

## ORIGINAL RESEARCH ARTICLE

## Inventory valuation under periodic and perpetual systems: A worked-example framework with pedagogical synthesis for supply chain education

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## Abstract

Inventory valuation choices ripple through the income statement, the balance sheet, and the tax bill, yet most teaching treatments collapse the topic into a single worked example under rising prices and leave students unable to reason about how the choice would change if conditions did. This paper offers two contributions. First, we formalize the six combinations of inventory system (periodic, perpetual) and cost flow assumption (first-in, first-out [FIFO], last-in, first-out [LIFO], weighted average) as a compact mathematical model and apply that model to a single normalized transaction dataset under three price regimes: rising, falling, and stable. The result is a side-by-side comparison of cost of goods sold, ending inventory, and gross profit across all eighteen cases, with the perpetual LIFO worked example completed and the periodic LIFO arithmetic corrected. Second, we synthesize pedagogical evidence on blended learning, visual aids, collaborative learning, classroom technology, and accounting education-specific effectiveness research, showing how instructors could translate that synthesis into concrete classroom materials such as a spreadsheet template or a reproducible Python notebook. The paper positions inventory valuation at the operations-finance interface and points to current data-driven inventory work as the bridge from accounting mechanics to supply chain decision-making.

**Keywords:** Inventory valuation; First-in, first-out; Last-in, first-out; Accounting education; Supply chain education

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## 1. Introduction

## 1.1. Background

Inventory sits at the operational core of every product-handling firm and at the accounting core of every set of financial statements that firm produces. In the United States, business inventories were valued at roughly USD 2.6 trillion at the end of 2023<sup>1</sup>, and the cost of moving and holding that inventory represented close to 8% of gross domestic product.<sup>2</sup> The choice of inventory valuation method is therefore not merely a clerical decision. It affects the cost of goods sold, gross profit, tax liabilities, free cash flow, and ultimately the amount of capital available for subsequent purchase orders. The choice also changes how operations and finance communicate, because the unit cost

from the accounting ledger is the same one that anchors safety-stock and reorder-point calculations downstream.<sup>3</sup>

Three forces have made this old topic newly urgent. Pandemic-era and post-pandemic price volatility pushed many input costs through annual swings of fifteen to thirty percent, magnifying the gap between what first-in, first-out (FIFO) and last-in, first-out (LIFO) report on the same physical flow. The continuing divergence between U.S. Generally Accepted Accounting Principles (GAAP), which permits LIFO, and International Financial Reporting Standards (IFRS), which does not<sup>4,5</sup>, means that multinational firms must reconcile valuations across the two reporting regimes for the same warehouse. And the rise of data-driven inventory policy, in which order quantities are set by machine-learning models trained on demand features<sup>6,7</sup>, has made the cost flow assumption a live input to operational models rather than a back-office afterthought.

The teaching task has not kept pace. Standard accounting textbooks present a single rising-price example, work through three or four method permutations, and stop. Students leave the topic with mechanical familiarity but no framework for the question their employer will actually ask, namely, how would these numbers look under different price conditions, under a different system, and under the constraints of the firm's reporting jurisdiction. The accounting education literature has repeatedly flagged this gap<sup>8,9</sup>, but the worked-example tradition that dominates textbooks has been slow to adopt the recommendation.

## 1.2. Research gap and contribution

Two gaps motivate this paper. The first is technical. Published worked examples rarely cover all six system-by-method combinations on the same dataset, rarely treat falling and stable price regimes alongside rising prices, and sometimes contain quiet arithmetic errors that propagate into class notes (the periodic LIFO presentation we examine below is a case in point). The second gap is pedagogical. Reviews of inventory valuation are not connected to either the operations-finance interface literature or to the empirical research on what actually works in accounting classrooms, so instructors are left to assemble the pieces themselves.

This paper presents a single normalized transaction dataset evaluated across all six method-system combinations and three price regimes, along with a compact mathematical model that makes the cost flow logic explicit. It also provides a framework that could support the development of reproducible classroom artifacts, such as a spreadsheet template or a Python notebook, without claiming that those artifacts are distributed with the

paper. We make no causal claim about learning outcomes; the pedagogical component is a structured narrative synthesis of prior empirical work, not a primary classroom experiment.

## 1.3. Scope

The paper serves as both a methodological tutorial and a reference resource for instructors and graduate students in supply chain and accounting programs, complemented by a narrative synthesis of pedagogical evidence. It is not a primary empirical study, and the claims for validity, reliability, and generalization are calibrated accordingly in Section 3.6. The U.S. accounting context (GAAP) is treated as the default; the IFRS divergence is addressed where the comparison matters.

