Seams Predictable:

MACHINE LEARNING FOR DEMAND FORECASTING IN SLOW FASHION

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KIERA PATTERSON



Frank& Eileen







7.5 YRS E-COMM

SALES

33 CORE **PRODUCTS**

16K PRODUCT

LAUNCHES

2 YRS WHOLESALE

DATA

PROBLEM STATEMENT AND OBJECTIVES

BUSINESS CONTEXT

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



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



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

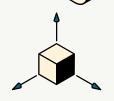
A proof-of-concept for scaling data science at F&E!

ANYA GERT

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

These diverse inputs (requiring custom scripts, manual coordination, and rigorous cleaning) feed into our hand-made

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

METHODOLOGY

DELIVERY LAYER

end-to-end automated ETL pipeline.

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 9/12month 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**



6M RMSE



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:

Recall ("High demand"):

Precision ("High demand"):

47-58%

59-86%

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

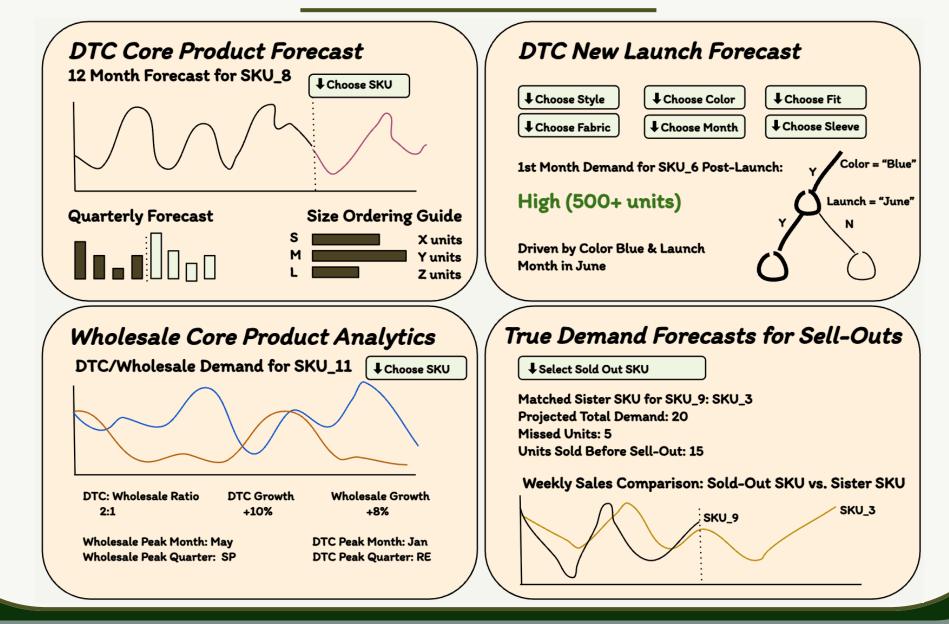
Selected tree is traversed

Display demand range and tree path





USER INTERFACE



EFFICIENCY TOOLS

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

CENSORED REGRESSION

РНОТО

FILLER

DISCREPANCY

CHECKER

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

Matches SKUs with photos and automatically

populates a buy sheet with product photos

Compares inputted buy quantities in separate

forecasting sheets to find discrepancies

Actionable demand insights with guided buy recommendations



SAVING ~72 PERSON-HOURS ANNUALLY

Automated manual tasks, freeing planners for strategic expertise



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

