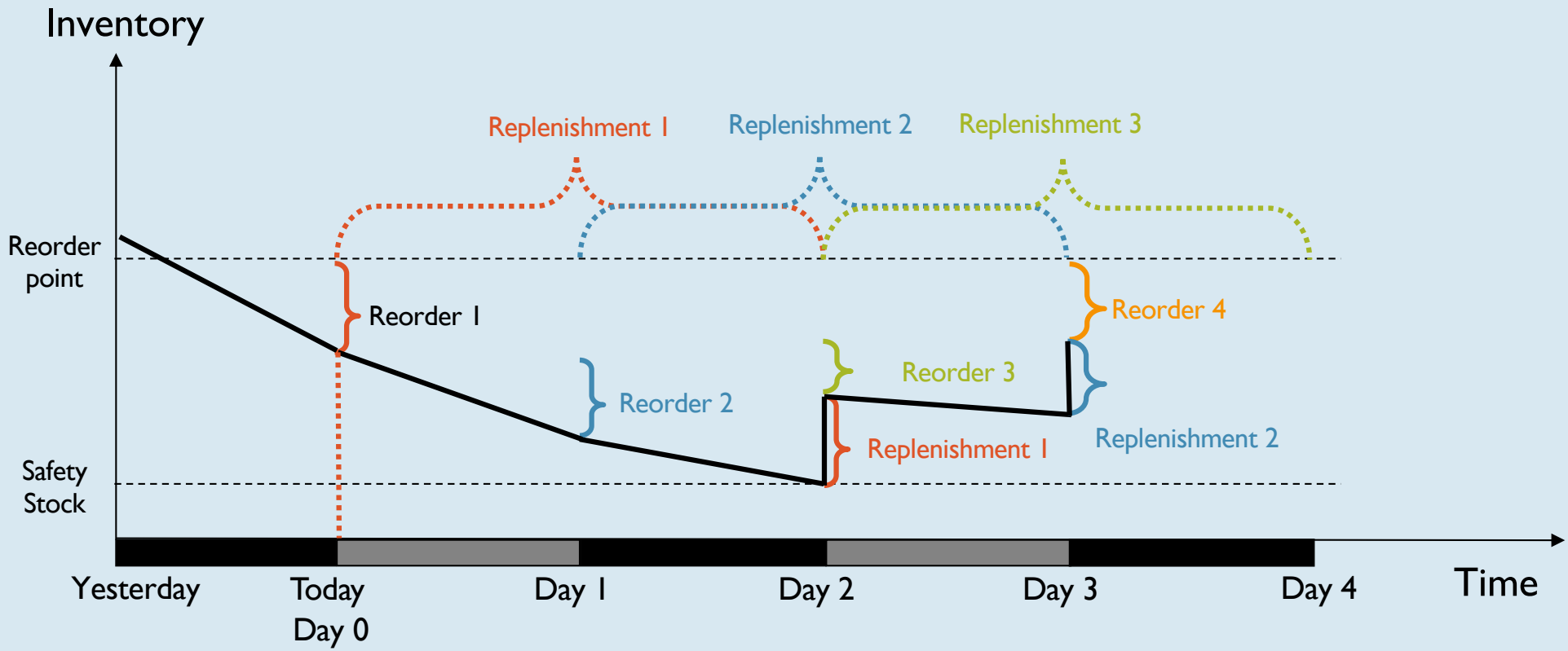
REORDER POINT

During Day 2, inventory is further consumed. Delivery of Reorder 1, Replenishment 1, is received. A third order, Reorder 3, is made to replace the days orders.



