

# GMP: Gap-Filled Market Profile and It's Variants

ConQ Research Team

*Continual Quasars*  
May 3, 2026

**Abstract**—Conventional Market Profile (CMP) aggregates price activity into histogram bins, but when applied to an ordered sequence of discrete price points, it leaves bins between consecutive observations empty. We propose GMP (Gap-Filled Market Profile), a universal construction that (i) operates on any ordered price sequence and (ii) interpolates every intermediate price bin traversed between successive points, producing a *gap-filled* profile. Building on this structure, we introduce an *Up/Down-Bin Footprint Profile* that classifies each bin's contribution directionally, revealing net upward or downward pressure without volume data. Furthermore, we extend GMP with two tick-volume amplification modes—GTMP-h (holistic) and GTMP-d (division)—that incorporate per-observation tick volumes, distributing them fully or proportionally across traversed bins. We formalise all variants with explicit algorithms, derive the relationship between bin count and the user-defined bin-size parameter  $\beta$ , and provide a complete worked example on a ten-point price series with tick volumes. Tables and colour-coded profile charts demonstrate that GMP yields a strictly denser and more informative distribution than CMP, while the GTMP extensions add volume-weighted depth, independent of the original data source.

**Index Terms**—Market Profile, gap-filling interpolation, price bins, directional footprint, tick volume, high-frequency data, time series

## I. INTRODUCTION

The Market Profile, introduced by Steidlmayer [1] and later formalised by Dalton et al. [2], represents price activity as a horizontal histogram whose bars count the number of times each price level was visited. Most implementations construct the profile from bar data (OHLCV), adding one stack to every bin between the bar's high and low.

When the input is an arbitrary sequence of discrete price observations—ticks, irregular samples, or synthetic paths—the conventional approach records a stack only at the bin of each observed value. Price levels lying between two consecutive observations remain empty, even though price must have traversed them. This gap neglect occurs regardless of the data source.

We address this shortcoming with **GMP (Gap-Filled Market Profile)**. The construction rule is universal: given any ordered sequence of price observations  $\{p_i\}_{i=1}^N$ , every bin between two successive points receives an interpolated stack, producing a profile free of gaps.

Beyond equal-weight gap-filling, we introduce **GTMP (Gap-filled Tick-volume Amplified Market Profile)** in two variants that exploit an optional per-observation tick volume  $V_i$ . Specifically, **GTMP-h (holistic)** assigns the full tick volume of an observation to every bin that the observation's forward path touches. Complementarily, **GTMP-d (division)**

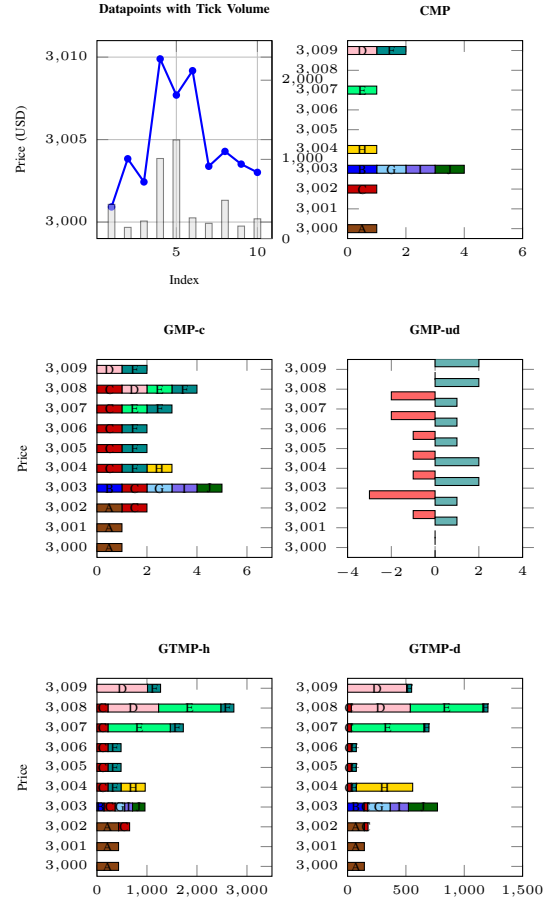


Fig. 1. Comparison of the proposed Market Profile variants on a 10-point price sequence: (1) Datapoints and Tick Volume trajectory, (2) Conventional Market Profile (CMP), (3) Gap-Filled Market Profile (GMP-c), (4) Up/Down-Bin Footprint (GMP-ud), (5) Holistic Tick-Volume Amplified (GTMP-h), and (6) Division Tick-Volume Amplified (GTMP-d). The GMP family effectively resolves gaps and adds multi-dimensional intensity and direction to the profile.

distributes the tick volume evenly across those same bins, yielding an accurate volume-density profile.

