INNOTOCK AI USER MANUAL

Real world supply chain optimization

Version 1.0.1 - 03/01/2023

INNOTOCK AI

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INNOTOCK AI INTRODUCTION

INNOTOCK AI© is a system of applied intelligence created to optimize Supply plans and inventory flow for any given SKU. The optimization algorithms in INNOTOCK AI balance the following concepts:

Total Cost of Ownership =
Cost of Goods (COGS) +
Fixed ordering cost (Sourcing dept + procurement + remote sourcing offices) +
Variable ordering cost (Freight per item door to door) +
Fixed holding costs (Fixed warehousing and shipping) +
Variable holding costs (Variable warehousing and shipping) +
Back-order processing costs +
Chargebacks from customers for Fill Rates +
Margin loss for lack of inventory

Service Levels = OTIF (On time and in full) performance ratio
Fill Rates = Total quantity delivered / Total customer PO accepted
Inventory Positions = Cycle stock (through the Planning Time Fence) + Safety Stock

The goal for the optimization algorithms is to find supply chain policies and strategies that provide target Service Levels and Fill Rates with the lowest inventory and the lowest Total Cost of Ownership (TCO).

This optimization will have to be able to "sense" actual company performance and be dynamic to "respond" to changes.

INNOTOCK AI has been created to solve the following problems:

- Use real-world volatility, uncertainty, and complexity when defining supply chain parameters and planning process.
- Use complex mathematical models that no planning personnel will ever use on their daily jobs, but are necessary to make better decisions and reduce supply chain costs.
- Accept that all calculations change every time a planning model is run and build a dynamic way to incorporate those changes.
- Accept the fact that ERP systems cannot model and build supply plans based on real-world parameters and they always simplify the models in order to be able to calculate a plan that is usually suboptimal

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What is the problem with ERP systems and good planning?

Companies implement expensive and complex ERP systems (Enterprise Resource Planning) that do not optimize the Supply Chain costs of the company. These ERP systems run a planning process, an MRP (Material Planning Processes), based on a set of Master Data (lead time, reorder point, lot size, safety stock, ...) that is fixed, and only change when the person responsible of Planning Master Data decides to change it.

The reality is that none of the planning parameters in the real world are fixed. They are all probabilistic. The future demand, the lead time, and any other supply chain parameter can be modelled based on statistical variables. The complexity of these models and the difficulty of combining their probabilistic effects can be overwhelming for any supply chain or planning analyst.

There is another effect that makes the assumption of real-world models even more difficult. All the statistical calculations for the next lead time cycle change in the real world as time goes by. The statistical distribution of supply chain parameters changes dynamically with time.

Major ERP systems can't model this reality and can't change dynamically based on real-world execution. One of the solutions they offer is to add additional functionality, usually at an additionally high cost, that can help with Integrated Business Planning, or Demand-Supply planning, or similar. Nowadays, some companies are embracing Machine Learning and more complex AI to create complex models with initial low accuracy that take time to train and, if successful, improve.

INNOTOCK AI provides a solution for dynamic inventory optimization.

INNOTOCK AI is based on the following principles:

- **Sensing and modeling** Supply Chain Variability and Volatility
- Calculating and proposing **cost-optimal "Plans for Every Part"**
- **Optimizing Service Levels** and Fill Rates
- Providing **Total Cost of Ownership** (**TOC** = **COGS** + **Supply Chain Costs**)
- **Exporting all Planning Parameters** needed by your ERP system
- Simplifying and **automating Planning Master Data updates**

INNOTOCK AI will model the following variables in the most precise statistical distribution:

- *Demand* ✓
- *Future-planned orders* ✓
- *Past shipments* ✓
- *Lead Times* ✓

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And will allow the following variables to impact the models:

1

STRATEGY

STATIC | DYNAMIC

DATA

Show Input | Change Input

2

SELECT INVENTORY POLICY

- (s,Q)
- (r,S)
- (s,r,S)
- (p,Q)

3

SELECT DISTRIBUTION

- Normal
- Gamma
- Gamma_Minimum

4

SELECT SAFETY STOCK METHOD

- Probabilistic SS
- Fixed 1 Month Avg. Demand
- Var 4 Weeks Rolling Demand
- Optimal SS
- Fixed Qty SS

5

SELECT LOT SIZE METHOD

- Probabilistic EOQ
- Simple EOQ
- 1 month Demand
- Fixed Qty Lot

6

SELECT REVIEW METHOD

- Continuous
- 1wk Review
- Opt Review
- Review Set

Calculation Strategy

- "STATIC"calculation will use distribution mean and standard deviation for all probabilistic parameters.
- "DYNAMIC" calculation will calculate, for each planning cycle, the value of all supply chain parameters. Innotock will ingest actual period performance and recalculate all cycle values.

5 Inventory Policies

- (s,Q) – When the inventory position reaches the Reorder Point "s", order the quantity "Q."
- (r,S) – Every "r" periods, order up to "S" inventory level.
- (s,r,S) – Combination of the two previous ones.
- (p,Q) – [Aggressive] Equal to (s, Q) with s= 10x Safety stock
- (s, S) – Min / Max Inventory Policy

3 Statistical Distributions for future Demand

- Normal, Gamma, or Gamma with minimum distributions.

5 different types of Safety Stock calculations:

- Probabilistic. A function of demand variation, lead time variation, holding costs and backlog costs.
- Fixed one month of demand. Average monthly demand for the whole planning Time Fence.
- Var 4 weeks Rolling Demand. For any period, the sum of four weeks of inventory after lead time.
- Optimal SS. Using optimization algorithm for Lead time calculation
- Fixed Qty SS. User entry for a fixed SS quantity

4 Lot Size methods:

- Probabilistic EOQ. A function of demand, ordering, holding and backlog costs.
- Simple EOQ. Traditional Economic Order Quantity formula.
- 1 month Demand. Average monthly demand for the whole planning Time Fence.
- Fixed Qty Lot. User entry for a fixed SS quantity.

4 types of Review Periods:

- Continuous Review. Assumes inventory, demand and supply are updated real-time and MRP is run every day.
- 1 wk Review. MRP is run once a week.
- Opt Review. The optimal review period is calculated based on all other planning parameters.
- Review set. User entry for a fixed review period.

All these variables give a total of 2400 combinations per item. Who can calculate these many alternatives to find the optimum for every item?

The complexity of the calculations for each variable can get pretty high, based on how backorders are treated, any penalty for fill rate issues, undershoots created because of review periods, and many other intermediate calculations.

INNOTOCK AI can work on automatic and/or manual analysis and optimization.

The end results provided by INNOTOCK AI can be described showing the Masterdata that will be uploaded through a simple API, or a csv upload, to the ERP Masterdata file:

SKU #	Item01	Item0C	Item00	Item01	Item00	Item00
SKU Description	Description_item_0178	Description_item_0040	Description_item_0018	Description_item_0120	Description_item_0084	Description_item_0038
SKU ABC-XYC Class	AZ	CZ	AX	AY	AZ	AZ
MOQ	1100	800	1200	1700	1000	1600
Supply Order Rounding	100	100	100	100	100	100
Inventory Policy	(r,S)	(r,S)	(r,S)	(p,Q)	(p,Q)	(p,Q)
Safety Stock	1254	93	542	301	199	1138
LT Avg Adjusted	7	9	6	16	17	15
Review Period	1	1	1	0	0	0
Planning TF	45	43	46	36	35	37
Reorder Reference	10518	803	4775	2591	1113	10551
Max Stock Reference	7954	534	3607	1959	1111	2671
Lot Size Reference	6555	474	1160	871	522	1961

INNOTOCK AI provides also detailed information needed to make supply chain decisions The output can be uploaded to your ERP execution system using the .csv files provided.

SKU #	Item01	Item0C	Item00	Item01	Item00
SKU Description	Description_item_0178	Description_item_0040	Description_item_0018	Description_item_0120	Description_item_0084
SKU ABC-XYC Class	AZ	CZ	AX	AY	AZ
SKU Cost	$ 13.3430	$ 14.5360	$ 8.3520	$ 16.4160	$ 9.5130
SKU Price	$ 20.2799	$ 22.9318	$ 13.4422	$ 23.5050	$ 16.0792
STRATEGY	rN11OD	rN1P1S	rN11OD	pN1PCD	pN11CS
Initial Inventory	8725	0	3469	967	383
Demand Through TF	57437	3985	24956	10823	6947
Average Demand TF	1254	93	542	301	199
$ Fixed Ordering/Setup Cost	500	150	500	150	150
% Holding Cost/Item Cost	6.6715	5.8144	4.176	6.5664	3.8052
% Backorders Lost	0.467005	0.50876	0.29232	0.57456	0.332955
% Fill Rate Penalty	0.66715	0.7268	0.4176	0.8208	0.47565
MOQ	1100	800	1200	1700	1000
Supply Order Rounding	100	100	100	100	100
Inventory Policy	(r,S)	(r,S)	(r,S)	(p,Q)	(p,Q)
Sourced / MFG	MFG	SOURCED	MFG	SOURCED	SOURCED
Safety Stock	1254	93	542	301	199
LT Avg Adjusted	7	9	6	16	17
Review Period	1	1	1	0	0
Planning TF	45	43	46	36	35
Annual Demand	63496	4576	28183	15473	8702
Inventory Turns	5.64	3.4	6.78	2.16	2.54
Average Inventory	9981	1147	3681	5008	2732
COGS	$ 867,819	$ 68,644	$ 235,619	$ 256,635	$ 98,186
Reorder Reference	10518	803	4775	2591	1113
Max Stock Reference	7954	534	3607	1959	1111
Lot Size Reference	6555	474	1160	871	522
Actual Fill Rate Average	98	98	100	100	100
Actual Service Level Average	98	98	100	100	100
Total Ordering Cost	$ 20,589	$ 7,355	$ 16,560	$ 14,330	$ 14,426
Total Holding Cost	$ 77,326	$ 6,994	$ 19,652	$ 30,781	$ 9,336
Total Penalty Cost	$ 104	$ 9	$ -	$ -	$ -
Total Backorder Cost	$ 73	$ 6	$ -	$ -	$ -
TF Policy Cost	$ 113,350	$ 17,371	$ 40,935	$ 65,161	$ 35,302

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GLOSSARY OF TERMS

- *ABC – XYZ Inventory Model ©*

Item classification based on annual sales volume (ABC) and item variability (XYZ), that has a big impact on determining targets for service levels and fill rates.

By default, fill rates are determined using the following matrix:

Fill Rates	X	Y	Z
A	0.98	0.96	0.92
B	0.96	0.94	0.90
C	0.92	0.90	0.85

XYZ is calculated based on Coefficients of Variation of demand and ABC is calculated based on relative sales volume for each item.

- *Cycle and Planning Time Fence*

Cycle Time Fence is the addition of projected Leadtime and review periods.
Planning time fence is the difference between the whole horizon of demand data and the Cycle Time Fence.

For instance:
Projected LT = 10 weeks
Review Period = 4 weeks
Demand planning used in the algorithm = 52 weeks

Then
Cycle = 14 weeks
Planning TF = 52-14 = 38

We can plan effectively the following 38 weeks.
We can plan dynamically blocks of 14 weeks at a time.

- ## *Inventory Positions*

Cycle stock (through the Cycle Time Fence) + Safety Stock, where Cycle Stock is, in its most simplified definition, the demand through Leadtime, and Safety Stock is the inventory on hand to cope with demand variability.

- ## *Strategies 'abcdef' (6 characters)*

Example: sNVE1S =

Policy = s = (s,Q)
Demand Distribution = N = Normal
Safety Stock method = V = Probabilistic SS
Lot Size = E = Simple EOQ
Review type = 1 = 1 week Review
Computation = S = Static

The strategies codes are the first letter of the selected option.

INNOTOCK AI assigns by default the sN111S strategy to any item, as this is one of the most popular strategies used by planners.

- ## *Total Cost of Ownership (TCO)*

Total Cost of Ownership =
Cost of Goods (COGS) +
Fixed ordering cost (Sourcing dept + procurement + remote sourcing offices) +
Variable ordering cost (Freight per item door to door) +
Fixed holding costs (Fixed warehousing and shipping) +
Variable holding costs (Variable warehousing and shipping) +
Back-order processing costs +
Chargebacks from customers for Fill Rates +
Margin lost for lack of inventory to ship.

Sometimes this TCO is also called Total Supply Chain Cost.

Best introductory notes on Supply Chain fundamentals from Open Course of MITx (by Chris Caplice), Pages 37-73

https://courses.edx.org/asset-v1:MITx+CTL.SC1x_2+1T2016+type@asset+block/SC1x_KeyConceptDocument_v5_1_Complete.pdf

This is a simple document that can give some light to the fundamentals of supply chain design and calculation.

INNOTOCK AI

FEATURES & SUBSCRIPTIONS

Please read the following table to understand what is included with each level of subscription.

This manual contains the descriptions for ALL INNOTOCK AI features included in the most complete "Advanced Subscription".

INNOTOCK AI Subscriptions can be accessed at Innotock.com/Subscription.

You can download INNOTOCK AI FREE DEMO by clicking on the button INNOTOCK AI FREE DEMO button. A window will pop up asking details to approve the download.

Please provide the required information (*) to proceed. A message will appear on your screen with the instructions to download INNOTOCK AI Free Demo.

If you are ready to subscribe to any of INNOTOCK AI products, just click on "Subscribe Now" and follow the instructions. If you click Subscribe Now, the following screen will ask for all your data to process the order.

