

Replenishment Policy Summary

Variable definitions (used below)

- ROP = reorder point
- Lead time (L): time between placing an order and receiving it
- Review period / order cycle (R): how often orders are placed
- Forecast_L: forecasted demand over the lead time window
- Forecast_R: forecasted demand over the review period (cycle stock)
- Inventory position: on-hand + on-order
- Safety stock: buffer stock added to protect against uncertainty

Mean forecast + safety stock (sigma as service level probability)

- Base-stock target = $\text{Forecast_L} + \text{SafetyStock}$
- $\text{SafetyStock} = Z(\text{sigma}) * \text{RMSE} * \text{sqrt}(L)$
- Sigma is the cycle service level (probability of no stockout during lead time)
- ROP variant (used in notebooks):
 $\text{ROP} = \text{Forecast_L} + \text{SafetyStock}$
 $\text{Order-up-to} = \text{ROP} + \text{Forecast_R}$
Order if inventory position \leq ROP

Percentile optimization

- Choose percentile pX that minimizes total cost
- Base-stock target = Forecast_L at pX
- ROP variant (used in notebooks):
 $\text{ROP} = \text{Forecast_L at pX}$
 $\text{Order-up-to} = \text{ROP} + \text{Forecast_R}$
Order if inventory position \leq ROP

Fill rate optimization

- Sigma is target fill rate (fraction of demand served)
- SafetyStock uses inverse normal loss to hit fill rate
- ROP variant not emphasized here (base-stock recommended)

