DEV DAY

Solve complex business problems with Amazon Forecast and Amazon Personalize

Julien Simon
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@julsimon

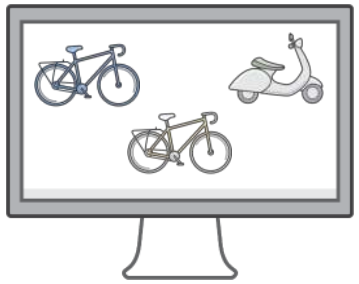
aws

DEV DAY

Personalizing user experience

aws

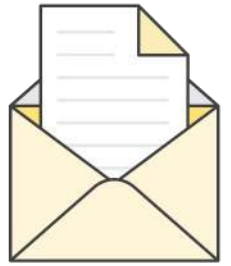
Common applications & use cases



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

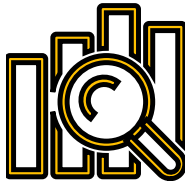
… However, most customers find personalization hard to get right

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)



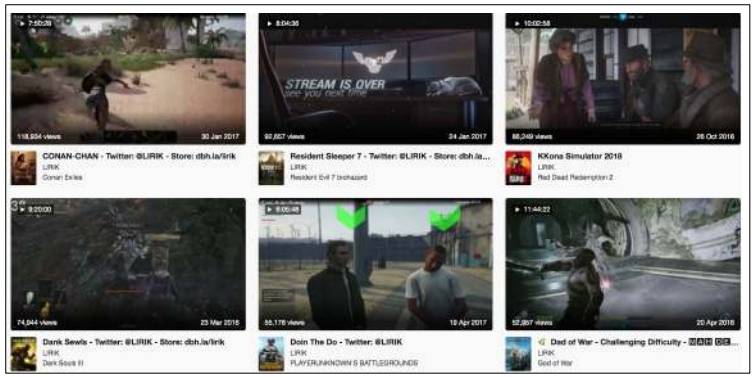
Scal
e

Deep learning techniques have a direct impact on the bottom line

