

Improving Demand Forecasting Models

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Hello!



Singapore



MS Business Analytics (Data Science)
Columbia University

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London School of Economics and Political Science



Grand Canyon, Arizona

Context

What are features used in forecasting demand for a product?



Past Demand



Holidays



Date



Promotions



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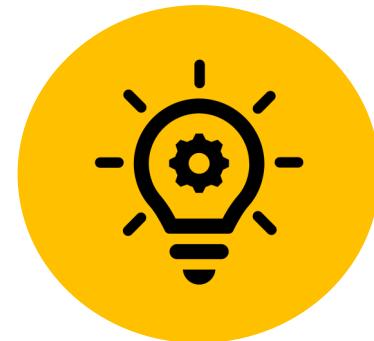
Feature Selection

Why do it?

Selecting a subset of features that hold greatest forecasting power and using only this subset when forecasting



Increase forecasting accuracy



Easier to explain model to stakeholders

Problem Statement: Why Select Features?

Nestlé currently uses data in 60+ features relevant to forecasting demand

In future, more data is expected to be used



Create robust & flexible feature selection tool that can be leveraged for any & all datasets

GOALS
Improve accuracy in demand forecasts

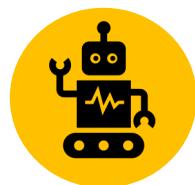
Project Overview

Phase 1

Develop feature selection tool in Azure DataBricks



Agile



Automated



Scalable

Compare against existing tool in SAS

Phase 2

Integrate feature selection tool at more granular forecasting levels



Agile

Explore various machine learning models for demand forecasting

Compare against existing model in SAS

1

Phase 1 Dynamic Feature Selection

Dynamic Feature Selection

1: Improving on the current approach

Method: Permutation Feature Importance

This week's demand	Last week's demand
1	4
2	5
3	6

Forecast Accuracy = 80%

This week's demand	Last week's demand
1	6
2	4
3	5

Forecast Accuracy = 75%

Feature importance of last week's demand = 5%

Dynamic Feature Selection

2: Developing entirely new approach

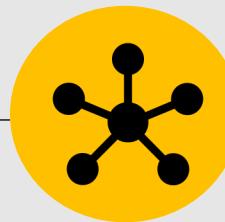
Method: Feature Engineering through Interaction

Current Approach

Uses only original features

New Approach

Creates useful features
from original features



Extracting utility
from data



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Dynamic Feature Selection

2: Developing entirely new approach

Method: Feature Engineering through Interaction

Original Features:



Feature 1



Feature 2



Feature 3

New Features:



Original Features

+

Interaction Terms

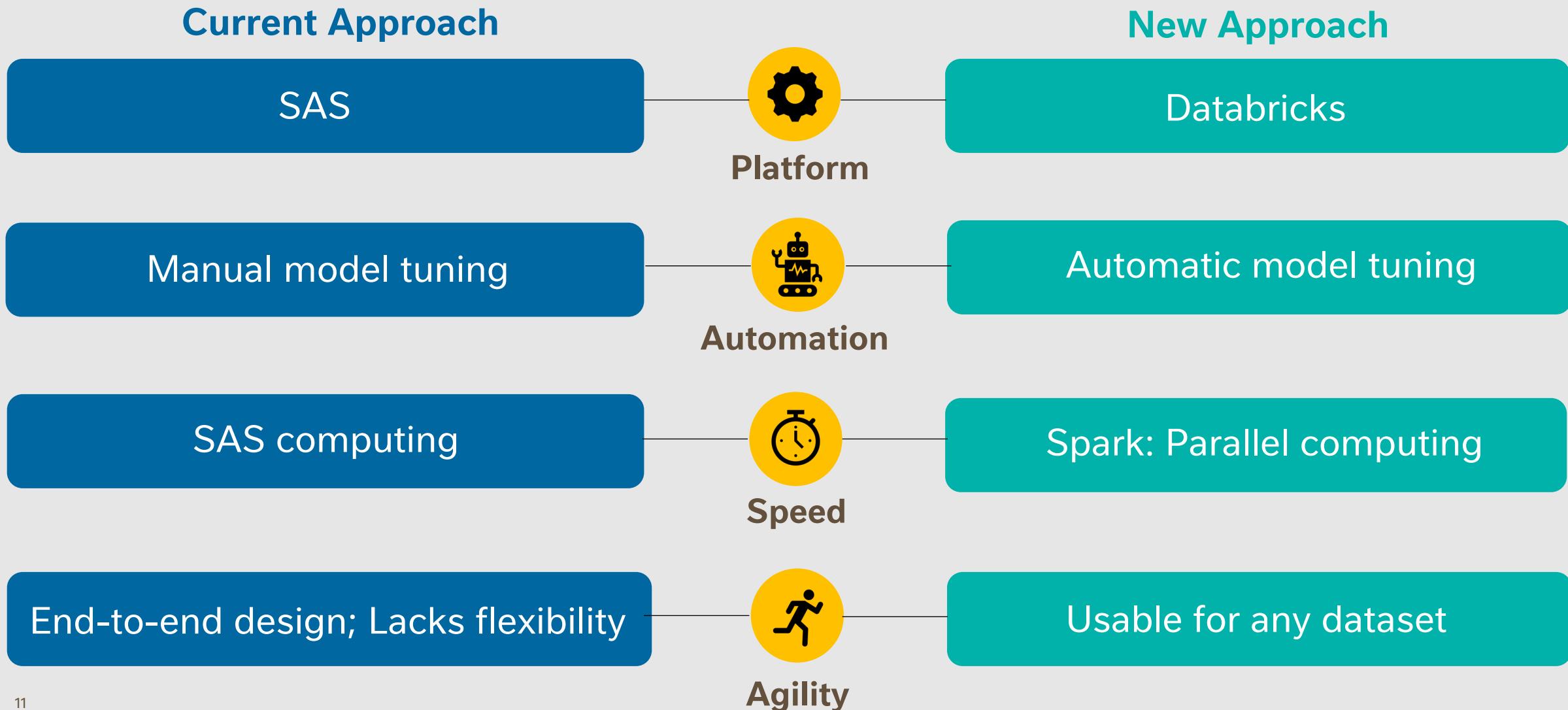


New features selected can now be a mixture of:
Original Features and Interaction Terms



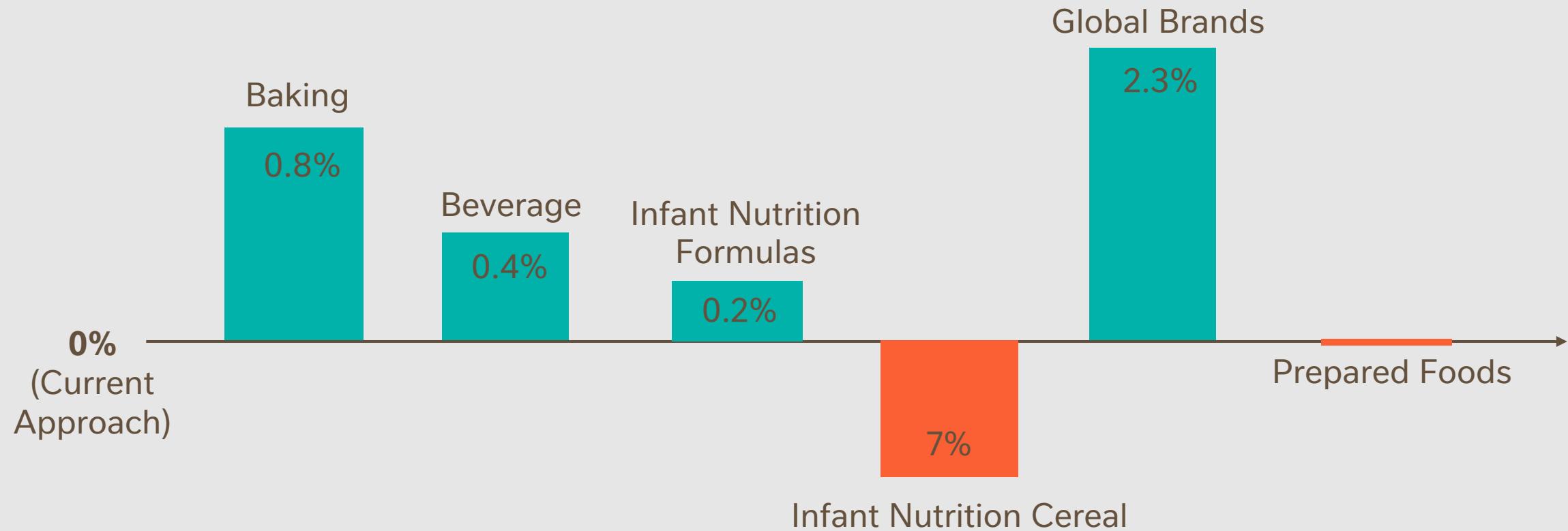
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Feature Selection Tool