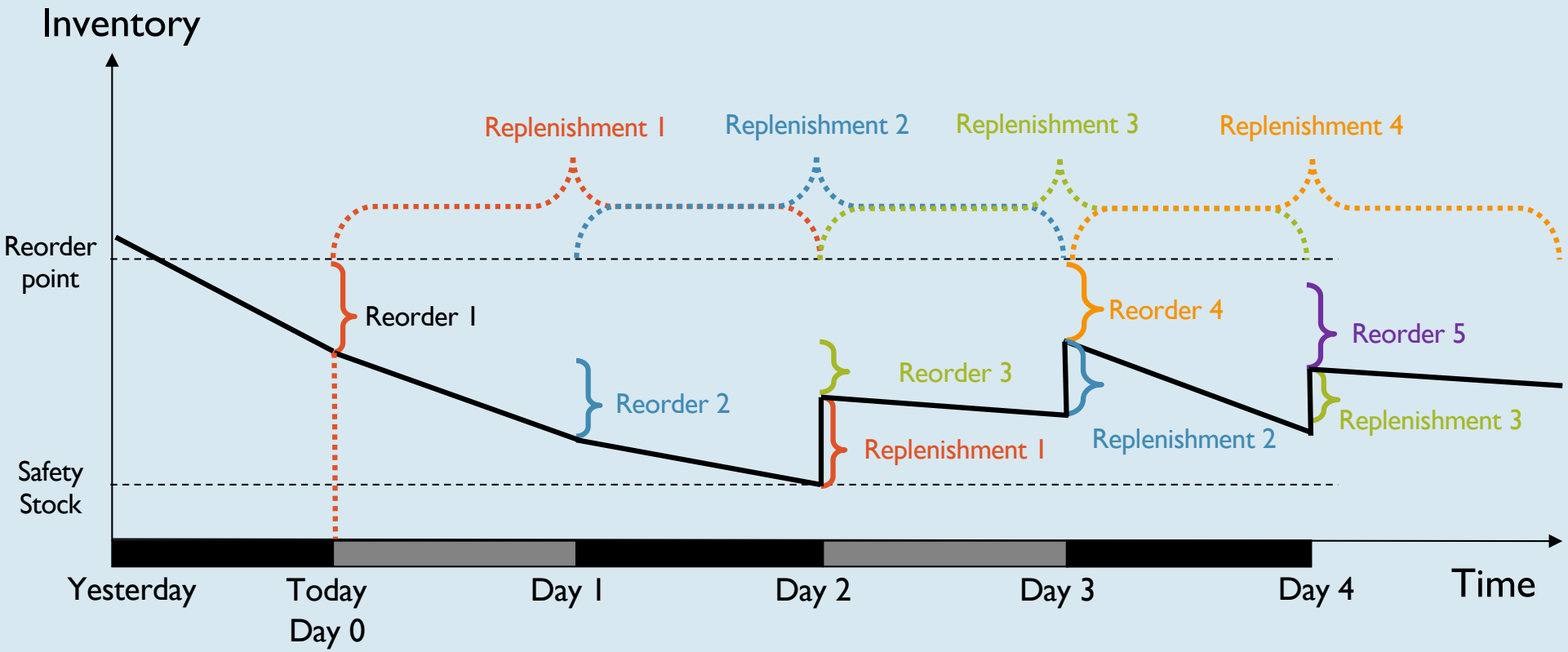
REORDER POINT

During Day 3, inventory is further consumed. Delivery of Reorder 2, Replenishment 2, is received. A fourth order, Reorder 4, is made to replace the days orders.



REORDER POINT

During Day 4, inventory is further consumed. Delivery of Reorder 3, Replenishment 3, is received. A fifth order, Reorder 5, is made to replace the days orders.



SAFETY STOCK

Safety stock, or buffer stock, is the amount of extra inventory you need to keep avoid a shortfall of materials. It is important to calculate your safety stock carefully because while too little stock will result in shortages, too much stock will inflate your inventory costs and increase your exposure to pilferage, obsolescence, and damage. Furthermore, too much inventory decreases cash flow.

SAFETY STOCK

Safety stocks are mainly used in a "make-to-stock" manufacturing strategy, which is employed when the lead time of manufacturing is too long to satisfy the customer demand at the right cost/quality/waiting time.

The main goal of safety stocks is to absorb the variability of customer demand. Indeed, production planning is based on a forecast, which is (by definition) different from the real demand. By absorbing these variations, safety stock improves the customer-service level.

SAFETY STOCK

Creating a safety stock will also prevent stockouts from other variations, like an upward trend in customer demand.

Safety stock is used as a buffer to protect organizations from stockouts caused by inaccurate planning or poor schedule adherence by suppliers.