## 2. Literature review

### 2.1. Inventory valuation in financial accounting

Three cost flow assumptions dominate practice. FIFO assumes the earliest units bought are the first ones expensed, so the cost of goods sold reflects older purchase prices and ending inventory reflects the newest ones.<sup>10</sup> LIFO does the opposite: the most recent purchases hit cost of goods sold first, with the oldest layers persisting on the balance sheet. The weighted-average method ignores the order in which units were bought and applies a single average cost across the entire pool.<sup>11</sup> FIFO is the only one of the three permitted under both U.S. GAAP and IFRS; LIFO remains acceptable under U.S. GAAP, often for the tax shield it produces during inflation, but is prohibited in International Accounting Standard 2.<sup>4,5</sup> The weighted-average method is universally accepted and is the default in many ERP implementations.

Two reporting systems sit underneath those three assumptions. The periodic system records purchases as they happen but defers the cost-of-goods-sold calculation until the end of the accounting period, when the cost flow assumption is applied to the aggregate units sold.<sup>12</sup> The perpetual system updates inventory after every transaction, applying the cost flow assumption sale by sale. For FIFO, the two systems produce identical totals; for LIFO and weighted average, they do not, and the differences matter.

### 2.2. Inventory policy and the operations-finance interface

Inventory valuation lives at the seam between financial accounting and operations. The unit cost recorded in the ledger is the same cost that enters the economic order quantity, the newsvendor critical ratio, and the safety stock under stochastic demand.<sup>2,3</sup> When that unit cost is computed by averaging across heterogeneous purchase

layers, as it is under weighted average, the resulting order quantity is robust to short-term price noise but slow to adapt. Under FIFO, the recorded unit cost lags current replacement cost during inflation, biasing reorder triggers downward unless the operations team explicitly substitutes a market-cost proxy. Under LIFO, the same lag runs the other way and accumulates on the balance sheet as a LIFO reserve.

The data-driven inventory literature has begun to absorb these accounting facts as model inputs rather than as boundary conditions. Bertsimas and Thiele<sup>7</sup> showed that robust optimization can deliver stable order quantities under cost uncertainty, and Ban and Rudin<sup>6</sup> demonstrated that machine-learning newsvendor models incorporating demand features outperform two-step estimate-then-optimize pipelines. Both lines of work treat the unit cost as a parameter that comes from somewhere; that somewhere is the cost flow assumption analyzed in this paper. Cachon and Terwiesch<sup>13</sup> make the operations-finance link explicit in their treatment of cash-to-cash cycles, where the choice of valuation method directly shapes the working-capital number that operations is asked to defend.

## 2.3. Pedagogical frameworks

### 2.3.1. Blended learning

Blended learning combines synchronous in-person instruction with asynchronous online material, giving students both the social structure of a classroom and the flexibility of self-paced study. Garrison and Kanuka<sup>14</sup> framed the format as transformative for higher education because it forces a redesign of how content is sequenced, not just where it is delivered. The meta-analyses by Means *et al.*<sup>15</sup> and Nair and George<sup>16</sup> found small but consistent gains for blended formats over fully face-to-face instruction, with effect sizes that grow when the online component is genuinely interactive rather than a video archive. For inventory valuation specifically, the format lets students rework FIFO and LIFO calculations at their own pace before joining a workshop on how those numbers feed into managerial decisions.

### 2.3.2. Visual aids

Mayer's<sup>17</sup> cognitive theory of multimedia learning argues that working memory has separate channels for verbal and visual information and that pairing the two reduces cognitive load. Larkin and Simon<sup>18</sup> made the stronger claim that a well-chosen diagram can shortcut several steps of inference that prose forces the reader to perform serially. For inventory valuation, the implication is direct: a layered bar chart showing how FIFO and LIFO carve a sale out of different cost vintages teaches the cost flow

assumption more efficiently than three paragraphs of text. The pedagogical risk is decorative graphics that look informative but encode nothing.<sup>19</sup> Clark and Lyons<sup>20</sup> provided a practical filter: every visual should encode a comparison the student is expected to make.

### 2.3.3. Collaborative learning

Collaborative learning treats peer interaction as a primary instructional channel rather than a supplement. Johnson and Johnson<sup>21</sup> summarized five decades of social interdependence research, showing that structured group work tends to outperform individual study in retention, problem-solving, and transfer, provided that the group task involves genuine interdependence and individual accountability. Panitz<sup>22</sup> drew the working distinction between cooperative learning, which is teacher-structured, and collaborative learning, which is student-directed. For inventory valuation, a group exercise in which pairs defend a method choice to a hypothetical chief financial officer under different price assumptions captures both modes.

### 2.3.4. Integrated technology

Classroom technology has moved past the early debates about whether it helps and into more useful questions about what it should be used for. Laurillard<sup>23</sup> frames the design problem as matching the learning task to the tool's affordances. For inventory valuation, the affordance that matters is computation. A spreadsheet model that recomputes all six methods whenever the student changes a purchase price provides immediate, contingent feedback that no static example can match. Adaptive systems and inventory simulations push the same idea further<sup>24,25</sup>, although the empirical evidence on adaptive accounting tutors specifically remains thin.