The main contributions of this work are:

- 1) Rigorous formalisation of CMP, GMP-c, GMP-ud, GTMP-h, and GTMP-d with explicit algorithms and complexity analyses.
- 2) A universal gap-filling methodology applicable to any ordered price sequence, independent of source or frequency.
- 3) The Up/Down-Bin Footprint Profile, a directional clas-

TABLE I  
NOTATION SUMMARY

| Symbol       | Description                                                  |
|--------------|--------------------------------------------------------------|
| $N$          | Number of observations                                       |
| $p_i$        | Price of $i$ -th observation, $i = 1, \dots, N$              |
| $V_i$        | Tick volume of $i$ -th observation (optional)                |
| $\beta$      | Bin size (price units per bin); default $\beta = 1$          |
| $b(p)$       | Bin index of price $p$ : $b(p) = \lfloor p/\beta \rfloor$    |
| $S[k]$       | Stack count at bin $k$                                       |
| $U[k], D[k]$ | Up-bin / Down-bin counts at bin $k$                          |
| $\delta[k]$  | Net footprint delta, $\delta[k] = U[k] - D[k]$               |
| $K_i$        | Number of bins traversed from $p_{i-1}$ to $p_i$ (inclusive) |

sification derived purely from the price traversal.

- 4) Tick-volume amplification modes (holistic and division) that enrich the profile with traded-size information without requiring order-book data.
- 5) A complete, self-contained illustration on a ten-point series with tick volumes, demonstrated through coloured profile charts and summary tables.

The rest of the paper is organised as follows. Section II surveys related work. Section III establishes the foundational notation. Section IV formally defines the core constructions. Section V provides the detailed worked example equipped with tables and charts. Section VI provides a mathematical analysis of bin size dynamics. Section VII critically discusses implications and limitations, and Section VIII concludes the study.

## II. RELATED WORK

### A. Market Profile

Steidlmayer [1] introduced Market Profile to reveal fair value through price distributions. Dalton et al. [2] extended the framework with auction-market theory. Both rely on time-based bars, but the underlying binning logic is data-source agnostic.

### B. Interpolation in Financial Time Series

High-frequency finance frequently uses interpolation. Clark [3] showed that subordinating returns to trade-count time yields near-Gaussian distributions. Ané and Geman [4] confirmed that business-time transformations normalise tick-level returns. Gap-filling on the price axis is equivalent to linear interpolation of histogram counts.

### C. Footprint and Order-Flow Analysis

Market microstructure theory [5]–[7] underpins directional pressure analysis. Traditional footprint charts classify trades as buyer/seller-initiated. Our Up/Down-Bin Footprint obtains directional information solely from the price path, complementing volume-based footprints.

## III. PRELIMINARIES

Table I summarises the notation. Table II shows the sample data used throughout.

TABLE II  
INPUT OBSERVATIONS WITH TICK VOLUMES

| Label | Index # | Price (USD) | Tick Volume |
|-------|---------|-------------|-------------|
| A     | 1       | 3000.914    | 432         |
| B     | 2       | 3003.837    | 141         |
| C     | 3       | 3002.432    | 221         |
| D     | 4       | 3009.892    | 1011        |
| E     | 5       | 3007.698    | 1245        |
| F     | 6       | 3009.176    | 261         |
| G     | 7       | 3003.381    | 192         |
| H     | 8       | 3004.283    | 483         |
| I     | 9       | 3003.512    | 157         |
| J     | 10      | 3003.012    | 249         |

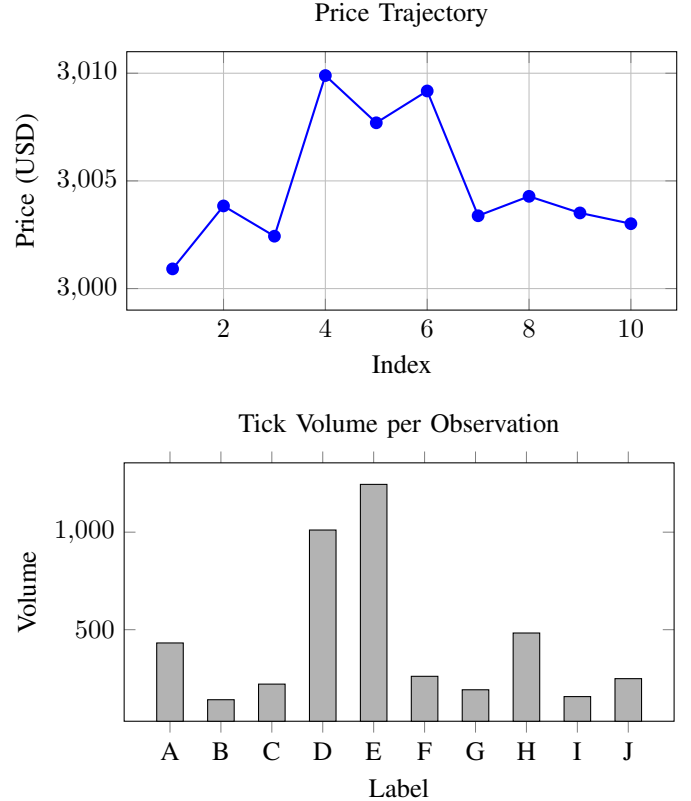


Fig. 2. Top: Price trajectory across the ten observations. Bottom: Bar chart of tick volumes per observation.

[Price observation sequence] A price observation sequence is an ordered set  $\mathcal{P} = \{(t_i, p_i, V_i)\}_{i=1}^N$  where  $t_i$  is a monotonic index and  $V_i \geq 0$  is an optional tick volume.

[Bin] Given  $\beta > 0$ , the bin of price  $p$  is

$$b(p) = \left\lfloor \frac{p}{\beta} \right\rfloor, \quad (1)$$

so that all prices  $k\beta \leq p < (k+1)\beta$  map to bin  $k$ .