Once the product has been subscribed, you will receive an email with your product key LICENSE, with the format:

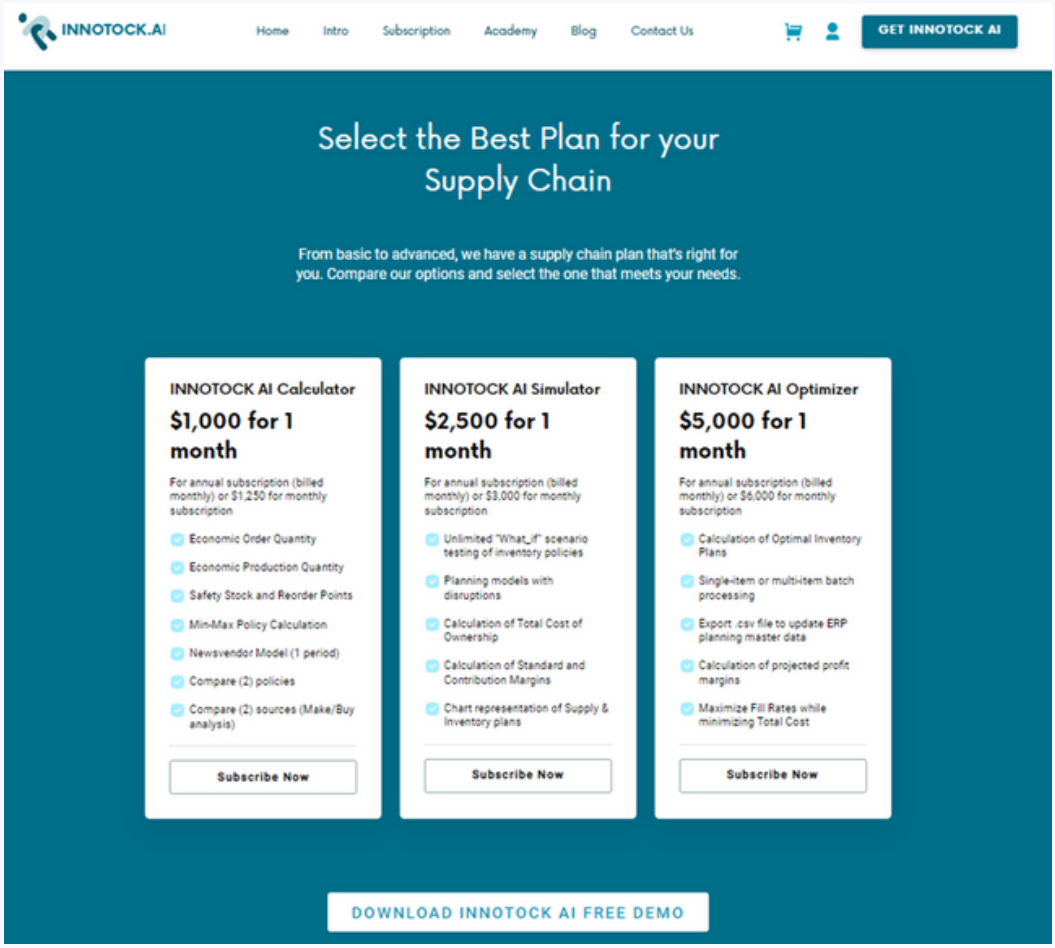
XXXX-XXXX-XXXX-XXXX
Example: IN7O-T88K-A9LI-2E7S

You will be asked to download the SETUP file of your subscription.

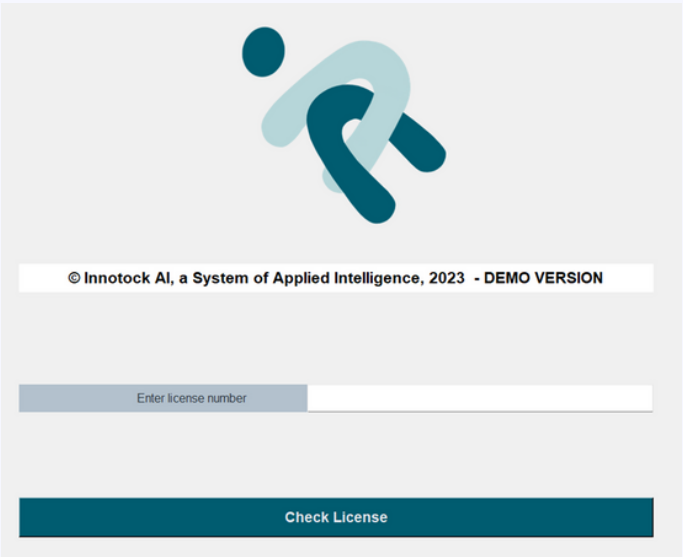
The proposed folder for INNOTOCK AI on your computer is c:\innotock_local\. All necessary files and images needed to run innotock are on that folder.

Eventually, you will create subfolders on c:\innotock.com\ to save datasets for your different projects.

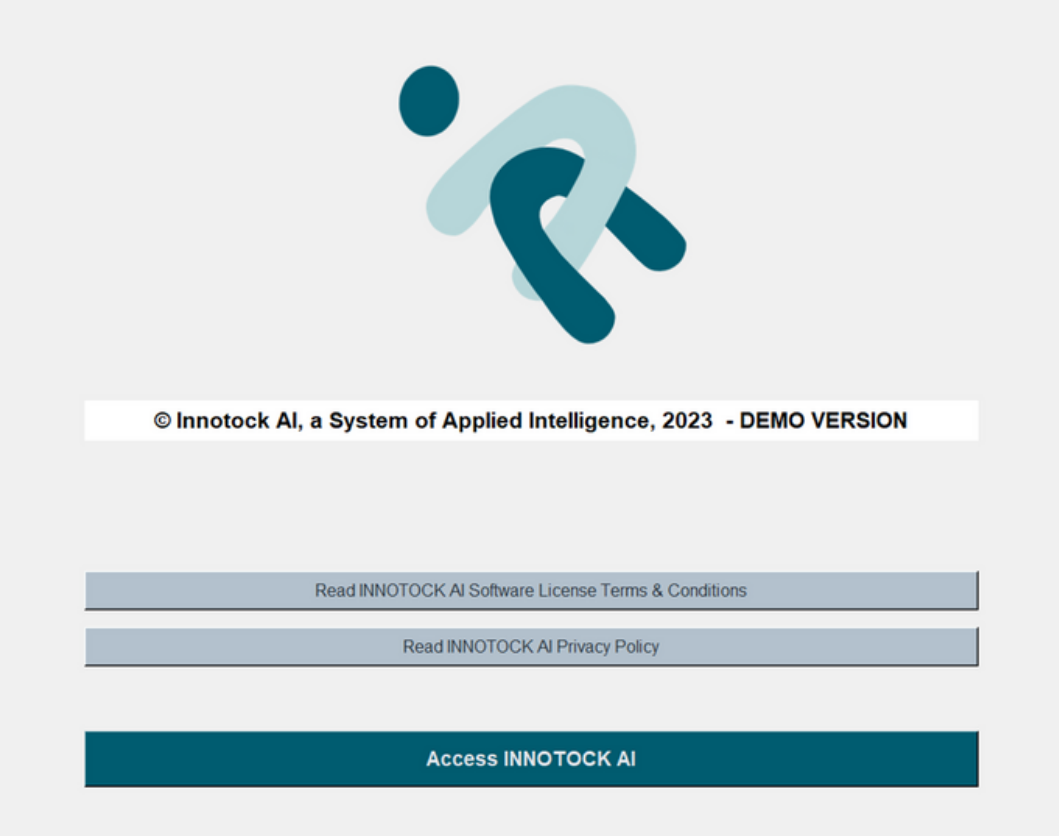
FEATURE	CALCULATOR	SIMULATOR	OPTIMIZER
Economic Order Quantity Calculator	✓	✓	✓
Production Economic Quantity Calculator	✓	✓	✓
Safety Stock Calculator	✓	✓	✓
Optimal Review Period Calculator	✓	✓	✓
Reorder Point Calculator	✓	✓	✓
Min-Max inventory Modeling	✓	✓	✓
Make vs Buy [2 Source Comparison]	✓	✓	✓
Quick 3 Supply Strategies Comparison	✓	✓	✓
Single period "Newsvendor" Problem	✓	✓	✓
Main Inventory Policy (s,Q)	✓	✓	✓
Normal Statistical Distribution	✓	✓	✓
Single SKU Processing – Unlimited Runs	✓	✓	✓
Unlimited "What_if" Multivariate Analysis	✗	✓	✓
Economic Order Quantity with Disruptions	✗	✓	✓
Economic Order Quantity with Partial Backorders	✗	✓	✓
Newsvendor Model with Disruption	✗	✓	✓
Total Cost of Ownership optimization for Fill Rate and Margin	✗	✓	✓
Main Inventory Policies (s,Q) (r,S) (s,r,S)	✗	✗	✓
Allows comparison between methods	✗	✗	✓
Charts (Demand / Supply / Inventory)	✗	✗	✓
Export Charts to Excel with Formulas	✗	✗	✓
Gamma & Gamma_min Statistical Dist	✗	✗	✓
Contribution Margin Computation	✗	✗	✓
Calculation of 250+ Inv Policies per Item	✗	✗	✓
Calculation of OPTIMAL Inv Policy for Every Item (PFEP)	✗	✗	✓
Dynamic & Static Time-Bound Algorithms	✗	✗	✓
Multiple Batch SKU Processing, Unlimited Runs	✗	✗	✓



When you run INNOTOCK AI for the first time, the following screen will appear. Please enter or paste your license and click "Check License".

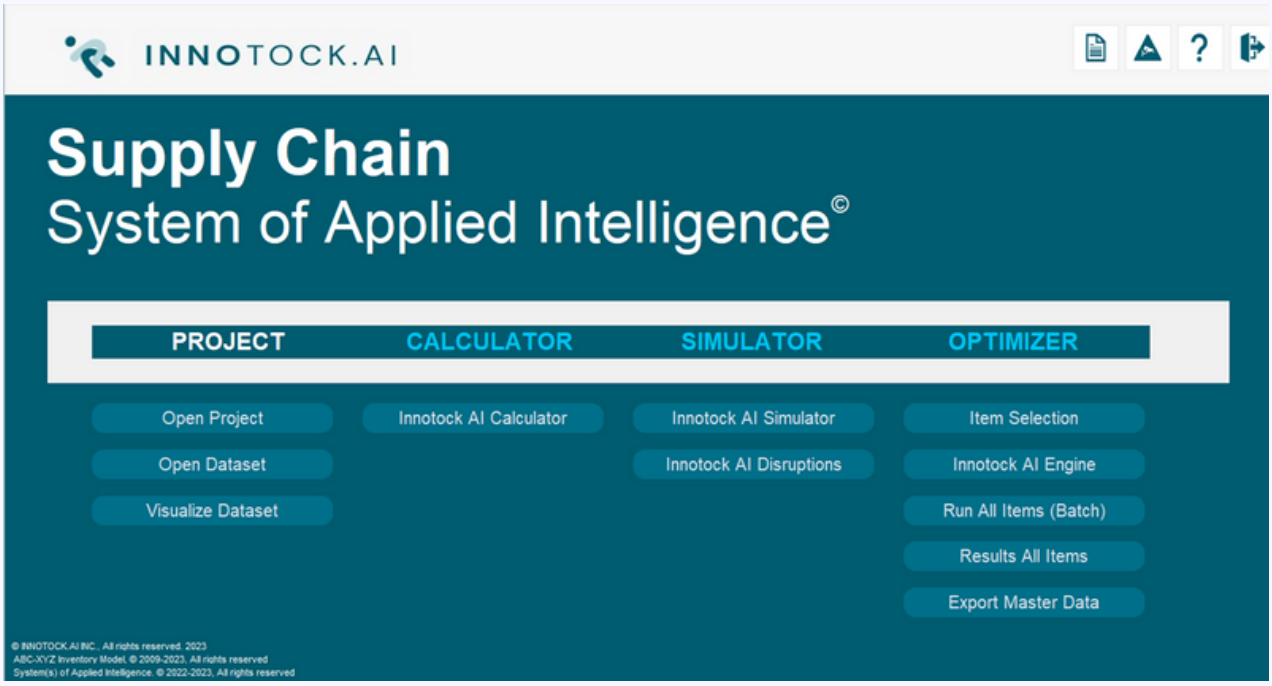


INNOTOCK AI will check the validity of your license and it will give you a message stating that the License is valid to operate the software or an error message otherwise. The following screen will appear. You will have to accept INNOTOCK AI' Terms and Conditions, as well as its Privacy Policy to continue by clicking on "Access INNOTOCK AI".



INNOTOCK AI

MAIN MENU

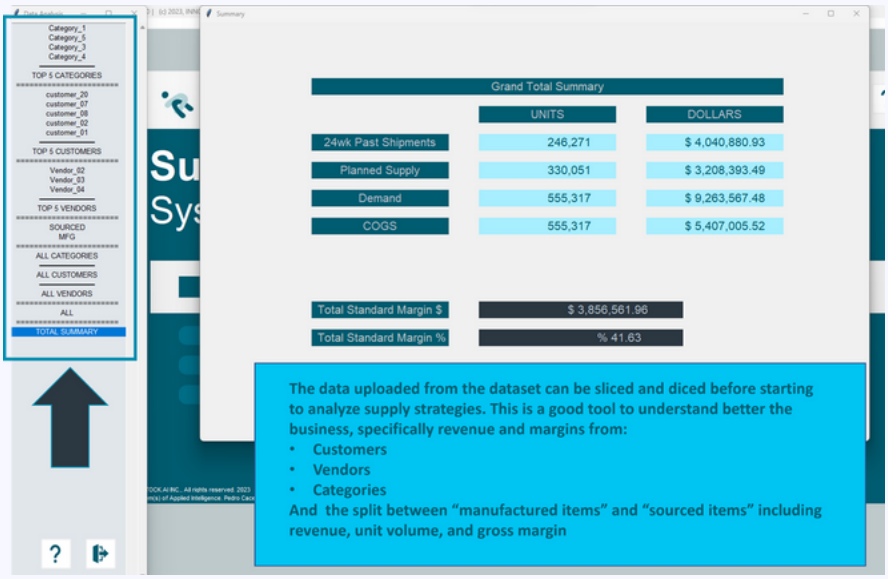


If you are running INNOTOCK AI Optimizer, you will have to create a project and a dataset.

