

DEV DAY

# Solve complex business problems with Amazon Personalize and Amazon Forecast

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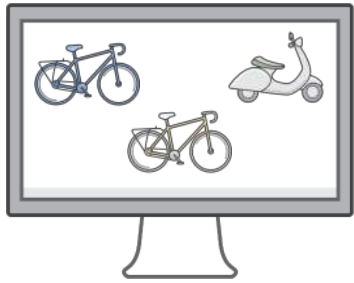
DEV DAY

# Personalizing user experience



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# Common applications & use cases



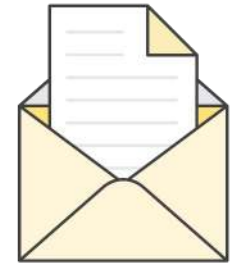
Personalized  
recommendations



Related Items



Search  
reranking



Notifications  
and emails

Personalizing user experience is proven to increase discoverability, engagement, user satisfaction, and revenue

30% of page views on Amazon are from recommendations



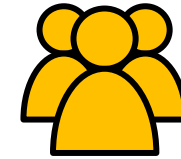
... However, most customers find personalization hard to get right

# Effective personalization requires solving multiple hard problems

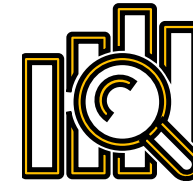
Reacting to user interactions in real time



Avoiding mostly showing popular items



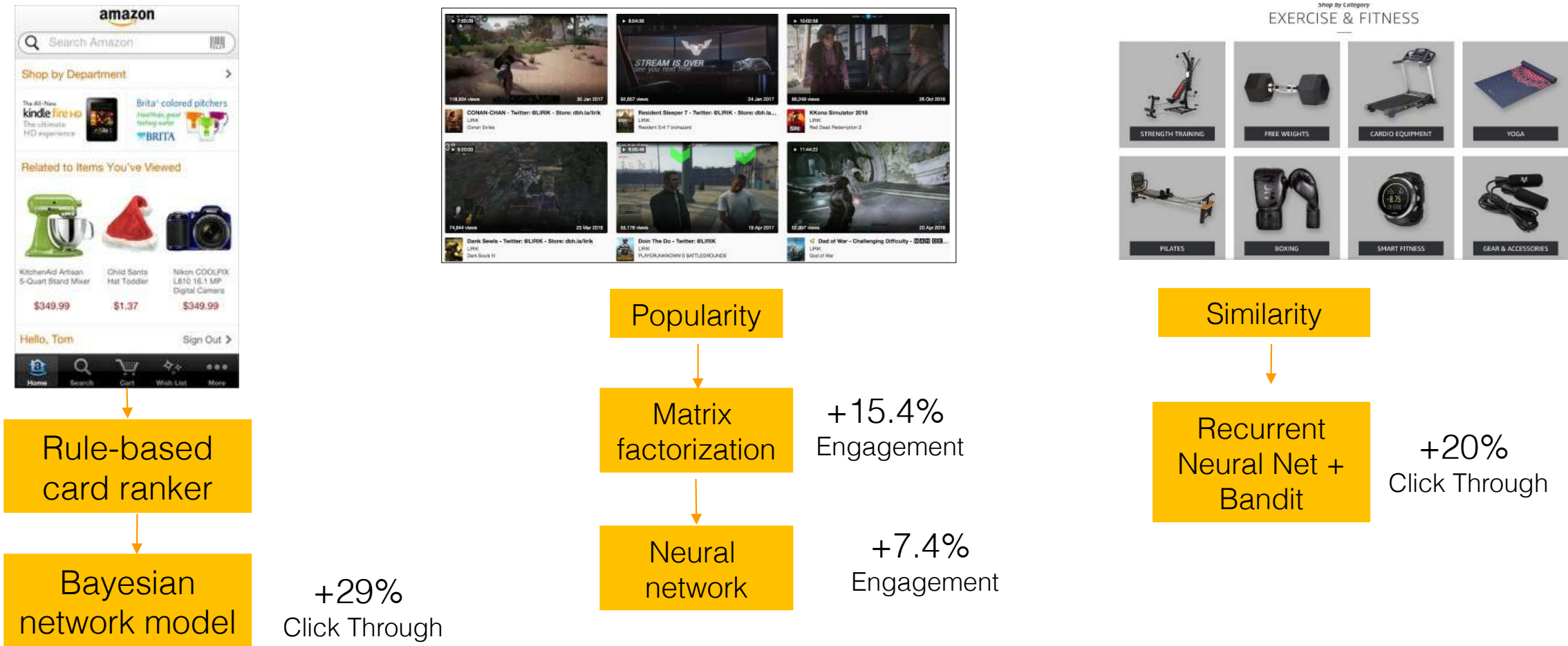
Handling cold start (insufficient data about new users/items)