[Market Profile] A market profile is a mapping  $S : \mathbb{Z} \rightarrow \mathbb{R}_{\geq 0}$  where  $S[k]$  measures the activity accumulated at bin  $k$ .

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**Algorithm 1** CMP Construction

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**Require:**  $\{p_i\}_{i=1}^N, \beta$   
**Ensure:** Profile  $S_{\text{CMP}}[\cdot]$

- 1: Initialise  $S_{\text{CMP}}[k] \leftarrow 0 \forall k$
- 2: **for**  $i = 1$  **to**  $N$  **do**
- 3:    $k \leftarrow \lfloor p_i / \beta \rfloor$
- 4:    $S_{\text{CMP}}[k] \leftarrow S_{\text{CMP}}[k] + 1$
- 5: **end for**
- 6: **return**  $S_{\text{CMP}}$

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**Algorithm 2** GMP-c Construction

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**Require:**  $\{p_i\}_{i=1}^N, \beta$   
**Ensure:** Profile  $S_{\text{GMP}}[\cdot]$

- 1: Initialise  $S_{\text{GMP}}[k] \leftarrow 0 \forall k$
- 2: **for**  $i = 1$  **to**  $N - 1$  **do**
- 3:    $k_{\text{from}} \leftarrow \lfloor p_i / \beta \rfloor; k_{\text{to}} \leftarrow \lfloor p_{i+1} / \beta \rfloor$
- 4:    $d \leftarrow \text{sign}(k_{\text{to}} - k_{\text{from}})$
- 5:    $k \leftarrow k_{\text{from}}$
- 6:   **while**  $k \neq k_{\text{to}}$  **do**
- 7:      $S_{\text{GMP}}[k] \leftarrow S_{\text{GMP}}[k] + 1$
- 8:      $k \leftarrow k + d$
- 9:   **end while**
- 10: **end for**
- 11:  $S_{\text{GMP}}[\lfloor p_N / \beta \rfloor] \leftarrow S_{\text{GMP}}[\lfloor p_N / \beta \rfloor] + 1$
- 12: **return**  $S_{\text{GMP}}$

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## IV. METHODOLOGY

## A. CMP: Conventional Market Profile

CMP records a stack only at the bin of each observed price:

$$S_{\text{CMP}}[k] = \sum_{i=1}^N \mathbf{1}[b(p_i) = k]. \quad (2)$$

**Complexity:**  $\mathcal{O}(N)$ .

## B. GMP-c: Gap-Filled Market Profile (Casual / Equal-Weight)

GMP-c fills every intermediate bin between consecutive observations. Let  $b_i = b(p_i)$ . Then

$$S_{\text{GMP}}[k] = \sum_{i=1}^N \mathbf{1}[b_i = k] + \sum_{i=2}^N \sum_{j=\min(b_{i-1}, b_i)+1}^{\max(b_{i-1}, b_i)-1} \mathbf{1}[j = k]. \quad (3)$$

When  $|b_i - b_{i-1}| > 1$ , the gap-filling adds  $|b_i - b_{i-1}| - 1$  intermediate stacks.

Conceptually, each observation  $i$  (except the last) contributes one stack to every bin traversed when moving from  $p_i$  to  $p_{i+1}$ , starting at  $b_i$  and ending just before  $b_{i+1}$ . The last observation  $p_N$  contributes only to  $b_N$ . Thus the set of bins touched by  $p_i$  is  $\mathcal{B}_i = \{b_i, b_i + d, \dots, b_{i+1} - d\}$  for  $i < N$ , with  $d = \text{sign}(b_{i+1} - b_i)$ , and  $\mathcal{B}_N = \{b_N\}$ .

**Complexity:**  $\mathcal{O}(N + D)$ , where  $D = \sum_{i=2}^N |b_i - b_{i-1}|$  is the cumulative bin displacement.

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**Algorithm 3** Up/Down-Bin Footprint (GMP-ud)

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**Require:**  $\{p_i\}_{i=1}^N, \beta$   
**Ensure:**  $U[\cdot], D[\cdot], \delta[\cdot]$

- 1: Initialise  $U[k] \leftarrow 0, D[k] \leftarrow 0 \forall k$
- 2: **for**  $i = 2$  **to**  $N$  **do**
- 3:    $k_{\text{from}} \leftarrow \lfloor p_{i-1} / \beta \rfloor; k_{\text{to}} \leftarrow \lfloor p_i / \beta \rfloor$
- 4:    $d \leftarrow \text{sign}(k_{\text{to}} - k_{\text{from}})$
- 5:    $k \leftarrow k_{\text{from}} + d$
- 6:   **if**  $p_i > p_{i-1}$  **then**
- 7:     **while**  $k \neq k_{\text{to}} + d$  **do**
- 8:        $U[k] \leftarrow U[k] + 1; k \leftarrow k + d$
- 9:     **end while**
- 10:   **else**
- 11:     **while**  $k \neq k_{\text{to}} + d$  **do**
- 12:        $D[k] \leftarrow D[k] + 1; k \leftarrow k + d$
- 13:     **end while**
- 14:   **end if**
- 15: **end for**
- 16: **for all**  $k$  **do**
- 17:    $\delta[k] \leftarrow U[k] - D[k]$
- 18: **end for**
- 19: **return**  $U, D, \delta$

---

## C. GMP-ud: Up/Down-Bin Footprint Profile

While GMP-c counts equal-weight contributions, GMP-ud classifies each bin traversal by direction. For each consecutive pair  $(p_{i-1}, p_i)$ , the bins on the path from  $b_{i-1}$  (exclusive) to  $b_i$  (inclusive) increment  $U$  if  $p_i > p_{i-1}$ , otherwise  $D$ . The net footprint is  $\delta[k] = U[k] - D[k]$ .