Topic	Instructions
PREVIOUS ACTION NEEDED _____ Prepare Data File	• Open c:\Innotock_Local\base_dataset • Add Available information to the columns. • Save_as "New File Name" in a new project directory under Innotock_Local to keep the "base_dataset" clean and useful for other projects.
Open Project	• Click "OPEN PROJECT" • Choose directory where your project dataset is located. • This directory becomes your default project_directory for this working session. • INNOTOCK AI will remember this folder as default unless changed by the user.
Open Dataset	• Click "OPEN DATASET" • Choose file where project dataset is stored. The files presented are contained in the project_directory chosen earlier.
Visualize	• Set of screen reports from the dataset file. • Choose from the menu presented on the left what you'd like to see. This option is very useful to check validity of data and to understand size and scope of the project. • Some examples below...

INNOTOCK AI

Examples of visualizations from the selected dataset. These visualizations are useful to understand the context and complexity of the problem. You can see revenue and margin by category, customer, or supplier, and the totals.



Grand Total Summary - Top 5 Categories

	Sales (Units)	Sales ($)	Standard Margin ($)	Standard Margin (%)
Category_3	271,981	$ 3,595,648	$ 1,495,372	% 41.59
Category_1	307,371	$ 4,999,038	$ 2,053,490	% 41.08
Category_6	208,275	$ 3,610,584	$ 1,439,701	% 39.87
Category_5	566,950	$ 10,750,692	$ 4,242,650	% 39.46
Category_7	167,560	$ 4,389,717	$ 1,622,240	% 36.96

Total Standard Margin $	$ 10,853,451.70
Total Standard Margin %	% 39.69

Grand Total Summary - Top 5 Customers

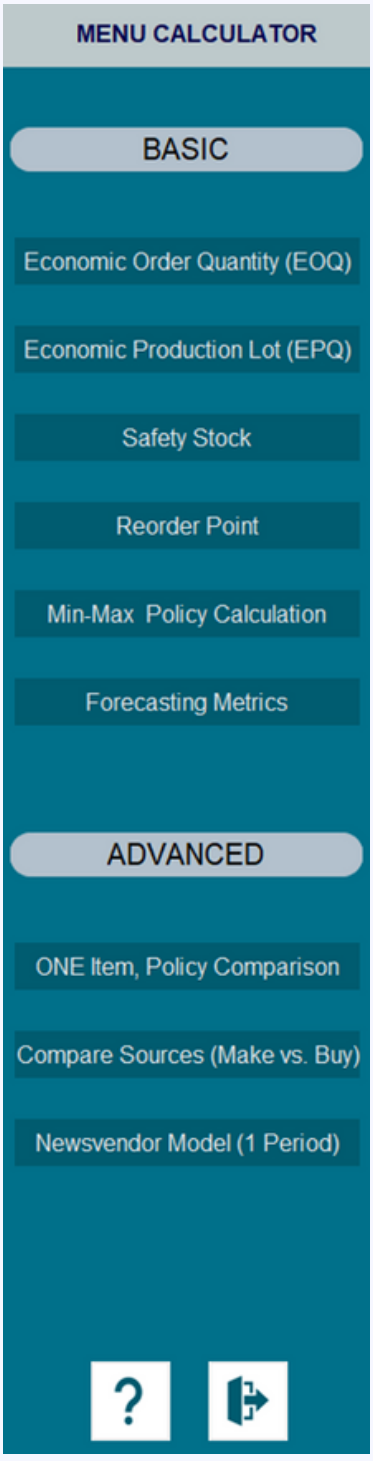
	Sales (Units)	Sales ($)	Standard Margin ($)	Standard Margin (%)
customer_20	211,146	$ 3,885,035	$ 1,632,181	% 42.01
customer_04	153,528	$ 3,140,010	$ 1,297,204	% 41.31
customer_08	422,276	$ 5,865,935	$ 2,351,127	% 40.08
customer_10	416,184	$ 6,256,673	$ 2,429,958	% 38.84
customer_02	512,078	$ 7,890,744	$ 3,022,580	% 38.31

Total Standard Margin $	$ 10,733,050.20
Total Standard Margin %	% 39.70

INNOTOCK AI

INNOTOCK AI CALCULATOR

The execution of INNOTOCK AI Calculator option will be managed by the following menu:



- *Supply EOQ based on annual demand, inventory holding costs and ordering costs*
- *Production EOQ based on annual demand, inventory holding costs and setup costs*
- *Safety Stock calculations following three different models*
- *Reorder point calculation*
- *Min-Max inventory model design based on multiple parameters*
- *Forecasting Metrics given the forecast and actual*

- *Compare three Inventory policies for a given item using multiple parameters*
- *Comparing two sources (make vs. buy) based on Total Cost of Ownership*
- *Single period Newsvendor model*

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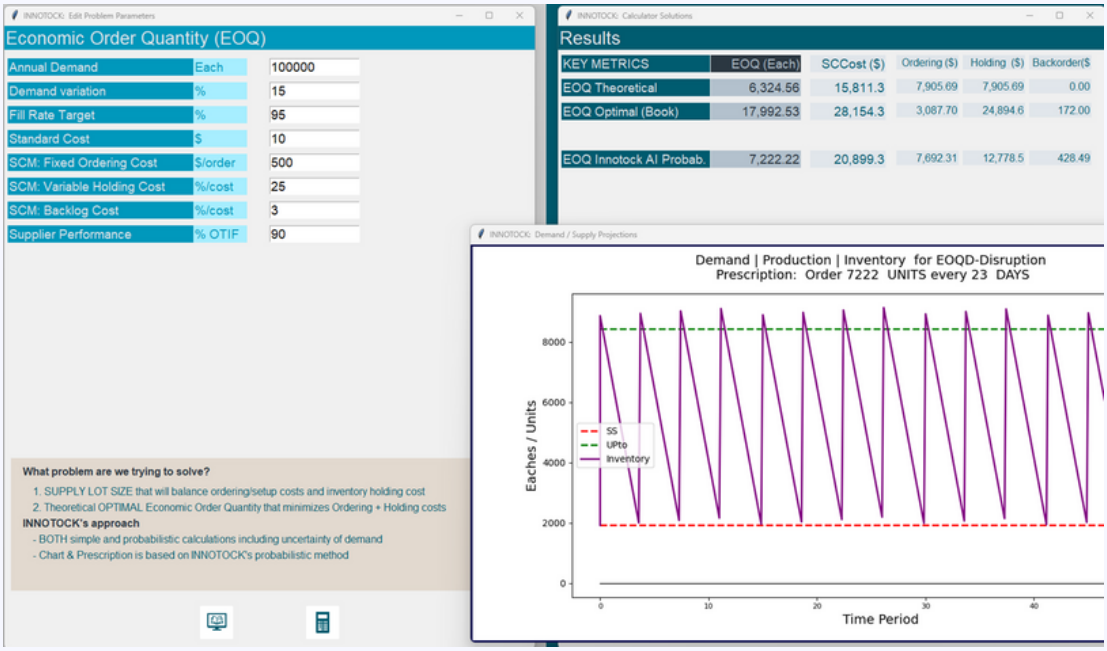
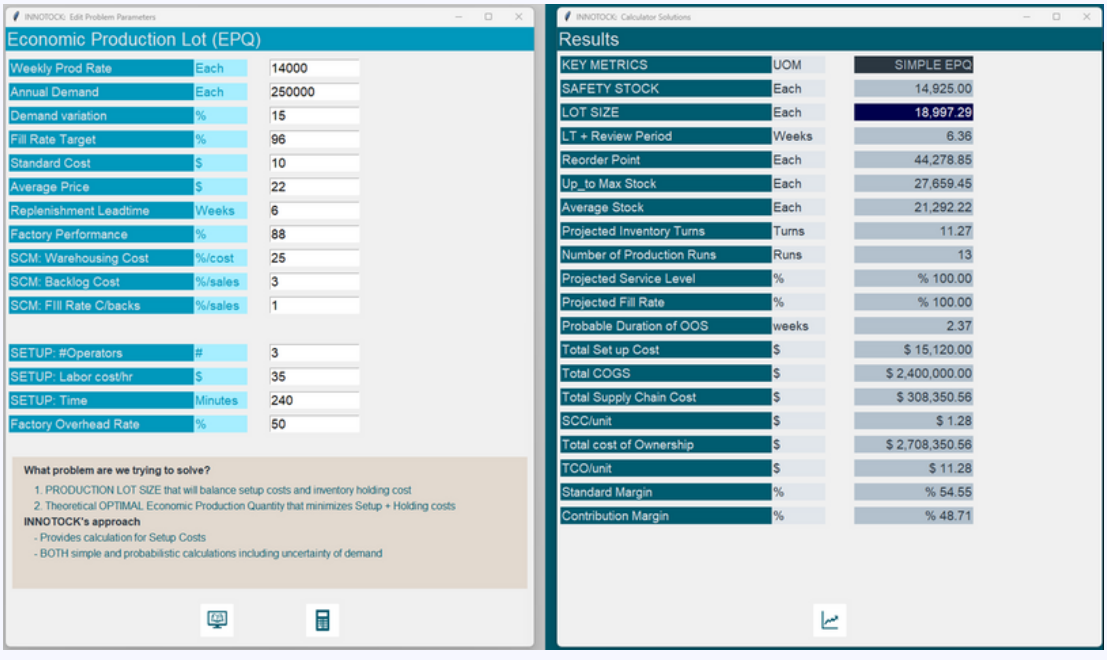
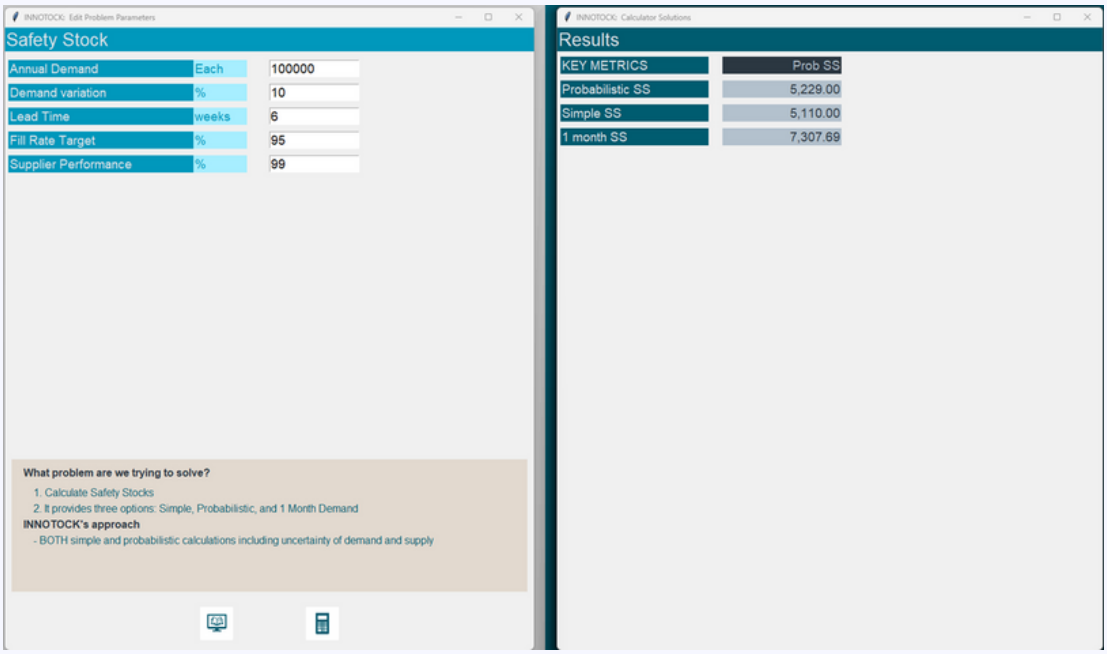
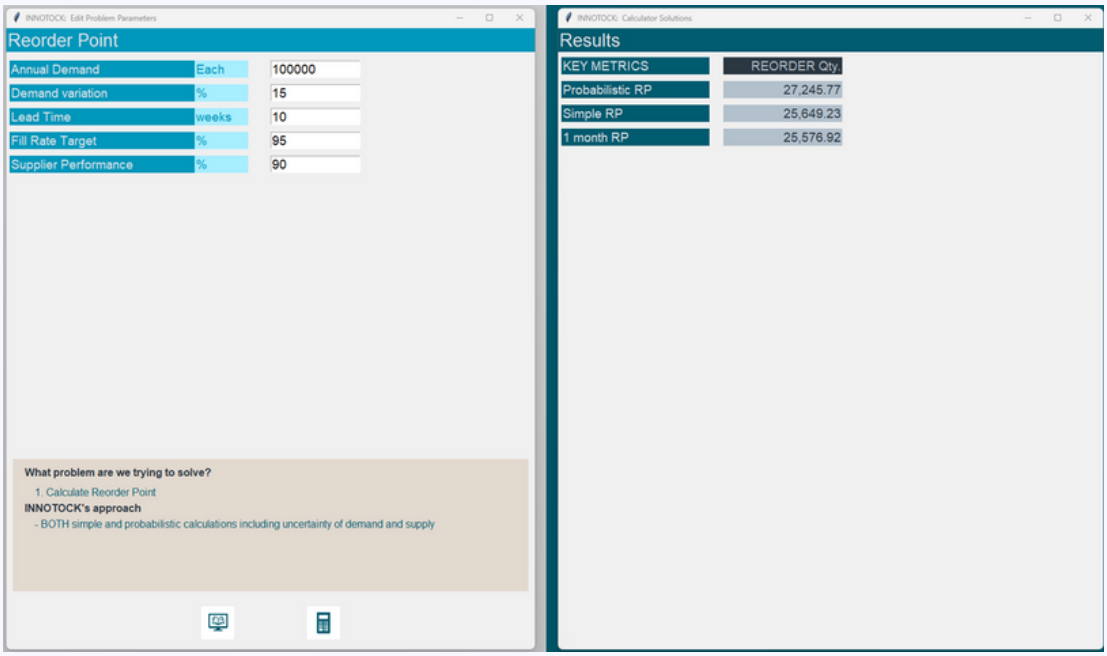