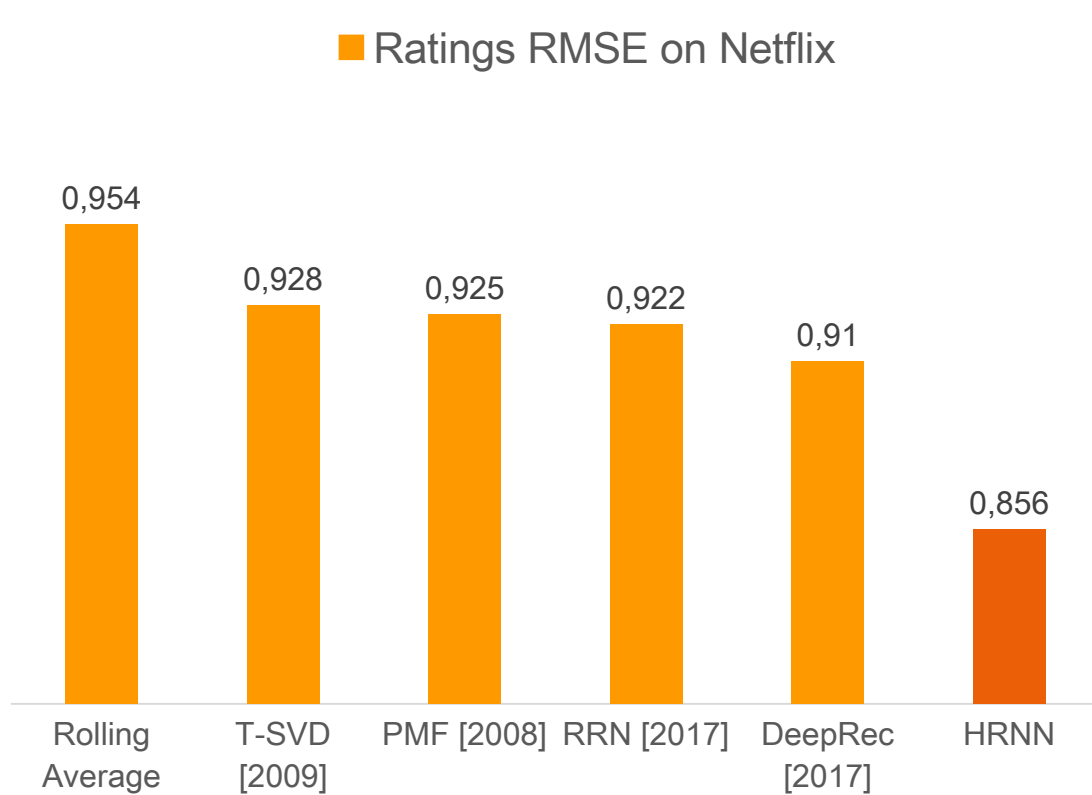
Scale



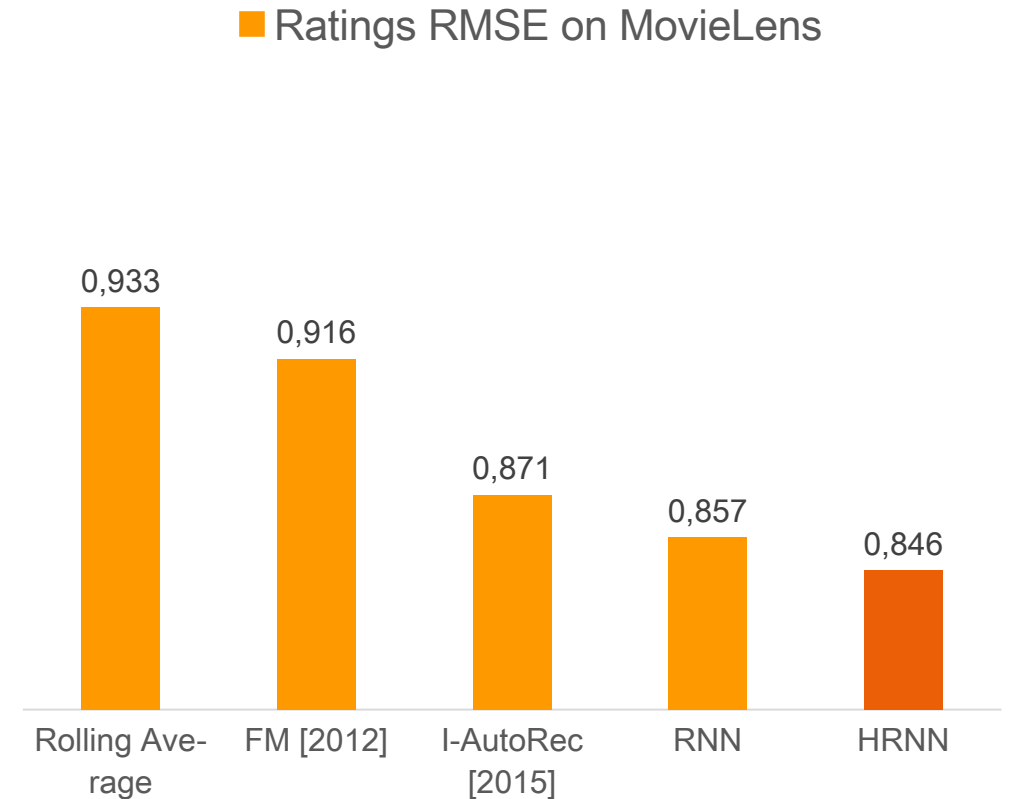
# Deep learning techniques have a direct impact on the bottom line



# Deep Learning delivers state of the art performance



Ratings RMSE on Netflix  
98 MM interactions, 500k users, 18k items



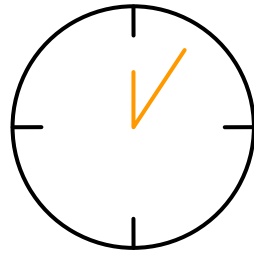
Ratings RMSE on MovieLens  
20 MM interactions, 173k users, 131k items

# Amazon Personalize – now generally available!

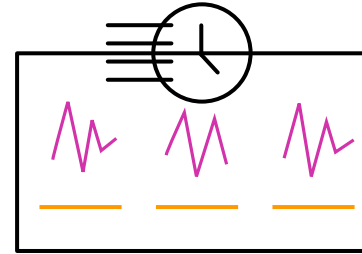
Improve customer experiences with personalization and recommendations



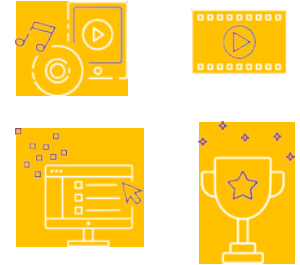
Deliver high quality recommendations



Real-time



Deliver personalization in days, not months



Works with any product or content

## KEY FEATURES

Context-aware  
Recommendations

Automated  
machine learning

Continuous learning  
to improve  
performance



PlayStation®





# Amazon Personalize: How it works

## Activity stream

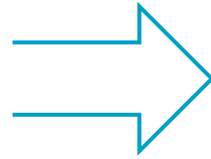
Views, signups, conversion, etc.

## Inventory (optional)

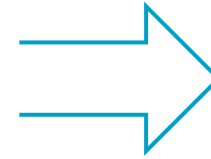
Videos, products, articles, etc.

## Demographics (optional)

Name, age, location, etc.



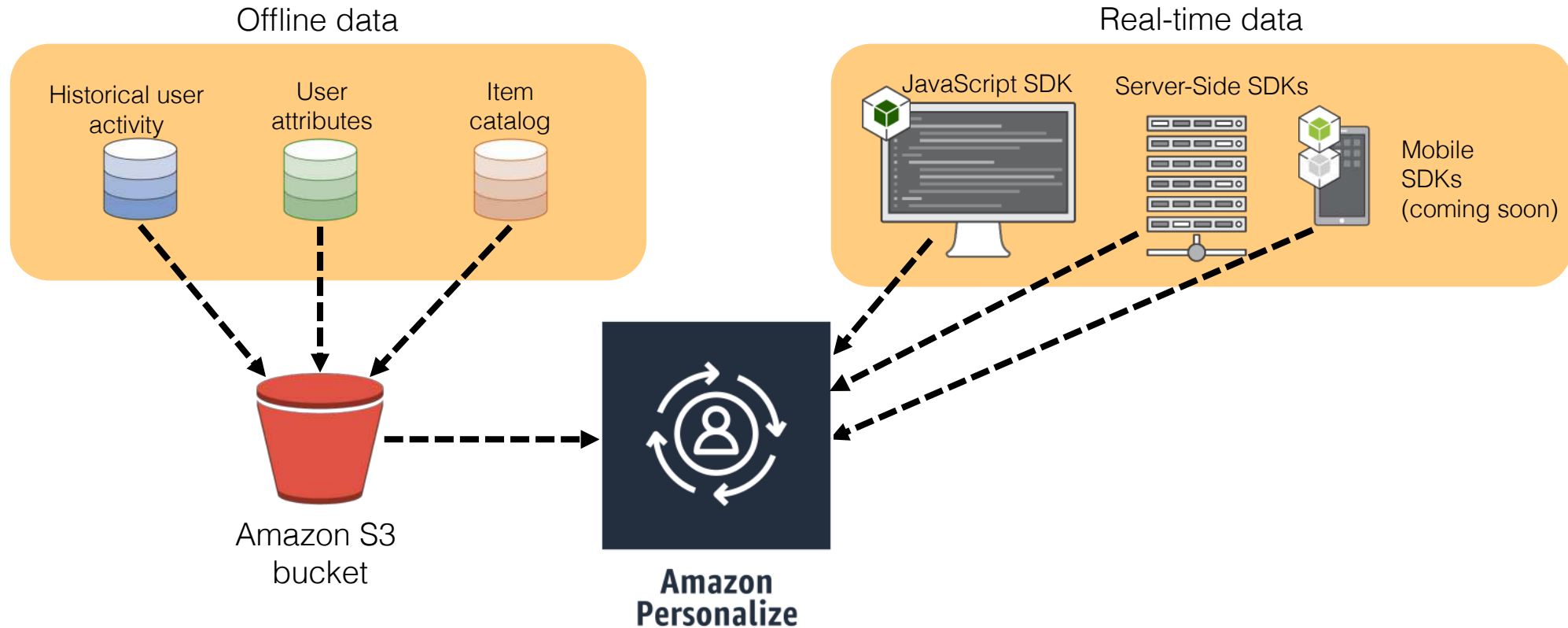
1. Load data
2. Inspect data
3. Identify features
4. Select algorithms
5. Select hyperparameters
6. Train models
7. Optimize models
8. Build feature store
9. Deploy and host models
10. Create real-time caches



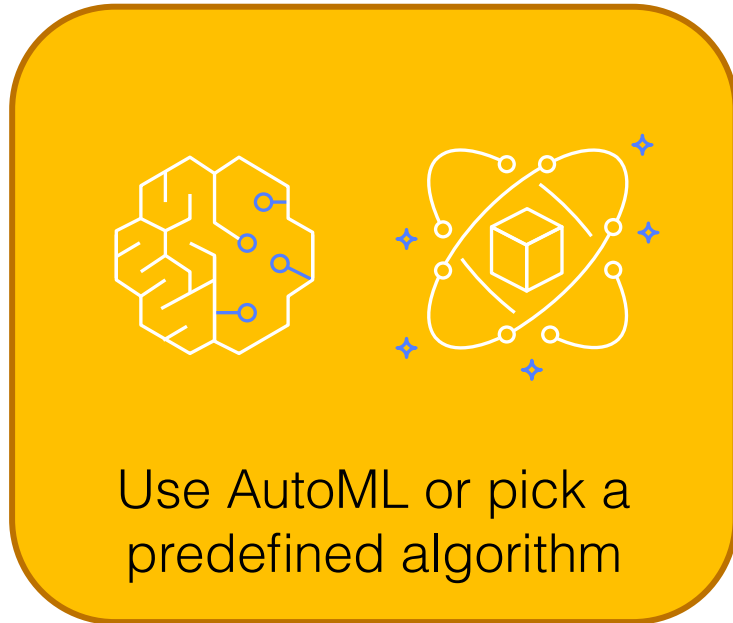
Private Customized  
Personalization  
API

Amazon Personalize

# Feeding data to Amazon Personalize



# Train custom models once you ingest data



- Choose a preconfigured algorithm (packaged as **recipes**) or use **AutoML**, and Amazon Forecast will pick the right recipe for you
- Amazon Personalize can use **Hyper Parameter Optimization** to tune models automatically.