## 2.4. Accounting education effectiveness

The *Journal of Accounting Education's* serial literature reviews provide the most comprehensive synthesis of what works in the discipline.<sup>8,9</sup> Across roughly three decades of articles, the reviews report consistent gains for case-based and problem-based instruction in financial accounting topics, mixed evidence for computer-assisted instruction in the absence of careful task design<sup>26,27</sup>, and a recurring methodological warning that much of the published evidence relies on single-section pre-post designs without control groups. Marriott<sup>28</sup> documented how spreadsheet-based simulations increased student engagement with cost behavior, and Watson *et al.*<sup>29</sup> called for more rigorous designs specifically in the inventory and cost accounting space. The honest summary is that the pedagogical strategies cited in Section 2.3 are well-supported in education research broadly and reasonably well-supported

in accounting education, but that the accounting-specific evidence on inventory valuation pedagogy remains modest in volume.

## 2.5. Real-world context and complexity

Three complications matter for any real application. First, inventory can become obsolete, and the lower-of-cost-or-market rule under U.S. GAAP (or lower-of-cost-or-net-realizable-value under IFRS) requires write-downs that none of the three cost flow assumptions handle on its own.<sup>30</sup> Second, supply chain disruptions can compress or invert the price sequence on which the choice of method depends, so a firm comfortable with LIFO during sustained inflation may find the method producing perverse numbers during a sharp price reversal.<sup>30</sup> Third, multinational reporting forces a reconciliation between LIFO-permitted GAAP statements and LIFO-prohibited IFRS statements, and the LIFO reserve disclosure becomes the bridge.<sup>30</sup>

## 3. Research methods

### 3.1. Approach

The paper combines two components. The quantitative component is a worked-example study: a single normalized transaction dataset is evaluated under all six combinations of inventory system and cost flow assumption, and the calculations are repeated under three price regimes (rising, falling, stable). The qualitative component is a narrative synthesis of pedagogical literature. We do not characterize this as a mixed-methods study in the empirical sense,

because we collect no primary classroom data. The framing is closer to a methodological tutorial paired with a structured review.

### 3.2. Illustrative dataset

The transaction sequence used throughout the paper is constructed by the authors specifically for pedagogical comparability. Five purchase-and-sale events are arranged so that each cost flow assumption produces a different result, and the calculations remain tractable by hand. The unit costs are chosen to span a USD 3 range, which is small enough to keep arithmetic readable and large enough to make the differences between methods visible. The dataset is presented in Table 1; it was used in every subsequent worked example.

### 3.3. Mathematical model

Let the firm record  $n$  transactions indexed by  $t = 1, \dots, n$ , where each transaction is either a purchase or a sale. Denote the quantity at transaction  $t$  by  $q_t$  and the unit cost by  $c_t$  (defined only for purchases). For each cost flow assumption, we track a layered inventory state, written as an ordered list  $L_t$  of (units, unit cost) pairs after transaction  $t$ .

Under a periodic system, the cost of goods sold for the period is computed at period-end. Let  $Q = \sum q_t$  over sales and let the cost layers (in chronological order) be  $(q_1, c_1)$ ,  $(q_2, c_2)$ , ...,  $(q_k, c_k)$  representing beginning inventory and purchases.

**Table 1. Standardized transaction dataset (rising-price regime)**

| Date   | Explanation         | Units | Unit cost (USD) | Total cost (USD) | Unit selling price (USD) |
|--------|---------------------|-------|-----------------|------------------|--------------------------|
| Jan 1  | Beginning inventory | 100   | 10.00           | 1,000            | n/a                      |
| Apr 15 | Purchase            | 200   | 11.00           | 2,200            | n/a                      |
| May 30 | Sale                | (200) | n/a             | n/a              | 20.00                    |
| Aug 14 | Purchase            | 300   | 12.00           | 3,600            | n/a                      |
| Nov 27 | Purchase            | 400   | 13.00           | 5,200            | n/a                      |
| Nov 30 | Sale                | (250) | n/a             | n/a              | 25.00                    |

Notes: Total units available for sale: 1,000 (100 beginning + 900 purchased); Total cost of goods available: USD 12,000; Total units sold: 450; Total sales revenue:  $200 \times \text{USD } 20 + 250 \times \text{USD } 25 = \text{USD } 10,250$ ; Ending units in inventory: 550; n/a: Not applicable.

Periodic FIFO: cost of goods sold consumes layers in chronological order until  $Q$  units are accounted for. Ending inventory is the residual layers, valued at their original unit costs.

Periodic LIFO: the same calculation but in reverse chronological order. The most recent purchase layer is consumed first.

Periodic weighted average: a single weighted-average unit cost is computed as  $\hat{c} = \sum q_i c_i / \sum q_i$  across all purchase and beginning-inventory layers. Cost of goods sold equals  $Q \times \hat{c}$ , and ending inventory equals  $(\sum q_i - Q) \times \hat{c}$ .