INNOTOCK: Edit Problem Parameters
Economic Order Quantity (EOQ)
Annual Demand Each 100000
Demand variation % 15
Fill Rate Target % 95
Standard Cost $ 10
SCM: Fixed Ordering Cost $/order 500
SCM: Variable Holding Cost %/cost 25
SCM: Backlog Cost %/cost 3
Supplier Performance % OTIF 90
What problem are we trying to solve?
1. SUPPLY LOT SIZE that will balance ordering/setup costs and inventory holding cost
2. Theoretical OPTIMAL Economic Order Quantity that minimizes Ordering + Holding costs
INNOTOCK's approach
- BOTH simple and probabilistic calculations including uncertainty of demand
- Chart & Prescription is based on INNOTOCK's probabilistic method
INNOTOCK: Calculator Solutions
Results
KEY METRICS EOQ (Each) SCCost ($) Ordering ($) Holding ($) Backorder($
EOQ Theoretical 6,324.56 15,811.3 7,905.69 7,905.69 0.00
EOQ Optimal (Book) 17,992.53 28,154.3 3,087.70 24,894.6 172.00
EOQ Innotock AI Probab. 7,222.22 20,899.3 7,692.31 12,778.5 428.49
INNOTOCK: Demand / Supply Projections
Demand | Production | Inventory for EOQD-Disruption
Prescription: Order 7222 UNITS every 23 DAYS
Eaches / Units
Time Period
SS
UPto
Inventory

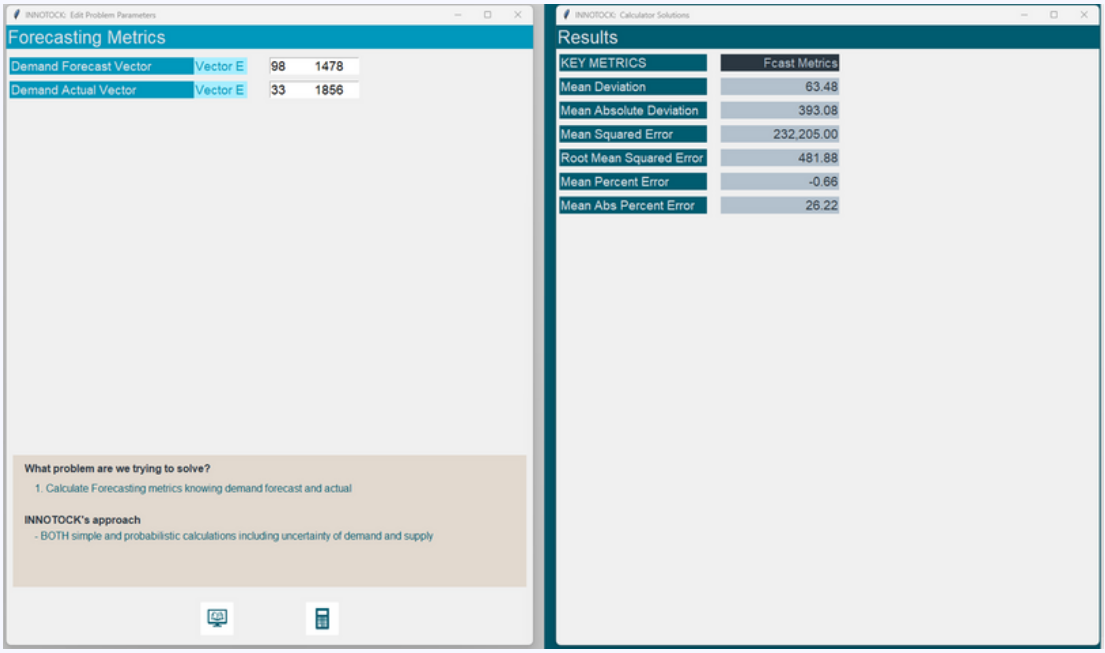

INNOTOCK: Edit Problem Parameters
Economic Production Lot (EPQ)
Weekly Prod Rate Each 14000
Annual Demand Each 250000
Demand variation % 15
Fill Rate Target % 96
Standard Cost $ 10
Average Price $ 22
Replenishment Leadtime Weeks 6
Factory Performance % 88
SCM: Warehousing Cost %/cost 25
SCM: Backlog Cost %/sales 3
SCM: Fill Rate C/backs %/sales 1
SETUP: #Operators # 3
SETUP: Labor cost/hr $ 35
SETUP: Time Minutes 240
Factory Overhead Rate % 50
What problem are we trying to solve?
1. PRODUCTION LOT SIZE that will balance setup costs and inventory holding cost
2. Theoretical OPTIMAL Economic Production Quantity that minimizes Setup + Holding costs
INNOTOCK's approach
- Provides calculation for Setup Costs
- BOTH simple and probabilistic calculations including uncertainty of demand
INNOTOCK: Calculator Solutions
Results
KEY METRICS UOM SIMPLE EPQ
SAFETY STOCK Each 14,925.00
LOT SIZE Each 18,997.29
LT + Review Period Weeks 6.36
Reorder Point Each 44,278.85
Up_to Max Stock Each 27,659.45
Average Stock Each 21,292.22
Projected Inventory Turns Turns 11.27
Number of Production Runs Runs 13
Projected Service Level % % 100.00
Projected Fill Rate % % 100.00
Probable Duration of OOS weeks 2.37
Total Set up Cost $ $ 15,120.00
Total COGS $ $ 2,400,000.00
Total Supply Chain Cost $ $ 308,350.56
SCC/unit $ $ 1.28
Total cost of Ownership $ $ 2,708,350.56
TCO/unit $ $ 11.28
Standard Margin % % 54.55
Contribution Margin % % 48.71

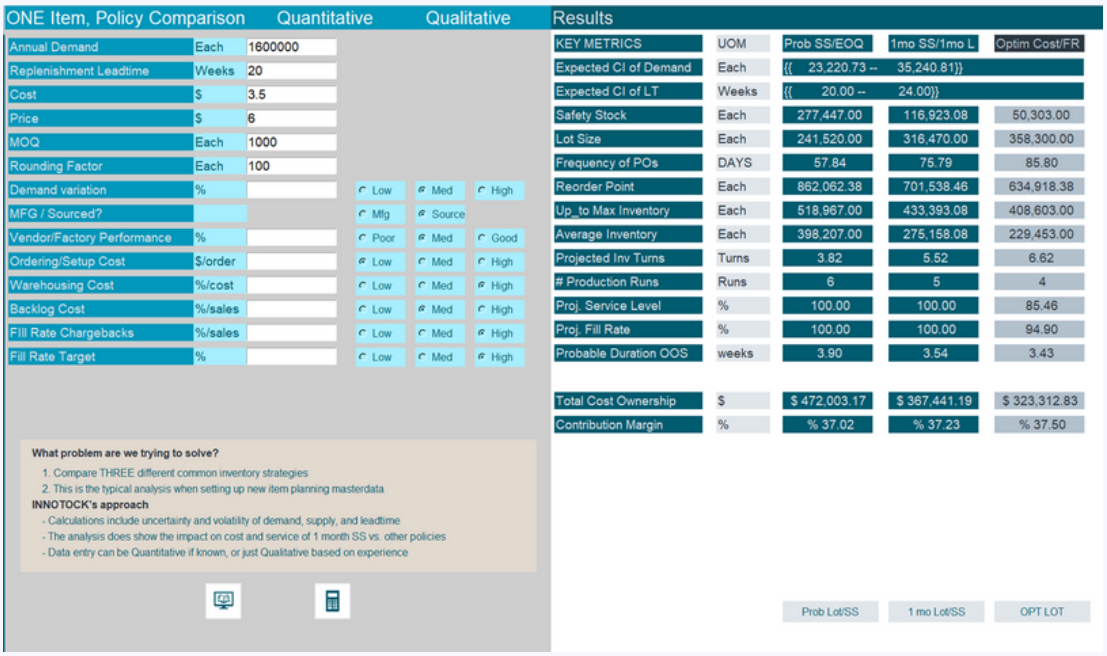
INNOTOCK AI


INNOTOCK: Edit Problem Parameters
Safety Stock
Annual Demand
Each
100000
Demand variation
%
10
Lead Time
weeks
6
Fill Rate Target
%
95
Supplier Performance
%
99
What problem are we trying to solve?
1. Calculate Safety Stocks
2. It provides three options: Simple, Probabilistic, and 1 Month Demand
INNOTOCK's approach
- BOTH simple and probabilistic calculations including uncertainty of demand and supply
INNOTOCK: Calculator Solutions
Results
KEY METRICS
Prob SS
Probabilistic SS
5,229.00
Simple SS
5,110.00
1 month SS
7,307.69

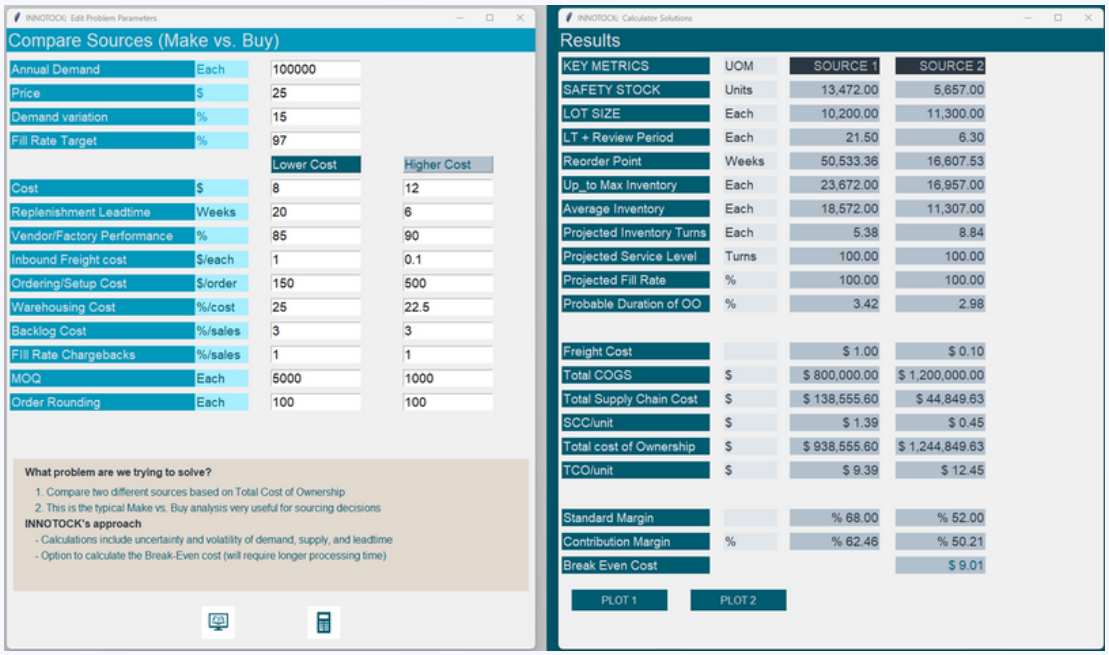

INNOTOCK: Edit Problem Parameters
Reorder Point
Annual Demand
Each
100000
Demand variation
%
15
Lead Time
weeks
10
Fill Rate Target
%
95
Supplier Performance
%
90
What problem are we trying to solve?
1. Calculate Reorder Point
INNOTOCK's approach
- BOTH simple and probabilistic calculations including uncertainty of demand and supply
INNOTOCK: Calculator Solutions
Results
KEY METRICS
REORDER Qty.
Probabilistic RP
27,245.77
Simple RP
25,649.23
1 month RP
25,576.92

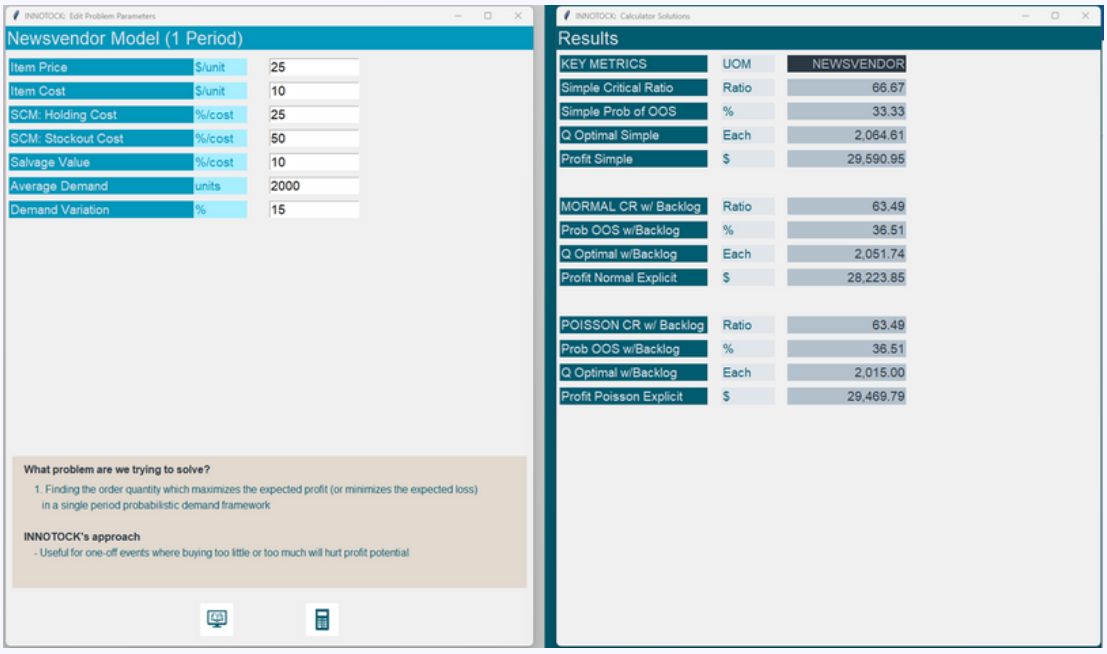
INNOTOCK AI


INNOTOCK: Edit Problem Parameters
Forecasting Metrics
Demand Forecast Vector
Vector E
98
1478
Demand Actual Vector
Vector E
33
1856
What problem are we trying to solve?
1. Calculate Forecasting metrics knowing demand forecast and actual
INNOTOCK's approach
- BOTH simple and probabilistic calculations including uncertainty of demand and supply
INNOTOCK: Calculator Solutions
Results
KEY METRICS
Fcast Metrics
Mean Deviation
63.48
Mean Absolute Deviation
393.08
Mean Squared Error
232,205.00
Root Mean Squared Error
481.88
Mean Percent Error
-0.66
Mean Abs Percent Error
26.22