Rule-based card ranker

Bayesian network model

+29% Click Through



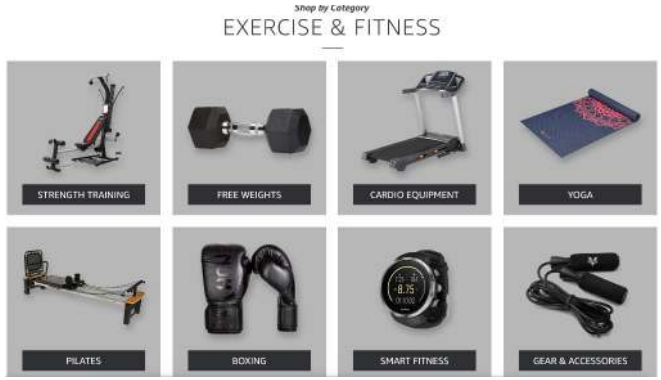
Popularity

Matrix factorization

+15.4% Engagement

Neural network

+7.4% Engagement

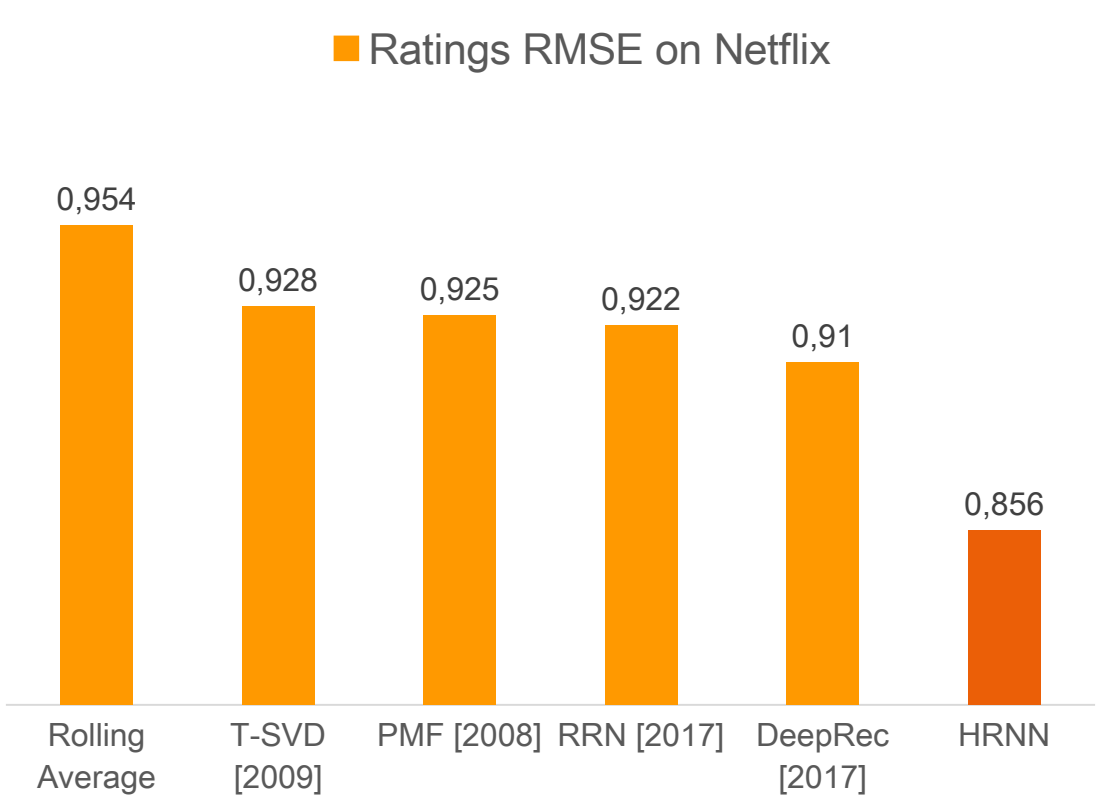


Similarity

Recurrent Neural Net + Bandit

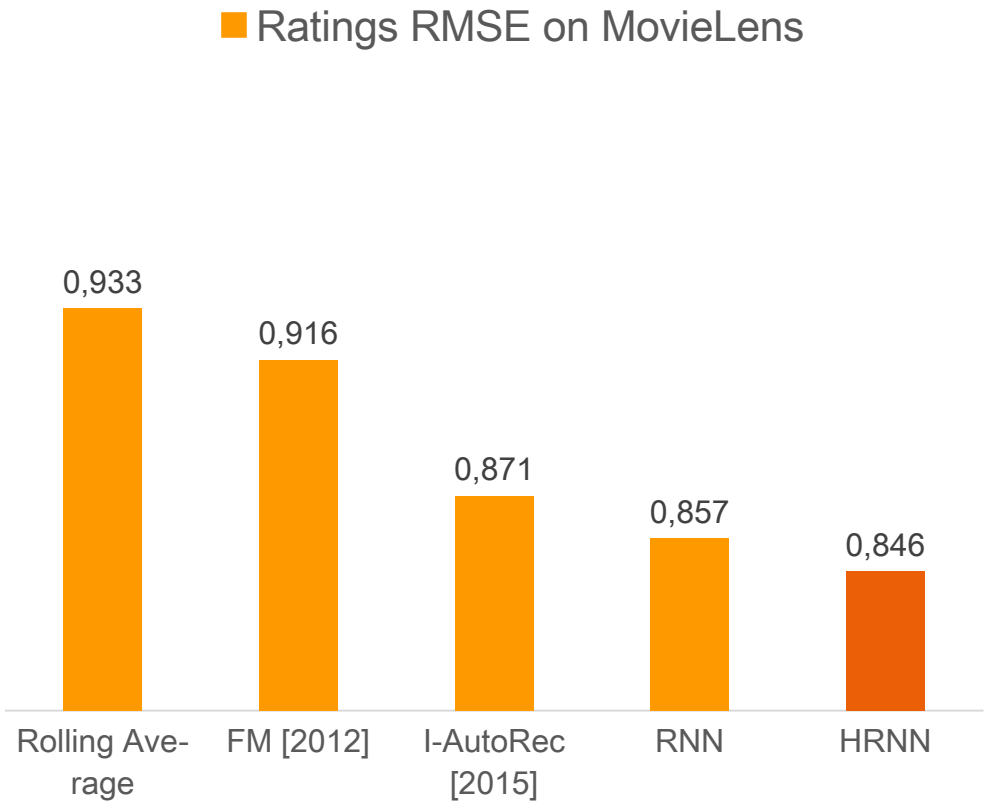
+20% Click Through

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

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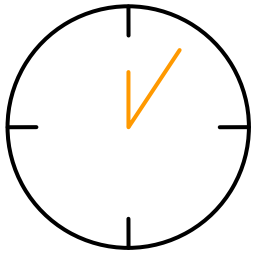
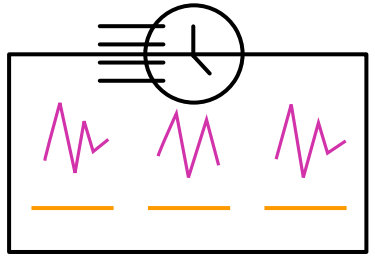
Improve customer experiences with personalization and recommendations