Under a perpetual system, the cost of goods sold is updated transaction by transaction. After each purchase, the inventory state  $L_t$  is  $L_{t-1}$  extended by a new layer ( $q_t, c_t$ ). After each sale of size  $q_t$ , the system consumes layers in the order dictated by the cost flow assumption (oldest first for FIFO, newest first for LIFO), or recomputes a running average for the weighted average method. For weighted average specifically, the running unit cost is updated only after each purchase, not after each sale, and that running cost is applied to every subsequent sale until the next purchase. This sequencing is the source of the difference between periodic and perpetual weighted-average results.

Three observations follow directly from the model and are worth highlighting before the worked examples. First, FIFO produces identical totals under both periodic and perpetual systems, regardless of the price path, because the order of consumption is the same. Second, under stable prices ( $c_t$  constant for all  $t$ ), all six method-system combinations produce identical results, providing instructors with a useful sanity check. Third, the difference between FIFO and LIFO is bounded above by  $Q \times |c_{\max} - c_{\min}|$ , which lets students estimate the maximum financial impact of the method choice before doing any arithmetic.

### 3.4. Price scenarios

Three regimes are evaluated using the same transaction structure. The rising-price regime uses the costs in [Table 1](#) (USD 10, 11, 12, and 13, in chronological order). The falling-price regime reverses the sequence (USD 13, 12, 11, and 10), holding the sale prices fixed. The stable-price regime sets the price of every purchase at USD 11.50, the midpoint of the range. The decision to hold sales revenue constant across regimes isolates the effect of the cost flow assumption on cost of goods sold and gross profit; it is artificial in the sense that real markets often co-move purchase and sale prices, but it is the cleanest way to teach the mechanism.

### 3.5. Research questions

Two research questions are examined in the current study. The first research question: How do the three cost flow assumptions (FIFO, LIFO, weighted average) under the two inventory systems (periodic, perpetual) differ in their reported cost of goods sold, ending inventory, and gross profit across rising, falling, and stable price regimes? The second research question: What pedagogical strategies have the strongest evidence base for teaching inventory valuation in supply chain and accounting curricula, and how can those strategies be operationalized in reproducible classroom materials?

### 3.6. Validity, reliability, and limitations

The internal validity of the quantitative component follows from the standardized dataset: every method is applied to the same transactions, so any difference in reported numbers is attributable to the method itself, not to the data.<sup>31,32,33</sup> External validity is intentionally narrow. A worked example, however carefully constructed, is not a representative sample of firm-level inventory data, and we do not claim generalization to specific industries or scales. The findings are statements about how the methods relate to one another under controlled inputs, not predictions about how any particular firm will report. Reliability in the conventional sense (consistency across repeated measurement) is structurally guaranteed: the calculations are deterministic given the inputs.

The pedagogical component is a narrative synthesis, not a meta-analysis. We do not weight studies by sample size or effect, and we draw no causal inference about classroom outcomes. A natural next step would be a controlled classroom trial built on instructional materials developed from the framework outlined in Section 7, comparing students who use the all-six-method framework against students who work through the conventional rising-price-only treatment.

## 4. Periodic inventory system: Worked examples

### 4.1. Periodic first-in, first-out

Under periodic FIFO, the firm waits until the end of the period, sums the units sold (450), and assigns those units to the oldest layers in chronological order. The first 100 units consume the beginning inventory at USD 10 (USD 1,000). The next 200 units consume the April 15 purchase at USD 11 (USD 2,200). The final 150 units consume part of the August 14 purchase at USD 12 (USD 1,800). Cost of goods sold, therefore, equals US 1,000 + USD 2,200 + USD 1,800 = USD 5,000.

Ending inventory is the residual: 150 units of the August 14 purchase (300 minus the 150 consumed) at USD 12, plus the entire November 27 purchase of 400 units at USD 13. That gives  $\text{USD } 1,800 + \text{USD } 5,200 = \text{USD } 7,000$ . Gross profit equals revenue ( $\text{USD } 10,250$ ) minus cost of goods sold ( $\text{USD } 5,000$ ), or  $\text{USD } 5,250$ . [Table 2](#) summarizes these calculations.

## 4.2. Periodic last-in, first-out

Under periodic LIFO, the same 450 units are assigned in reverse chronological order. The first 400 of those units consume the entire November 27 purchase at USD 13 ( $\text{USD } 5,200$ ). The remaining 50 units consume part of the August 14 purchase at USD 12 ( $\text{USD } 600$ ). Cost of goods sold, therefore, equals  $\text{USD } 5,200 + \text{USD } 600 = \text{USD } 5,800$ .

This is the calculation that earlier drafts of this material reported incorrectly as USD 5,650, with 250 units (rather than 400) assigned to the November 27 layer and 200 units (rather than 50) assigned to the August 14 layer. The corrected ending inventory is what remains after the LIFO consumption: the entire beginning inventory of 100 units

at USD 10 ( $\text{USD } 1,000$ ), the entire April 15 purchase of 200 units at USD 11 ( $\text{USD } 2,200$ ), and the residual 250 units of the August 14 purchase at USD 12 ( $\text{USD } 3,000$ ). Ending inventory, therefore, equals  $\text{USD } 1,000 + \text{USD } 2,200 + \text{USD } 3,000 = \text{USD } 6,200$ . No units remain from the November 27 layer under correct periodic LIFO, because all 400 units of that layer were consumed first. Gross profit equals  $\text{USD } 10,250 - \text{USD } 5,800 = \text{USD } 4,450$ . [Table 3](#) summarizes these calculations.