Impact on Demand Forecasts

Average Change in Demand Planning Accuracy (DPA), SKU-Month



Back-Test Period: Jun 2019 – Feb 2020

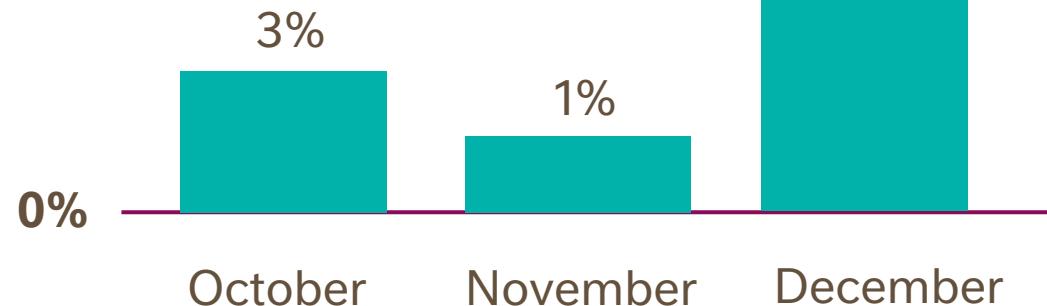
Baking Business: Impact on Demand Forecasts

Average Change in DPA, SKU-Month

Baking

0.8%

Volatile months show significant DPA improvement



Back-Test Period: Jun 2019 – Feb 2020

Baking Business: Impact on Selected Features

Current Approach

Seasonality in baking demand better captured through robust feature selection

Apr, May, Aug



New Approach

Sept, Oct, Dec

Month

Easter, NBA Playoffs



Halloween

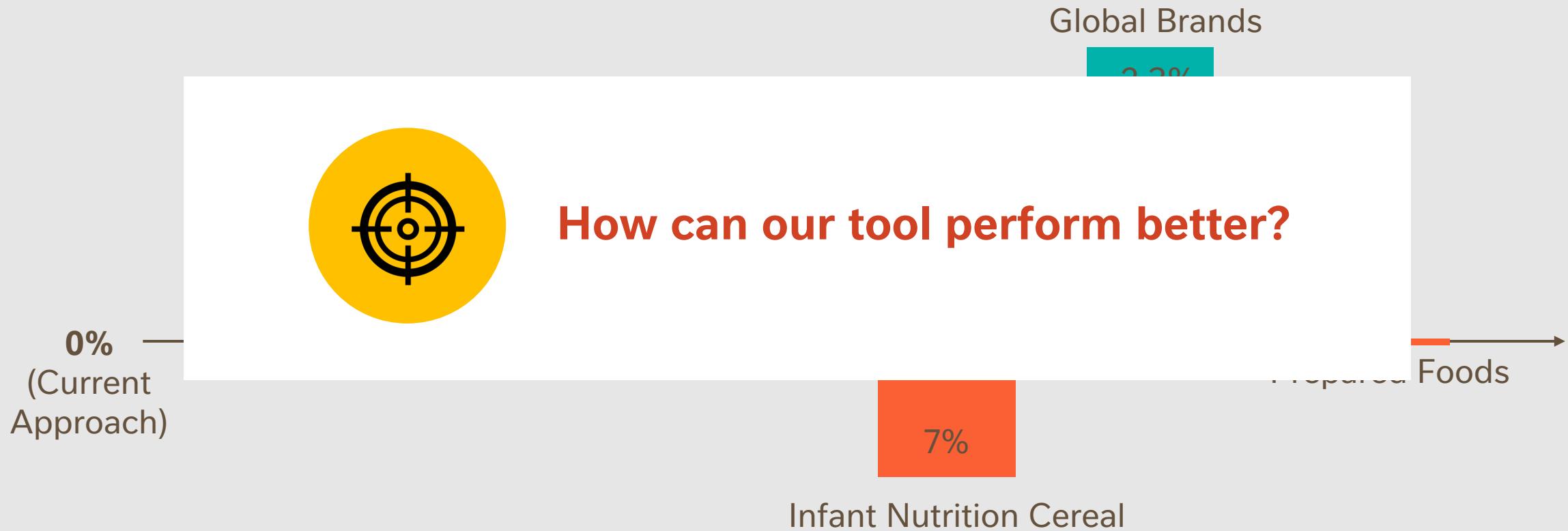
Holidays



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Impact on Demand Forecasts

Average Change in Demand Planning Accuracy (DPA), SKU-Month



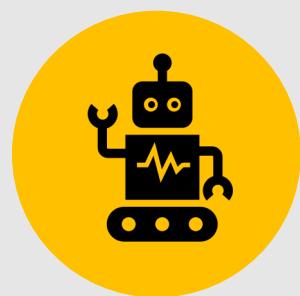
Back-Test Period: Jun 2019 – Feb 2020

What We've Achieved So Far

Developed feature selection tool in Azure DataBricks



Agile



Automated



Scalable



Speed



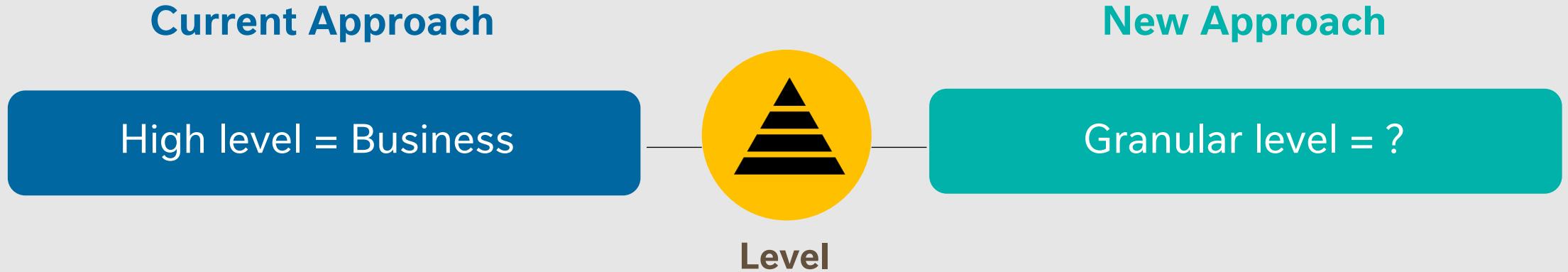
How can our tool perform better?