## D. GTMP-h: Holistic Tick-Volume Amplified Profile

When each observation  $i$  carries a tick volume  $V_i$ , GTMP-h assigns the full volume to every bin in the forward path  $\mathcal{B}_i$  defined earlier. Formally,

$$S_{\text{GTMP-h}}[k] = \sum_{i=1}^N V_i \cdot \mathbf{1}[k \in \mathcal{B}_i]. \quad (4)$$

Thus the total profile value at bin  $k$  is the sum of tick volumes of all observations whose path crosses that bin.

**Complexity:** identical to GMP-c,  $\mathcal{O}(N + D)$ .

## E. GTMP-d: Division Tick-Volume Amplified Profile

GTMP-d distributes each  $V_i$  evenly across the bins in  $\mathcal{B}_i$ . For  $i < N$ , the number of bins in the path is  $K_i = |b_{i+1} - b_i|$ ; for  $i = N$ ,  $K_N = 1$ . Then

$$S_{\text{GTMP-d}}[k] = \sum_{i=1}^N \frac{V_i}{K_i} \cdot \mathbf{1}[k \in \mathcal{B}_i]. \quad (5)$$

This yields a volume-density profile where each bin's value is the sum of proportionate volume contributions.

**Complexity:**  $\mathcal{O}(N + D)$ .

**Algorithm 4** GTMP-h Construction**Require:**  $\{p_i\}_{i=1}^N, \{V_i\}_{i=1}^N, \beta$ **Ensure:** Profile  $S_h[\cdot]$ 

```

1: Initialise  $S_h[k] \leftarrow 0 \forall k$ 
2: for  $i = 1$  to  $N - 1$  do
3:    $k_{\text{from}} \leftarrow \lfloor p_i/\beta \rfloor; k_{\text{to}} \leftarrow \lfloor p_{i+1}/\beta \rfloor$ 
4:    $d \leftarrow \text{sign}(k_{\text{to}} - k_{\text{from}})$ 
5:    $k \leftarrow k_{\text{from}}$ 
6:   while  $k \neq k_{\text{to}}$  do
7:      $S_h[k] \leftarrow S_h[k] + V_i$ 
8:      $k \leftarrow k + d$ 
9:   end while
10: end for
11:  $S_h[\lfloor p_N/\beta \rfloor] \leftarrow S_h[\lfloor p_N/\beta \rfloor] + V_N$ 
12: return  $S_h$ 

```

**Algorithm 5** GTMP-d Construction**Require:**  $\{p_i\}_{i=1}^N, \{V_i\}_{i=1}^N, \beta$ **Ensure:** Profile  $S_d[\cdot]$ 

```

1: Initialise  $S_d[k] \leftarrow 0 \forall k$ 
2: for  $i = 1$  to  $N - 1$  do
3:    $k_{\text{from}} \leftarrow \lfloor p_i/\beta \rfloor; k_{\text{to}} \leftarrow \lfloor p_{i+1}/\beta \rfloor$ 
4:    $K \leftarrow |k_{\text{to}} - k_{\text{from}}|$ 
5:    $d \leftarrow \text{sign}(k_{\text{to}} - k_{\text{from}})$ 
6:    $v \leftarrow V_i/K$ 
7:    $k \leftarrow k_{\text{from}}$ 
8:   while  $k \neq k_{\text{to}}$  do
9:      $S_d[k] \leftarrow S_d[k] + v$ 
10:     $k \leftarrow k + d$ 
11:   end while
12: end for
13:  $S_d[\lfloor p_N/\beta \rfloor] \leftarrow S_d[\lfloor p_N/\beta \rfloor] + V_N$ 
14: return  $S_d$ 

```

## V. ILLUSTRATION: TEN-POINT PRICE SERIES

We apply all methods to the ten-point series of Table II with bin size  $\beta = 1$ . The bin range covers 3000 to 3009 (bins 1–10).

## A. CMP Profile

Table III and Figure 3 show the conventional profile. Four bins are empty.

## B. GMP-c Profile

Gap-filling produces the continuous profile in Table IV and Figure 4. Every bin now contains at least one stack.

## C. GMP-ud Profile

Table V and Figure 5 give the directional breakdown. Positive delta indicates net upward pressure, negative delta net downward pressure.

## D. GTMP-h Profile

Table VI and Figure 6 present the holistic tick-volume profile. Each bin's total equals the sum of full tick volumes of all observations that traverse it.