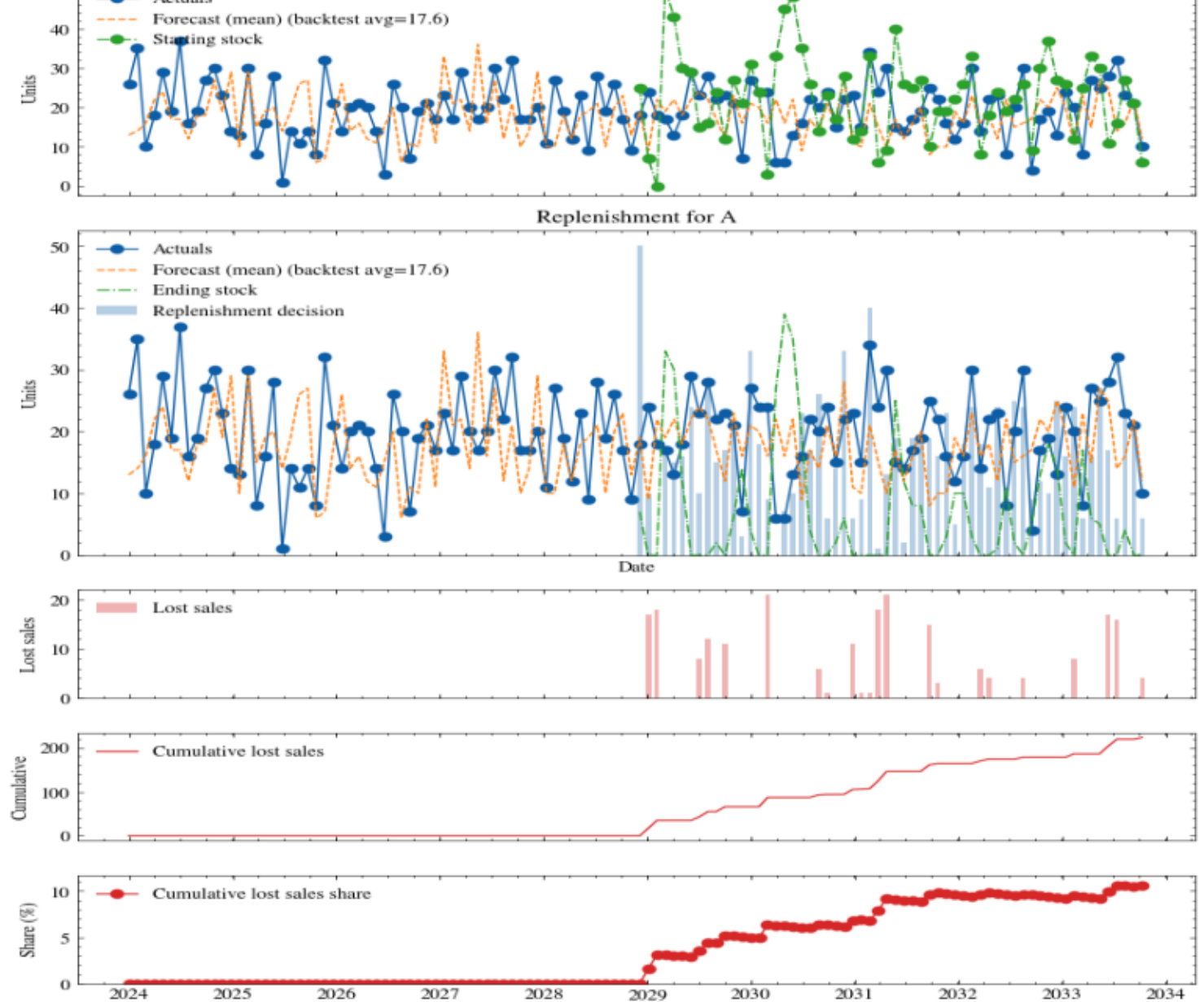
Simulation + optimization

- Backtest: grid-search sigma/percentile/window to minimize total cost
- Costs = holding + stockout + ordering
- Evaluation: apply chosen params to forecast period with actuals

Pros / cons

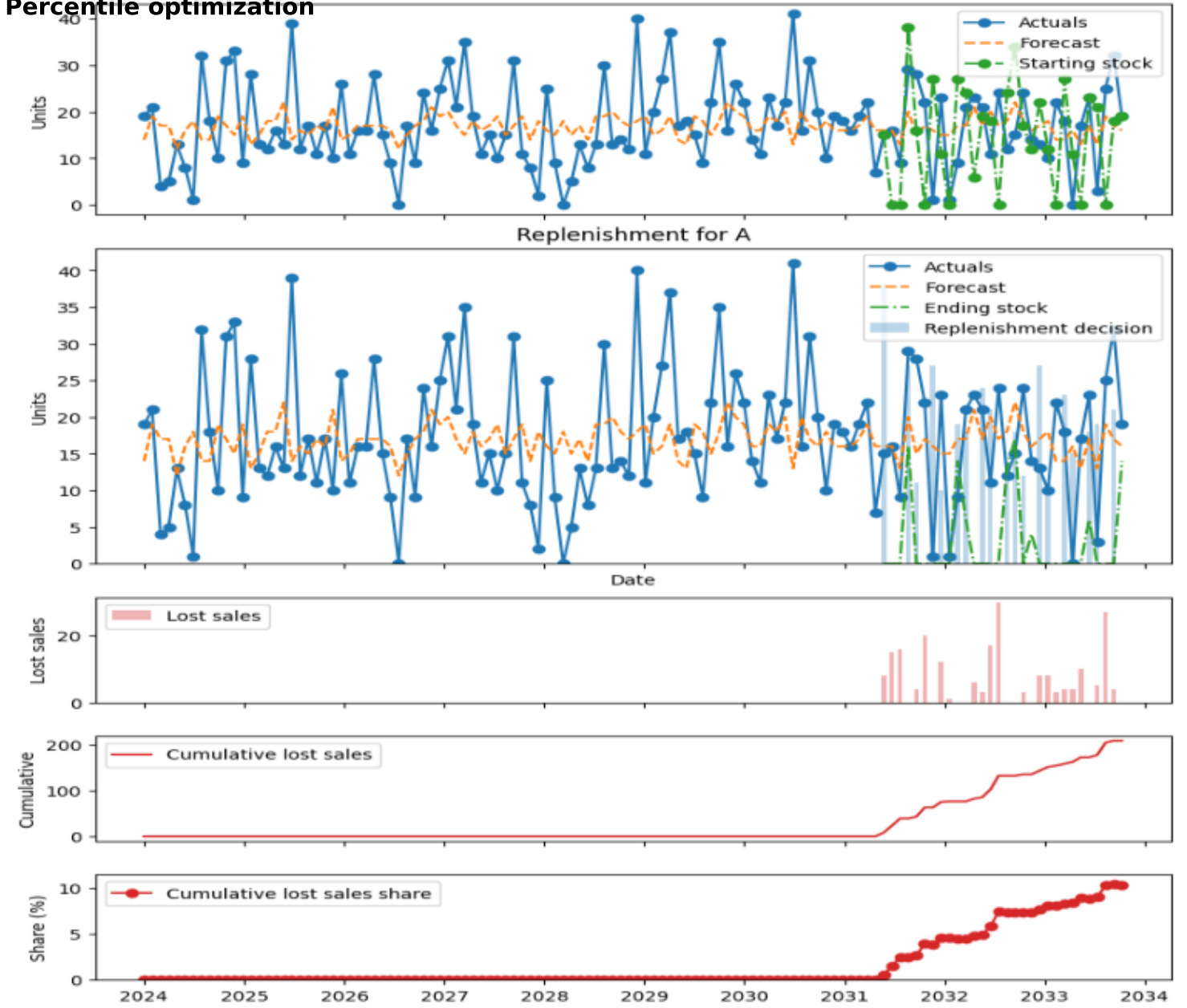
- Mean+SS: easy to use, but sigma does not map directly to missed-sales share
- Percentile: intuitive and robust, but hard to target a specific service level
- Fill rate: best for hitting missed-sales share, but relies on distribution assumptions