2

Phase 2

Dynamic Feature Selection with Increased Forecast Granularity

Improving on Feature Selection Tool



Improving on Feature Selection Tool

Current Approach:
High Level



Baking



Do feature selection for each business



A



B



B

Use same features across all
products and customers in the business

Improving on Feature Selection Tool

New Approach:
Granular Level



Baking



Use different features for each customer

→ **Do feature selection for each customer**

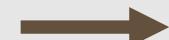
{ → **Do feature selection for each customer**

Improving on Feature Selection Tool

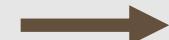
New Approach:
Granular Level



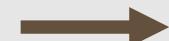
Baking



Do feature selection for each product-store pair

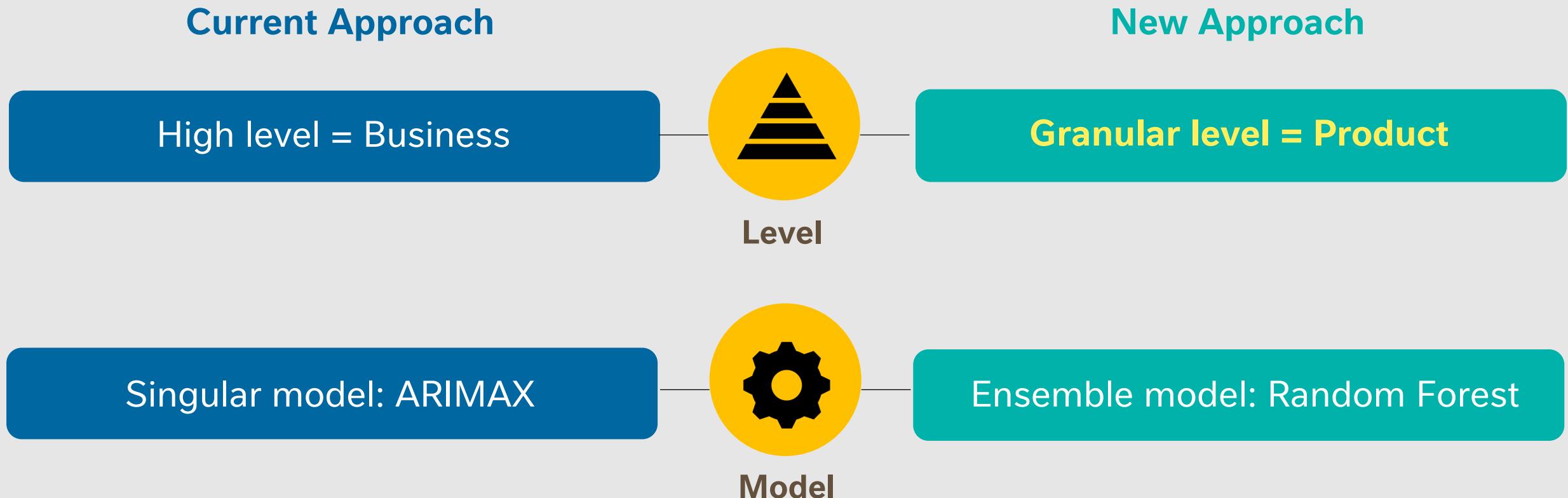


Do feature selection for each product-store pair



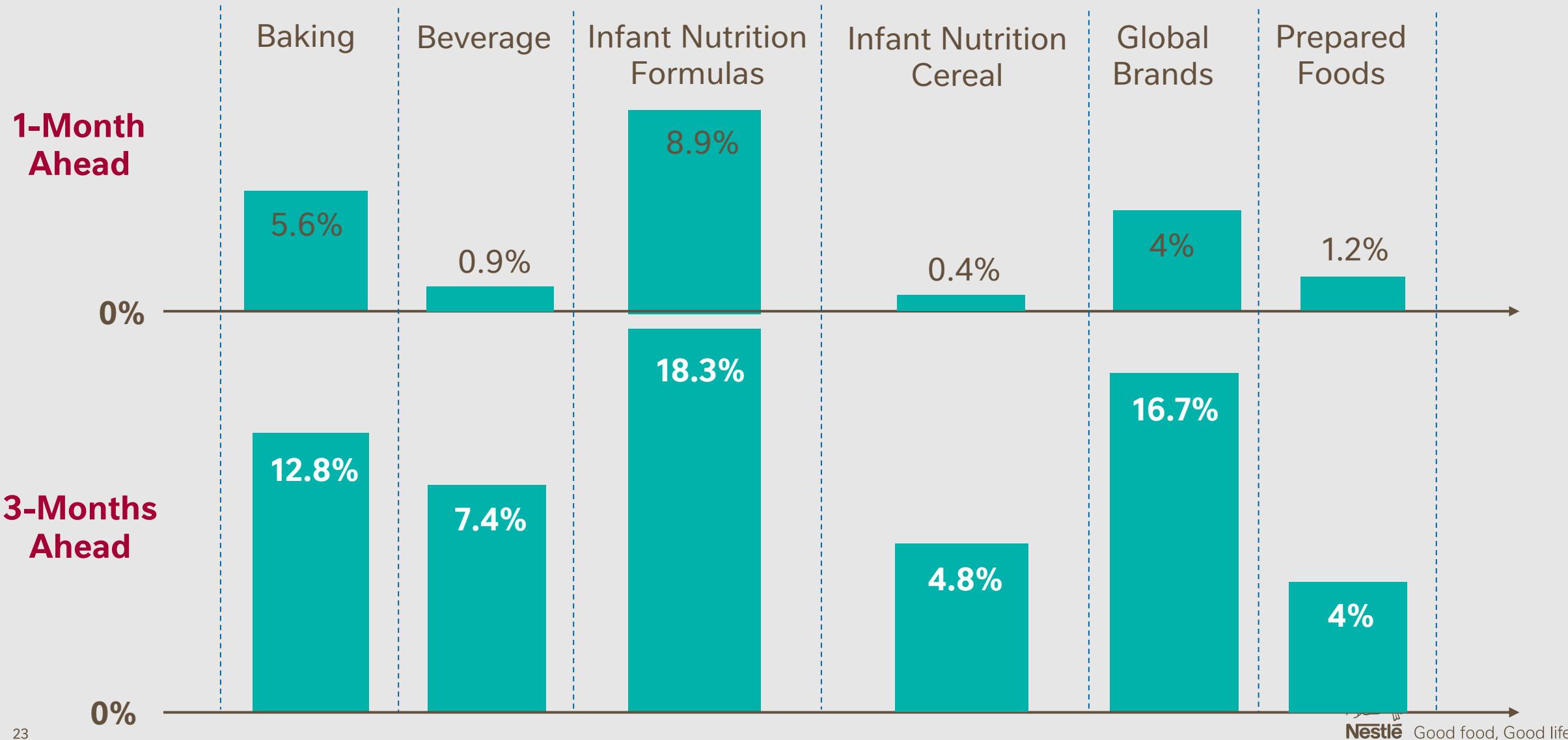
Do feature selection for each product-store pair