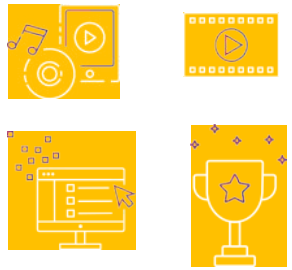
Deliver high quality recommendations



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

Domino's

NAVITIME

rb digital

spüul

PlayStation

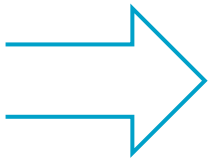
ZOLA

Amazon Personalize: How it works

Activity stream
Views, signups, conversion, etc.

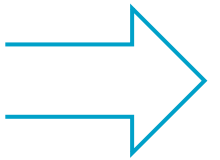
Inventory (optional)
Videos, products, articles, etc.

Demographics (optional)
Name, age, location, etc.



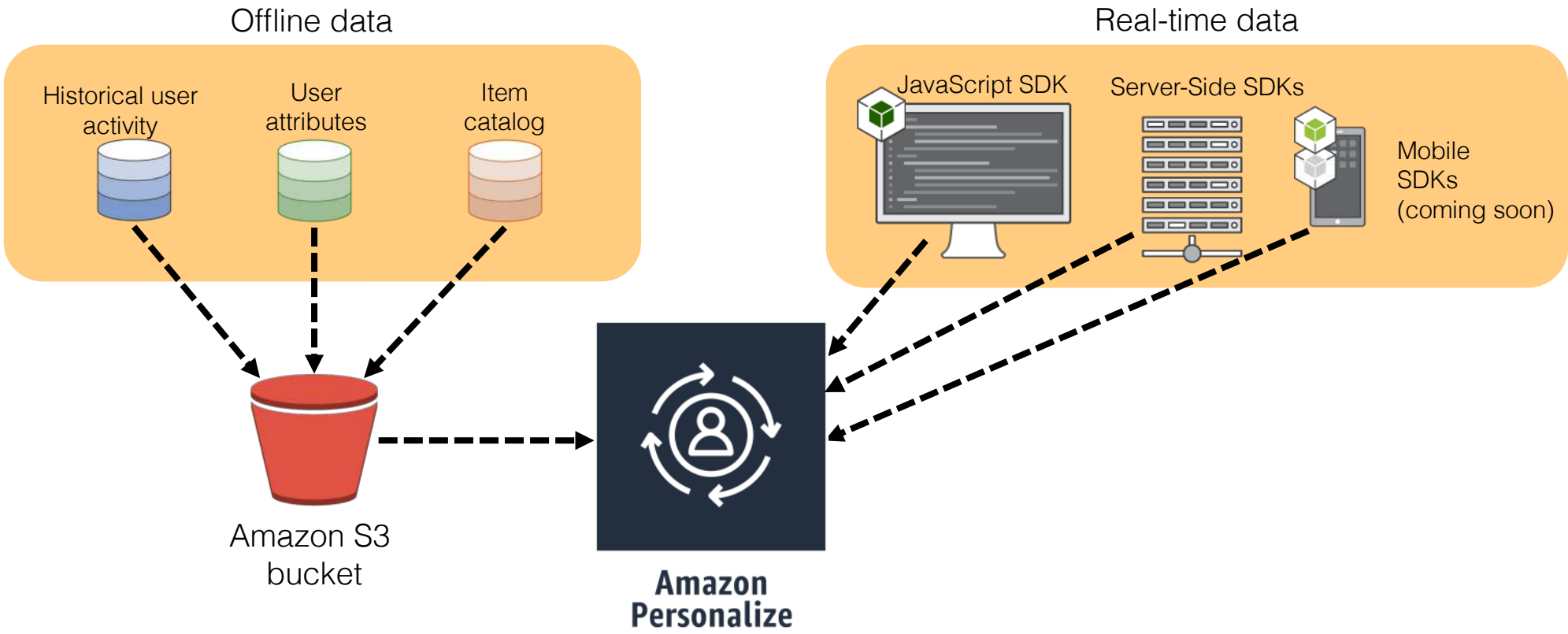
1. Load data
2. Inspect data
3. Identify features
4. Select algorithms
5. Select hyperparameters
6. Train models
7. Optimize models
8. Build feature store
9. Deploy and host models
10. Create real-time caches