Mean forecast + safety stock (service level probability)



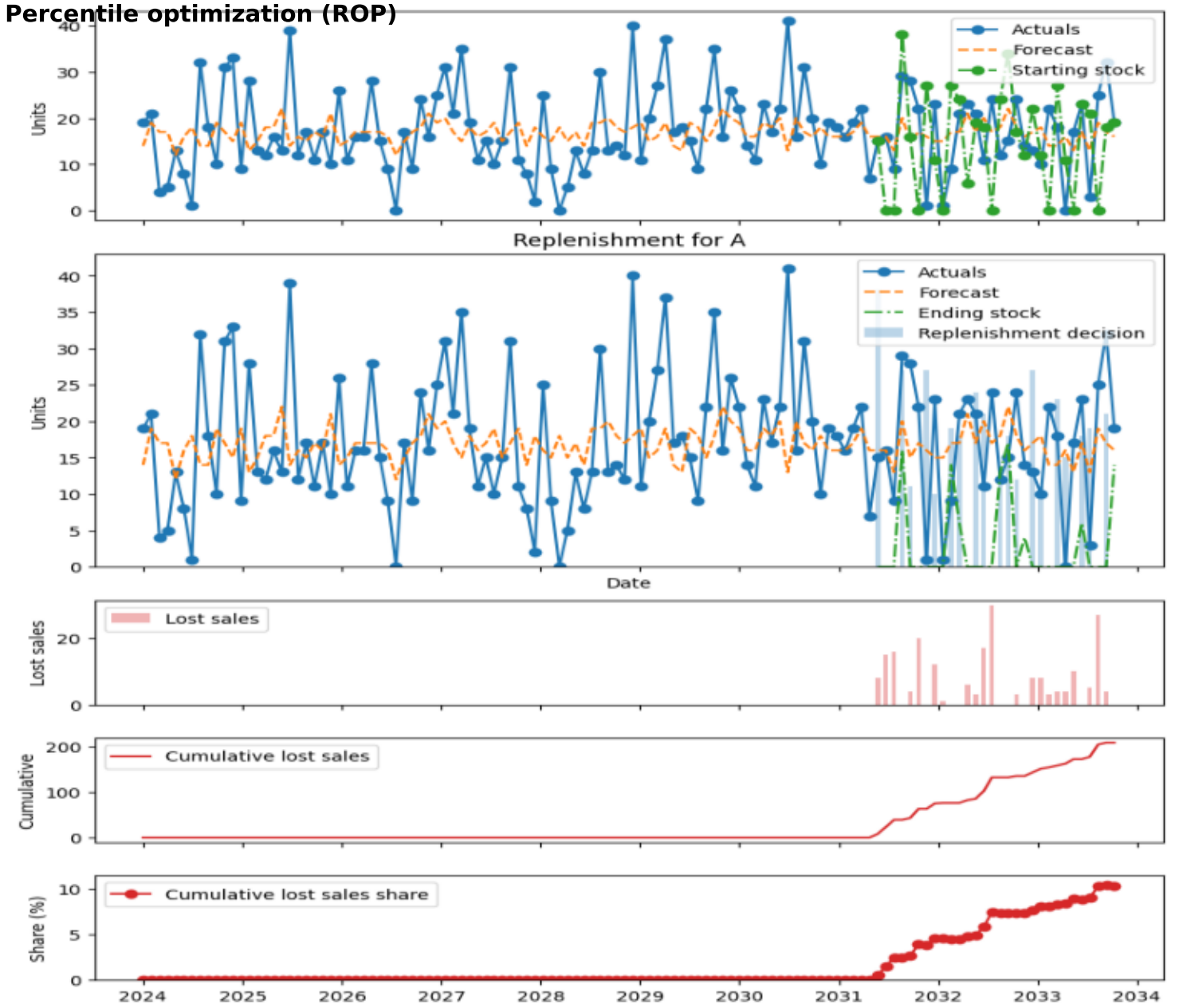
Params: history_mean=20.0; history_std=8.0; forecast_mean=18.0; forecast_std=6.0; lead_time=3; initial_on_hand=25; current_stock=25; holding_cost=1; stockout_cost=5; order_cost=10; candidate_windows=[3,6,9]; candidate_service_levels=[.1,.12,.14,.16,.18,.2,.22,.24,.26,.28,.3,.32,.34,.36,.38,.4,.42,.5,.6,.62,.64,.66,.68,.7,.72,.74,.76,.78,.8,.82,.84,.86,.88,.9,.92,.94,.96,.99]; candidate_factors=[.95]

