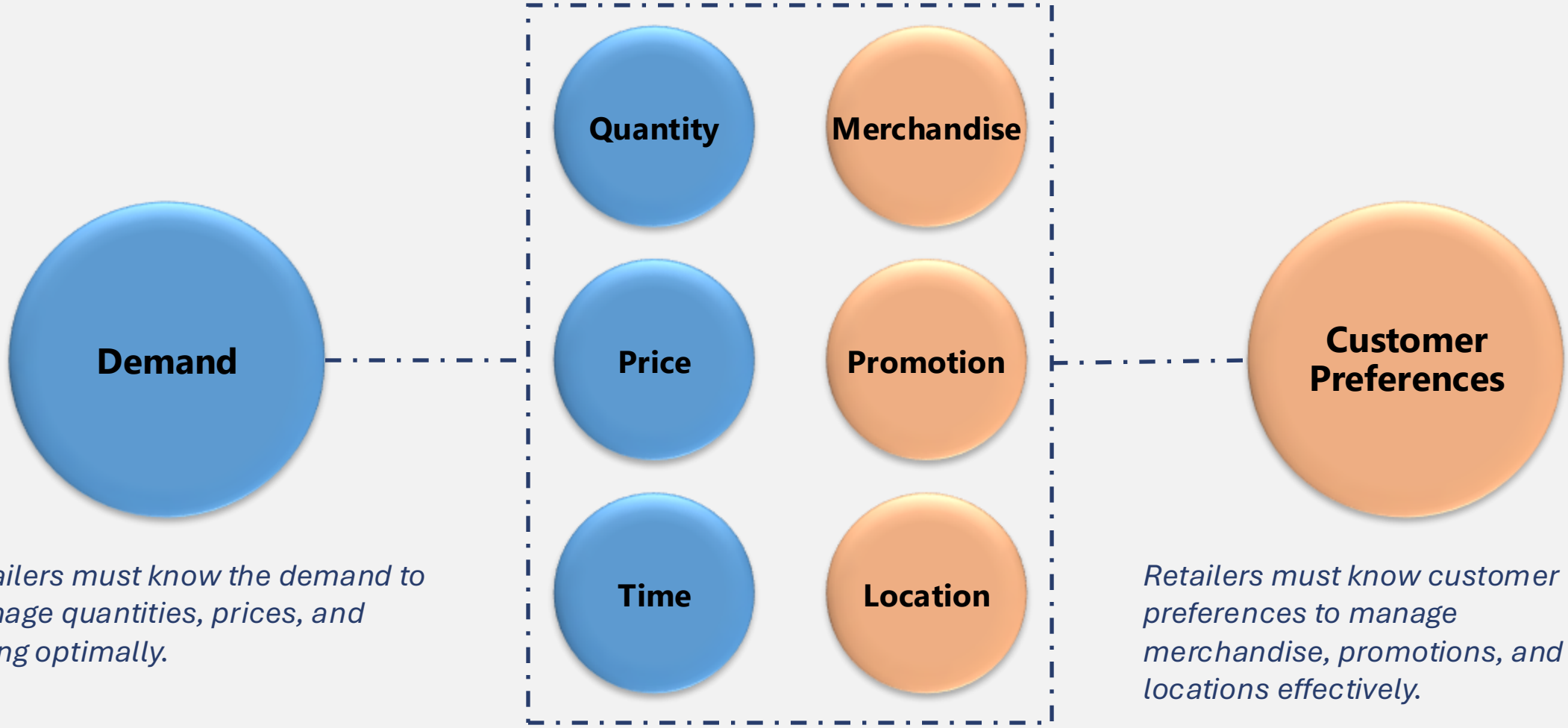
NOVEL SOLUTIONS TO EXISTENTIAL RETAIL PROBLEMS

by YieldWise Inc.

The challenge is to determine the right merchandise in the correct quantities, with the best pricing and promotions, delivered at the right time to the right location.



Retailers must know the demand to manage quantities, prices, and timing optimally.

Retailers must know customer preferences to manage merchandise, promotions, and locations effectively.

How to “Know” Demand

Redefining Demand Forecasting

SHIFT IN DEMAND FORECASTING PARADIGM

TRADITIONAL

Commonly accepted, but incorrect and misleading, understanding of demand forecasting and forecast error:

Forecast = expected value of demand

Forecast error = difference between forecasted value and actual value

Accuracy: Measure how closely the forecast value matches the actual value

Precision: The spread of the forecast residuals

PROBABILISTIC

The comprehensive and correct understanding of demand forecasting and forecast error:

Forecast = the distribution of possible demand values (the range of potential demand values)

Forecast error = the error in the distribution (the discrepancy in the range)

Accuracy: is a crucial factor in determining how close the forecast distribution is to the actual distribution

Precision: is the key to understanding the dispersion of the forecast distribution.