Amazon Personalize

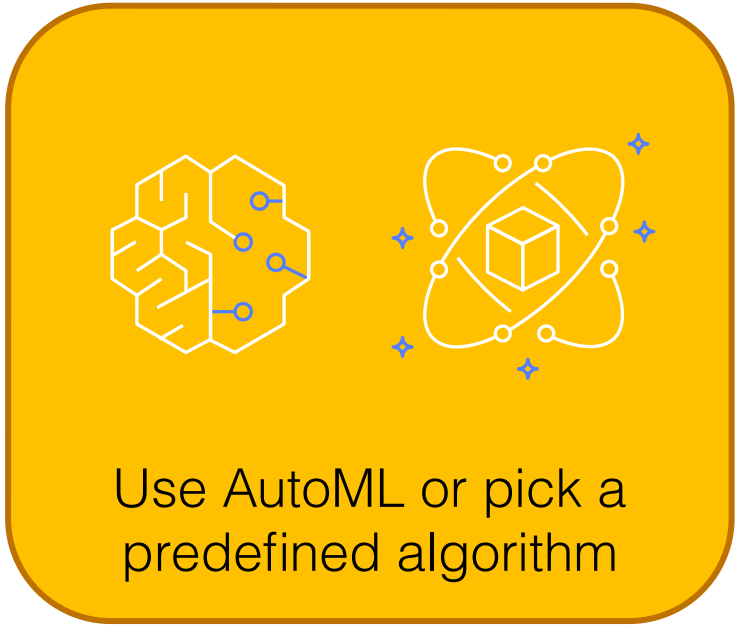


Private Customized Personalization API

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

DEV DAY

Predicting future points in a time-series

