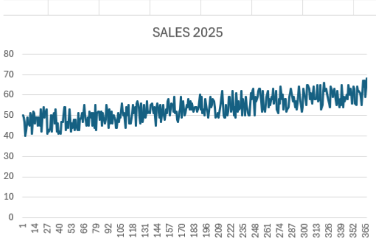
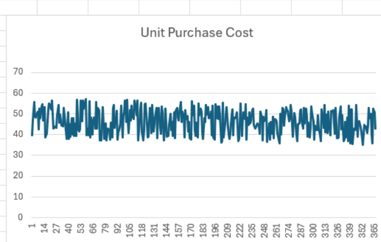
Module 11 – EOQ

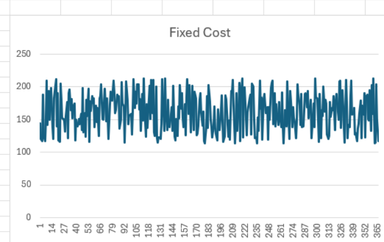
Exploratory Data Analysis
In this section, you should perform some data analysis on the data provided to you. Please format your findings in a visually pleasing way and please be sure to include these cuts:

- *Make line graphs showing the following data over time:*
  - *Sales*
  - *Unit Purchase Cost*
  - *Fixed Order Cost*
- *Use a forecast method to determine annual demand for 2025 to use for our model*
  - *Naïve*
  - *Moving Average / Weighted Moving Average*
  - *Linear Regression*
  - *Exponential Smoothing*
- *For costs, use a similar/different method. Otherwise, a simple overall average is fine.*

2025	
Naïve	19590
Purchase Cost	46.117
Fixed Cost	161.211
Order Quantity	989
Purchasing Cost	903432
Cost or Ordering	3193.25
Inventory Cost	3192.68
Total Cost	909818







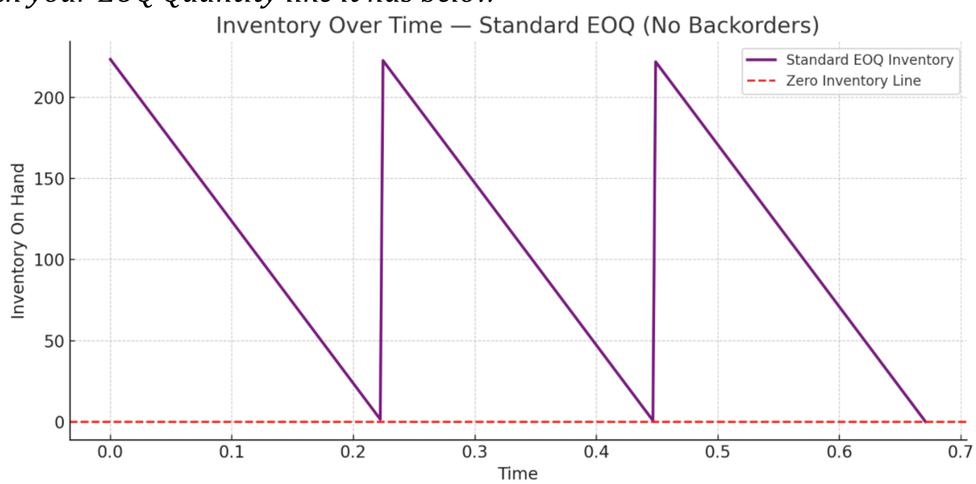
Model Formulation
Write the formulation of the model into here prior to implementing it in your Excel model. Be explicit with the definition of the decision variables, objective function, and constraints. Please restate the variables in the algorithm (i.e. D = Annual Demand)

