

StorePulse

Demand Forecasting Automation Platform using NB-INGARCH Models

MTech Technical Presentation - Complete System Architecture

💡 Why NB-INGARCH for Retail Forecasting?

The Problem with Traditional Methods

METHOD	LIMITATIONS	WHY IT FAILS FOR RETAIL
Moving Average	Lags behind trends	Misses promotional spikes, holidays
Linear Regression	Assumes Gaussian errors	Can predict negative visitors
ARIMA	Continuous-valued	Doesn't respect count data
LSTM/Deep Learning	Needs massive data	Retailers have limited history

NB-INGARCH Solution

```
graph LR
    A[Non-negative Var >> Mean] --> B[Today ~ Holidays, Distribution]
    B --> C[Autoregressive]
    C --> D[Regressors]
    D --> E[Model]
    E --> F[Autoregressive]
    F --> G[NB-β₀ + Σβᵢyₜ₋ᵢ + Σγⱼxₜ,j]
    G --> H[Exogenous INGARCH]
    H --> I[NegBin μₜ φₜ]
    I --> J[μₜ φₜ]
    J --> K[Yₜ]
    K --> L[Properties]
    L --> M[Autocorrelation]
    M --> N[Exogenous]
    N --> O[Negative]
    O --> P[Overdispersion]
    P --> Q[Exogenous Effects]
    Q --> R[Negative Binomial]
```

Mathematical Formulation:

Conditional Mean: $\mu_t = \beta_0 + \beta_1 \cdot y_{t-1} + \beta_2 \cdot y_{t-2} + \gamma_1 \cdot \text{is_weekend} + \gamma_2 \cdot \text{is_holiday} + \dots$

Distribution: $Y_t \sim \text{NegativeBinomial}(\mu_t, \phi_t)$ where $\text{Var}(Y_t) = \mu_t + \phi_t \cdot \mu_t^2$

Estimation: Maximum Likelihood via statsmodels library

Parameters: p=2 (AR lags), q=1 (ARCH term), k=21 (exogenous features)

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MTech Project | NB-INGARCH Implementation | Verified Metrics

All diagrams, metrics, and architecture details are based on actual implementation