## 4.3. Periodic weighted average

Under the periodic weighted-average method, the firm pools all 1,000 units available for sale at their total cost of USD 12,000, computes the average unit cost as  $\text{USD } 12,000 \div 1,000 = \text{USD } 12.00$ , and applies that average to both cost of goods sold and ending inventory. Cost of goods sold equals  $450 \times \text{USD } 12.00 = \text{USD } 5,400$ . Ending inventory equals  $550 \times \text{USD } 12.00 = \text{USD } 6,600$ . Note that the two sales (200 on May 30 and 250 on November 30) sum to 450 units; both are valued at the same period-end average. The November 27 line in [Table 1](#) is a purchase of 400 units at

**Table 2. Periodic first-in, first-out summary (rising-price regime)**

| Metric             | Calculation                                           | Amount (USD) | Note                         |
|--------------------|-------------------------------------------------------|--------------|------------------------------|
| Cost of goods sold | $(100 \times 10) + (200 \times 11) + (150 \times 12)$ | 5,000        | Oldest layers consumed first |
| Ending inventory   | $(150 \times 12) + (400 \times 13)$                   | 7,000        | Newest layers retained       |
| Sales revenue      | $(200 \times 20) + (250 \times 25)$                   | 10,250       |                              |
| Gross profit       | Revenue – COGS                                        | 5,250        |                              |

Abbreviation: COGS: Cost of goods sold.

**Table 3. Periodic last-in, first-out summary (rising-price regime, corrected)**

| Metric             | Calculation                                           | Amount (USD) | Note                         |
|--------------------|-------------------------------------------------------|--------------|------------------------------|
| Cost of goods sold | $(400 \times 13) + (50 \times 12)$                    | 5,800        | Newest layers consumed first |
| Ending inventory   | $(100 \times 10) + (200 \times 11) + (250 \times 12)$ | 6,200        | Oldest layers retained       |
| Sales revenue      | $(200 \times 20) + (250 \times 25)$                   | 10,250       |                              |
| Gross profit       | Revenue – COGS                                        | 4,450        |                              |

Abbreviation: COGS: Cost of goods sold.

USD 13, not a sale, and is one of the four layers that feed into the average. Gross profit equals USD 10,250 – USD 5,400 = USD 4,850. [Table 4](#) summarizes these calculations.

## 5. Perpetual inventory system: Worked examples

### 5.1. Perpetual first-in, first-out

Under perpetual FIFO, each sale is costed at the time it occurs using the oldest layers available at that moment. The May 30 sale of 200 units consumes the entire beginning inventory of 100 units at USD 10 (USD 1,000) and 100 of the April 15 units at USD 11 (USD 1,100), for a sale-specific cost of USD 2,100. Inventory after that sale holds 100 units at USD 11. The August 14 purchase adds 300 units at USD 12; the November 27 purchase adds 400 units at USD 13. The November 30 sale of 250 units consumes the remaining 100 units at USD 11 (USD 1,100) and 150 units of the August 14 purchase at USD 12 (USD 1,800), for a sale-specific cost of USD 2,900.

Total cost of goods sold is USD 2,100 + USD 2,900 = USD 5,000. Ending inventory holds the residual 150 units of the August 14 purchase at USD 12 (USD 1,800) and the entire November 27 purchase of 400 units at USD 13 (USD 5,200), totaling USD 7,000. As predicted by the mathematical model, perpetual FIFO produces the same totals as periodic FIFO. Gross profit equals USD 10,250 – USD 5,000 = USD 5,250. [Table 5](#) summarizes these calculations.

### 5.2. Perpetual last-in, first-out

Perpetual LIFO consumes the most recent layer available at the time of each sale. The May 30 sale of 200 units consumes the entire April 15 purchase of 200 units at USD 11 (USD 2,200). This is the most recent layer present at the time of the sale; the November 27 layer does not yet exist. Inventory after the May sale holds 100 units of beginning inventory at USD 10. The August 14 purchase then adds 300 units at USD 12, and the November 27 purchase adds 400 units at USD 13. The November 30 sale of 250 units

**Table 4. Periodic weighted-average summary (rising-price regime)**

| Metric             | Calculation             | Amount (USD) | Note                      |
|--------------------|-------------------------|--------------|---------------------------|
| Average unit cost  | USD 12,000 ÷ 1,000      | 12.00        | Single period-end average |
| Cost of goods sold | 450 × 12.00             | 5,400        | All sales at same average |
| Ending inventory   | 550 × 12.00             | 6,600        |                           |
| Sales revenue      | (200 × 20) + (250 × 25) | 10,250       |                           |
| Gross profit       | Revenue – COGS          | 4,850        |                           |

Abbreviation: COGS: Cost of goods sold.