ONE Item, Policy Comparison
Quantitative
Qualitative
Annual Demand
Each
1600000
Replenishment Leadtime
Weeks
20
Cost
$
3.5
Price
$
6
MOQ
Each
1000
Rounding Factor
Each
100
Demand variation
%
Low
Med
High
MFG / Sourced?
Mfg
Source
Vendor/Factory Performance
%
Poor
Med
Good
Ordering/Setup Cost
$/order
Low
Med
High
Warehousing Cost
%/cost
Low
Med
High
Backlog Cost
%/sales
Low
Med
High
Fill Rate Chargebacks
%/sales
Low
Med
High
Fill Rate Target
%
Low
Med
High
What problem are we trying to solve?
1. Compare THREE different common inventory strategies
2. This is the typical analysis when setting up new item planning masterdata
INNOTOCK's approach
- Calculations include uncertainty and volatility of demand, supply, and leadtime
- The analysis does show the impact on cost and service of 1 month SS vs. other policies
- Data entry can be Quantitative if known, or just Qualitative based on experience
Results
KEY METRICS
UOM
Prob SS/EOQ
1mo SS/1mo L
Optim Cost/FR
Expected CI of Demand
Each
{{ 23,220.73 -- 35,240.81}}
Expected CI of LT
Weeks
{{ 20.00 -- 24.00}}
Safety Stock
Each
277,447.00
116,923.08
50,303.00
Lot Size
Each
241,520.00
316,470.00
358,300.00
Frequency of POs
DAYS
57.84
75.79
85.80
Reorder Point
Each
862,062.38
701,538.46
634,918.38
Up_to Max Inventory
Each
518,967.00
433,393.08
408,603.00
Average Inventory
Each
398,207.00
275,158.08
229,453.00
Projected Inv Turns
Turns
3.82
5.52
6.62
Production Runs
Runs
6
5
4
Proj. Service Level
%
100.00
100.00
85.46
Proj. Fill Rate
%
100.00
100.00
94.90
Probable Duration OOS
weeks
3.90
3.54
3.43
Total Cost Ownership
$
$ 472,003.17
$ 367,441.19
$ 323,312.83
Contribution Margin
%
% 37.02
% 37.23
% 37.50
Prob Lot/SS
1 mo Lot/SS
OPT LOT

INNOTOCK AI

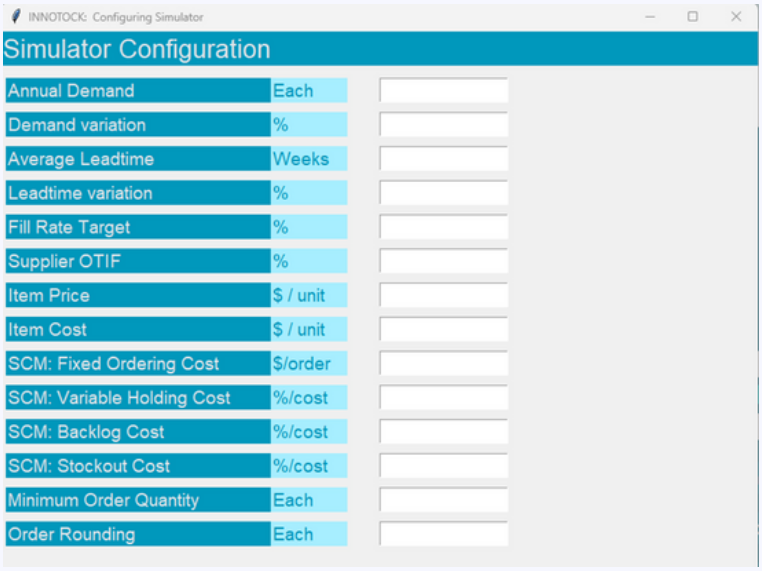

INNOTOCK: Edit Problem Parameters
Compare Sources (Make vs. Buy)
Annual Demand Each 100000
Price $ 25
Demand variation % 15
Fill Rate Target % 97
Lower Cost Higher Cost
Cost $ 8 12
Replenishment Leadtime Weeks 20 6
Vendor/Factory Performance % 85 90
Inbound Freight cost $/each 1 0.1
Ordering/Setup Cost $/order 150 500
Warehousing Cost %/cost 25 22.5
Backlog Cost %/sales 3 3
Fill Rate Chargebacks %/sales 1 1
MOQ Each 5000 1000
Order Rounding Each 100 100
What problem are we trying to solve?
1. Compare two different sources based on Total Cost of Ownership
2. This is the typical Make vs. Buy analysis very useful for sourcing decisions
INNOTOCK's approach
- Calculations include uncertainty and volatility of demand, supply, and leadtime
- Option to calculate the Break-Even cost (will require longer processing time)
INNOTOCK: Calculator Solutions
Results
KEY METRICS UOM SOURCE 1 SOURCE 2
SAFETY STOCK Units 13,472.00 5,657.00
LOT SIZE Each 10,200.00 11,300.00
LT + Review Period Each 21.50 6.30
Reorder Point Weeks 50,533.36 16,607.53
Up_to Max Inventory Each 23,672.00 16,957.00
Average Inventory Each 18,572.00 11,307.00
Projected Inventory Turns Each 5.38 8.84
Projected Service Level Turns 100.00 100.00
Projected Fill Rate % 100.00 100.00
Probable Duration of OO % 3.42 2.98
Freight Cost $ 1.00 $ 0.10
Total COGS $ $ 800,000.00 $ 1,200,000.00
Total Supply Chain Cost $ $ 138,555.60 $ 44,849.63
SCC/unit $ $ 1.39 $ 0.45
Total cost of Ownership $ $ 938,555.60 $ 1,244,849.63
TCO/unit $ $ 9.39 $ 12.45
Standard Margin % 68.00 % 52.00
Contribution Margin % % 62.46 % 50.21
Break Even Cost $ 9.01
PLOT 1
PLOT 2


INNOTOCK: Edit Problem Parameters
Newsvendor Model (1 Period)
Item Price $/unit 25
Item Cost $/unit 10
SCM: Holding Cost %/cost 25
SCM: Stockout Cost %/cost 50
Salvage Value %/cost 10
Average Demand units 2000
Demand Variation % 15
What problem are we trying to solve?
1. Finding the order quantity which maximizes the expected profit (or minimizes the expected loss) in a single period probabilistic demand framework
INNOTOCK's approach
- Useful for one-off events where buying too little or too much will hurt profit potential
INNOTOCK: Calculator Solutions
Results
KEY METRICS UOM NEWSVENDOR
Simple Critical Ratio Ratio 66.67
Simple Prob of OOS % 33.33
Q Optimal Simple Each 2,064.61
Profit Simple $ 29,590.95
MORMAL CR w/ Backlog Ratio 63.49
Prob OOS w/Backlog % 36.51
Q Optimal w/Backlog Each 2,051.74
Profit Normal Explicit $ 28,223.85
POISSON CR w/ Backlog Ratio 63.49
Prob OOS w/Backlog % 36.51
Q Optimal w/Backlog Each 2,015.00
Profit Poisson Explicit $ 29,469.79

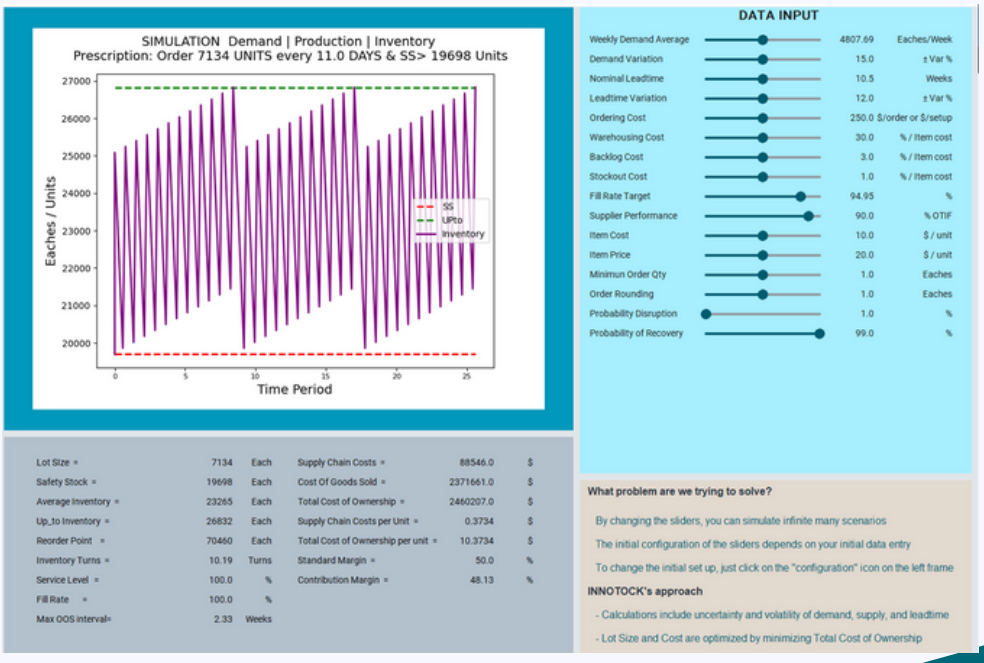
INNOTOCK AI

INNOTOCK AI SIMULATOR

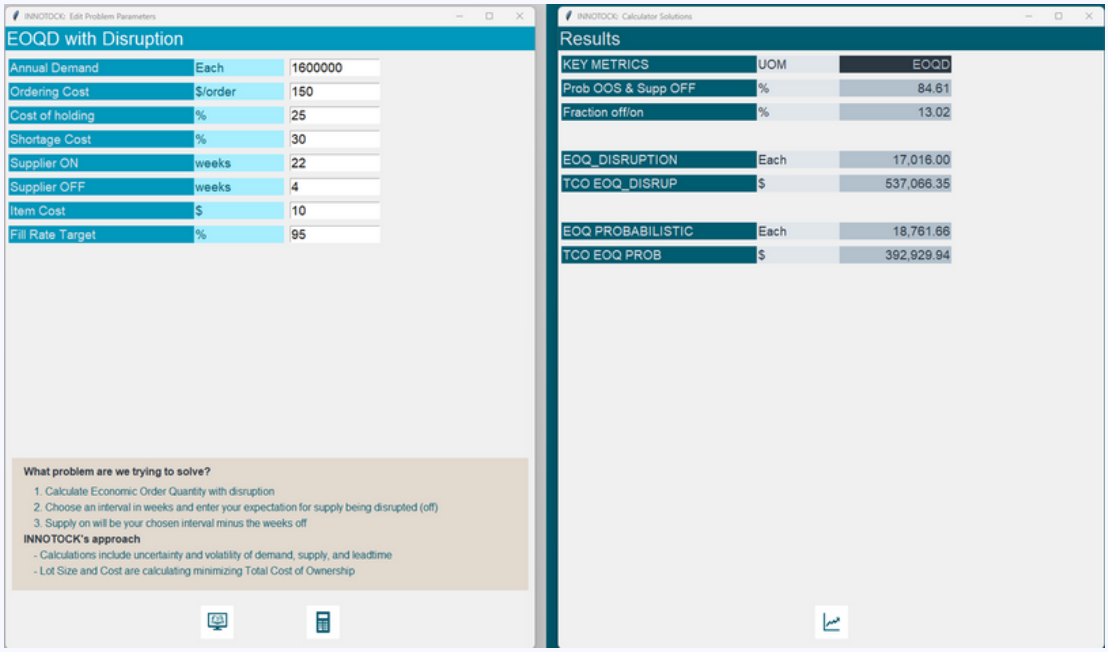
The execution of INNOTOCK AI Simulator option will run the following input screen to configure the simulator engine:



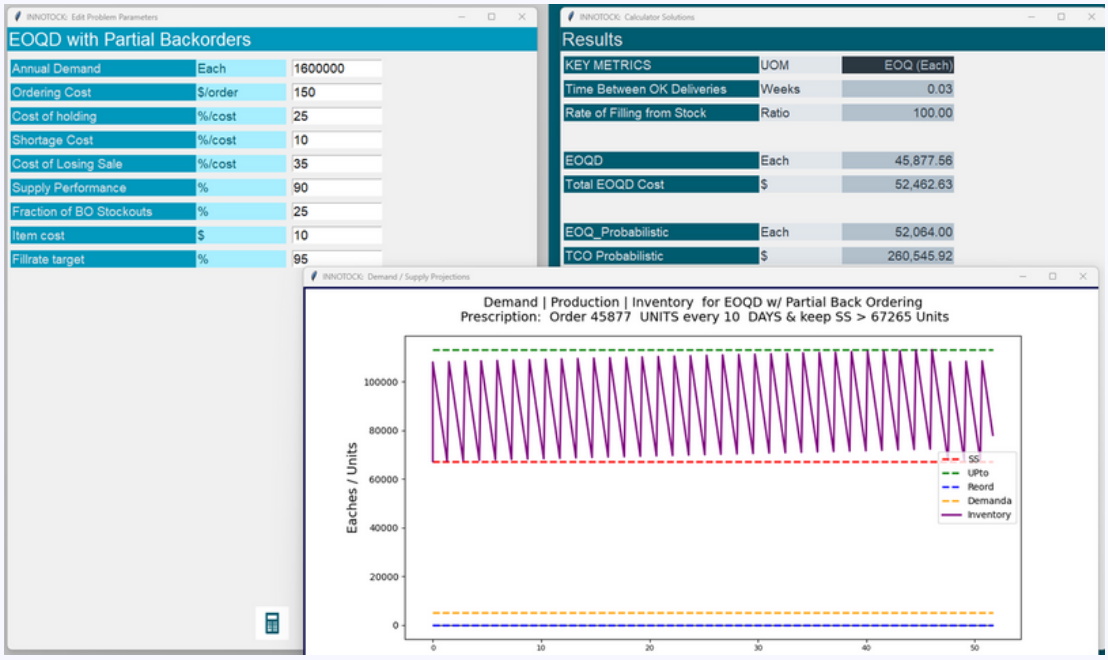
Once the calculator icon is clicked, the Simulator will kick off:



The Simulator also allows to compute economic order quantities in Supply Chain with disruptions:

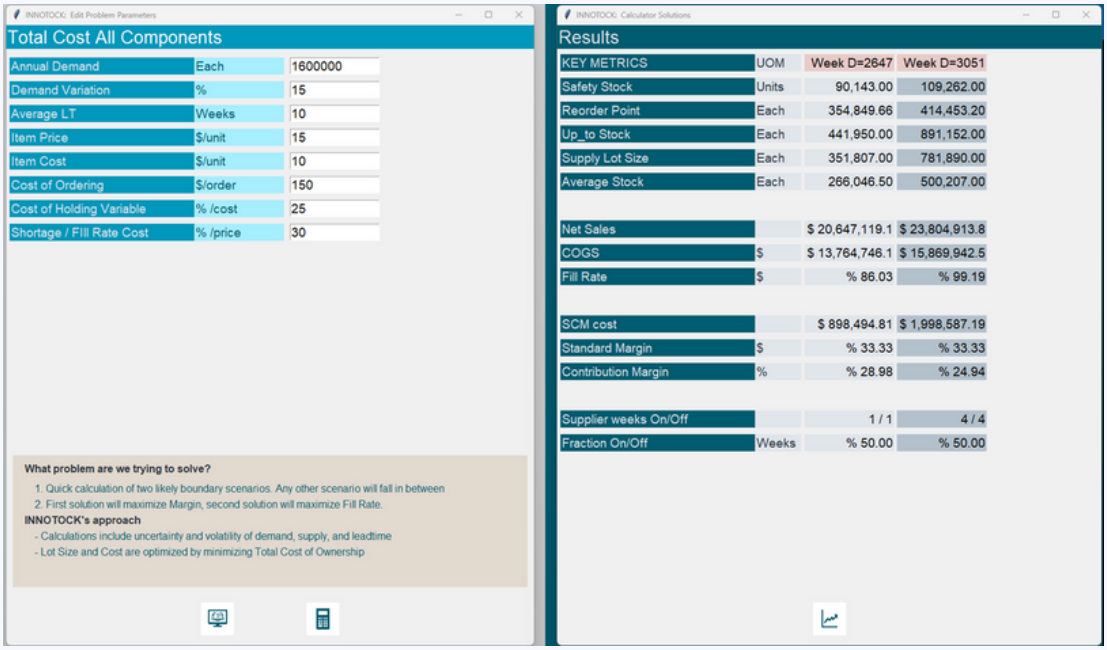


Where Supplier ON/OFF are projected weeks of supplier being able to process and ship order or not. Choose an interval in weeks and enter your expectation for supply being disrupted (off), Supply on will be your chosen interval minus the weeks off.

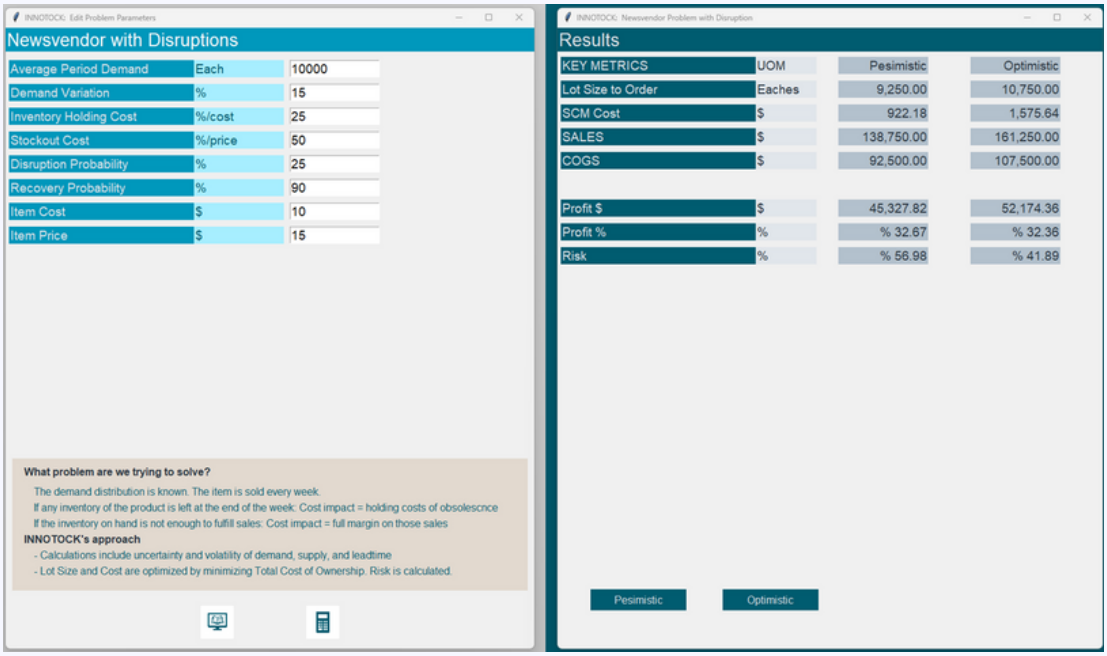


In this case, you must decide what percentage of the customers for the item will accept that you backorder their orders:

INNOTOCK AI



In this case, two different optimizations take place, first one will maximize margins, second one will maximize fill rate. Very useful to know the boundaries of your potential supply chain decisions.



"Newsvendor" problem, with a certain probability of disruption and a different probability of recovery. This is useful when deciding how much to buy for a new product based on prior knowledge of the market and similar products.

INNOTOCK AI

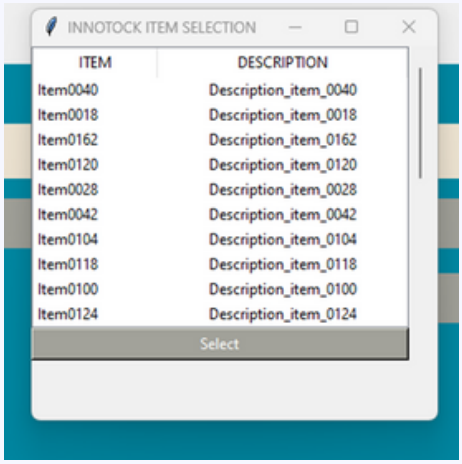
INNOTOCK AI OPTIMIZER

INNOTOCK AI assumes that you have "Open Project" and "Open Dataset". You will know decide to run:

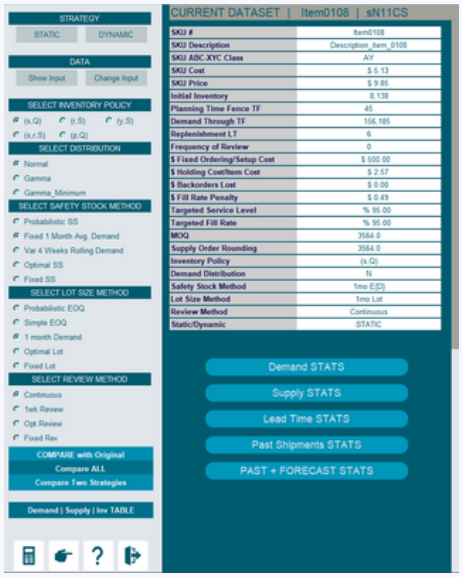
- Single item and "Select an Item"
- Multi-item and "Run All Items (batch)"

If you are running single item, the flow will be as follows:

SELECT ITEM	**Choose the item from the dataset you want to work on**



RUN INNOTOCK	**Access INNOTOCK AI engine console. All data for the selected item has been loaded and the engine is ready to process calculations**



Notes:

- INNOTOCK AI Optimizer will generate working files that will be stored in the project_directory (the one chosen with the"OPEN PROJECT" option)

- These files contain three types of information:
  - Input data
  - Working data
  - Results data

- Please familiarize with these files as you will need the results to update your ERP masterdata fields for (potentially depending on your selected strategy):
  - Safety Stock
  - Review Period
  - Reorder Point
  - Lot Size
  - Up-to Total inventory

- Examples of these files are shown in the following pages:

Example of file [_TEMP_matriz_item]:

SKU #	Item0104	Item0104	Item0104	Item0104	Item0104	Item0104	Item0104
SKU Description	Description_Item_0104	Description_Item_0104	Description_Item_0104	Description_Item_0104	Description_Item_0104	Description_Item_0104	Description_Item_0104
SKU ABC-XYC Class	AY	AY	AY	AY	AY	AY	AY
SKU Cost	10.888	10.888	10.888	10.888	10.888	10.888	10.888
SKU Price	18.76752	18.76752	18.76752	18.76752	18.76752	18.76752	18.76752
STRATEGY	pN11CD	pN11CS	pN1ECD	pN1ECS	pN1PCD	pN1PCS	pN41CD
Initial Inventory	565	565	565	565	565	565	565
Demand Through TF	13035	13054	13054	13035	13035	13035	13035
Average Demand TF	292	288	288	292	292	292	292
Average Std Dev TF	128.3176614	132.9115288	132.9115288	128.3176614	128.3176614	128.3176614	128.3176614
Nominal LT	6	6	6	6	6	6	6
LTAI	6	5	5	6	6	6	6
Expected LT	7	6	6	7	7	7	7
Expected LT stdev	1.48	1.65	1.55	1.56	1.59	1.43	1.32
Frequency of Review	0	0	0	0	0	0	0
$ Fixed Ordering/Setup Cost	500	500	500	500	500	500	500
% Holding Cost/Item Cost	5.444	5.444	5.444	5.444	5.444	5.444	5.444
% Backorders Lost	0.38108	0.38108	0.38108	0.38108	0.38108	0.38108	0.38108
% Fill Rate Penalty	0.5444	0.5444	0.5444	0.5444	0.5444	0.5444	0.5444
Targeted Service Level	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Targeted Fill Rate	0.95	0.95	0.95	0.95	0.95	0.95	0.95
MOQ	1800	1800	1800	1800	1800	1800	1800
Supply Order Rounding	100	100	100	100	100	100	100
Inventory Policy	(p,Q)	(p,Q)	(p,Q)	(p,Q)	(p,Q)	(p,Q)	(p,Q)
Demand Distribution	N	N	N	N	N	N	N
Safety Stock Method	1mo E(D)	1mo E(D)	1mo E(D)	1mo E(D)	1mo E(D)	1mo E(D)	4wk Roll
Lot Size Method	1mo Lot	1mo Lot	EOQ Simple	EOQ Simple	Prob EOQ	Prob EOQ	1mo Lot
Review Method	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
Static/Dynamic	DYNAMIC	STATIC	DYNAMIC	STATIC	DYNAMIC	STATIC	DYNAMIC
EOQ	1800	1800	1800	1800	1800	1800	1800
Sourced / MFG	MFG	MFG	MFG	MFG	MFG	MFG	MFG
Safety Stock	292	288	288	292	292	292	986.3272254
Demand Average	292	288	288	292	292	292	292
Min Demand	0	0	0	0	0	0	0
Demand a TF Cycle	13035	13054	13054	13035	13035	13035	13035
LT Avg Adjusted	7	6	6	7	7	7	7
Review Period	0	0	0	0	0	0	0
Planning TF	45	46	46	45	45	45	45
Annual Demand	14306	14306	14306	14306	14306	14306	14306
Total Units Sold TF	13035	13054	13054	13035	13035	13035	13035
Total Units Supply	15918	15720	15720	14118	15218	14118	19518
Inventory Turns	5.12	5.35	4.63	5.66	4.89	5.66	2.06
Average Inventory	2546	2440	2820	2301	2666	2301	6331
COGS	164002.3147	160670.9	160670.9	164002.3147	164002.3147	164002.3147	164002.3147
Reorder Reference	1239	1181	1429	1061	1296	1062	4932
Max Stock Reference	2047	2036	2085	2012	2234	2012	2786
Lot Size Reference	1326	1429	1429	1326	1383	1326	1421
Actual Fill Rate Average	100	100	100	100	100	100	100
Actual Service Level Average	100	100	100	100	100	100	100
Total Ordering Cost	8653	8120	8120	7853	8036.333333	7853	10253
Total Holding Cost	16139.20158	15238.40674	17553.86691	14563.2968	16615.12872	14564.87424	38280.08538
Total Penalty Cost	3	4	4	3	3	3	0
Total Backorder Cost	2	3	2	2	2	2	0
Total Policy Cost	28654.54222	26413.07217	28808.3313	25909.05778	28491.90983	25910.872	56082.68178