Improving on Feature Selection Tool



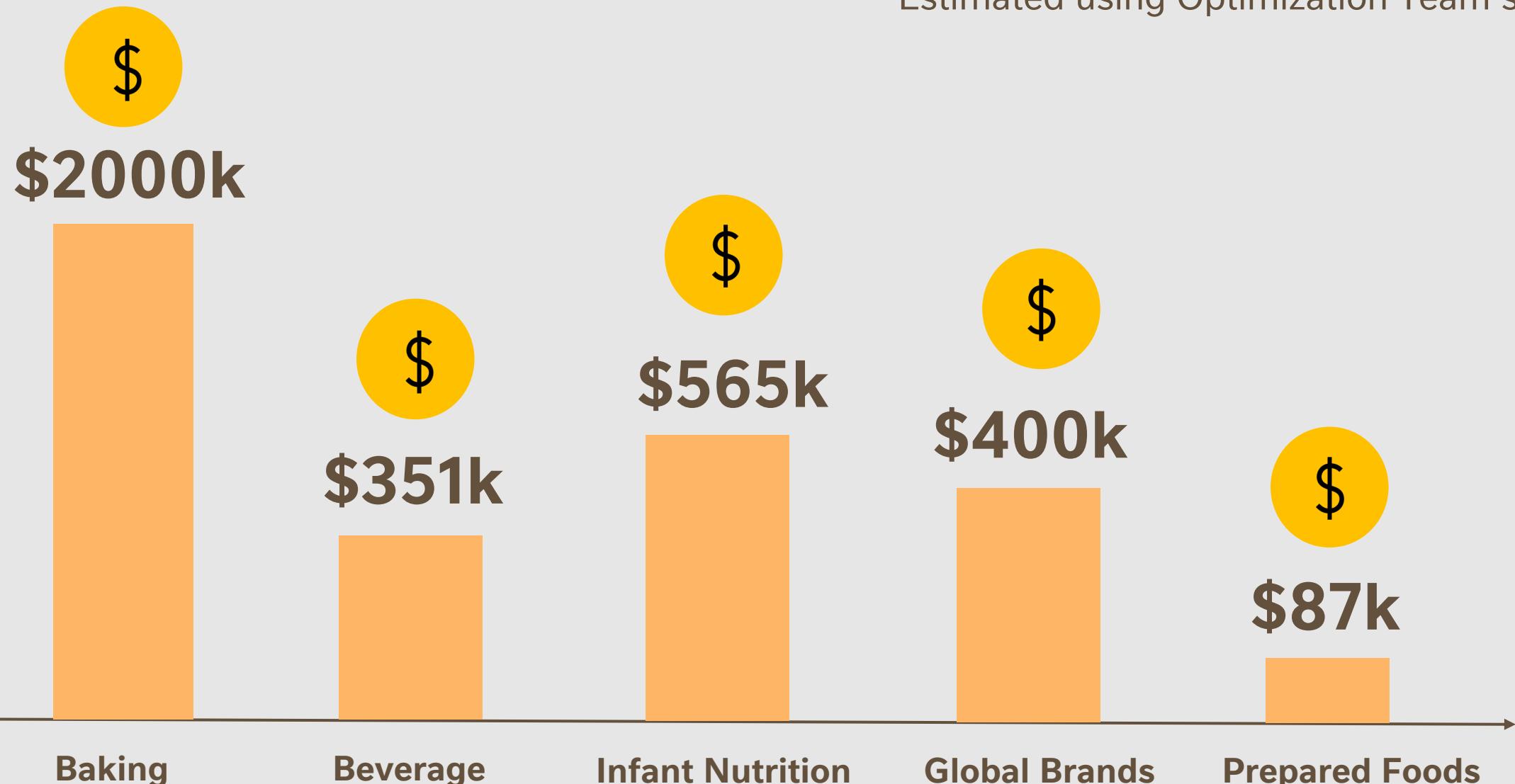
Impact on Demand Forecasts

Average Change in Demand Planning Accuracy (DPA), SKU-Month



Cost Savings

Based on inventory cost reduction only
*Estimated using Optimization Team's tool



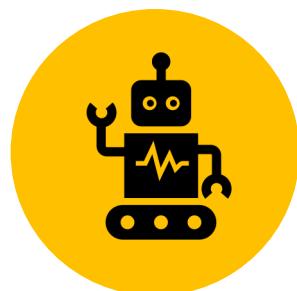
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What We've Achieved

Developed feature selection tool in Azure DataBricks



Agile



Automated



Scalable



Speed



Accuracy

Determined optimal level for feature selection
and integrated tool at this level

My Time at Nestlé



My Internship Takeaways



How Nestlé works



Time-series forecasting



To love what you do, and do what you love!



Nestlé

Questions?

Thank You!



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