TABLE III  
CMP PROFILE ( $\beta = 1$ )

| Bin          | Range     | Group | Stacks    |
|--------------|-----------|-------|-----------|
| 3000         | 3000–3001 | A     | 1         |
| 3001         | 3001–3002 | —     | 0         |
| 3002         | 3002–3003 | C     | 1         |
| 3003         | 3003–3004 | BGIJ  | 4         |
| 3004         | 3004–3005 | H     | 1         |
| 3005         | 3005–3006 | —     | 0         |
| 3006         | 3006–3007 | —     | 0         |
| 3007         | 3007–3008 | E     | 1         |
| 3008         | 3008–3009 | —     | 0         |
| 3009         | 3009–3010 | DF    | 2         |
| <b>Total</b> |           |       | <b>10</b> |

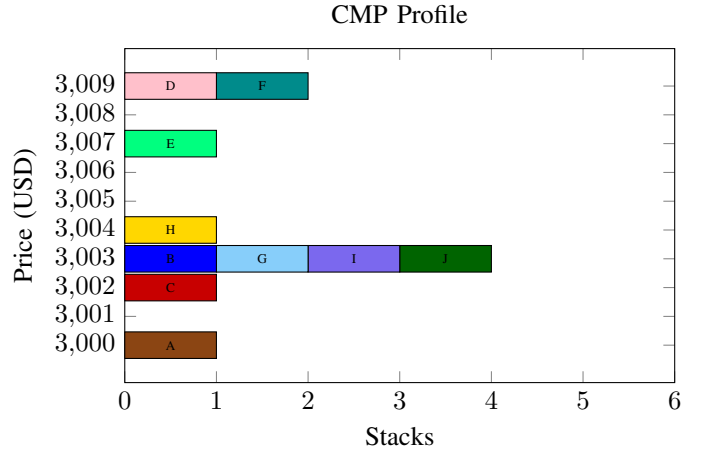


Fig. 3. CMP profile: letters A–J coloured by observation; four bins empty.

TABLE IV  
GMP-C PROFILE ( $\beta = 1$ )

| Bin          | Range     | Group | Stacks    |
|--------------|-----------|-------|-----------|
| 3000         | 3000–3001 | A     | 1         |
| 3001         | 3001–3002 | A     | 1         |
| 3002         | 3002–3003 | AC    | 2         |
| 3003         | 3003–3004 | BCGIJ | 5         |
| 3004         | 3004–3005 | CFH   | 3         |
| 3005         | 3005–3006 | CF    | 2         |
| 3006         | 3006–3007 | CF    | 2         |
| 3007         | 3007–3008 | CEF   | 3         |
| 3008         | 3008–3009 | CDEF  | 4         |
| 3009         | 3009–3010 | DF    | 2         |
| <b>Total</b> |           |       | <b>25</b> |

## E. GTMP-d Profile

Table VII and Figure 7 show the division mode. Volumes are split evenly among the traversed bins, preventing excessive accumulation on long jumps.

## VI. EFFECT OF BIN SIZE ON PROFILE RESOLUTION

The bin size  $\beta$  directly controls profile granularity. For a price displacement  $|\Delta p|$ , the number of bins traversed is

$$K(\beta) = \left\lceil \left\lfloor \frac{p_i}{\beta} \right\rfloor - \left\lfloor \frac{p_{i-1}}{\beta} \right\rfloor \right\rceil + 1. \quad (6)$$

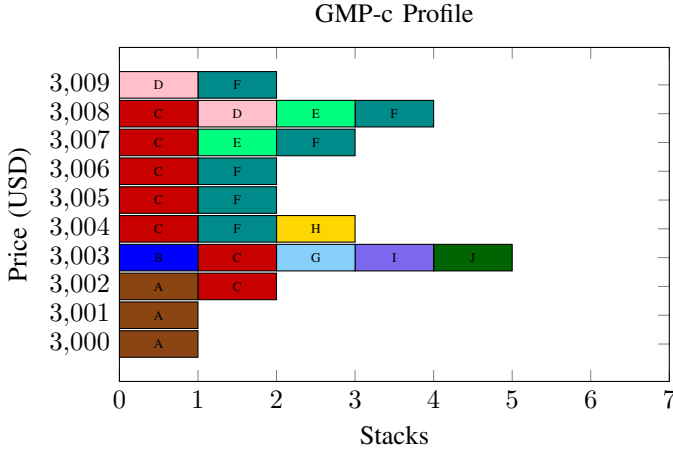


Fig. 4. GMP-c profile: letters extend along their forward paths; no gaps.

TABLE V  
UP/DOWN-BIN FOOTPRINT ( $\beta = 1$ )

| Bin  | Range     | Group | Down | Up | $\delta$ |
|------|-----------|-------|------|----|----------|
| 3000 | 3000–3001 | A     | 0    | 0  | 0        |
| 3001 | 3001–3002 | A     | 0    | 1  | +1       |
| 3002 | 3002–3003 | AC    | 1    | 1  | 0        |
| 3003 | 3003–3004 | BCGIJ | 3    | 2  | -1       |
| 3004 | 3004–3005 | CFH   | 1    | 2  | +1       |
| 3005 | 3005–3006 | CF    | 1    | 1  | 0        |
| 3006 | 3006–3007 | CF    | 1    | 1  | 0        |
| 3007 | 3007–3008 | CEF   | 2    | 1  | -1       |
| 3008 | 3008–3009 | CDEF  | 2    | 2  | 0        |
| 3009 | 3009–3010 | DF    | 0    | 2  | +2       |