Percentile optimization



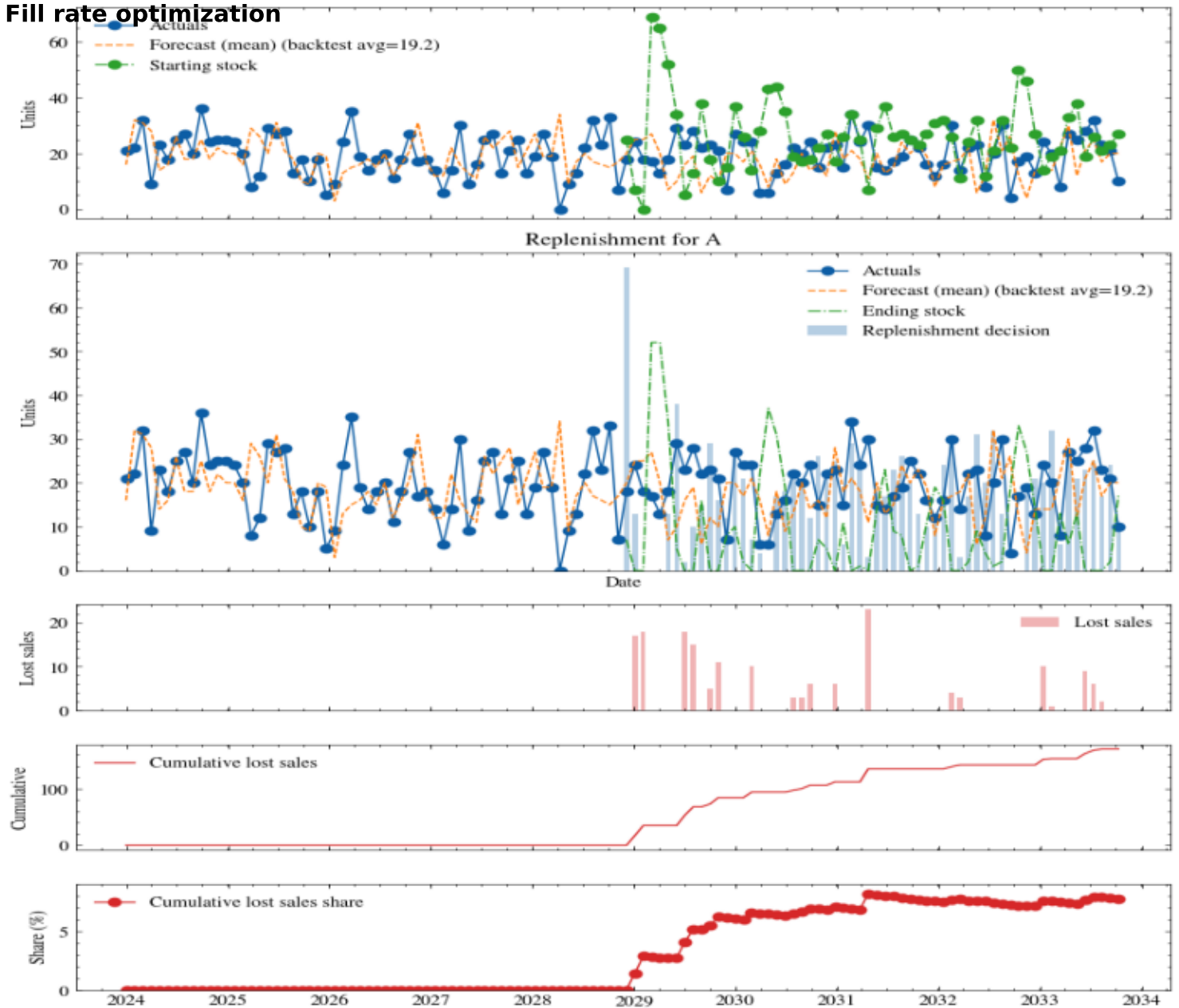
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Percentile optimization (ROP)



Params: history_mean=18; history_std=10; forecast_mean=17; forecast_std=2; lead_time=3; initial_on_hand=15; current_stock=15; holding_cost=5; stockout_cost=1; order_cost=10; candidate_windows=[7,8,9,10]; percentiles=p10,p15,p20,p25,p30,p35,p40,p45,p50,p55,p60,p65,p70,p75,p80,p85,p90; aggregation_window=1

Fill rate optimization



Params: history_mean=20.0; history_std=8.0; forecast_mean=18.0; forecast_std=6.0; lead_time=3; initial_on_hand=25; current_stock=25; holding_cost=1; stockout_cost=5; order_cost=10; candidate_windows=[3,6,9]; candidate_service_levels=[.1,.12,.14,.16,.18,.2,.22,.24,.26,.28,.3,.32,.34,.36,.38,.4,.42,.5,.6,.62,.64,.66,.68,.7,.72,.74,.76,.78,.8,.82,.84,.86,.88,.9,.92,.94,.96,.99]; candidate_factors=[.95]