==========

MODULE 1 — INVENTORY ANALYTICS

==========

Task 1.1 — Inventory Snapshot

Business purpose: Provide a complete view of current inventory levels by product and warehouse location.

	ProductID	Product_name	ProductNumber	Location_name	Quantity
1	1	Adjustable Race	AR-5381	Miscellaneous Storage	324
2	1	Adjustable Race	AR-5381	Subassembly	353
3	1	Adjustable Race	AR-5381	Tool Crib	408
4	2	Bearing Ball	BA-8327	Miscellaneous Storage	318
5	2	Bearing Ball	BA-8327	Subassembly	364
6	2	Bearing Ball	BA-8327	Tool Crib	427
7	3	BB Ball Bearing	BE-2349	Miscellaneous Storage	443
8	3	BB Ball Bearing	BE-2349	Subassembly	324
9	3	BB Ball Bearing	BE-2349	Tool Crib	585

Task 1.2 — Low Stock Alerts

Business purpose: Identify SKUs at risk of stockout by flagging inventory levels below a defined threshold.

How this helps: Supports replenishment planning (purchase/production/transfers) to prevent lost sales and maintain service level.

	ProductID	Product_name	ProductNumber	Location_name	Quantity	LowStockThreshold
1	859	Half-Finger Gloves, M	GL-H102-M	Finished Goods Storage	0	20
2	876	Hitch Rack - 4-Bike	RA-H123	Finished Goods Storage	0	20
3	882	Short-Sleeve Classic Jersey, M	SJ-0194-M	Finished Goods Storage	0	20
4	853	Women's Tights, M	TG-W091-M	Finished Goods Storage	0	20
5	494	Paint - Silver	PA-529S	Paint	4	20
6	494	Paint - Silver	PA-529S	Paint Storage	12	20
7	492	Paint - Black	PA-187B	Paint Storage	14	20

Task 1.3 — Inventory Valuation

Business purpose: Calculate the monetary value of current inventory at each warehouse/location.

Business Value: Shows where capital is tied up in stock, helping prioritize reduction of overstock and focus on the highest-value SKUs/locations.

ProductID	Product_name	ProductNumber	Location_name	Quantity	StandardCost	Inventory_Value
750	Road-150 Red, 44	BK-R93R-44	Final Assembly	121	2171,2942	262726,5982
753	Road-150 Red, 56	BK-R93R-56	Finished Goods Storage	112	2171,2942	243184,9504
751	Road-150 Red, 48	BK-R93R-48	Final Assembly	108	2171,2942	234499,7736
750	Road-150 Red, 44	BK-R93R-44	Finished Goods Storage	102	2171,2942	221472,0084
776	Mountain-100 Black, 42	BK-M82B-42	Final Assembly	116	1898,0944	220178,9504
774	Mountain-100 Silver, 48	BK-M82S-48	Final Assembly	102	1912,1544	195039,7488
792	Road-250 Red, 58	BK-R89R-58	Final Assembly	123	1554,9479	191258,5917
771	Mountain-100 Silver, 38	BK-M82S-38	Final Assembly	100	1912,1544	191215,44
777	Mountain-100 Black, 44	BK-M82B-44	Final Assembly	100	1898,0944	189809,44

Task 1.4 — Inventory Turnover

Business purpose: Measure how many times inventory is sold and replenished over a year.

Business Value: Highlights slow-moving vs fast-rotating SKUs to optimize replenishment, reduce overstock, and improve working capital.

Assumption: Uses last 12 months sales vs current inventory because AdventureWorks does not provide historical inventory snapshots.

	ProductID	Name	ProductNumber	Sales_Qty	Inventory_QT	Turnover	Rotation
1	877	Bike Wash - Dissolver	CL-9009	3072	36	85.00	Quick_Rotation
2	883	Short-Sleeve Classic Jersey, L	SJ-0194-L	2609	36	72.00	Quick_Rotation
3	884	Short-Sleeve Classic Jersey, XL	SJ-0194-X	3535	72	49.00	Quick_Rotation
4	870	Water Bottle - 30 oz.	WB-H098	6469	252	25.00	Quick_Rotation
5	860	Half-Finger Gloves, L	GL-H102-L	905	36	25.00	Quick_Rotation
6	880	Hydration Pack - 70 oz.	HY-1023-70	2574	108	23.00	Quick_Rotation
7	864	Classic Vest, S	VE-C304-S	3908	180	21.00	Quick_Rotation
8	873	Patch Kit/8 Patches	PK-7098	3732	180	20.00	Quick_Rotation
9	878	Fender Set - Mountain	FE-6654	2071	108	19.00	Quick_Rotation

Task 1.5 — Days of Supply (DoS)

Business purpose: Estimate how many days current inventory will last at the current sales rate.