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Sample use cases

Product demand

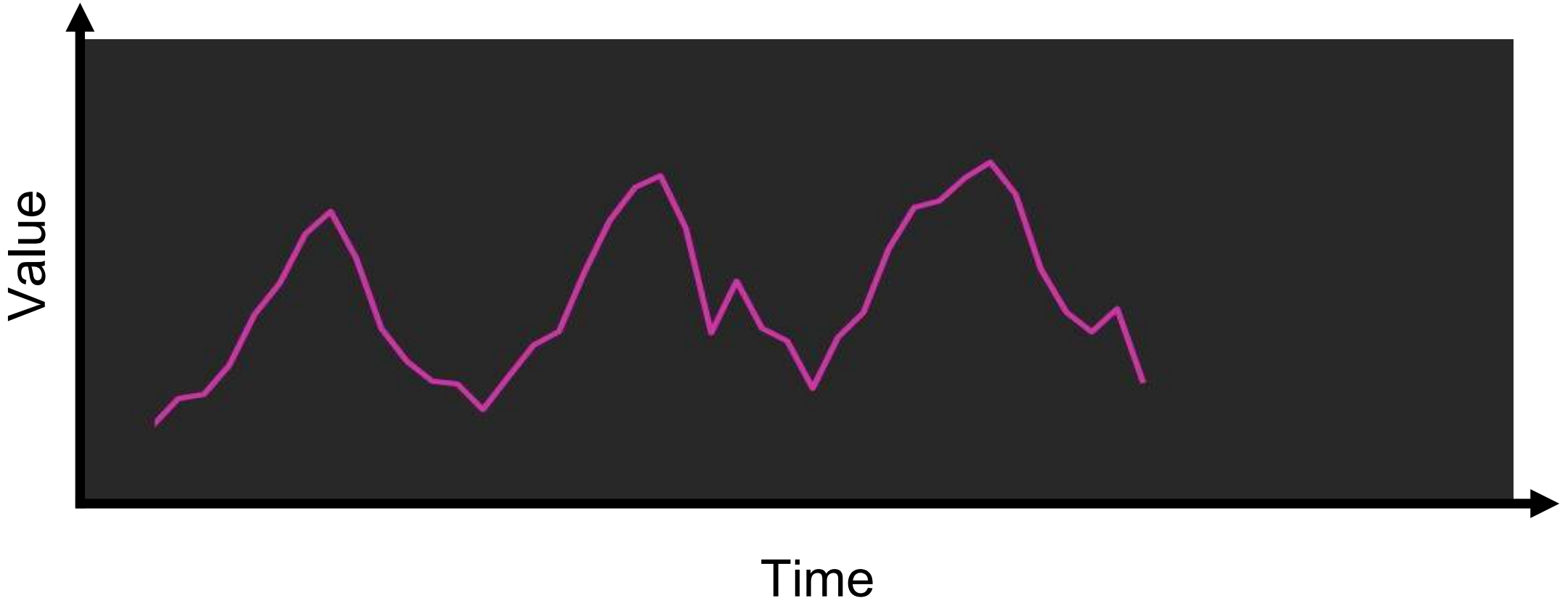
Workforce demand

Financial metrics

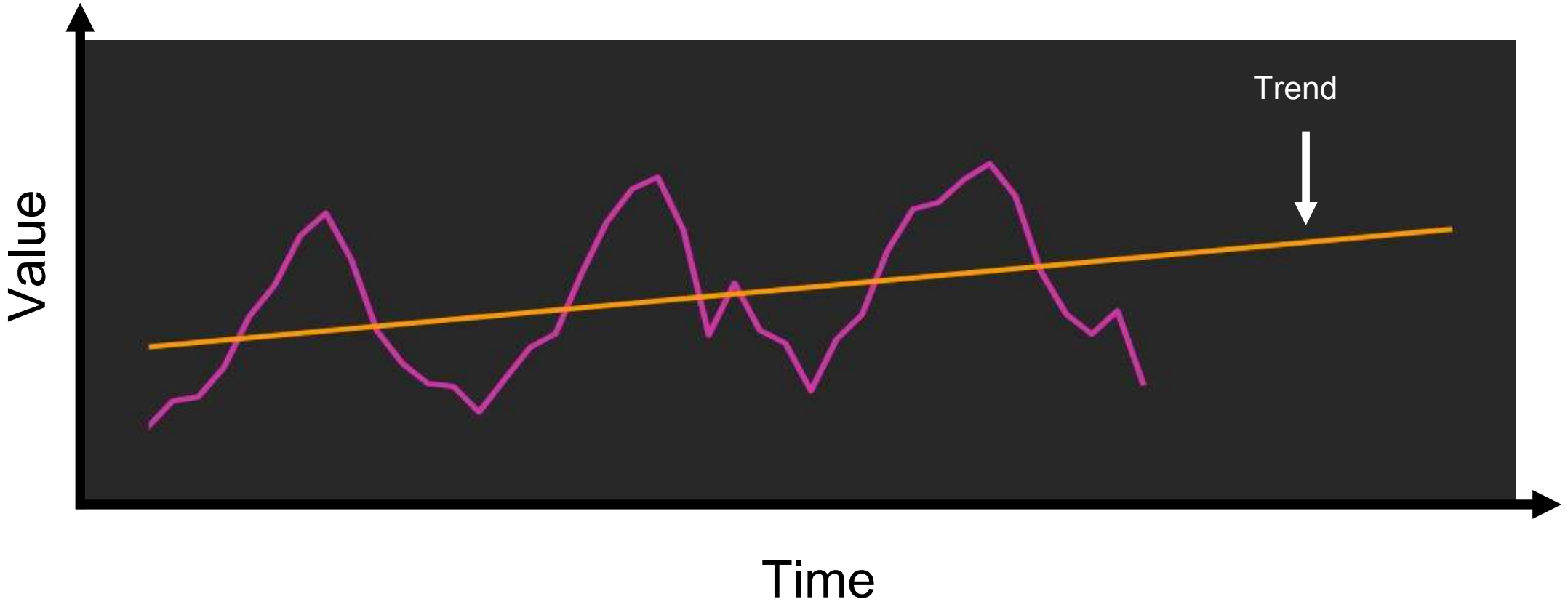