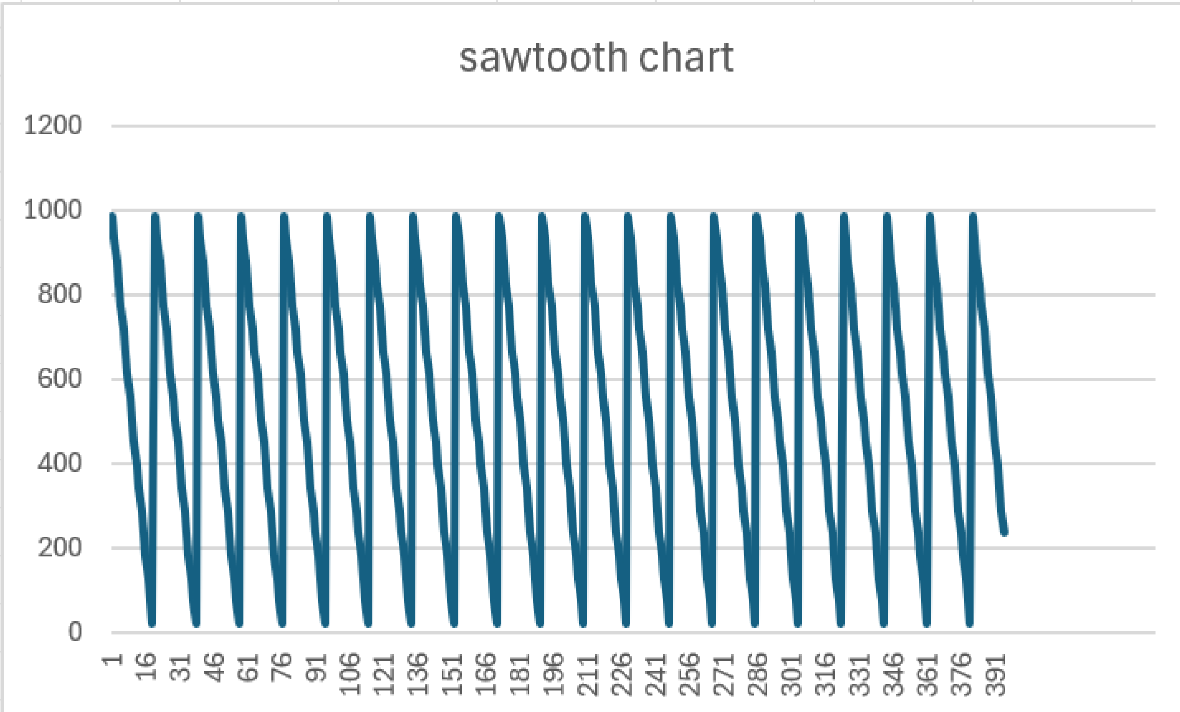
MIN: DC+(D/Q)S+(Q/2)Ci
Subject to: Q>=1
Annual demand: 19590
Purchase Unit:46.117
Cost per Order:161.211
Quantity:989

*MIN: 19590*46.117+(19590/989)161.211+(989)46.117*

Model Optimized for Minimizing Costs with Optimal Order Quantity
Implement your formulation into Excel and be sure to make it neat. This section should include:

- *A screenshot of your optimized final model (formatted nicely, of course)*
- *A text explanation of what your model is recommending*
- *Make a "sawtooth chart" for 2025, see below for reference. Assume you start with year with your EOQ Quantity like it has below*





The sawtooth chart represents an inventory replenishment model that illustrates how stock levels fluctuate over time. In this model, inventory is regularly replenished to a consistent maximum level and then gradually decreases as products are sold or used. Once the inventory reaches a minimum threshold often zero or a predefined reorder point a new order is placed, bringing the inventory back to its peak. This cycle repeats, forming the distinctive "sawtooth" pattern. The model is recommending a fixed ordering strategy based on predictable demand, aiming to maintain sufficient inventory to avoid stockouts while minimizing excess stock. By balancing the timing and quantity of orders, the model supports efficient inventory management, reducing both holding and ordering costs.

Model with Stipulation

Please copy the tab of your original model before continuing with the next part to avoid messing up your original solution.

Implement the below EOQ extension, EOQ with planned backorders. We have added 2 new variables: A = shortage cost & b = planned back orders. Restate the previous variables with these new ones please. Note, you'll need to solve for both Q and b* here to get the optimal solution. You should start Q out as the EOQ from the previous section and b as 0. Also, note that this algorithm does not include `D * C` as it's not relevant to this analysis*

$$\text{Total Relevant Cost} = \frac{D}{Q}S + \frac{(Q-b)^2}{2Q}C_i + \frac{b^2}{2Q}A$$

Lastly, do the following:

- *Explain why you may include planned backorders (i.e. plan to accept purchases when out-of-stock such that some customers will wait for their purchase). Please think critically prior to doing any searches for why*
- *Make a similar "sawtooth chart" with the results here. Note, it will be very similar as before, but inventory will go below 0 before replenishing*

holding_cost_rate	shortage_c
0.14	20

2025	
Naïve	19590
Purchase Cost	46.117
Fixed Cost	161.211
Order Quantity	1138
COST OF PLANNED BACK ORDERS	677.735
Cost or Ordering	2775.16
Inventory Cost	2099.43
Total Cost	5552.32
A	20
B	277.716

Rather than always keeping enough inventory on hand to meet every possible purchase instantly, which can lead to high holding costs, a business may intentionally allow a small portion of orders to be temporarily delayed. This approach makes sense when the cost of a short wait for the customer (the shortage cost) is lower than the cost of storing excess inventory. If customers are generally willing to wait, and the business can reliably fulfill those back-orders in a timely manner, it becomes a cost-effective trade-off. As reflected in the model, planned backorders help minimize total costs by balancing ordering, holding, and shortage costs more efficiently than a zero-backorder strategy.