# Demo

<https://github.com/aws-samples/amazon-personalize-samples>

# Predicting future points in a time-series

# Sample use cases



Product demand



Workforce demand

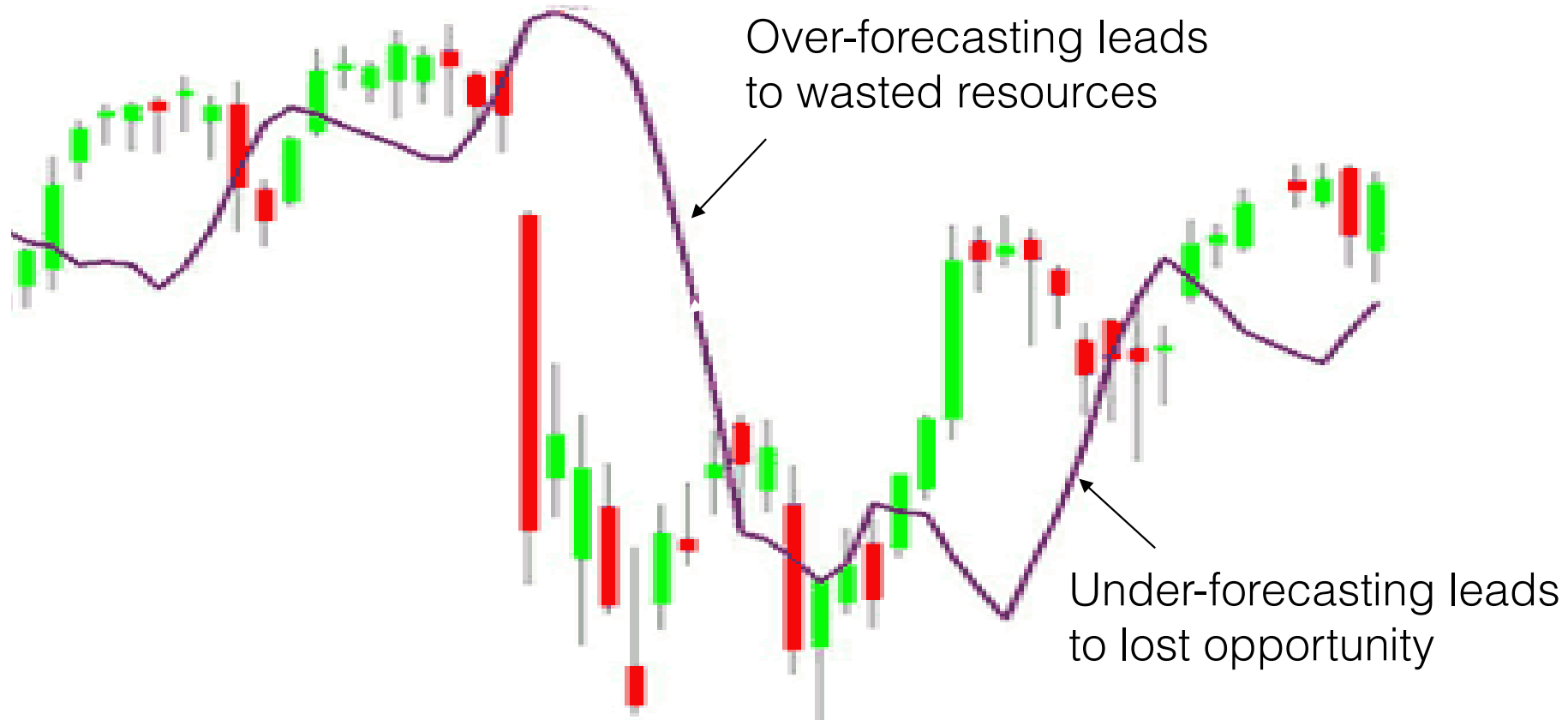


Financial  
metrics

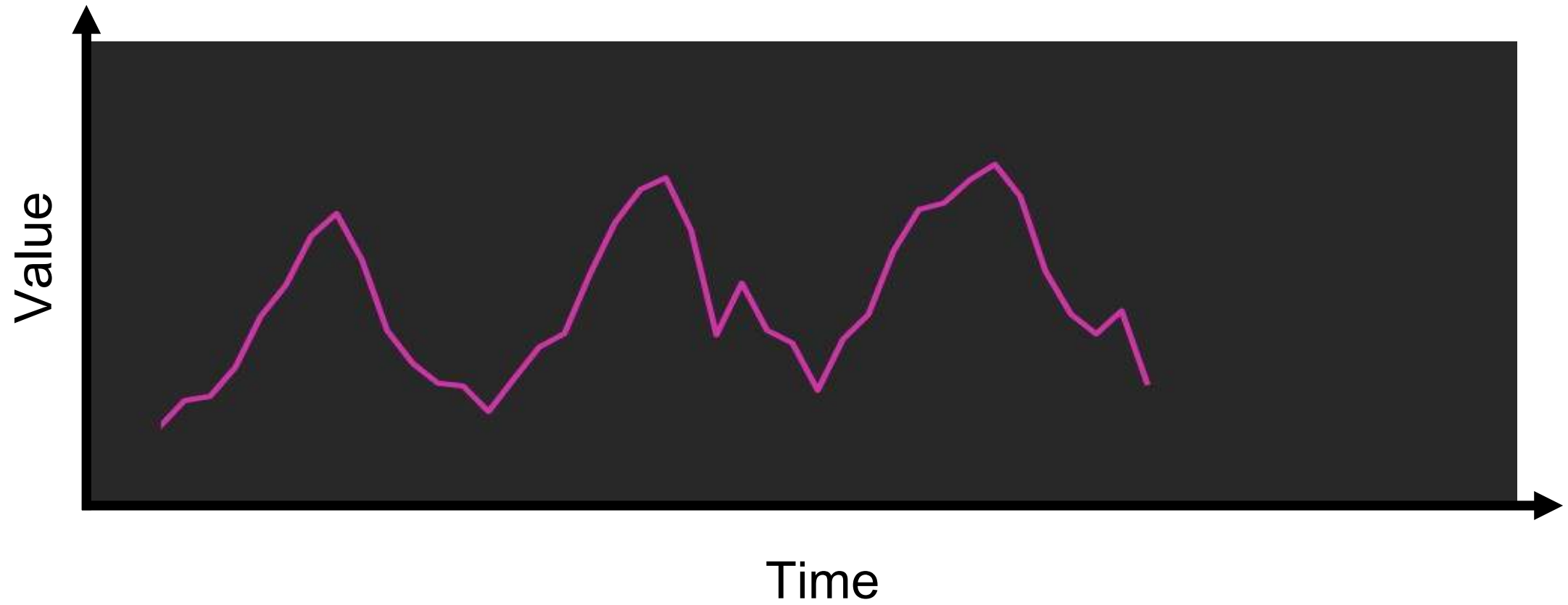


Inventory  
planning

# Accuracy is the most important factor in forecasting

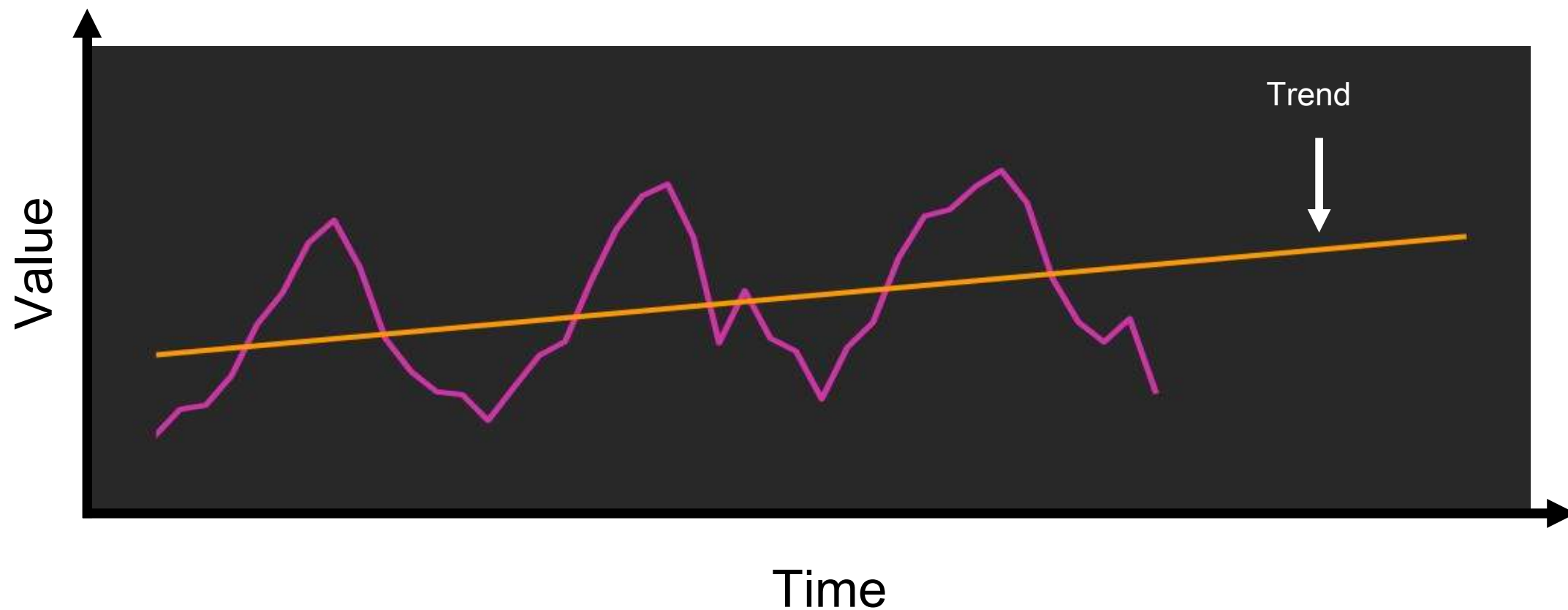


# Traditional time-series models

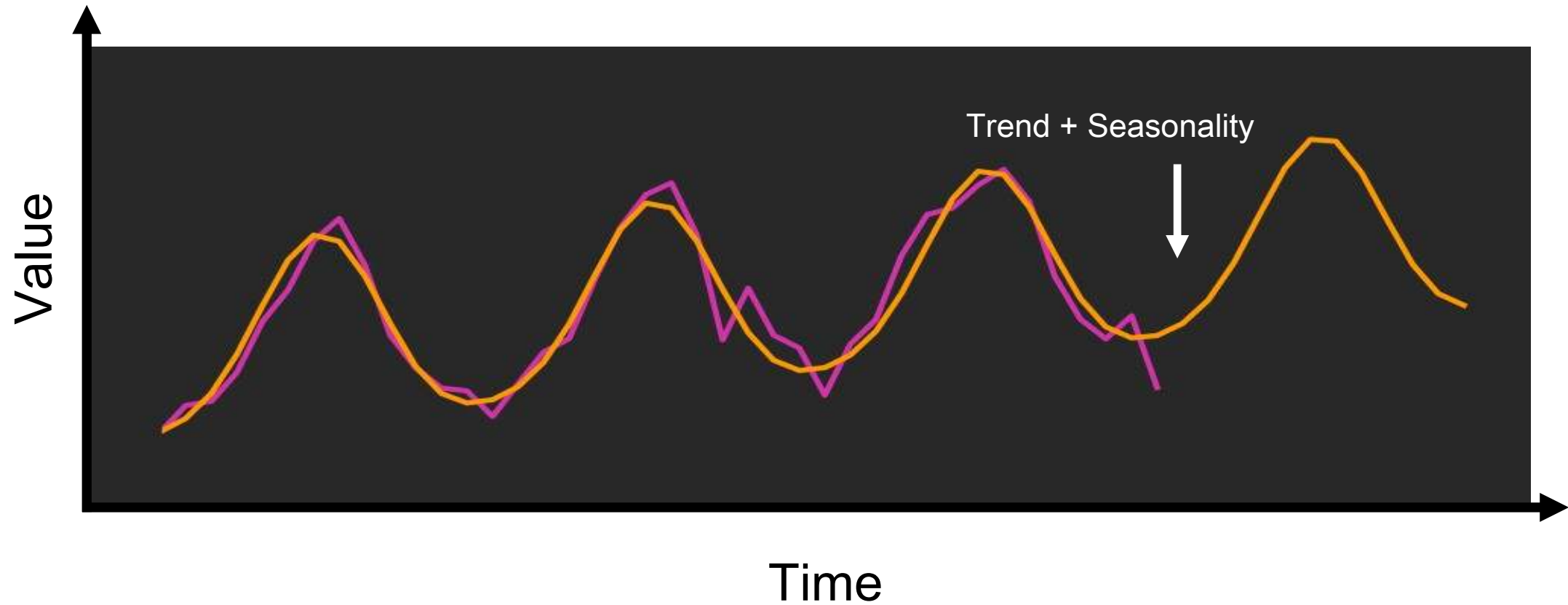




