What WEAR When?

Demand Forecasting for Future Fashion Products

Alex Birch
Vincent Lao

Iris Singhania
Jingjing Ni
“Pink top, long slv ruched floral style blouse spring, weekend retreat, drawstring front elasticized details sleeves Kit & Sky...”
“Pink top, long slv ruched floral style blouse spring, weekend retreat, drawstring front elasticized details sleeves Kit & Sky…”
Project Context - Macy's

- Macy's department stores: 446
- Women's apparel revenue: 4.3B+
- Total annual revenue: 24B+
Project Context - Forecasting

Traditionally:
Project Context - Forecasting

Our Project:
How do we do it?
Model Framework

Product / Store / Micro-econ / Data

Product-Trend Matching

Forecasting

Forecast 1

Forecast 2

Forecast 3

Forecast

"Pink top, long slv, ruched floral style, blouse spring, weekend retreat, drawstring front, elasticized details, sleeves Kit & Sky."

Herald Square, NYC

Jan-Jun 2023
Results

*Use Case 1*

**Buy Forecast**

*Use Case 2*

**Allocation Forecast**
Results

Use Case 1

- **Buy Forecast**
  - Capture Percentage: 79%

Use Case 2

- **Trend Matching**
  - Correlation: 64%

- **Allocation Forecast**
  - Capture Percentage: 2%
Dashboard Prototype
Impact

Innovated novel methodology for demand forecasting, pioneering a new class of forecasting at Macy’s

Reinterpret Models for New Use Cases

Product Popularity Estimator

Product Matching Tool
Thank you to:

- Macy’s Analytics Team
- Sandra, Iris, Jingjing, Akhil, and many others
- Prof. Fazel
- MIT MBA n Program

Thank you! Any questions are welcome!

vlao@mit.edu  bircha@mit.edu
Appendix
Future Work

New Data Sources
- Predicted fashion trends
- Better inventory data

New Forecast Scopes
- Partition locations into regions
- Partition products based on their intended life cycle

New Methodologies
- Tensor Completion
- Time-series Approaches
Use Cases

Allocation Forecast

Buy Forecast

*Data censored at request of Macy's*
Product Matching Tool

8 most similar products in Millennial Sportswear

*soft ecru pants striped tie waist tapere, fabric pattern stripe, pant length ankle, style straight, cotton, Striped Tie-Waist Pants…

Product Matching

39376679336*

885151044697
627962836289
39376677288*
195054441357
39376679336
627962836081
195203300160
792831373315
627962897143

*12 digit upc code
"lavender top, long slv ruched floral style blouse spring, weekend retreat, drawstring front; elasticized details sleeves Kit & Sky ..."
Top-Down Trend Matching - Overview

**X** - NLP embeddings from text data

**y** - Clusters found from pure demand clustering (n=5, weighted)
Top-Down Trend Matching - Example

Predicted Cluster: 0
Actual Cluster: 0

Predicted Cluster: 1
Actual Cluster: 4
Product-Trend Matching - Ensemble Method

Hyperparameter Tuning
Product-Trend Matching - R-Squared

Classification
Mean R2: 0.2711333041601214
Median R2: 0.3717150408131663

KNN
Mean R2: 0.08241844813950884
Median R2: 0.17189358004760624

Ensemble
Mean R2: 0.3295331148712052
Median R2: 0.4054799609351912
Product-Trend Matching - Mean Absolute Error

Classification
Mean MAE: 0.024777997511992254
Median MAE: 0.02212645287870084

KNN
Mean MAE: 0.027436192264568646
Median MAE: 0.02577599005588107

Ensemble
Mean MAE: 0.024139177700174794
Median MAE: 0.02184279620621709
Random Forest Feature Importances [.COM]