Business Value: Helps prevent stockouts and overstock by prioritizing replenishment decisions based on consumption speed.

Assumption: Average daily demand is calculated from the last 30 days of sales because a longer, cleaner demand history is not provided as a ready KPI in AdventureWorks.

ProductID	Name	Inventory_Qt	Avg_Daily_Demand	Days_Of_Supply	DoS_Category
707	Sport-100 Helmet, Red	288	2.67	108.00	Dead Stock
708	Sport-100 Helmet, Black	324	3.10	104.52	Dead Stock
711	Sport-100 Helmet, Blue	216	3.20	67.50	Overstock Risk
712	AWC Logo Cap	288	3.17	90.95	Dead Stock
713	Long-Sleeve Logo Jersey, S	144	0.93	154.29	Dead Stock
714	Long-Sleeve Logo Jersey, M	180	0.80	225.00	Dead Stock

Task 1.6 — Inventory Aging

Business purpose: Estimate how long inventory has been sitting in stock using the last modified date of the inventory record.

Business Value: Highlights potentially obsolete / slow-moving items, supporting write-off decisions, promotions, and inventory reduction actions.

Assumption: Uses Production.ProductInventory.ModifiedDate as a proxy for stock age because AdventureWorks does not provide receipt-date / lot-level inventory history.

	ProductID	Name	ModifiedDate	Days_in_stock
1	1	Adjustable Race	2014-08-08	4160
2	1	Adjustable Race	2014-08-08	4160
3	1	Adjustable Race	2014-08-08	4160
4	2	Bearing Ball	2014-08-08	4160
5	2	Bearing Ball	2014-08-08	4160
6	2	Bearing Ball	2014-08-08	4160
7	3	BB Ball Bearing	2008-03-31	6481
8	3	BB Ball Bearing	2008-03-31	6481

Task 1.7 — ABC Classification (by inventory value)

Business purpose: Prioritize SKUs based on their contribution to total inventory value (A/B/C segmentation).

Business Value: Focuses control on high-value SKUs (A-class) to improve cycle counting, replenishment priority, and working capital efficiency.

Assumption: Inventory value is based on StandardCost * on-hand quantity (current snapshot), since AdventureWorks does not provide receipt-level valuation history.

ProductID	Name	Cum_Share_Pct	ABC_Class
747	HL Mountain Frame - Black, 38	3.07	A
748	HL Mountain Frame - Silver, 38	5.81	A
750	Road-150 Red, 44	8.22	A
776	Mountain-100 Black, 42	10.05	A
753	Road-150 Red, 56	11.82	A
792	Road-250 Red, 58	13.57	A
774	Mountain-100 Silver, 48	15.13	A
751	Road-150 Red, 48	16.65	A
773	Mountain-100 Silver, 44	18.15	A

Task 1.8 — Safety Stock

Business purpose: Calculate safety stock based on demand variability and supplier lead time.

Business Value: Protects service level against demand and delivery uncertainty, reducing the risk of stockouts.

Assumptions:

- Uses last 30 days of sales to estimate demand variability and average lead time from purchase orders, because AdventureWorks does not provide explicit safety stock or service-level targets.
- Z-score fixed at 1.65 (~95% service level).

	ProductID	Name	Avg_Daily_Demand	Demand_Std_Dev	Avg_Lead_Time	Safety_Stock
1	707	Sport-100 Helmet, Red	2,85714285714286	1,79	25	14,74
2	708	Sport-100 Helmet, Black	3,1	1,49	25	12,3
3	711	Sport-100 Helmet, Blue	3,31034482758621	1,62	25	13,37
4	712	AWC Logo Cap	3,16666666666667	1,46	25	12,07
5	713	Long-Sleeve Logo Jersey, S	1,47368421052632	0,82	25	6,75
6	714	Long-Sleeve Logo Jersey, M	1,26315789473684	0,44	25	3,63
7	715	Long-Sleeve Logo Jersey, L	1,66666666666667	0,75	25	6,15

Task 1.9 — Reorder Point (ROP)

Business purpose: Determine the inventory level at which a replenishment order should be triggered to avoid shortages during lead time.

Business Value: Helps planners reorder at the right moment, balancing stockout risk vs excess inventory and improving service level.

Assumptions:

- Average daily demand is estimated from last 30 days of sales and lead time from purchase orders in AdventureWorks.
- Assumption: Safety stock uses Z = 1.65 (~95% service level).

