

Seams Predictable:

MACHINE LEARNING FOR DEMAND FORECASTING IN SLOW FASHION

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PROBLEM STATEMENT AND OBJECTIVES

BUSINESS CONTEXT

Frank & Eileen: A luxury slow-fashion basics brand focused on sustainability and quality

MAIN CHALLENGE

Quarterly, buy process (orders for manufacturers) relies on “by-feel” estimates and siloed data sources

KEY QUESTION

How can we develop tools that complement planners’ expertise and streamline buy decisions?

OBJECTIVE

Empower inventory planners with reliable product demand forecasts via ML pathways, backed by an interactive dashboard with supporting analytics and efficiency utilities

A proof-of-concept for scaling data science at F&E!

DATA COLLECTION PROCESSES

Order Data Extraction Via Shopify APIs

Disparate Product Metadata via Airtable APIs

RBG Photo-based Color Mapping

Full Circle Wholesale Reports

Custom data definitions & threshold logic

7.5 YRS E-COMM SALES

33 CORE PRODUCTS

16K PRODUCT LAUNCHES

2 YRS WHOLESALE DATA

These diverse inputs (requiring custom scripts, manual coordination, and rigorous cleaning) feed into our hand-made end-to-end automated ETL pipeline.

METHODOLOGY

DATA INGESTION

Collection from APIs, cleaning, enrichment

E-COMMERCE DEMAND MODELING ENGINE

CORE PRODUCTS

Stable best-sellers, abundant history, minimal planner oversight → Transformer time-series model for monthly demand a year out

NEW LAUNCHES

New product variants, no data precedent, high planner oversight → Interpretable decision-tree model for first-month demand

DELIVERY LAYER

Interactive web app development to house models, wholesale analytics, and tools

EFFICIENCY & STRATEGY

Tools to streamline buy processes & ideas for scaling data science at F&E

TIME SERIES MODEL FOR CORE PRODUCTS

BUSINESS GOAL

Predict monthly demand for 33 stable best-sellers over the next 12 months to accurately guide buy decisions

CHALLENGE

A single model must handle diverse demand cycles and feature inputs across many SKUs

SOLUTION

Global Transformer (TimesFM) fine-tuned on multi-year sales + product covariates for high-accuracy, automated forecasts

EVALUATION FRAMEWORK

Primary Metric: Average Style Level RMSE on 6-month backtests

Robustness: Size/Style Level RMSE (more granular) and 9/12-month sliding window cross-validation (more seasonally robust)

Approach: Evaluate Bottom-up vs Top-down backtesting (size-first vs style-first predictions)

Baseline: Zero-Shot TimesFM Forecasts

Hyperparam Grid Search & Architecture Distillation

Post-Processing: Business & Seasonal Layers

UI Integration with auto monthly refresh

266

6M RMSE

→

210

6M RMSE

→

173

6M RMSE

TREE MODELS FOR NEW LAUNCHES

BUSINESS GOAL

Predict the demand for a new product before it launches to add a third, data driven voice into buy decisions

CHALLENGE

Predicting demand for new items relies on historical data for similar products as there is no direct historical data

SOLUTION

A classification tree per category (Dresses, Tops, Bottoms, Button Ups) used to classify a launch as high, medium, or low demand

Tested on the last 12 months of launches:

Overall Accuracy: 47-58%

Recall (“High demand”): 59-86%

Precision (“High demand”): 54-60%

“High demand” is key: F&E sells out to maintain exclusivity while preventing overstock

Automated Monthly

Backfill order & product data → Clean and re-train trees → User inputs new product features in UI → Selected tree is traversed → Display demand range and tree path

USER INTERFACE

DTC Core Product Forecast
12 Month Forecast for SKU_8

Quarterly Forecast

Size Ordering Guide

DTC New Launch Forecast

Choose Style

Choose Color

Choose Fit

Choose Fabric

Choose Month

Choose Sleeve

1st Month Demand for SKU_6 Post-Launch: High (500+ units)

Driven by Color Blue & Launch Month in June

Wholesale Core Product Analytics
DTC/Wholesale Demand for SKU_11

DTC: Wholesale Ratio 2:1

DTC Growth +10%

Wholesale Growth +8%

Wholesale Peak Month: May

DTC Peak Month: Jan

Wholesale Peak Quarter: SP

DTC Peak Quarter: RE

True Demand Forecasts for Sell-Outs

Select Sold Out SKU

Matched Sister SKU for SKU_9: SKU_3

Projected Total Demand: 20

Missed Units: 5

Units Sold Before Sell-Out: 15

Weekly Sales Comparison: Sold-Out SKU vs. Sister SKU

EFFICIENCY TOOLS

Aimed at addressing heavy manual processes: small automation tools for faster workflows & early data-science wins!

CENSORED REGRESSION

Uses sister-SKUs to predict potential lost sales due to an item running out of stock → MAPE: 2.7% on a test set of 10 products

PHOTO FILLER

Matches SKUs with photos and automatically populates a buy sheet with product photos

DISCREPANCY CHECKER

Compares inputted buy quantities in separate forecasting sheets to find discrepancies

SAVING ~72 PERSON-HOURS ANNUALLY

1

Actionable demand insights with guided buy recommendations

2

Automated manual tasks, freeing planners for strategic expertise

3

Proof-of-concept for data science adoption and future growth at F & E

IMPACT

“IN A MATTER OF MONTHS ANYA & KIERA WERE ABLE TO CLEARLY SHOW HOW INVESTING IN DATA SCIENCE AND TAKING A MORE ADVANCED APPROACH TO PLANNING COULD HAVE A SIGNIFICANT IMPACT ON OUR BUSINESS. THEY WERE ABLE TO PROVIDE A GLIMPSE INTO OUR FUTURE AS A TRULY DATA-ENABLED COMPANY.”
-BRAD BARRISH, CTO