# Traditional time-series models

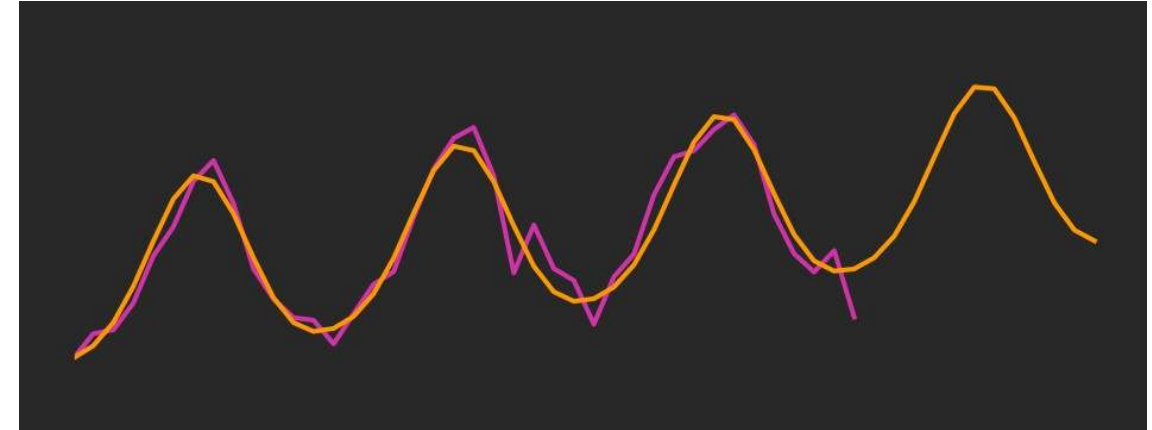


# Traditional time-series models



# Traditional time-series models

- Independent forecasts
  - Strong structural assumptions
  - De-facto industry standard
  - Well-understood, > 50 yrs. research
- 
- Data must match the **structural** assumptions
  - Cannot identify **patterns** across time series



## Algorithms

- Nonparametric Time Series Model
- Exponential Smoothing (ETS)
- (Auto-) ARIMA
- Prophet