	ProductID	Name	Avg_Daily_Demand	Demand_Std_Dev	Avg_Lead_Time	Safety_Stock	Reorder_Point
1	707	Sport-100 Helmet, Red	2,85714285714286	1,79	25	14,74	86,17
2	708	Sport-100 Helmet, Black	3,1	1,49	25	12,3	89,8
3	711	Sport-100 Helmet, Blue	3,31034482758621	1,62	25	13,37	96,13
4	712	AWC Logo Cap	3,16666666666667	1,46	25	12,07	91,23
5	713	Long-Sleeve Logo Jersey, S	1,47368421052632	0,82	25	6,75	43,6
6	714	Long-Sleeve Logo Jersey, M	1,26315789473684	0,44	25	3,63	35,21
7	715	Long-Sleeve Logo Jersey, L	1,66666666666667	0,75	25	6,15	47,82

Task 1.10 — MOQ (Minimum Order Quantity)

Business purpose: Estimate a practical minimum order quantity needed to cover demand during lead time.

Business Value: Supports purchasing decisions by suggesting an order size that avoids frequent small orders and reduces stockout risk during replenishment.

Assumptions:

- True supplier MOQ is not available in AdventureWorks; MOQ is approximated as average weekly demand * average lead time (in weeks).
- Weekly demand is computed from the last 30 days of sales (ISO week aggregation).

	ProductID	Name	Avg_Lead_Time_Weeks	Avg_Weekly_Demand	MOQ
1	707	Sport-100 Helmet, Red	3,57142857142857	13,3333333333333	48
2	708	Sport-100 Helmet, Black	3,57142857142857	15,5	56
3	711	Sport-100 Helmet, Blue	3,57142857142857	16	58
4	712	AWC Logo Cap	3,57142857142857	15,8333333333333	57
5	713	Long-Sleeve Logo Jersey, S	3,57142857142857	4,66666666666667	17
6	714	Long-Sleeve Logo Jersey, M	3,57142857142857	4,8	18
7	715	Long-Sleeve Logo Jersey, L	3,57142857142857	3,33333333333333	12
8	716	Long-Sleeve Logo Jersey, XL	3,57142857142857	3,66666666666667	14

Task 1.11 — EOQ (Economic Order Quantity)

Business purpose: Determine the cost-optimal order quantity that minimizes total ordering and holding costs.

Business Value: Supports purchasing policy by balancing frequent ordering costs vs inventory carrying costs (working capital + storage).

Assumptions:

- Ordering cost is fixed at 50 (currency units) because AdventureWorks does not provide order processing cost per PO.
- Holding cost is estimated as 25% of StandardCost per year (carrying rate proxy), since actual storage/finance costs are not available.

	ProductID	Name	Annual_Demand	Ordering_Cost	Annual_Holding_Cost	EOQ
1	707	Sport-100 Helmet, Red	3940	50.0	3.2716	348
2	708	Sport-100 Helmet, Black	4031	50.0	3.2716	352
3	711	Sport-100 Helmet, Blue	4056	50.0	3.2716	353
4	712	AWC Logo Cap	4711	50.0	1.7306	522
5	713	Long-Sleeve Logo Jersey, S	425	50.0	9.6231	67
6	714	Long-Sleeve Logo Jersey, M	1793	50.0	9.6231	137
7	715	Long-Sleeve Logo Jersey, L	2989	50.0	9.6231	177

Task 1.12 — EPQ (Economic Production Quantity)

Business purpose: Estimate the cost-optimal production lot size that minimizes setup and holding costs under finite production capacity.

How this helps: Supports production planning by defining an efficient batch size, reducing excessive setups and avoiding unnecessary inventory buildup.

Assumption: Setup cost is fixed at 120 (currency units) because AdventureWorks does not provide per-product setup cost data.

Assumption: Annual production capacity is set to 100000 units per product as a proxy, since actual capacity constraints are not available in AdventureWorks.

Assumption: Holding cost is estimated as 25% of StandardCost per year (carrying rate proxy).

Results Messages

	ProductID	Name	Annual_Demand	Setup_Cost	Annual_Holding_Cost	Annual_Prod_Capacity	EPQ
1	707	Sport-100 Helmet, Red	3940	120.0	3.2716	100000.0	549
2	708	Sport-100 Helmet, Black	4031	120.0	3.2716	100000.0	556
3	711	Sport-100 Helmet, Blue	4056	120.0	3.2716	100000.0	557
4	712	AWC Logo Cap	4711	120.0	1.7306	100000.0	829
5	713	Long-Sleeve Logo Jersey, S	425	120.0	9.6231	100000.0	104
6	714	Long-Sleeve Logo Jersey, M	1793	120.0	9.6231	100000.0	214
7	715	Long-Sleeve Logo Jersey, L	2989	120.0	9.6231	100000.0	278
8	716	Long-Sleeve Logo Jersey, XL	1257	120.0	9.6231	100000.0	179

==========

MODULE 2 — DEMAND ANALYSIS

==========

Task 2.1 — Daily Demand Calculation

Business purpose: Calculate daily demand per product based on sales orders.