Inventory planning

Accuracy is the most important factor in forecasting

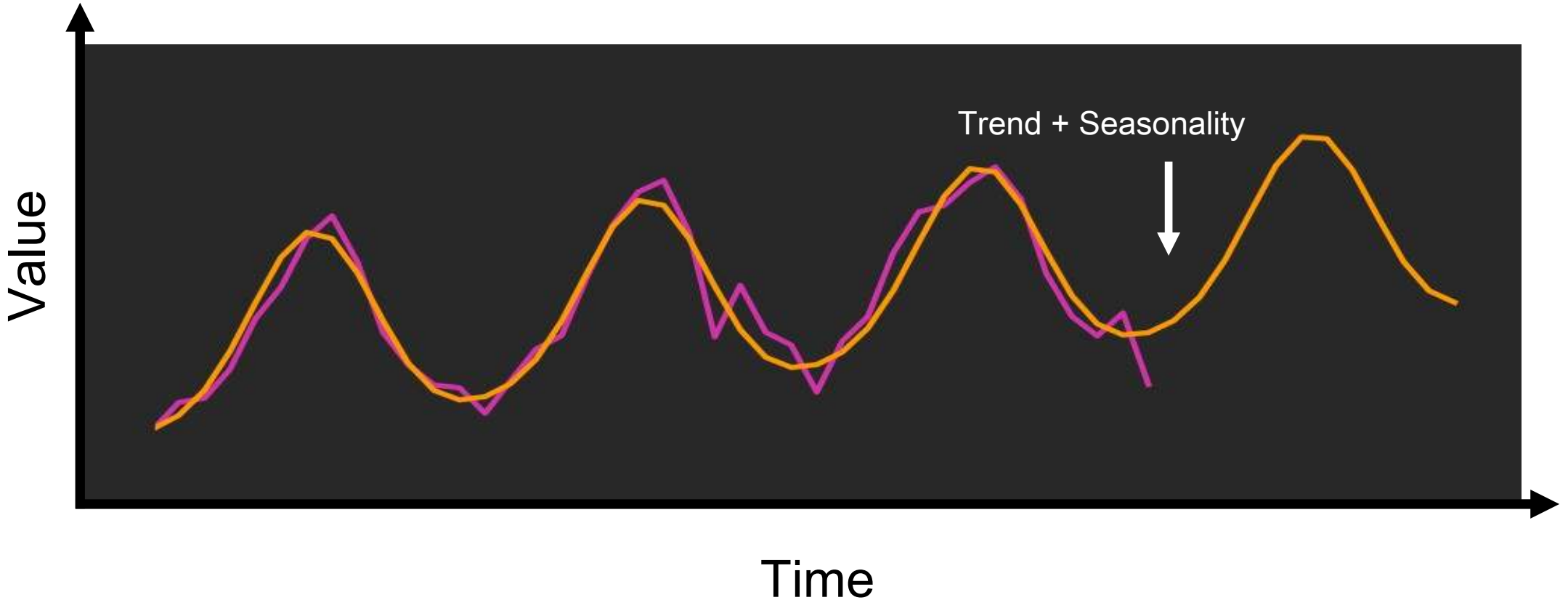
Traditional time-series models



Traditional time-series models

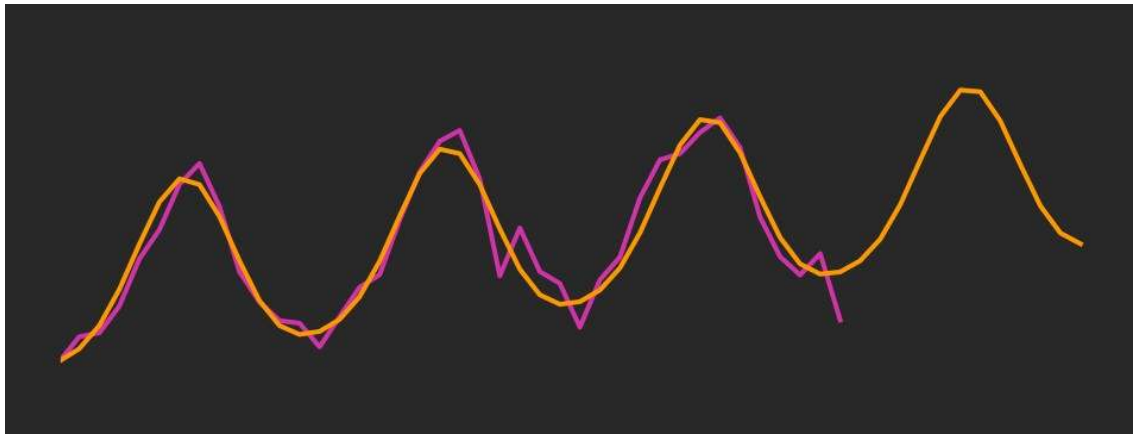