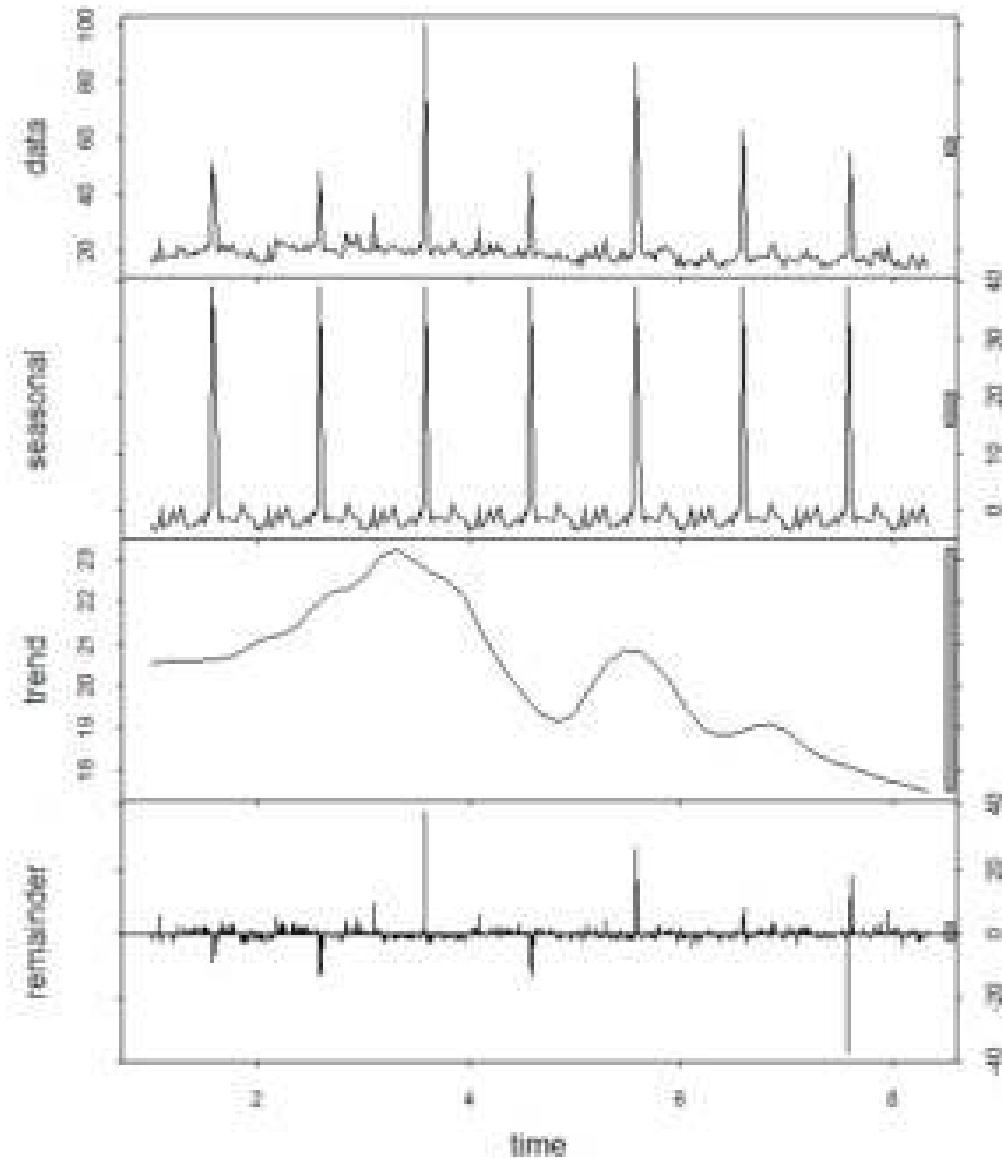
# Example

Data

Seasonality

Trend

Noise ?  
or useful information?



# Traditional methods struggle with real-world forecasting



Only process a  
single time-  
series at a time



Can't handle  
time-series with  
no history



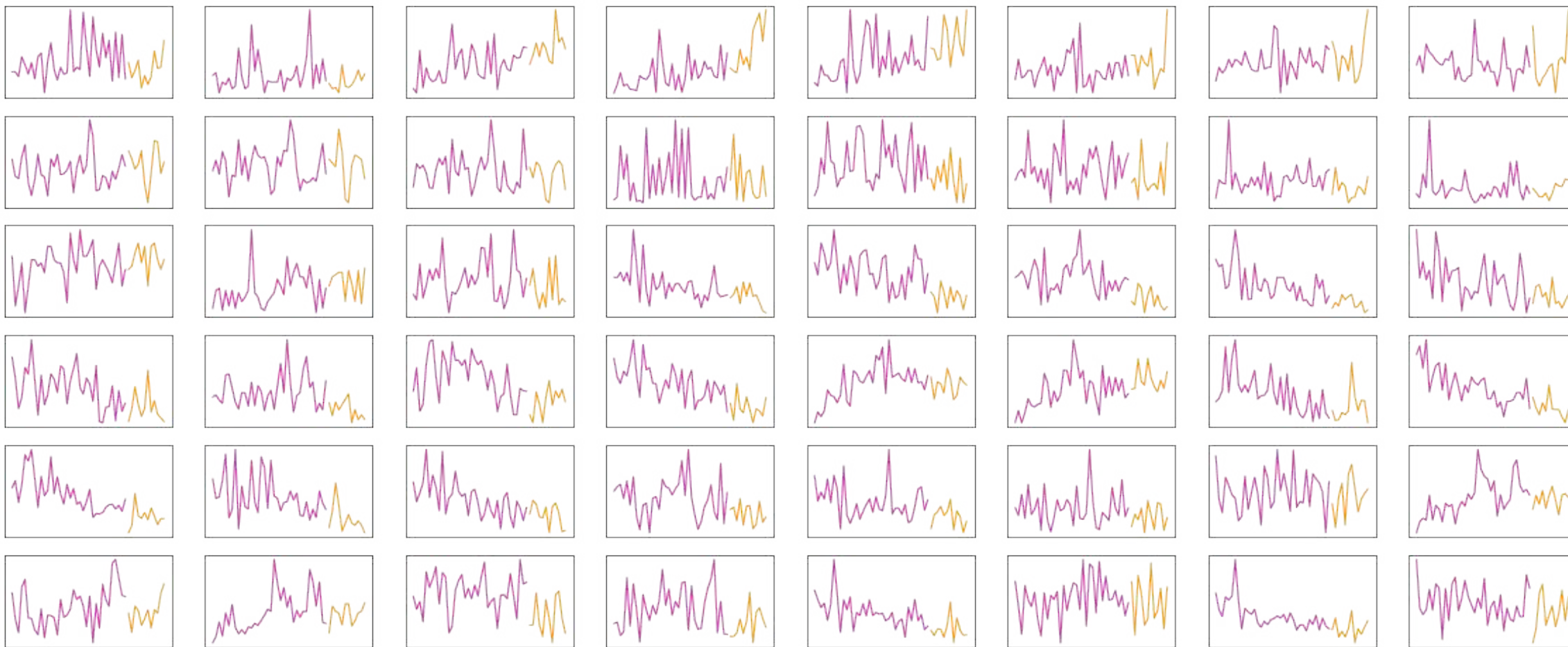
Don't consider  
additional inputs:  
related time-series,  
metadata



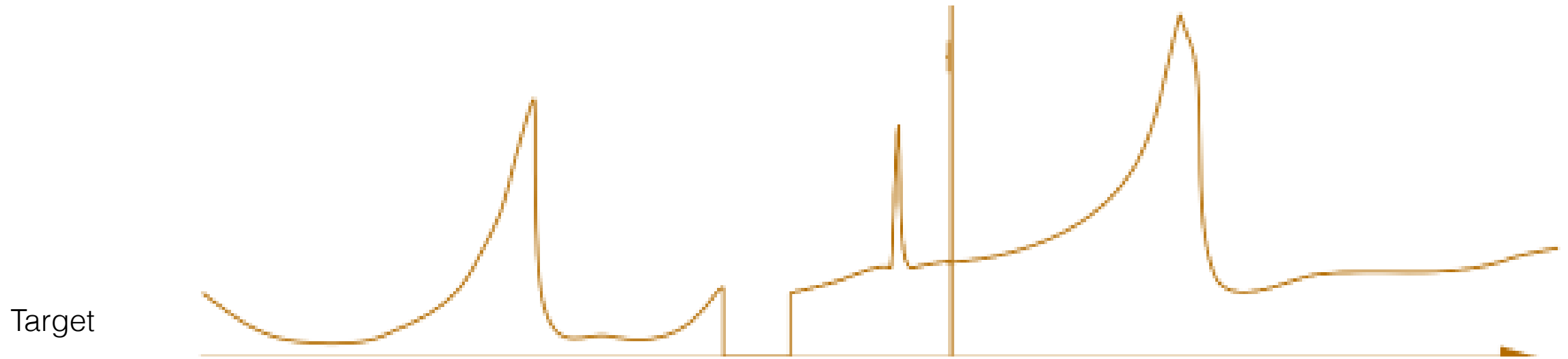
Only predict a single  
value: how  
trustworthy is it?

Can we do better?

