Flash Sale Detection: Comparing Binomial-Based Methods

Evaluation of Binomial PMF, CDF, and Z-Score Methods

Condition	Binomial PMF	Binomial CDF (Right-Tail)	Z-Score (Standardized)
Balanced Conversion Probabilities $p \approx 0.5$	**Valid** Works symmetrically	**Valid** Interpretable thresholds	**Best** Intuitive standardized alert
Rare Conversion ($p \ll 0.1$)	**Cautious** Sensitive to small spikes	**Valid** Suitable for rare-event tail	**Valid** Needs stable variance
Low Visitor Counts ($n < 10$)	**Cautious** Resolution too low	**Cautious** May misclassify	**Invalid** StdDev unreliable
High Traffic ($n > 30$)	**Valid** Smooth probability	**Best** Stable and scalable	**Valid** Normal approximation holds
Zero-Inflated Hours	**Invalid** No way to separate	**Invalid** Fails on structure	**Best** Use with residual modeling
Real-Time Use	**Valid** Lightweight calculation	**Best** Tail thresholding ideal	**Cautious** Needs live distribution
Explainability	**Valid** Probability logic clear	**Valid** Event likelihood based	**Best** Easy for business teams

Legend

Criteria	Meaning
Best	Most recommended for the scenario; optimal for robust flash sale detection
Valid	Sound and practical in most cases; can be reliably deployed
Cautious	Needs tuning, context-aware thresholds, or has minor limitations
Invalid	Not suitable due to poor reliability, false signals, or instability