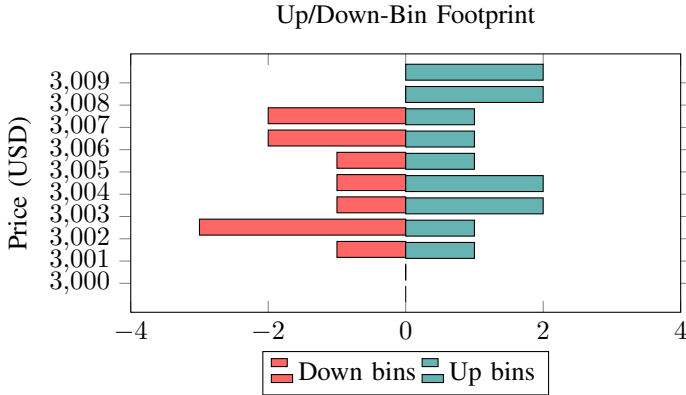


Fig. 5. Directional footprint: red = downward pressure, teal = upward pressure.

[Bin-count scaling] For fixed  $\Delta p$  and  $\beta_1 > \beta_2 > 0$ ,

$$K(\beta_2) \geq \left\lfloor \frac{\beta_1}{\beta_2} \right\rfloor (K(\beta_1) - 1) + 1. \quad (7)$$

Write  $\Delta p = (K(\beta_1) - 1)\beta_1 + r_1$  with  $0 \leq r_1 < \beta_1$ . Then  $K(\beta_2) = \lfloor \Delta p / \beta_2 \rfloor + 1 \geq \lfloor (K(\beta_1) - 1)\beta_1 / \beta_2 \rfloor + 1 \geq \lfloor \beta_1 / \beta_2 \rfloor (K(\beta_1) - 1) + 1$ .

Table VIII illustrates the scaling for  $\Delta p = 10$ . CMP always occupies exactly two bins regardless of  $\beta$ , while GMP (and

TABLE VI  
GTMP-H PROFILE ( $\beta = 1$ )

| Bin  | Range     | Group | Tick Volume |
|------|-----------|-------|-------------|
| 3000 | 3000–3001 | A     | 432         |
| 3001 | 3001–3002 | A     | 432         |
| 3002 | 3002–3003 | AC    | 653         |
| 3003 | 3003–3004 | BCGIJ | 960         |
| 3004 | 3004–3005 | CFH   | 965         |
| 3005 | 3005–3006 | CF    | 482         |
| 3006 | 3006–3007 | CF    | 482         |
| 3007 | 3007–3008 | CEF   | 1727        |
| 3008 | 3008–3009 | CDEF  | 2738        |
| 3009 | 3009–3010 | DF    | 1272        |

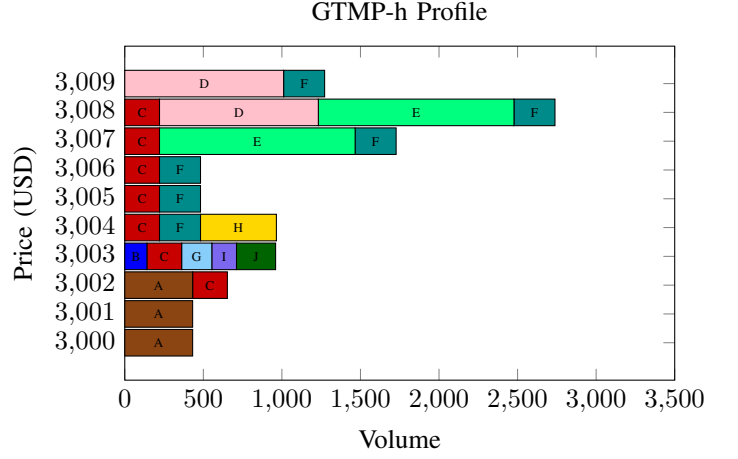


Fig. 6. GTMP-h profile: full tick volume repeated on every bin the observation touches.

TABLE VII  
GTMP-D PROFILE ( $\beta = 1$ )

| Bin  | Range     | Group | Tick Volume (distr.) |
|------|-----------|-------|----------------------|
| 3000 | 3000–3001 | A     | 144.00               |
| 3001 | 3001–3002 | A     | 144.00               |
| 3002 | 3002–3003 | AC    | 175.57               |
| 3003 | 3003–3004 | BCGIJ | 770.57               |
| 3004 | 3004–3005 | CFH   | 558.07               |
| 3005 | 3005–3006 | CF    | 75.07                |
| 3006 | 3006–3007 | CF    | 75.07                |
| 3007 | 3007–3008 | CEF   | 697.57               |
| 3008 | 3008–3009 | CDEF  | 1203.07              |
| 3009 | 3009–3010 | DF    | 549.00               |

TABLE VIII  
BIN COUNT VS.  $\beta$  FOR  $\Delta p = 10$

| $\beta$ | $K(\beta)$ | CMP bins | GMP bins |
|---------|------------|----------|----------|
| 2.0     | 6          | 2        | 6        |
| 1.0     | 11         | 2        | 11       |
| 0.5     | 21         | 2        | 21       |
| 0.25    | 41         | 2        | 41       |
| 0.1     | 101        | 2        | 101      |

its volume-amplified variants) gains resolution inversely with  $\beta$ .