# 1 – Multiple time-series help identify common patterns

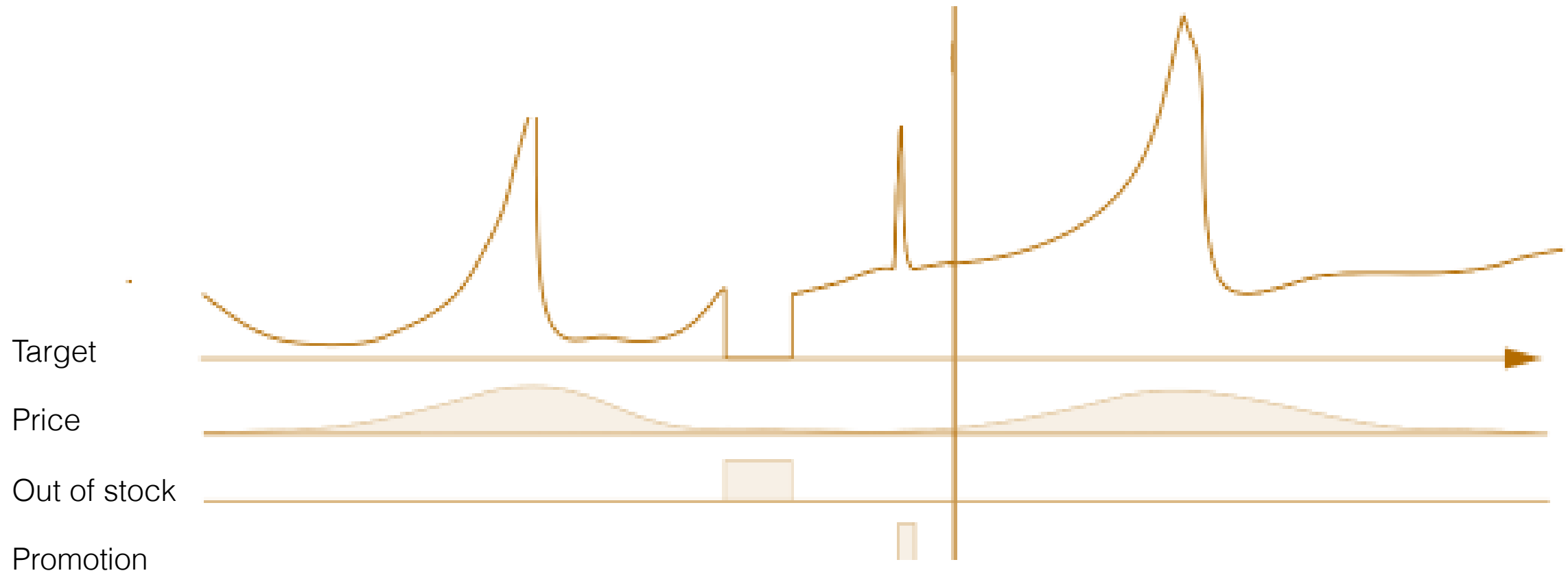


## 2 – Real-world time series are not well-behaved...



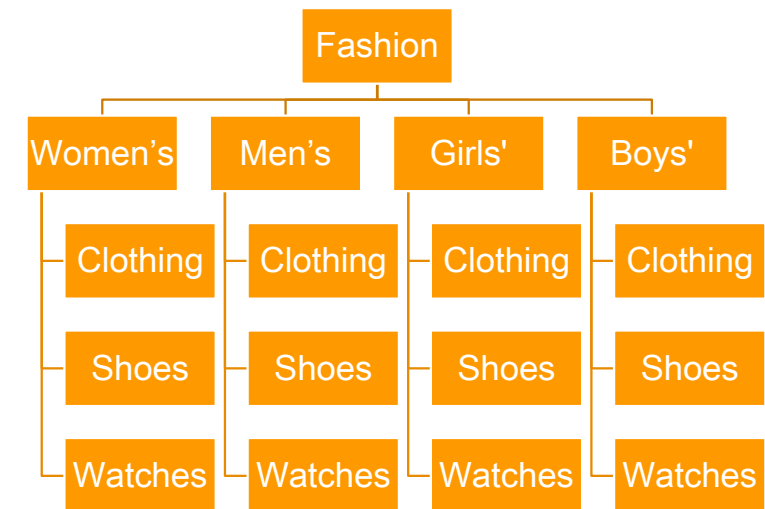
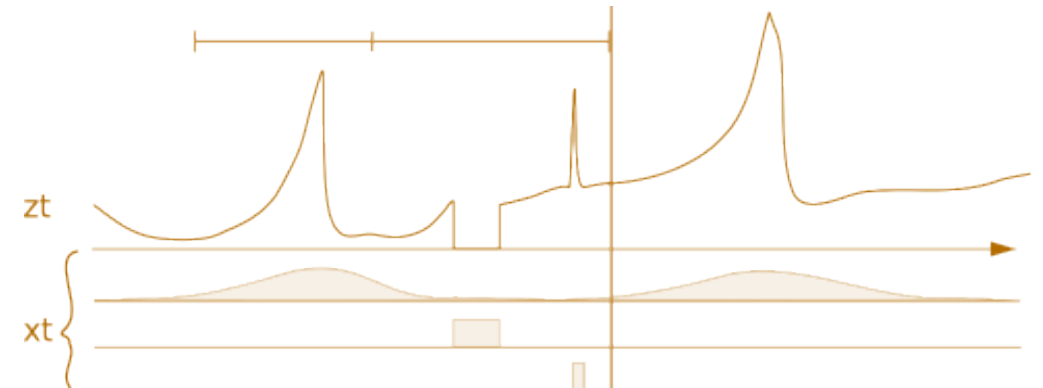