Business Value: Provides a granular demand signal used for short-term planning, variability analysis, safety stock, and demand forecasting.

	ProductID	Name	OrderDate	Order_Qty
1	707	Sport-100 Helmet, Red	2011-05-31	24
2	708	Sport-100 Helmet, Black	2011-05-31	27
3	709	Mountain Bike Socks, M	2011-05-31	38
4	710	Mountain Bike Socks, L	2011-05-31	5
5	711	Sport-100 Helmet, Blue	2011-05-31	33
6	712	AWC Logo Cap	2011-05-31	40

Task 2.2 — Monthly Demand

Business purpose: Aggregate product demand at a monthly level to identify longer-term patterns.

Business Value: Supports capacity planning and inventory policy decisions by smoothing daily noise and enabling trend/seasonality analysis.

	ProductID	Name	MonthDate	Monthly_Qty
1	707	Sport-100 Helmet, Red	2011-05-01	24
2	708	Sport-100 Helmet, Black	2011-05-01	27
3	709	Mountain Bike Socks, M	2011-05-01	38
4	710	Mountain Bike Socks, L	2011-05-01	5
5	711	Sport-100 Helmet, Blue	2011-05-01	33
6	712	AWC Logo Cap	2011-05-01	40
7	714	Long-Sleeve Logo Jersey, M	2011-05-01	16

Task 2.3 — Rolling 3-Month Demand

Business purpose: Calculate rolling 3-month demand per product to smooth short-term fluctuations.

Business Value: Helps planners identify underlying demand trends while reducing month-to-month volatility for better forecasting and planning.

	ProductID	Name	MonthDate	Monthly_Qty	Rolling_3M_Demand
1	707	Sport-100 Helmet, Red	2011-05-01	24	24
2	707	Sport-100 Helmet, Red	2011-07-01	58	82
3	707	Sport-100 Helmet, Red	2011-08-01	96	178
4	707	Sport-100 Helmet, Red	2011-10-01	141	295
5	707	Sport-100 Helmet, Red	2011-12-01	12	249
6	707	Sport-100 Helmet, Red	2012-01-01	61	214
7	707	Sport-100 Helmet, Red	2012-02-01	27	100

Task 2.4 — Trend Analysis (Month-over-Month)

Business purpose: Detect demand direction changes by measuring month-over-month (MoM) quantity shifts per product.

Business Value: Flags products with accelerating or declining demand, supporting proactive replenishment and inventory adjustments.

	ProductID	Name	MonthDate	Monthly_Qty	Prev_Month_Qty	MoM_Change	Trend_Label
1	707	Sport-100 Helmet, Red	2011-05-01	24	NULL	NULL	No trend yet
2	707	Sport-100 Helmet, Red	2011-07-01	58	24	34	Upward Trend
3	707	Sport-100 Helmet, Red	2011-08-01	96	58	38	Upward Trend
4	707	Sport-100 Helmet, Red	2011-10-01	141	96	45	Upward Trend
5	707	Sport-100 Helmet, Red	2011-12-01	12	141	-129	Downward Trend
6	707	Sport-100 Helmet, Red	2012-01-01	61	12	49	Upward Trend
7	707	Sport-100 Helmet, Red	2012-02-01	27	61	-34	Downward Trend

Task 2.5 — Seasonality Index

Business purpose: Measure seasonal demand patterns by comparing monthly demand to the product's average demand level.

Business Value: Identifies peak and off-season periods, enabling better inventory positioning, capacity planning, and promotion timing.

Assumption: Seasonality index is calculated as Monthly Demand / Average Monthly Demand per product, since no predefined seasonality indicators exist in AdventureWorks.

	ProductID	Name	MonthDate	Monthly_Qty	Avg_Monthly_Qty	Seasonality_Index	Season_Label
10	707	Sport-100 Helmet, Red	2012-05-01	162	179,028571428571	0.90	Below Normal
11	707	Sport-100 Helmet, Red	2012-06-01	214	179,028571428571	1.20	Strong Peak Season
12	707	Sport-100 Helmet, Red	2012-07-01	197	179,028571428571	1.10	Above Normal
13	707	Sport-100 Helmet, Red	2012-08-01	108	179,028571428571	0.60	Off-Season
14	707	Sport-100 Helmet, Red	2012-09-01	147	179,028571428571	0.82	Below Normal
15	707	Sport-100 Helmet, Red	2012-10-01	113	179,028571428571	0.63	Off-Season
16	707	Sport-100 Helmet, Red	2012-11-01	50	179,028571428571	0.28	Off-Season