Traditional time-series models



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

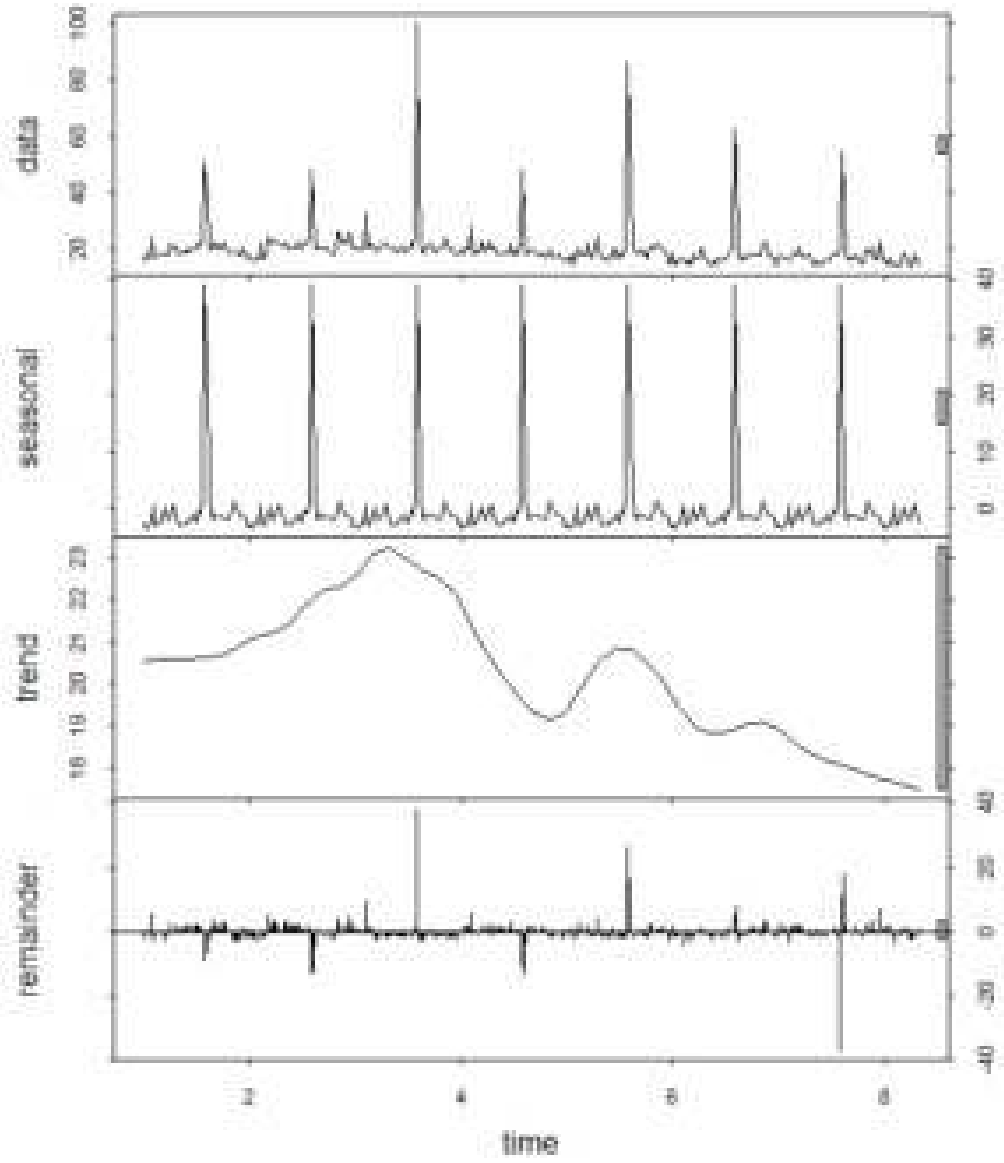
Example

Data

Seasonality

Trend

Noise ?
or useful information?