... but using additional inputs helps to figure them out

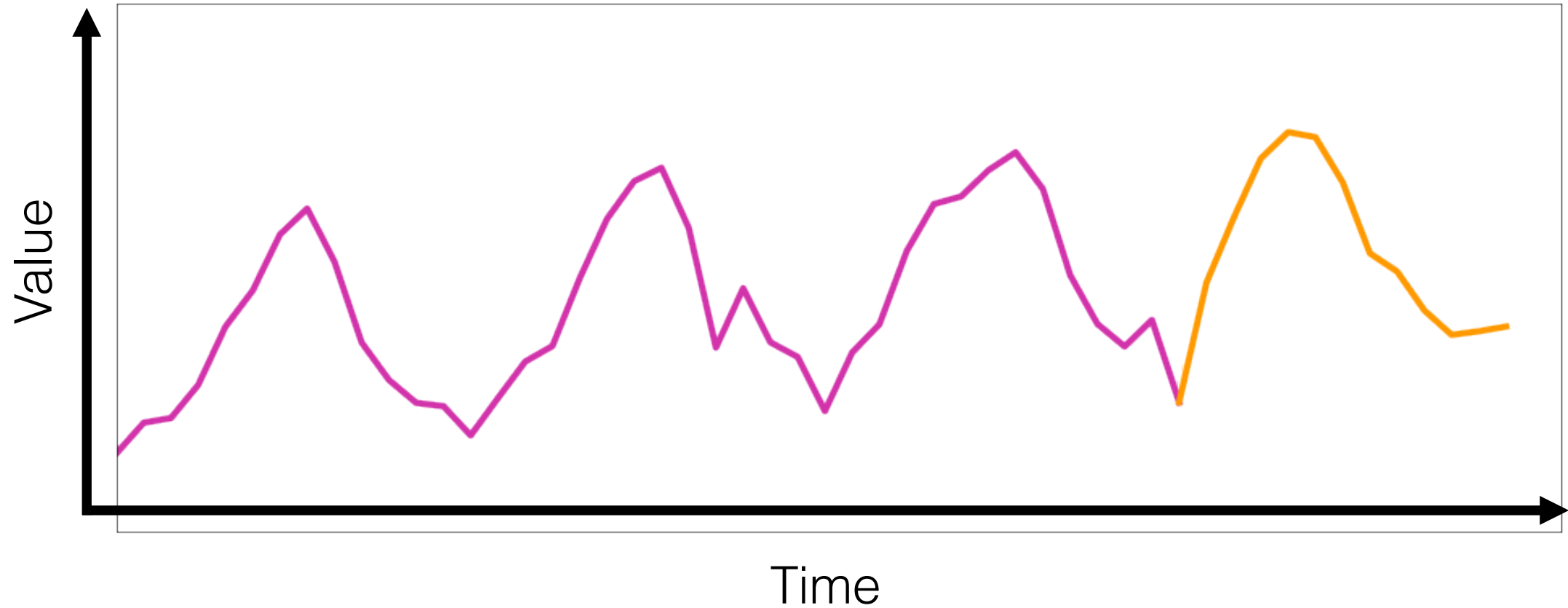


# Using additional inputs

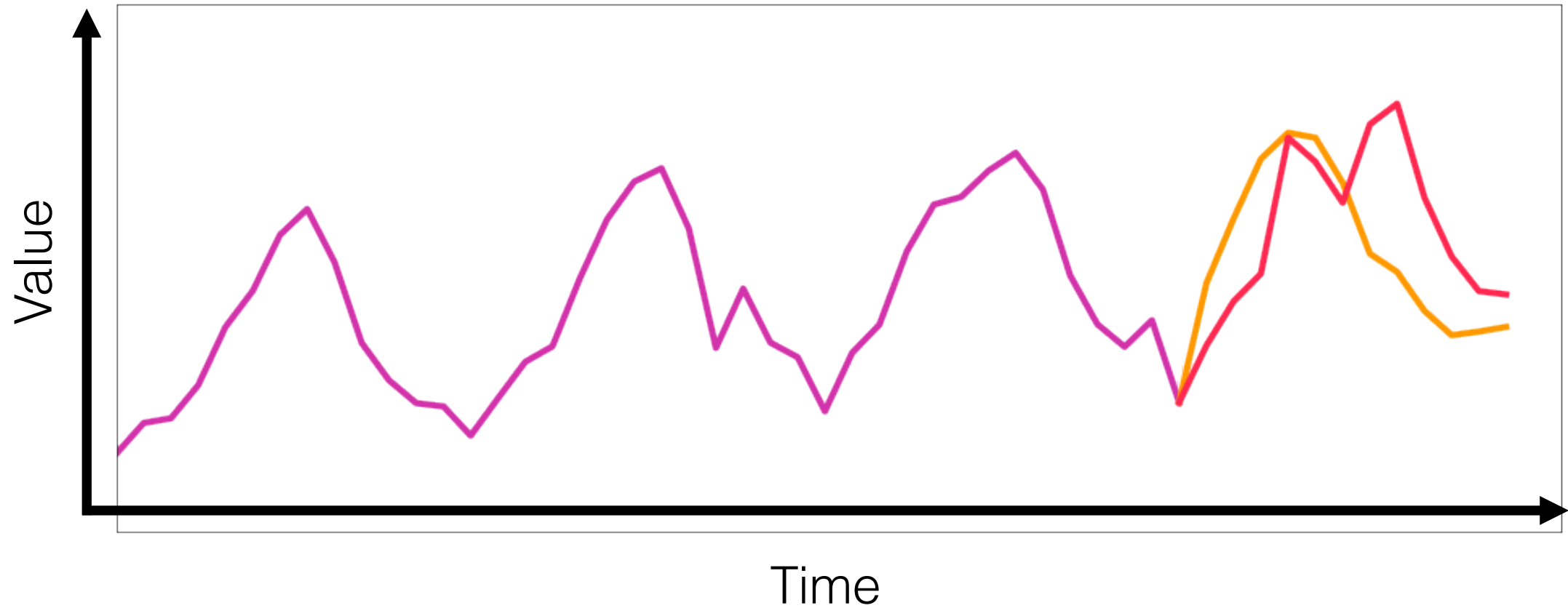
- Additional inputs can
  - Explain historical data
  - Drive forecast behavior
- Examples from retail
  - Price information
  - Information about promotions
  - Out-of-stock information
  - Web page views
  - Known future events
- Categorical inputs can be used to identify group-level patterns



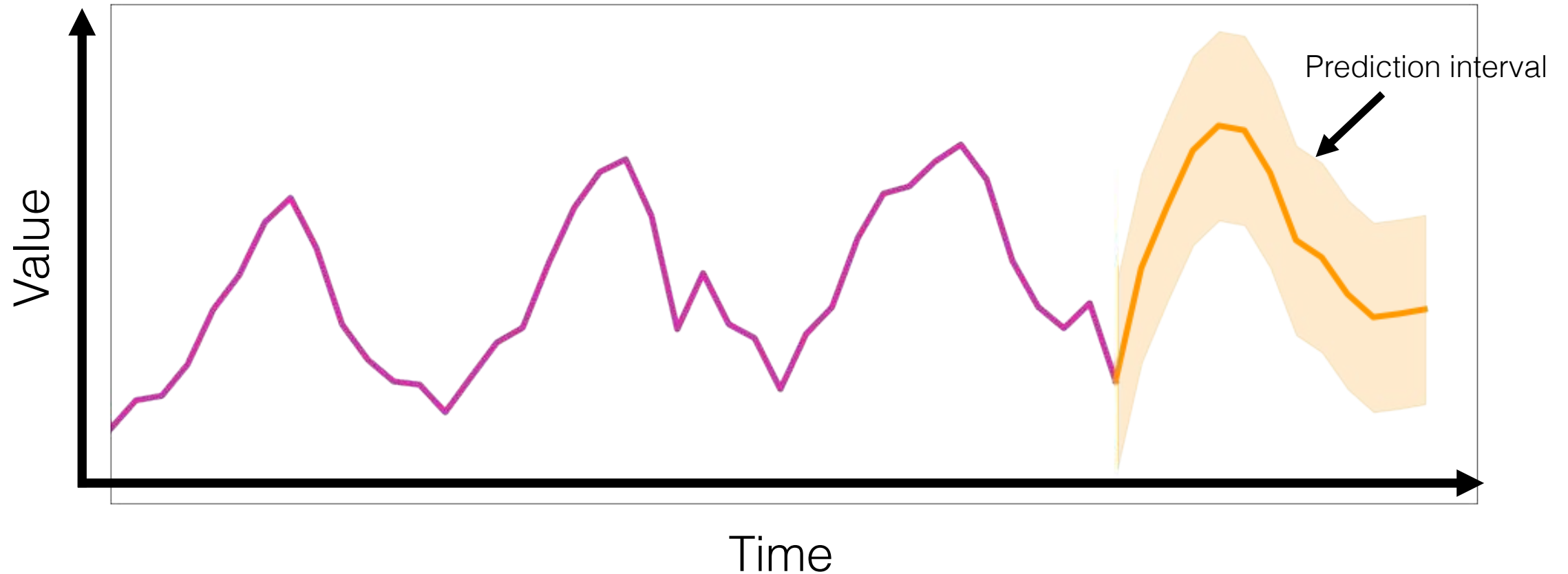
### 3 – The future could look like this...



Or like this.. So how confident are we?

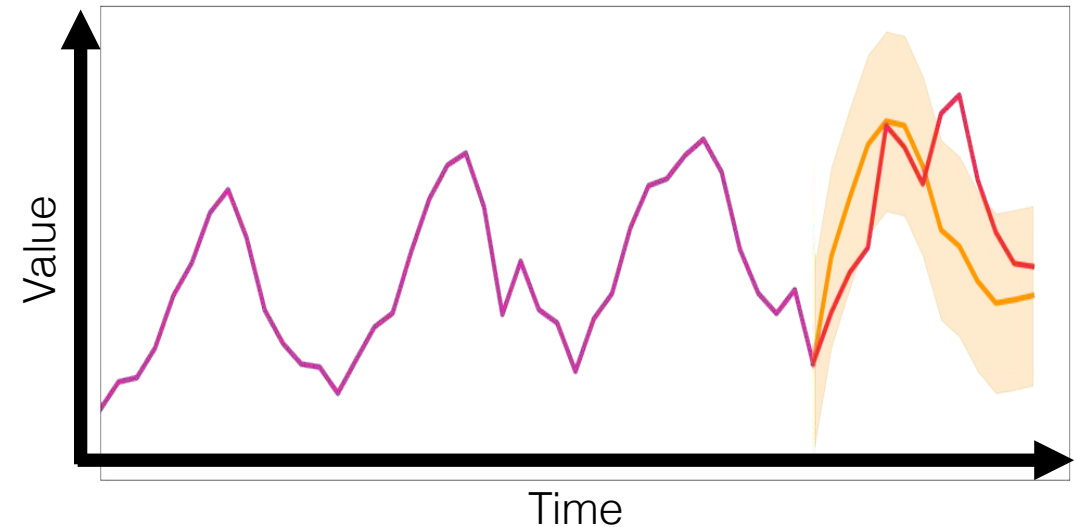


# Probabilistic forecasts: intervals and confidence



# Probabilistic forecasts

- Quantification of **uncertainty**
- Support optimal **decision making**
- Make “wrong” forecasts useful
- Forecasts can be obtained for different **quantiles** of the predictive distribution



p10: 10% of predictions will be lower

p50: the mean value

p90: 90% of predictions will be lower

**p10-p90 interval: 80% of possible predictions.**

# Deep learning time-series models

- Global models: identify patterns using all available time series
  - Group-dependent seasonality and lifecycle
  - Behavior in response to extra inputs
- Weak structural assumptions
- Can be significantly more accurate than traditional methods
- Can easily incorporate and learn from rich metadata
- Support cold-start forecasts for new items



## Algorithms



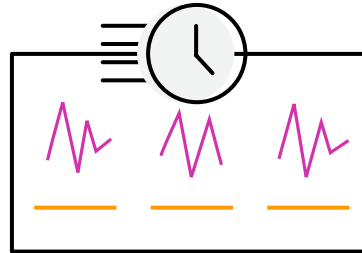
- Autoregressive LSTM (DeepAR)
- More algos to come

# Amazon Forecast

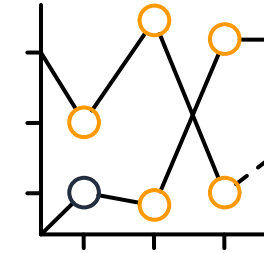
Improve forecasting accuracy by up to 50% at 1/10th the cost