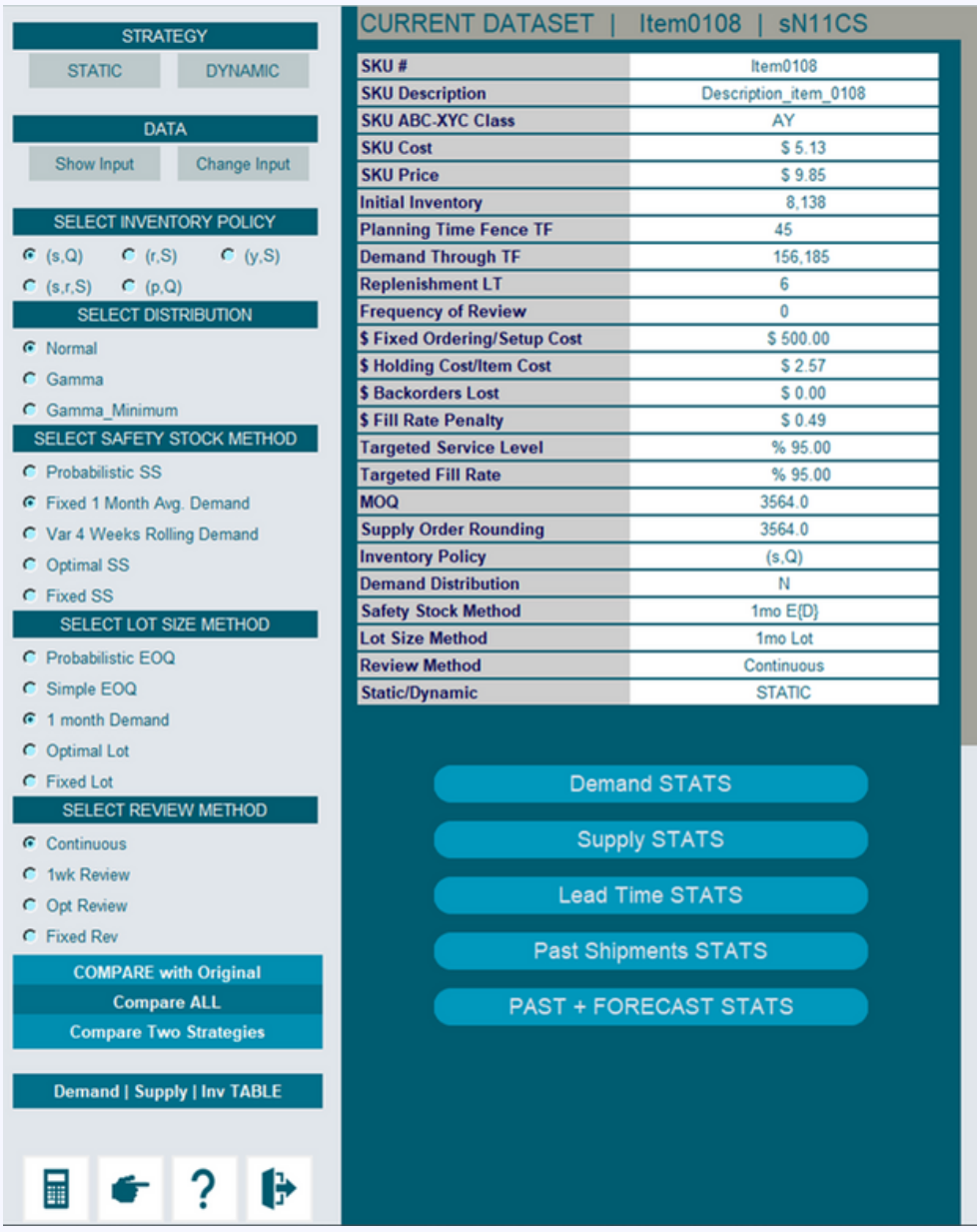
INNOTOCK AI

For "Advanced Subscriptions" the final optimal strategy for every product from "Batch Processing" is saved in the "_INNOTOCK_OPTIMAL_PFEP" file:

SKU #	Item0200	Item0118	Item0108	Item0060	Item0124	Item0152	Item0196
SKU Description	Description_item_0200	Description_item_0118	Description_item_0108	Description_item_0060	Description_item_0124	Description_item_0152	Description_item_0196
SKU ABC-XYC Class	AZ	AZ	AZ	AZ	AZ	AZ	AZ
SKU Cost	21.228	6.721	5.13	10.068	5.544	17.163	5.296
SKU Price	30.6578	10.80451	9.8489	15.99452	10.53776	26.88635	9.46736
STRATEGY	pN1ECS	sNVPCS	pN11CD	pN11CS	pN1ECS	pN1PCS	pN1ECD
Initial Inventory	122	0	42539	3717	0	889	27528
Demand Through TF	14844	60358	156185	47899	45385	18322	115432
Average Demand TF	343	1316	3425	1064	1323	404	2606
Average Std Dev TF	314.9306627	678.8719418	3244.477694	1241.720995	838.4831737	521.2517905	2202.166789
Nominal LT	8	6	6	6	14	6	8
LTAi	7	5	6	5	14	5	7
Expected LT	8	6	7	6	17	6	8
Expected LT stdev	2.02	1.4	1.46	1.61	3.79	1.6	2.18
Frequency of Review	0	0	0	0	0	0	0
$ Fixed Ordering/Setup Cost	150	500	500	500	150	500	150
% Holding Cost/Item Cost	8.4912	3.3605	2.565	5.034	2.2176	8.5815	2.1184
% Backorders Lost	0.74298	0.235235	0.17955	0.35238	0.19404	0.600705	0.18536
% Fill Rate Penalty	1.0614	0.33605	0.2565	0.5034	0.2772	0.85815	0.2648
Targeted Service Level	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Targeted Fill Rate	0.9	0.9	0.9	0.9	0.9	0.9	0.9
MOQ	1600	1400	1100	1600	1400	1200	1200
Supply Order Rounding	100	100	100	100	100	100	100
Inventory Policy	(p,Q)	(s,Q)	(p,Q)	(p,Q)	(p,Q)	(p,Q)	(p,Q)
Demand Distribution	N	N	N	N	N	N	N
Safety Stock Method	1mo E{D}	Var SS	1mo E{D}	1mo E{D}	1mo E{D}	1mo E{D}	1mo E{D}
Lot Size Method	EOQ Simple	Prob EOQ	1mo Lot	1mo Lot	EOQ Simple	Prob EOQ	EOQ Simple
Review Method	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous
Static/Dynamic	STATIC	STATIC	DYNAMIC	STATIC	STATIC	STATIC	DYNAMIC
EOQ	1600	4800	1900	1600	1500	1900	1700
Sourced / MFG	SOURCED	MFG	MFG	MFG	SOURCED	MFG	SOURCED
Safety Stock	343	1278	3425	1064	1323	404	2606
Demand Average	343	1316	3425	1064	1323	404	2606
Min Demand	0	0	0	0	0	0	0
Demanda TF Cycle	14844	60358	156185	47899	45385	18322	115432
LT Avg Adjusted	8	6	7	6	17	6	8
Review Period	0	0	0	0	0	0	0
Planning TF	44	46	45	46	35	46	44
Annual Demand	17302.00	68042.00	185358.00	54177.00	69465.00	21791.00	131747.00
Total Units Sold TF	14844.00	58961.00	152100.00	46611.00	44932.00	18322.00	115432.00
Total Units Supply	16919.00	68817.00	131244.00	49761.00	49421.00	22016.00	100337.00
Inventory Turns	4.90	5.64	7.30	8.76	3.02	5.18	6.22
Average Inventory	3032.00	10462.00	20823.00	5318.00	14875.00	3535.00	18559.00
COGS	372400.87	447965.17	901648.80	530489.93	370095.90	355477.08	722478.39
Reorder Reference	1685.00	8132.00	14444.00	4903.00	4834.00	2245.00	12555.00
Max Stock Reference	1937.00	5973.00	4526.00	2580.00	2466.00	2349.00	4213.00
Lot Size Reference	1183.00	4901.00	4332.00	1750.00	2123.00	1708.00	4022.00
Actual Fill Rate Average	100.00	97.69	97.38	97.31	99.00	100.00	100.00
Actual Service Level Average	100.00	97.83	95.56	97.83	97.14	100.00	100.00
Total Ordering Cost	11502.58	21746.50	50793.82	23330.19	55951.07	12004.00	76612.40
Total Holding Cost	30703.58	40876.27	67611.88	37253.03	32994.90	35748.47	48592.12
Total Penalty Cost	0.00	4.00	656.00	95.00	41.00	1.00	85.00
Total Backorder Cost	0.00	3.00	459.00	66.00	29.00	0.00	59.00
Total Policy Cost	49880.00	70798.87	138112.80	68667.37	132252.30	53982.18	148139.16

ENGINE MENU

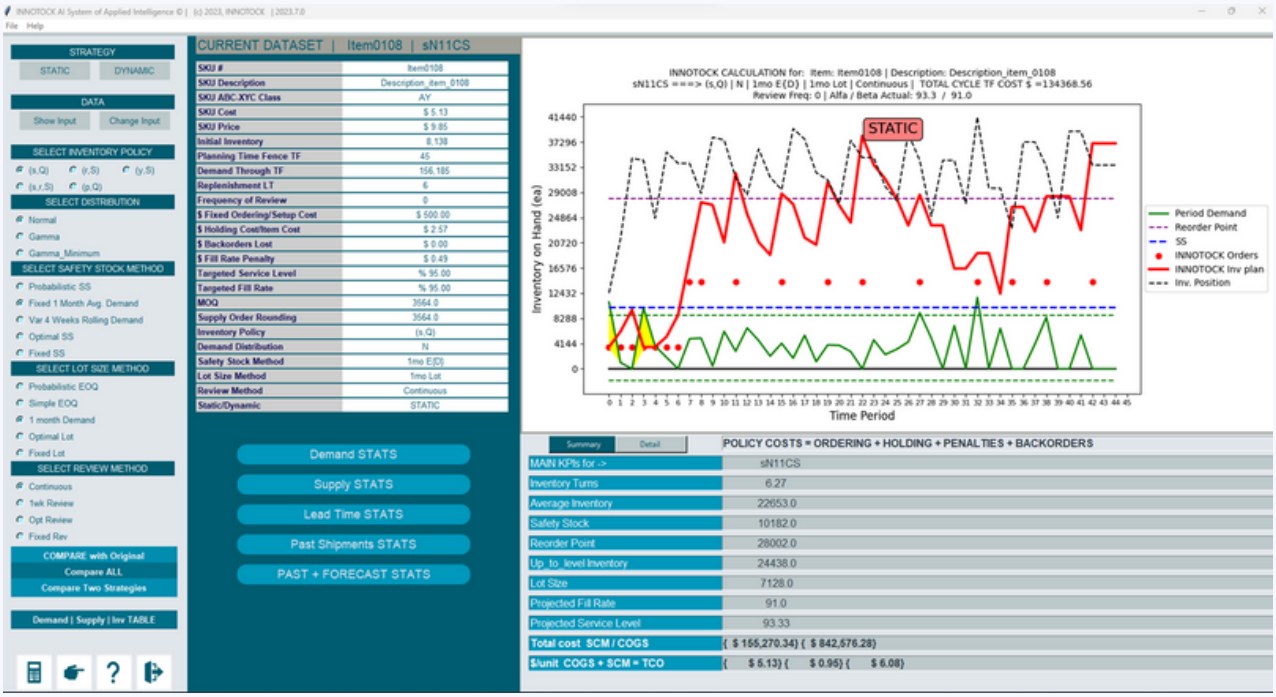
The engine menu appears when we click "RUN INNOTOCK" on the Main menu. Please remember that the options on this menu depend on the subscription level. The menu below shows "Advanced Subscription").



There are different ways to run the engine. INNOTOCK AI assumes that every user will decide the "ways of working".

As an example, this is a typical run of the Engine for Advanced subscription.

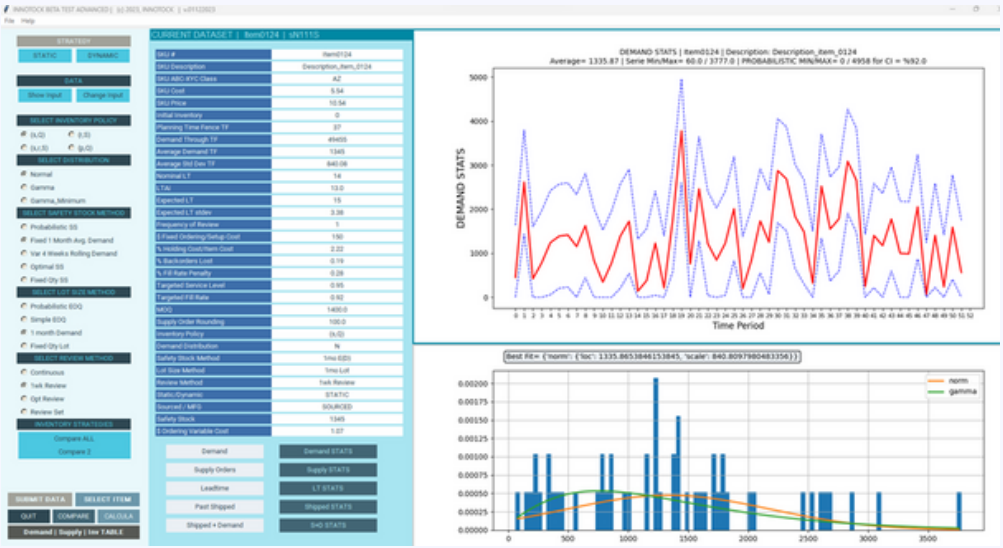
Calculate and understand the engine results with the data uploaded for the item selected.