**Table 5. Perpetual FIFO summary (rising-price regime)**

| Metric           | Calculation             | Amount (USD) | Note                 |
|------------------|-------------------------|--------------|----------------------|
| May 30 sale COGS | (100 × 10) + (100 × 11) | 2,100        |                      |
| Nov 30 sale COGS | (100 × 11) + (150 × 12) | 2,900        |                      |
| Total COGS       | Sum of sale-level costs | 5,000        | Equals periodic FIFO |
| Ending inventory | (150 × 12) + (400 × 13) | 7,000        |                      |
| Gross profit     | Revenue – COGS          | 5,250        |                      |

Abbreviations: COGS: Cost of goods sold; FIFO: First-in, first-out.

consumes 250 units of the November 27 purchase at USD 13 (USD 3,250), leaving 150 of that layer intact along with the earlier layers.

Total cost of goods sold is USD 2,200 + USD 3,250 = USD 5,450. Ending inventory holds 100 units of beginning inventory at USD 10 (USD 1,000), the entire August 14 purchase of 300 units at USD 12 (USD 3,600), and the residual 150 units of the November 27 purchase at USD 13 (USD 1,950), totaling USD 6,550. Gross profit equals USD 10,250 – USD 5,450 = USD 4,800. The contrast with periodic LIFO is instructive: perpetual LIFO reports a lower cost of goods sold (USD 5,450 vs USD 5,800) because the May 30 sale was costed before the November 27 purchase, and so could not draw on that more expensive layer. Table 6 below summarizes these calculations.

### 5.3. Perpetual weighted average

The perpetual weighted-average method (sometimes called the moving-average method) recomputes a running average unit cost after each purchase and applies it to each subsequent sale until the next purchase resets it. The arithmetic proceeds step by step:

Step 1 (Jan 1): 100 units at USD 10, running average USD 10.00.

Step 2 (Apr 15): purchase 200 units at USD 11. New totals are 300 units and USD 3,200, so the running average becomes USD  $3,200 \div 300 = \text{USD } 10.6667$ .

Step 3 (May 30): sell 200 units at the running average. Cost of goods sold for this sale equals  $200 \times \text{USD } 10.6667 = \text{USD } 2,133.33$ . Inventory after the sale holds 100 units valued at USD 1,066.67.

Step 4 (Aug 14): purchase 300 units at USD 12. New

totals are 400 units and USD 4,666.67, so the running average becomes USD 11.6667.

Step 5 (Nov 27): purchase 400 units at USD 13. The new totals are 800 units and USD 9,866.67, so the running average becomes USD 12.3333.

Step 6 (Nov 30): sell 250 units at the running average. Cost of goods sold for this sale equals  $250 \times \text{USD } 12.3333 = \text{USD } 3,083.33$ . Inventory after the sale holds 550 units at the same running average, valued at USD 6,783.33.

Total cost of goods sold equals USD 2,133.33 + USD 3,083.33 = USD 5,216.67. Gross profit equals USD 10,250 – USD 5,216.67 = USD 5,033.33. The perpetual weighted-average result is not equal to the periodic weighted-average result (USD 5,400 cost of goods sold, USD 6,600 ending inventory), and the gap is a useful classroom point: under perpetual averaging, the May 30 sale was costed at a lower running average than the period-end average that periodic averaging applies to all sales. Table 7 summarizes these calculations.

## 6. Comparative analysis

### 6.1. Consolidated comparison across all six methods (rising prices)

Table 8 brings the six worked examples into a single view. The pattern under rising prices is the textbook one, but with the magnitudes made concrete: FIFO produces the lowest cost of goods sold and the highest gross profit, LIFO the opposite, and weighted average sits between the two. The perpetual system softens both the FIFO and LIFO extremes, because partial sales early in the period are costed before the most expensive late-period purchases are recorded in inventory.

**Table 6. Perpetual last-in, first-out summary (rising-price regime, complete)**

| Metric           | Calculation                                           | Amount (USD) | Note                          |
|------------------|-------------------------------------------------------|--------------|-------------------------------|
| May 30 sale COGS | $200 \times 11$                                       | 2,200        | The newest layer at that time |
| Nov 30 sale COGS | $250 \times 13$                                       | 3,250        | The newest layer at that time |
| Total COGS       | Sum of sale-level costs                               | 5,450        |                               |
| Ending inventory | $(100 \times 10) + (300 \times 12) + (150 \times 13)$ | 6,550        |                               |
| Gross profit     | Revenue – COGS                                        | 4,800        |                               |

Abbreviation: COGS: Cost of goods sold.

**Table 7. Perpetual weighted-average summary (rising-price regime)**

| Metric           | Calculation             | Amount (USD) | Note                             |
|------------------|-------------------------|--------------|----------------------------------|
| May 30 sale COGS | $200 \times 10.6667$    | 2,133.33     | Running average at the sale time |
| Nov 30 sale COGS | $250 \times 12.3333$    | 3,083.33     | Running average at the sale time |
| Total COGS       | Sum of sale-level costs | 5,216.67     |                                  |
| Ending inventory | $550 \times 12.3333$    | 6,783.33     |                                  |
| Gross profit     | Revenue – COGS          | 5,033.33     |                                  |

Abbreviation: COGS: Cost of goods sold.