SAFETY STOCK CALCULATION

$$SS = z_\alpha * \sqrt{E(L)\sigma_D^2 + (E(D))^2\sigma_L^2}$$

α is the service level
z_α is the service factor (the inverse of the service level)
E(L) and σ_L are the mean and standard deviation of lead time
E(D) and σD are the mean and standard deviation of demand in each unit time period

SAFETY STOCK : THINGS TO REMEMBER

↑ Service Level = ↑ Safety Stock = ↑ Inventory = ↓ Cash Flow
↑ Standard Deviation LT = ↑ Safety Stock = ↑ Inventory = ↓ Cash Flow
↑ Standard Deviation D = ↑ Safety Stock = ↑ Inventory = ↓ Cash Flow

↩

↓ Service Level = ↓ Safety Stock = ↓ Inventory = ↑ Cash Flow
↓ Standard Deviation LT = ↓ Safety Stock = ↓ Inventory = ↑ Cash Flow
↓ Standard Deviation D = ↓ Safety Stock = ↓ Inventory = ↑ Cash Flow

SAFETY STOCK: EXAMPLE

	A	B	C
1			Unit Consumption
2	Past Sales	Jul-19	5,031
3		Aug-19	4,745
4		Sep-19	4,987
5		Oct-19	5,125
6		Nov-19	5,098
7		Dec-19	5,222
8	Forecasted Sales	Jan-20	5,200
9		Feb-20	5,200
10		Mar-20	5,200
11			
12	Assumptions	Lead time (months):	2
13		Service level:	0.9
14			
15	Calculations	Lead time demand:	10,400
16		Standard deviation:	163
17		Service factor:	1.28
18		Lead time factor:	1.41
19		Safety stock:	296
20		**Reorder point:**	10,696
21			
22			
23		SKU Costs	$ 45.00
24			
25		Safety Stock Cost	$ 13,324.47
26		% of Avg. Mos. Demand	5.82%

Service level at 90%

Safety Stock equals 5.8% of average monthly demand

Formulas	Comments
=SUM(C8:C9)	Lead time demand
=STDEV(C2:G7)	Deviation in the past sales
=NORMSINV(C13)	Inverse of the normal distribution
=SQRT(C12)	Square root of lead-time to forecast ratio
=C16*C17*C18	Combining factors
=C15+C19	Lead time demand + safety stock

SAFETY STOCK : EXAMPLE

	A	B	C
1			Unit Consumption
2	Past Sales	Jul-19	5,031
3		Aug-19	4,745
4		Sep-19	4,987
5		Oct-19	5,125
6		Nov-19	5,098
7		Dec-19	5,222
8	Forecasted Sales	Jan-20	5,200
9		Feb-20	5,200
10		Mar-20	5,200
11			
12	Assumptions	Lead time (months):	2
13		Service level:	0.95
14			
15	Calculations	Lead time demand:	10,400
16		Standard deviation:	163
17		Service factor:	1.64
18		Lead time factor:	1.41
19		Safety stock:	380
20		**Reorder point:**	10,780
21			
22			
23		SKU Costs	$ 45.00
24			
25		Safety Stock Cost	$ 17,101.77
26		% of Avg. Mos. Demand	7.47%

Service level at 95%

Safety Stock equals 7.5% of average monthly demand

Formulas	Comments
=SUM(C8:C9)	Lead time demand
=STDEV(C2:G7)	Deviation in the past sales
=NORMSINV(C13)	Inverse of the normal distribution
=SQRT(C12)	Square root of lead-time to forecast ratio
=C16*C17*C18	Combining factors
=C15+C19	Lead time demand + safety stock

SAFETY STOCK: EXAMPLE

	A	B	C
1			Unit Consumption
2	Past Sales	Jul-19	5,031
3		Aug-19	4,745
4		Sep-19	4,987
5		Oct-19	5,125
6		Nov-19	5,098
7		Dec-19	5,222
8	Forecasted Sales	Jan-20	5,200
9		Feb-20	5,200
10		Mar-20	5,200
11			
12	Assumptions	Lead time (months):	2
13		Service level:	0.999999
14			
15	Calculations	Lead time demand:	10,400
16		Standard deviation:	163
17		Service factor:	4.75
18		Lead time factor:	1.41
19		Safety stock:	1,098
20		**Reorder point:**	11,498
21			
22			
23		SKU Costs	$ 45.00
24			
25		Safety Stock Cost	$ 49,422.00
26		% of Avg. Mos. Demand	21.58%

Service level at 99.999%

Safety Stock equals 21.6% of average monthly demand

Formulas	Comments
=SUM(C8:C9)	Lead time demand
=STDEV(C2:G7)	Deviation in the past sales
=NORMSINV(C13)	Inverse of the normal distribution
=SQRT(C12)	Square root of lead-time to forecast ratio
=C16*C17*C18	Combining factors
=C15+C19	Lead time demand + safety stock