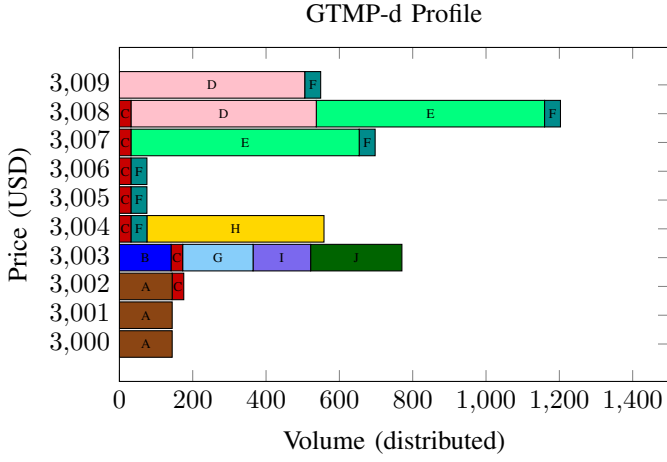


Fig. 7. GTMP-d profile: volume evenly split across traversed bins.

## VII. DISCUSSION

### A. Advantages

The proposed methodologies offer several distinct advantages. Primarily, they generate a **gap-free profile** where all traversed price levels are accurately represented, causing the empty bins characteristic of CMP to vanish completely. In terms of **universality**, the method natively applies to any ordered price sequence, including raw ticks, time-based candles, or irregular data samples. Furthermore, the **directional classification** within GMP-ud successfully reveals net buying or selling pressure without requiring external order-flow data. Additionally, **tick-volume integration** through GTMP-h and GTMP-d enriches the overall profile with traded size; the holistic variant preserves volume inventory, whereas the division variant accurately illustrates volume density. The framework also features **tunable resolution**, as the bin size parameter  $\beta$  adjusts independently of the underlying data frequency. Computationally, the framework ensures **efficient computation**, with all algorithmic variants operating in  $\mathcal{O}(N+D)$  time, making them highly suitable for real-time, high-frequency data streams.

### B. Limitations

Despite these robust advantages, certain limitations must be carefully acknowledged. A core limitation is that **continuous traversal is assumed**; true price gaps resulting from market closures or extreme illiquidity may be synthetically filled by interpolation. Implementing a threshold filter for large temporal gaps could effectively mitigate this issue. Moreover, a large **cumulative displacement**  $D$  proportionally increases the computational load, suggesting that adaptive sampling or decimation of unusually long, unidirectional moves might be necessary in extreme edge cases. Regarding **volume interpretation**, GTMP-h and GTMP-d represent two methodological extremes—full repetition versus full dilution. Developing a hybrid scheme that employs partial volume repetition could provide a more nuanced structural representation. Finally, it

must be noted that this approach is **not a full volume-at-price profile**. While our method significantly enhances pure traversal profiles by integrating tick volume, it does not aim to replace dedicated, order-book derived volume-profile algorithms. Combining our interpolated gap-filling constructions directly with Level II order-book data remains an important and promising avenue for future research.

## VIII. CONCLUSION

We have presented a unified family of gap-filled market profiles. GMP-c universally interpolates intermediate price bins, GMP-ud adds directional classification, and GTMP-h/d incorporate tick volume through holistic or proportional distribution. All constructions are formally specified, analysed, and illustrated on a ten-point example with colour-coded charts. The methods close the gaps inherent in conventional profiles and provide a richer, more complete picture of price traversal, applicable across any ordered price sequence. Future work may explore weighted interpolation and integration with granular order-book data.

APPENDIX A  
COMPLETE TABULAR DATA AND EXACT CSV OUTPUT

This appendix details the exact tabular data generated and utilised throughout the study. The data corresponds precisely to the input observations and the resulting algorithmic outputs for the Conventional Market Profile (CMP), Gap-Filled Market Profile casual mode (GMP-c), Up/Down-Bin Footprint mode (GMP-ud), and the tick-volume amplified extensions (GTMP-h and GTMP-d) at a defined bin size of  $\beta = 1.000$ .

**Table A1: Input Observations / Data Points**

| Label | Index # | Price    |
|-------|---------|----------|
| A     | 1       | 3000.914 |
| B     | 2       | 3003.837 |
| C     | 3       | 3002.432 |
| D     | 4       | 3009.892 |
| E     | 5       | 3007.698 |
| F     | 6       | 3009.176 |
| G     | 7       | 3003.381 |
| H     | 8       | 3004.283 |
| I     | 9       | 3003.512 |
| J     | 10      | 3003.012 |

**Table A2: Conventional Market Profile (CMP) — with Binsize = 1.000**

| Bin | From | Until | Group | Stacks |
|-----|------|-------|-------|--------|
| 1   | 3000 | 3001  | A     | 1      |
| 2   | 3001 | 3002  |       | 0      |
| 3   | 3002 | 3003  | C     | 1      |
| 4   | 3003 | 3004  | BGIJ  | 4      |
| 5   | 3004 | 3005  | H     | 1      |
| 6   | 3005 | 3006  |       | 0      |
| 7   | 3006 | 3007  |       | 0      |
| 8   | 3007 | 3008  | E     | 1      |
| 9   | 3008 | 3009  |       | 0      |
| 10  | 3009 | 3010  | DF    | 2      |