ADVANTAGES OF PROBABILISTIC PARADIGM [1]

The methodology reveals how traditional outdated perspectives on demand forecasting and forecast errors are detrimental to business operations and undermine competitiveness.

- **Demand and out-of-stock:**

  Does being out-of-stock pose an equal risk as being overstocked?

  Or… does each one have its own probability and mitigation plan?

- **Intermittent demand:**

  (characterized by having several sporadic or highly varying periods of demand, 60%-75% of merchandise have intermittent demand)

  Do you sell 0.1 units each week?

  Or… is there a 0.1 probability of selling 1 unit each week?

ADVANTAGES OF PROBABILISTIC PARADIGM [2]

The methodology emphasizes the importance of correctly measuring demand forecast errors to instigate change.

Traditional metrics like MAPE, WMAPE, MASE, MAD, MAE, MSE, RMSE, and FVA only assess the error of a single central point per period.

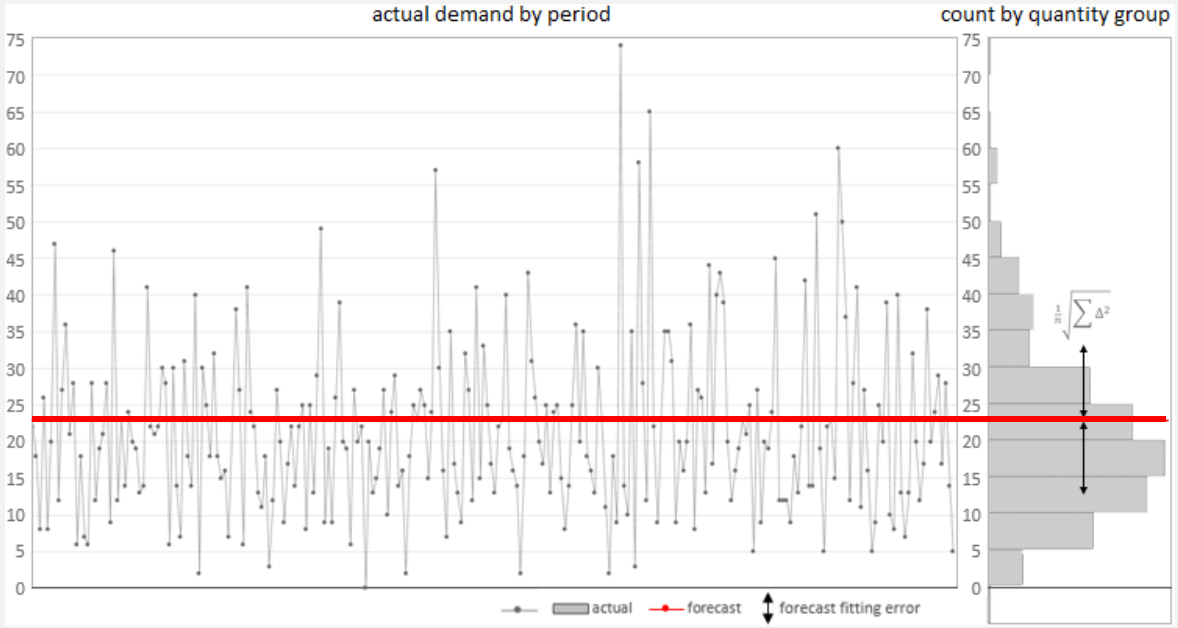
A new metric, Total Percentile Error, assesses the error in the distribution of possible demand values:

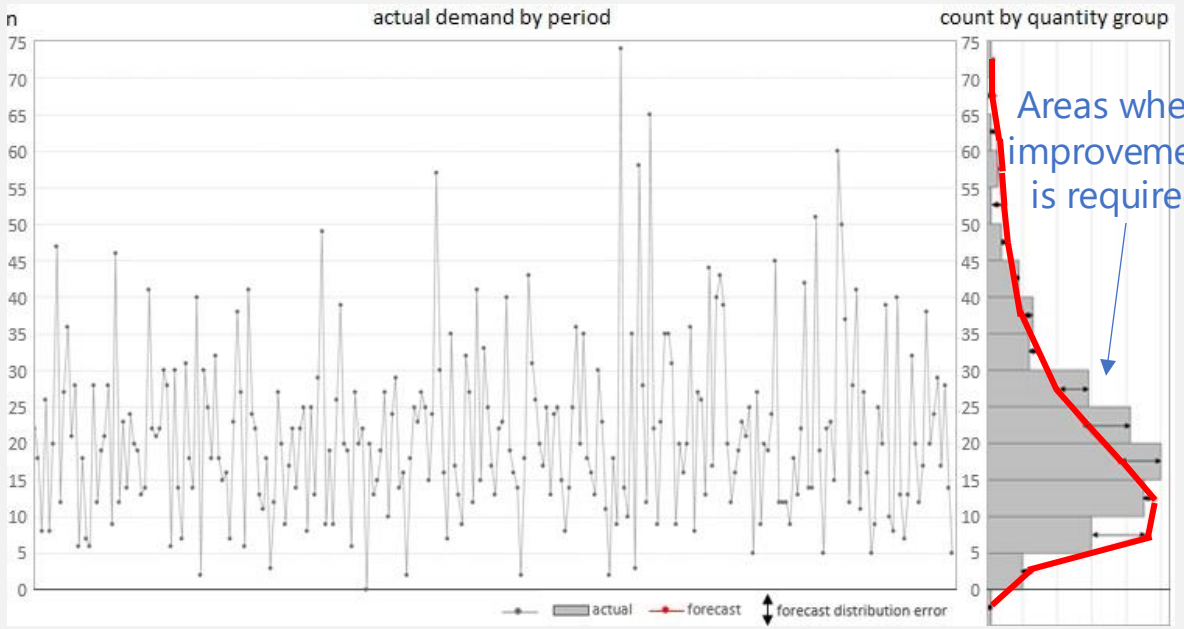
$$\varepsilon_{general} = \frac{\sum_{b=1}^{B} w_b \left| \sum_{i=1}^{n} \mu_i \left(l_b - \lambda_{b,i} \right) \right|}{\sum_{b=1}^{B} w_b \sum_{i=1}^{n} \mu_i}$$

n is the number of observations
B is the number of percentile bins
w_b is the weight for percentile bin b
l_b is the size of the percentile bin b
μ_i is a weight assigned to the i-th actual
$\lambda_{b,l}$ is the spreading factor

ADVANTAGES OF PROBABILISTIC PARADIGM [3]

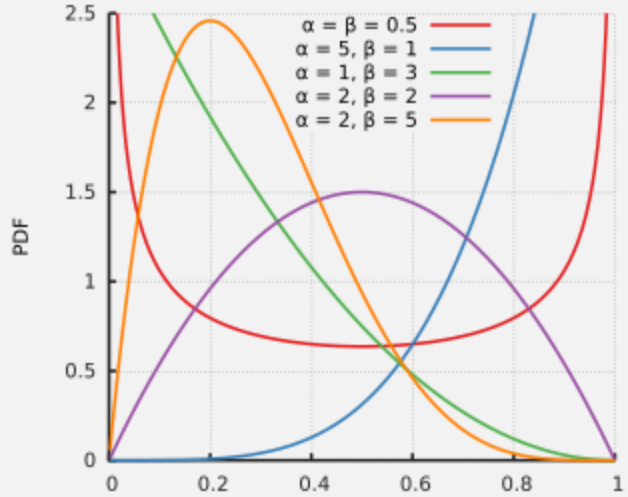
The probabilistic forecasting and the new metric of forecast error are eye-openers as to why all the previous efforts never worked. Probabilistic forecasting explains the magnitude of demand variability. The new metric of forecast error properly measures uncertainty in forecasts, guiding improvements in forecasting.