Analyze all insights. In this case, the company is Planning Item0124 using a (s,Q) policy, which means that the company will order Q units when the Inventory position is at or less than "s". The company usually sets safety stocks equal to 1 month demand, lot size equal to 1 month demand, and runs MRP every week. All calculations from their ERP are static, which means that all supply chain parameters will be set by an average over a period, and possibly a variance of that average. INNOTOCK AI can do these calculations AND adds a possibility of running DYNAMIC calculations that uses supply chain parameters for "cycles" so they can vary dynamically from one cycle to the next.

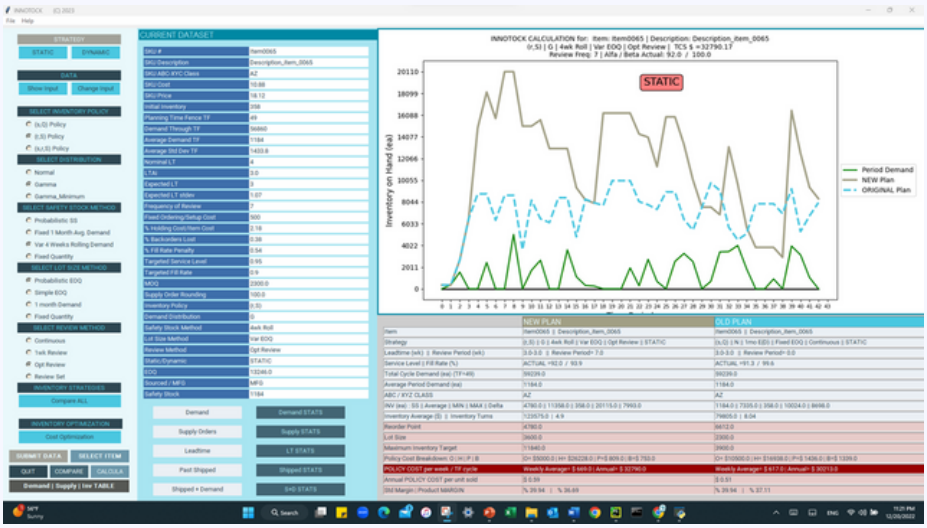
INNOTOCK AI

Understand Parameter Variability (Demand, Lead time, past shipments, etc)	**DEMAND STATS** **LT STATS** **S+D STATS**



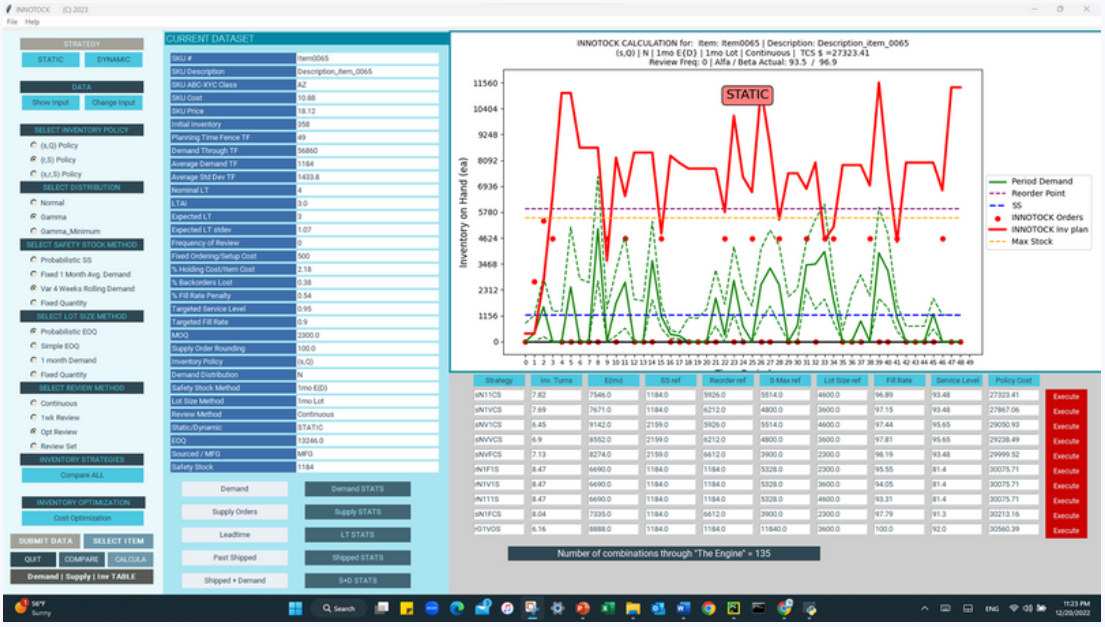
Analyze all insights. In this case the demand is pretty "Normal", statistically speaking.

Or we can compare with original strategy.	**"COMPARE"**



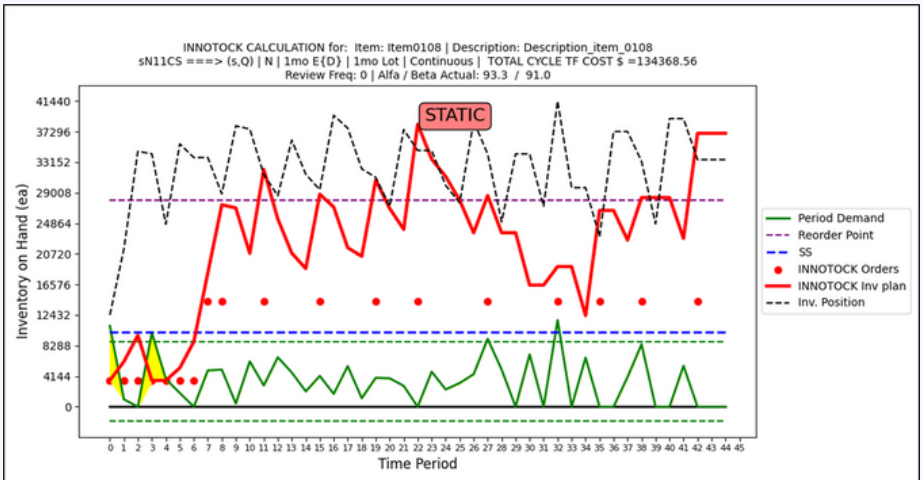
Analyze all insights. In this case, the new strategy is not better. The cost is higher, and the projected Fill rate is lower.

In Advanced Mode we can run a "Compare All" analysis for Static, and Dynamic including new strategies such as (p,Q) where the reorder point is linked to the Safety Stock calculations.	**"COMPARE ALL"**

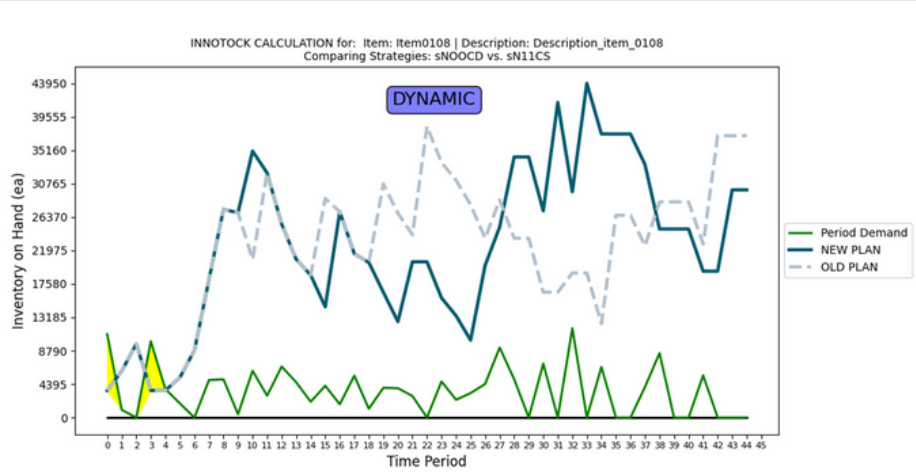


Analyze all insights. INNOTOCK AI Optimizer calculates over 300 potential strategies PER ITEM and shows the results on a table that can be scrolled up and down. The last column to the right gives the opportunity to visualize each one of the policies on the table

INNOTOCK AI



Summary / Detail	POLICY COSTS = ORDERING + HOLDING + PENALTIES + BACKORDERS
Item	Item0108 || Description_item_0108 || sN11CS
Strategy	(s,Q) || N || 1mo E{D} || 1mo Lot || Continuous || STATIC
Leadtime (wk) ▌ Review Period (wk) ▌ Class	5.0 / 7.0 || Review Period= 0.0 CLASS: AY
Service Level ▌ Fill Rate (%)	ACTUAL =93.33 / 91.0
Average Period Demand (ea)	3425.0
Annual DEMAND UNITS	180480.0 || DemandTF DOLLARS = 1777534.0
Annual SHIPPED UNITS	164245.0 || ShippedTF DOLLARS = 1617631.0
INV: Avg ▌ Min ▌ Max ▌ Delta ▌ D_LT	22653.0 || 3564.0 || 38307.0 || 33510.0 || 17820.0
Avg Inv($) ▌ InvTurns ▌ Min WOS ▌ Max WOS	116210.0 | 6.27 | 3.61 | 11.18
TF Policy Cost Breakdown: O | H | P | B	**O$:64275.0 \| H$:89085.0 | P$:1910.0 \| B$:0.0**
TCO: OF|OV|HF|HV| %Freight | %Dist	OF$:10400.0 \| OV$:53875.0 | HF$:30980.0 \| HV$:58105.0 | 3.0 | 5.0
POLICY COST {weekly} ▌ {annual}	**Weekly Average= $ 3450.0 | Annual = $ 155270.0**
ANNUAL UNIT COST: COGS ▌ Policy	**$ FOB Cost = 5.13 ▌ $ SCM cost = 0.95 ▌ $ Unit TCO = 6.08**
% Std Margin ▌ % Contribution Margin	% 47.91 | % 38.31



Summary / Detail	NEW PLAN Annual Savings = 6256.09	OLD PLAN
MAIN KPIs for ->	sNOOCD	sN11CS
Inventory Turns	6.32	6.27
Average Inventory	22495.0	22653.0
Safety Stock	5609.0	10182.0
Reorder Point	23511.0	28002.0
Up_to_level Inventory	18044.0	24438.0
Lot Size	7128.0	7128.0
Projected Fill Rate	91.0	91.0
Projected Service Level	93.33	93.33
Total cost SCM / COGS	{ $ 149,500.94} { $ 842,576.28}	{ $ 155,270.34} { $ 842,576.28}
$/unit COGS + SCM = TCO	{ $ 5.13} { $ 0.91} { $ 6.04}	{ $ 5.13} { $ 0.95} { $ 6.08}

Analyze all insights. The table shows that:

- The TCO cost of the new strategy per item is $6.04 ($5.13 is COGS and $0.91 Supply Chain Cost)
- This cost is lower than the original TCO cost of $6.08.
-

We should always remember that the savings are based on TCO, not just supply chain cost only, which impacts 1:1 the EBITDA.

As we saw earlier, applying the most optimal suggestions for all items, will result in significant EBITDA improvement, as you can see in this example:

Item0100	Description_item_0100	AY	10.58	18.3	sN11CS	171423	8	SOURCED	16104	42	3.93	43647	44486	25610	4000	100.0	100.0	2246326	262372.65
Item0100	Description_item_0100	AY	10.58	18.3	sG1ECS	171423	8	SOURCED	16104	42	5.08	32758	38242	15321	3200	97.02	92.86	2179496	210885.96
Item0108	Description_item_0108	BY	5.13	9.85	sN11CS	156185	6	MFG	14016	44	5.0	31210	32076	21492	3200	100.0	100.0	946907	124694.71
Item0108	Description_item_0108	BY	5.13	9.85	yN4OCD	156185	6	MFG	16386	45	6.93	21962	31262	31262	2900	97.45	95.56	902235	93546.82
Item0042	Description_item_0042	CX	12.74	20.86	sN11CS	22990	8	SOURCED	2192	42	3.01	7788	6563	3875	1000	100.0	100.0	369900	67617.46
Item0042	Description_item_0042	CX	12.74	20.86	yG4PCD	22990	8	SOURCED	2525	42	4.26	5372	4398	6456	1000	97.45	95.24	360578	54554.97
Item0162	Description_item_0162	AX	21.96	35.27	sN11CS	53908	6	MFG	5020	43	6.25	8630	10798	6822	1400	100.0	100.0	1431595	112919.58
Item0162	Description_item_0162	AX	21.96	35.27	pNOPCS	56178	6	MFG	2205	45	12.36	4428	4248	4216	1400	97.42	93.33	1388853	74186.37
Item0118	Description_item_0118	CY	6.72	10.8	sN11CS	57178	6	MFG	5172	44	4.51	12690	11772	8024	1400	100.0	100.0	454164	50754.39
Item0118	Description_item_0118	CY	6.72	10.8	xNO11D	55474	6	MFG	2266	43	6.19	8694	4974	9274	1400	97.05	95.35	437572	41167.42

SUMMARY RESULTS

SUMMARY	$ Demand	$ Shipped	% SM	$ INV	TURNS	$ COGS	$ TCO	% CM
TOTAL ORIGINAL	$ 7,673,520.92	$ 7,683,135.17	41.66	$ 996,090.56	4.5	$ 4,482,448.84	$ 618,358.79	32.27
TOTAL OPTIMAL	$ 7,735,162.95	$ 7,531,151.01	41.63	$ 683,486.27	6.43	$ 4,396,111.14	$ 474,341.54	35.33

IMPACT $SCM Cost / CM $ =	$ 144,017.25	$ -63,267.41	$ 80,749.84

INNOTOCK AI

TECHNICAL INFORMATION

Innotock AI System of Applied Intelligence © runs in the following environment:

- *OS: Windows 10 or posterior*
- *CPU: Intel or AMD processor with 64-bit support; Recommended: 2.8 GHz or faster processor*
- *Disk Storage: 2 GB of free disk space*
- *Monitor Resolution: 1280x800; Recommended: 1920x1080*
- *Internet: Internet connection required for software activation and 'HELP'*

INNOTOCK AI

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