Accurate  
forecasts



Get to results  
quickly



Works with any historical  
time-series

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## KEY FEATURES

Consider multiple  
time-series  
at once

Automatic  
machine  
learning

Evaluate model  
accuracy

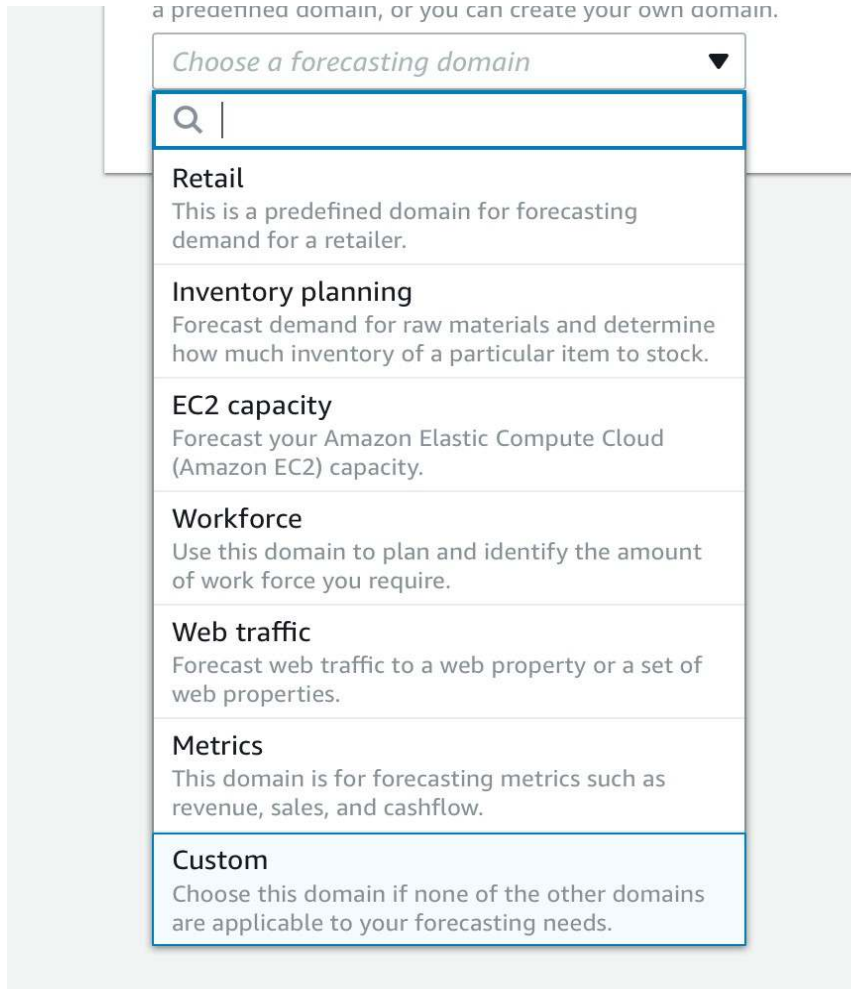
Visualize forecasts  
& import results  
into business apps

Schedule  
forecasts and  
model retraining





# Pre-defined schemas for different business domains



- Amazon Forecast is applicable across multiple **domains**
- You can set your domain using the AWS Management Console or via the API
- You upload datasets with different **schemas** based on the domain

# Amazon Forecast: How it works

## Target time-series

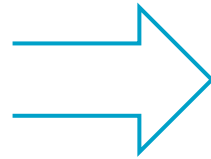
Sales, inventory, pricing, etc.

## Related time-series (optional)

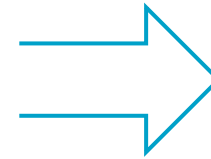
Weather, competitive promotions, etc.

## Item meta-data (optional)

Category, genre, brand, etc.



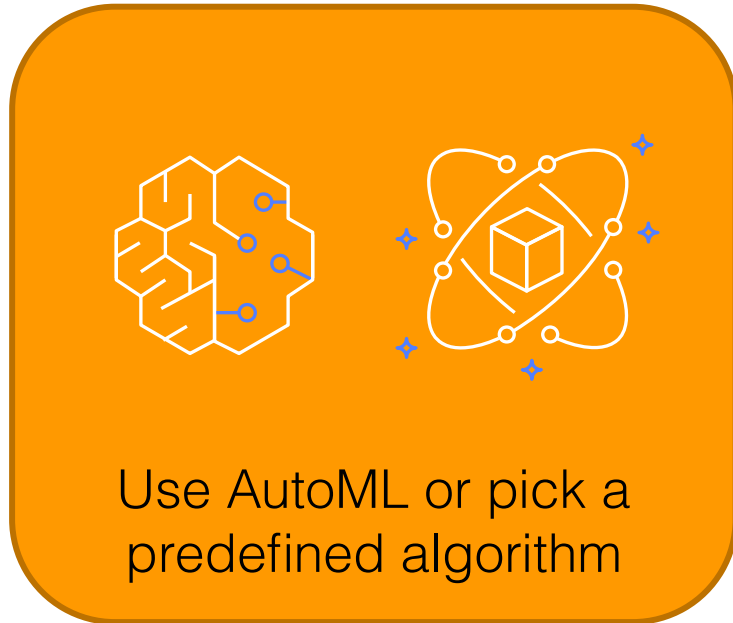
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Private  
Customized  
Forecasting  
API

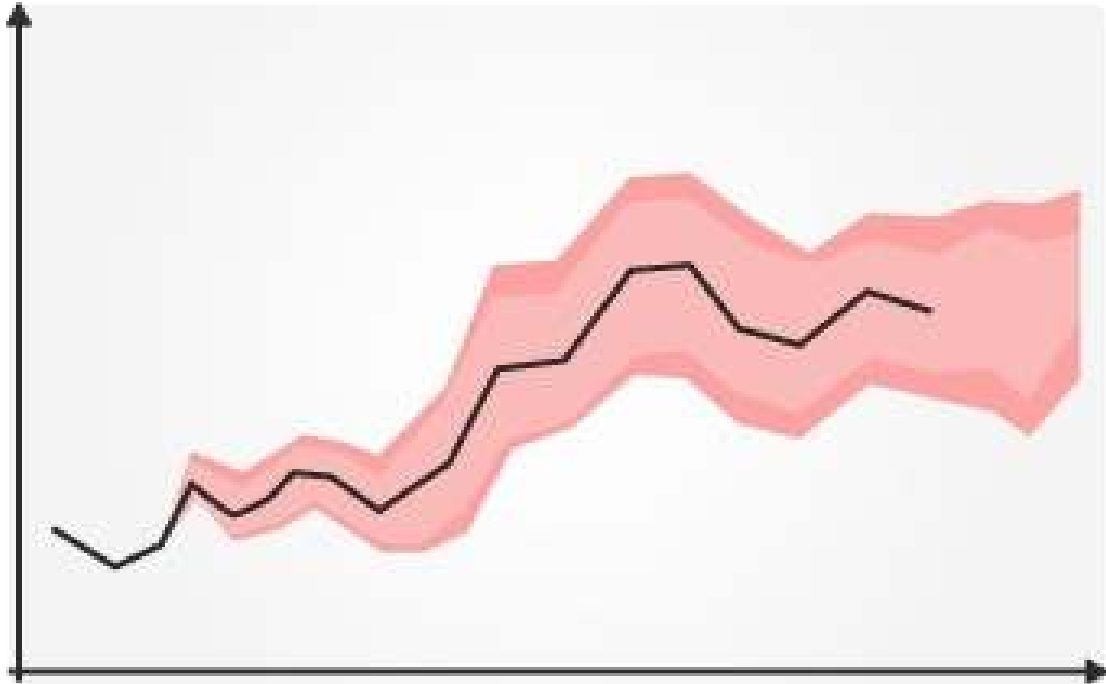
Amazon Forecast

# Train custom models once you ingest data



- Choose a preconfigured algorithm (packaged as **recipes**) or use **AutoML**, and Amazon Forecast will pick the right recipe for you
- Amazon Forecast can use **Hyper Parameter Optimization** to tune models automatically.

# Key metrics reported by Amazon Forecast



Predictor metrics

Latest version

Overall metrics

By velocity

[0, 0.1]	(1, 5]	(5, 50]	[>50]
Item count	Item count	Item count	Item count
1	5	71	293
P50 MAPE	P50 MAPE	P50 MAPE	P50 MAPE
-	0.98	0.97	0.97
RMSE	RMSE	RMSE	RMSE
0.09	3.65	37.23	2606.82
P90 MAPE	P90 MAPE	P90 MAPE	P90 MAPE
-	0.32	0.37	0.25
P10 MAPE	P10 MAPE	P10 MAPE	P10 MAPE
-	0.46	0.38	0.41

# Demo

<https://github.com/aws-samples/amazon-forecast-samples>

# Getting started

<https://ml.aws>

<https://aws.amazon.com/personalize>

<https://aws.amazon.com/blogs/aws/amazon-personalize-real-time-personalization-and-recommendation-for-everyone/>

<https://aws.amazon.com/blogs/aws/amazon-personalize-is-now-generally-available/>

<https://aws.amazon.com/forecast>

<https://aws.amazon.com/blogs/aws/amazon-forecast-time-series-forecasting-made-easy/>

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# Thank you!

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