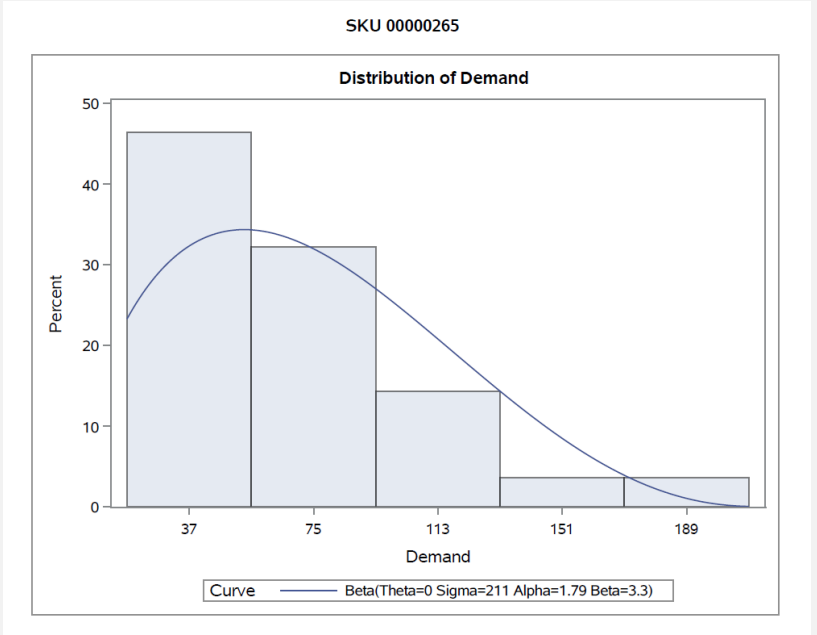




PROBABILISTIC METHODOLOGY

1. **Demand is decomposed into different sources** of demand (e.g., types of customers, sales channels, etc.)
2. **The Beta distribution is essential in probabilistic demand forecasting**, modeling empirical distributions of demand levels. **The resulting forecasts present modeled demand levels with their associated probabilities.**
3. **The quality of the forecast is assessed using the Total Percentile Error** which:
   - **Measures the complete value of a forecast**, not just the average expected value per period.
   - **Is robust to intermittency, outliers, trends, seasonality, promotions**, etc.





BUSINESS VALUE

Embracing a probabilistic approach to forecasting is essential for effectively managing demand and delivering powerful outcomes:

- Superior inventory management
- Reduced inventory levels without sacrificing customer satisfaction
- The ability to pinpoint improvement areas across all product types.

By grasping the nuances of demand probabilities, retailers can decisively enhance capacity planning, purchasing, production, inventory management, and budgeting. This strategic approach not only minimizes risks but also also positions businesses to capitalize on growth opportunities with confidence.

How to “Know” Customer Preferences

Redefining Customer Analytics :: Customer and Product Success Profile

SHIFT IN CUSTOMER ANALYTICS PARADIGM

Surveys are everywhere, as they are a never-ending dialogue with customers about their opinions on new or existing products, brand awareness, customer needs, and other topics.

TRADITIONAL

Survey data is often inappropriately analyzed, leading to incorrect conclusions about customer preferences:

- Survey responses are often treated as numbers, even though they are measured on an ordinal scale and do not represent actual values.
- Different difficulties of survey items (survey questions) and the dependencies among them are often overlooked.
- Different abilities of respondents are ignored.

NOVEL

Survey data is appropriately analyzed, and it leads to correct conclusions about customer preferences when:

- Responses measured on an ordinal scale are converted to a probability scale.
- The analysis considers the difficulty of survey items and the ability of respondents.
- Dependencies among items are used to identify foundational (key) survey items.

AI/ML CUSTOMER ANALYTICS

Modified Polytomous Rasch Measurement Model

$$P\{X_{ni} = x\} = \frac{exp\sum_{k=0}^{x}(\beta_n - (\delta_i - \tau_k))}{\sum_{j=0}^{m} exp\sum_{k=0}^{j}(\beta_n - (\delta_i - \tau_k))}$$

Relational Bayesian Network

Proprietary algorithms

- Identifies malfunctioning survey items and untrustworthy responses
- Identifies difficulty of survey items and ability of respondents
- Establishes causal relations among survey items
- Produces actionable outcomes for the respondents as a whole and for individual respondent

By conducting a series of short consecutive surveys, the system can accurately identify customer preferences and product strengths and weaknesses eliminating the bias of sample under-representation. This process creates a Customer and Product Success Profile that quantifies the impact of foundational items on consumer preferences.

BUSINESS VALUE

The Customer and Product Success Profile (or Model) offers numerous benefits to a business:

- Enhances demand forecasting by integrating it with customer preferences.
- Generates product demand.
- Reveals genuine customer opinions on product attributes and promotions.
- Identifies crucial product attributes and their alignment with customer preferences.
- Provides actionable recommendations for product and promotion improvement
- Helps prevent costly errors in product and promotion decisions.

ABOUT US

- YieldWise Inc., has developed an analytical platform that supports applications like SINTENO. The YieldWise application suite also includes:

  A-SCALA which focuses on redefining student success, and

  EXOUSIA which focuses on redefining employee success

- YieldWise is a leading provider of innovative analytical solutions specializing in the research and development of sophisticated analytical methods and software tools for various applications such as demand forecasting, design of experiments, survey analysis, statistical quality control, survival analysis, time series analysis and forecasting, and consulting services.