**Table 8. Consolidated comparison of all six methods under rising prices**

| Method         | COGS (USD) | Ending inventory (USD) | Gross profit (USD) | Gross margin (%) | Tax effect  |
|----------------|------------|------------------------|--------------------|------------------|-------------|
| Periodic FIFO  | 5,000.00   | 7,000.00               | 5,250.00           | 51.2             | Highest tax |
| Perpetual FIFO | 5,000.00   | 7,000.00               | 5,250.00           | 51.2             | Highest tax |
| Periodic WA    | 5,400.00   | 6,600.00               | 4,850.00           | 47.3             | Middle      |
| Perpetual WA   | 5,216.67   | 6,783.33               | 5,033.33           | 49.1             | Middle      |
| Perpetual LIFO | 5,450.00   | 6,550.00               | 4,800.00           | 46.8             | Reduced     |
| Periodic LIFO  | 5,800.00   | 6,200.00               | 4,450.00           | 43.4             | Lowest tax  |

Notes: Revenue is constant at USD 10,250 across all methods; Gross margin = Gross profit/Revenue; Tax effect is relative within the table; the actual tax outcome depends on the firm's marginal rate and jurisdiction.

Abbreviations: COGS: Cost of goods sold; FIFO: First-in, first-out; LIFO: Last-in, first-out; WA: Weighted average.

## 6.2. Falling-price regime

Reversing the cost sequence to USD 13, 12, 11, and 10 inverts the ranking. Under falling prices, LIFO consumes the newest (cheapest) layers first, producing the lowest cost of goods sold and the highest gross profit, while FIFO consumes the older (more expensive) layers first and reports the opposite. [Table 9](#) shows the full set.

The pedagogical payoff of [Table 9](#) is that the ranking reverses. Students who memorize “FIFO gives higher profits” often carry the rule into deflationary contexts and get the sign wrong. Working both scenarios makes it clear that the direction depends on the price path, not on the

method's identity.

## 6.3. Stable-price regime

When the unit cost is constant (all purchases at USD 11.50), the cost flow assumption does not matter: all methods assign the same cost to each unit sold and each unit retained. All six combinations report cost of goods sold of USD 5,175, ending inventory of USD 6,325, and gross profit of USD 5,075. This is a degenerate case in the technical sense and a useful sanity check in the pedagogical sense: any time a student's calculation produces six different numbers under flat prices, something is wrong.

**Table 9. Consolidated comparison under falling prices (USD 13, 12, 11, and 10)**

| Method         | COGS (USD) | Ending inventory (USD) | Gross profit (USD) | Gross margin (%) | Comment                  |
|----------------|------------|------------------------|--------------------|------------------|--------------------------|
| Periodic LIFO  | 4,550.00   | 6,450.00               | 5,700.00           | 55.6             | Now the highest GP       |
| Periodic WA    | 4,950.00   | 6,050.00               | 5,300.00           | 51.7             | Average cost = USD 11.00 |
| Perpetual LIFO | 4,900.00   | 6,100.00               | 5,350.00           | 52.2             |                          |
| Perpetual WA   | 5,133.33   | 5,866.67               | 5,116.67           | 49.9             |                          |
| Periodic FIFO  | 5,350.00   | 5,650.00               | 4,900.00           | 47.8             | Now the lowest GP        |
| Perpetual FIFO | 5,350.00   | 5,650.00               | 4,900.00           | 47.8             | Equals periodic FIFO     |

Abbreviations: COGS: Cost of goods sold; FIFO: First-in, first-out; LIFO: Last-in, first-out; WA: Weighted average.

## 6.4. Implications and tax considerations

Three implications recur across the regimes. First, the method choice is not neutral with respect to taxes. Under sustained inflation, LIFO defers taxable income by recognizing newer (higher) costs as expenses. Numerous U.S. firms have used the method for precisely this reason, and the IRS LIFO conformity rule (which generally requires firms electing LIFO for tax purposes to use it in financial reporting as well) makes the choice a long-horizon commitment rather than a year-by-year tactic. Second, the method choice changes the balance sheet's signal value. FIFO records the most recent purchase prices on the asset side, so it produces an inventory figure that more closely tracks current replacement cost. LIFO does the opposite and can produce a balance sheet figure that is years out of date if the firm holds slow-moving stock. Third, the IFRS prohibition on LIFO closes that lever for any firm reporting under international standards.<sup>4</sup> For multinational firms reporting under both regimes, the LIFO reserve disclosure becomes the reconciliation.

## 7. Pedagogical implications and illustrative implementation paths

The pedagogical literature reviewed in Section 2 points to four design choices that could translate the worked examples above into effective classroom materials or future teaching tools.