**Table A3: (GMP-c) Gap-filled Market Profile (casual ‘c’ mode) — with Binsize = 1.000**

| Bin | From | Until | Group | Stacks |
|-----|------|-------|-------|--------|
| 1   | 3000 | 3001  | A     | 1      |
| 2   | 3001 | 3002  | A     | 1      |
| 3   | 3002 | 3003  | AC    | 2      |
| 4   | 3003 | 3004  | BCGIJ | 5      |
| 5   | 3004 | 3005  | CFH   | 3      |
| 6   | 3005 | 3006  | CF    | 2      |
| 7   | 3006 | 3007  | CF    | 2      |
| 8   | 3007 | 3008  | CEF   | 3      |
| 9   | 3008 | 3009  | CDEF  | 4      |
| 10  | 3009 | 3010  | DF    | 2      |

**Table A4: (GMP-ud) Gap-filled Market Profile (up/down-bin ‘ud’ mode) — with Binsize = 1.000**

| Bin | From | Until | Group | Down Stack | Up Stack | Delta Stack |
|-----|------|-------|-------|------------|----------|-------------|
| 1   | 3000 | 3001  | A     | 0          | 0        | 0           |
| 2   | 3001 | 3002  | A     | 0          | 1        | 1           |
| 3   | 3002 | 3003  | AC    | 1          | 1        | 0           |
| 4   | 3003 | 3004  | BCGIJ | 3          | 2        | -1          |
| 5   | 3004 | 3005  | CFH   | 1          | 2        | 1           |
| 6   | 3005 | 3006  | CF    | 1          | 1        | 0           |
| 7   | 3006 | 3007  | CF    | 1          | 1        | 0           |
| 8   | 3007 | 3008  | CEF   | 2          | 1        | -1          |
| 9   | 3008 | 3009  | CDEF  | 2          | 2        | 0           |
| 10  | 3009 | 3010  | DF    | 0          | 2        | 2           |

**Table A5: Input Observations / Data Points and Tick Volume**

| Label | Index # | Price    | Tick Volume |
|-------|---------|----------|-------------|
| A     | 1       | 3000.914 | 432         |
| B     | 2       | 3003.837 | 141         |
| C     | 3       | 3002.432 | 221         |
| D     | 4       | 3009.892 | 1011        |
| E     | 5       | 3007.698 | 1245        |
| F     | 6       | 3009.176 | 261         |
| G     | 7       | 3003.381 | 192         |
| H     | 8       | 3004.283 | 483         |
| I     | 9       | 3003.512 | 157         |
| J     | 10      | 3003.012 | 249         |

**Table A6: (GTMP-h) Gap-filled Tick-volume Amplified Market Profile (holistic ‘h’ mode) — with Binsize = 1.000**

| Bin | From | Until | Group | Tick Volume                 | Stacks |
|-----|------|-------|-------|-----------------------------|--------|
| 1   | 3000 | 3001  | A     | 432                         | 432    |
| 2   | 3001 | 3002  | A     | 432                         | 432    |
| 3   | 3002 | 3003  | AC    | 432 + 221                   | 653    |
| 4   | 3003 | 3004  | BCGIJ | 141 + 221 + 192 + 157 + 249 | 960    |
| 5   | 3004 | 3005  | CFH   | 221 + 261 + 483             | 965    |
| 6   | 3005 | 3006  | CF    | 221 + 261                   | 482    |
| 7   | 3006 | 3007  | CF    | 221 + 261                   | 482    |
| 8   | 3007 | 3008  | CEF   | 221 + 1245 + 261            | 1727   |
| 9   | 3008 | 3009  | CDEF  | 221 + 1011 + 1245 + 261     | 2738   |
| 10  | 3009 | 3010  | DF    | 1011 + 261                  | 1272   |

**Table A7: (GTMP-d) Gap-filled Tick-volume Amplified Market Profile (division ‘d’ mode) — with Binsize = 1.000**

| Bin | From | Until | Group | Tick Volume                                     | Stacks     |
|-----|------|-------|-------|-------------------------------------------------|------------|
| 1   | 3000 | 3001  | A     | (432/3)                                         | 144        |
| 2   | 3001 | 3002  | A     | (432/3)                                         | 144        |
| 3   | 3002 | 3003  | AC    | (432/3) + (221/7)                               | 175.571429 |
| 4   | 3003 | 3004  | BCGIJ | (141/1) + (221/7) + (192/1) + (157/1) + (249/1) | 770.571429 |
| 5   | 3004 | 3005  | CFH   | (221/7) + (261/6) + (483/1)                     | 558.071429 |
| 6   | 3005 | 3006  | CF    | (221/7) + (261/6)                               | 75.0714286 |
| 7   | 3006 | 3007  | CF    | (221/7) + (261/6)                               | 75.0714286 |
| 8   | 3007 | 3008  | CEF   | (221/7) + (1245/2) + (261/6)                    | 697.571429 |
| 9   | 3008 | 3009  | CDEF  | (221/7) + (1011/2) + (1245/2) + (261/6)         | 1203.07143 |
| 10  | 3009 | 3010  | DF    | (1011/2) + (261/6)                              | 549        |

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