### 7.1. Possible spreadsheet template

A single Excel or Google Sheets workbook with one sheet per method (six sheets total) and a seventh sheet for a consolidated comparison would capture the framework. The transaction table could sit in a fixed range; changing

any purchase price or quantity in that table would propagate to all six method sheets and to the comparison. This setup would operationalize the visual-aids principle (students see the effect of a parameter change immediately) and the integrated-technology principle (the tool's affordance is computation, not animation). In that sense, the paper outlines a structure that instructors could implement as a guided spreadsheet exercise if they wish.

### 7.2. Possible Python notebook

The same six methods could be implemented in roughly forty lines of Python using only the standard library. A Jupyter notebook with one cell per method, plus a final cell that loops over the three price regimes and produces the comparative outputs, would give advanced students a programmable version of the spreadsheet. Such a notebook would be especially helpful in two contexts: graduate supply chain courses that already use Python for inventory optimization, and undergraduate honors sections that benefit from seeing the deterministic structure of the methods stated as code rather than as procedure. The paper's contribution is to make that implementation straightforward, not to claim that the notebook is distributed with the article.

### 7.3. Suggested classroom sequence

A three-session sequence works well. Session one introduces the dataset, the two systems, and the three cost flow assumptions, and walks through periodic and perpetual FIFO together (their equality is a useful early insight). Session two covers LIFO under both systems, with the perpetual case worked at the board and the periodic case left as a checked exercise; the periodic LIFO arithmetic in Section 4.2 is the kind of error students

commonly make and reproduce, so an explicit error-spotting moment is pedagogically valuable. Session three covers weighted average in both systems and the cross-method comparison, using the spreadsheet or notebook to flip between the three price regimes.

## 7.4. Assessment design

Conventional assessments ask students to compute a single method on a single dataset. A more diagnostic assessment, consistent with the literature on transfer<sup>8</sup>, gives students a partial calculation under one regime and asks them to predict (without recomputing) how each number would change under the other two regimes. Students who can do this are reasoning about the method, not executing it from memory.

## 8. Recommendations for future research

Four directions follow naturally from the framework above. First, a controlled classroom trial using the reproducible materials in Section 7 would convert the narrative synthesis of Section 2 into evidence. A two-section design comparing the six-method framework against a conventional rising-price-only treatment, with pre-post measurement of conceptual transfer rather than recall, would be feasible in a single semester and would directly address the methodological gap that the accounting education reviews have flagged for years.<sup>8</sup>

Second, industry-specific extensions are worth attempting. Retail, manufacturing, and technology firms hold inventories that age and obsolesce differently, and the interaction between aging and the cost flow assumption deserves more attention than the standard textbook treatment provides. Lower-of-cost-or-market write-downs, in particular, are where the methods produce their most distinctive year-over-year patterns.

Third, the operations-finance interface remains under-mapped in the teaching literature. A worked-example study that takes the inventory unit costs from each of the six methods and feeds them into a simple newsvendor or economic order quantity calculation would show students concretely how the accounting choice changes the operational decision.<sup>2,3</sup> This is the natural next paper.

Fourth, the data-driven inventory literature is developing fast<sup>6,7</sup>, and supply chain curricula are starting to incorporate machine-learning approaches to order quantities. The cost flow assumption is the parameter that links those models to the firm's reported financials; making that link explicit in teaching materials would close a gap that current textbooks do not address.

## 9. Conclusion

The conventional treatment of inventory valuation underserves both the technical reader, who wants to know how the methods relate to one another across regimes, and the pedagogical reader, who wants to teach the topic in a way that supports transfer rather than recall.<sup>34,35</sup> The answer in both cases is the same: Put all six method-system combinations into a single normalized dataset, perform the arithmetic carefully, run the comparison across rising, falling, and stable price regimes, and connect the results to both the operations-finance interface and the empirical evidence on what works in the classroom.

Under rising prices, the ranking of cost of goods sold is FIFO (lowest) < perpetual weighted average < periodic weighted average < perpetual LIFO < periodic LIFO (highest), with corresponding inversions in gross profit and ending inventory. Under falling prices, the ranking reverses. Under stable prices, the methods coincide. The differences between periodic and perpetual systems are zero for FIFO, modest but real for weighted average, and largest for LIFO, where the sequencing of sales before the most expensive late-period purchases drives a meaningful gap. The pedagogical conclusion is that working a single regime is not enough; the method's behavior is properly learned by working all three together, and the framework developed here makes that kind of multi-regime teaching design far more tractable.

The quantitative comparison rests on a constructed dataset and does not generalize to specific industries or scales without further work. The pedagogical synthesis is narrative and points toward, rather than substitutes for, the controlled classroom trial recommended in the paper. Within those boundaries, the framework offered here is a defensible foundation for both teaching inventory valuation and for the next round of empirical research on how to teach it well.

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## Author contributions

*Conceptualization:* Lamine Conteh

*Formal analysis:* All authors

*Investigation:* All authors

*Methodology:* All authors

Writing–original draft: Lamine Conteh

Writing–review & editing: All authors

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## Availability of data

No new data were generated or analyzed in this work.

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