Traditional methods struggle with real-world forecasting

Only process a single time-series at a time

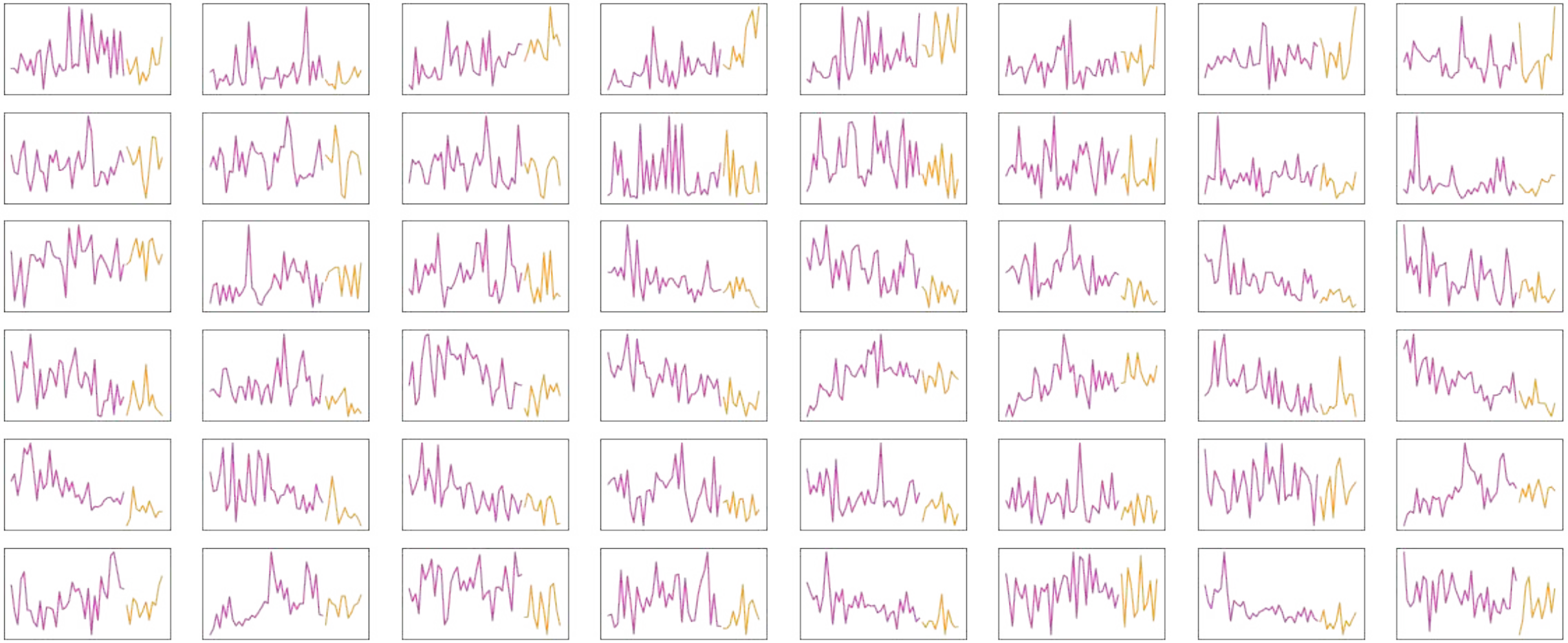
Can’t handle time-series with no history

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

Only predict a single value: how trustworthy is it?

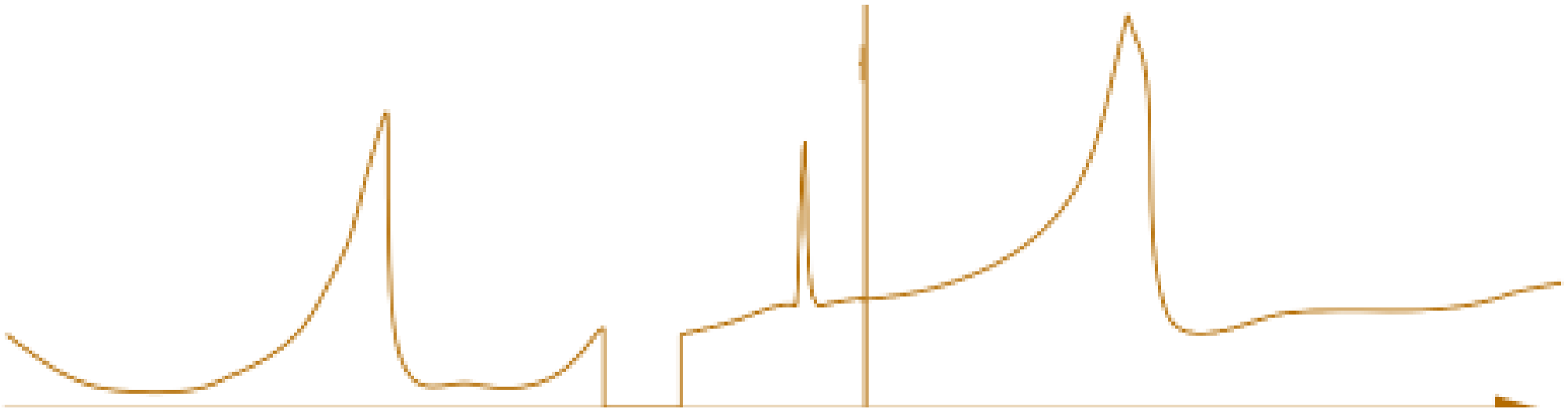
Can we do better?

1 – Multiple time-series help identify common patterns

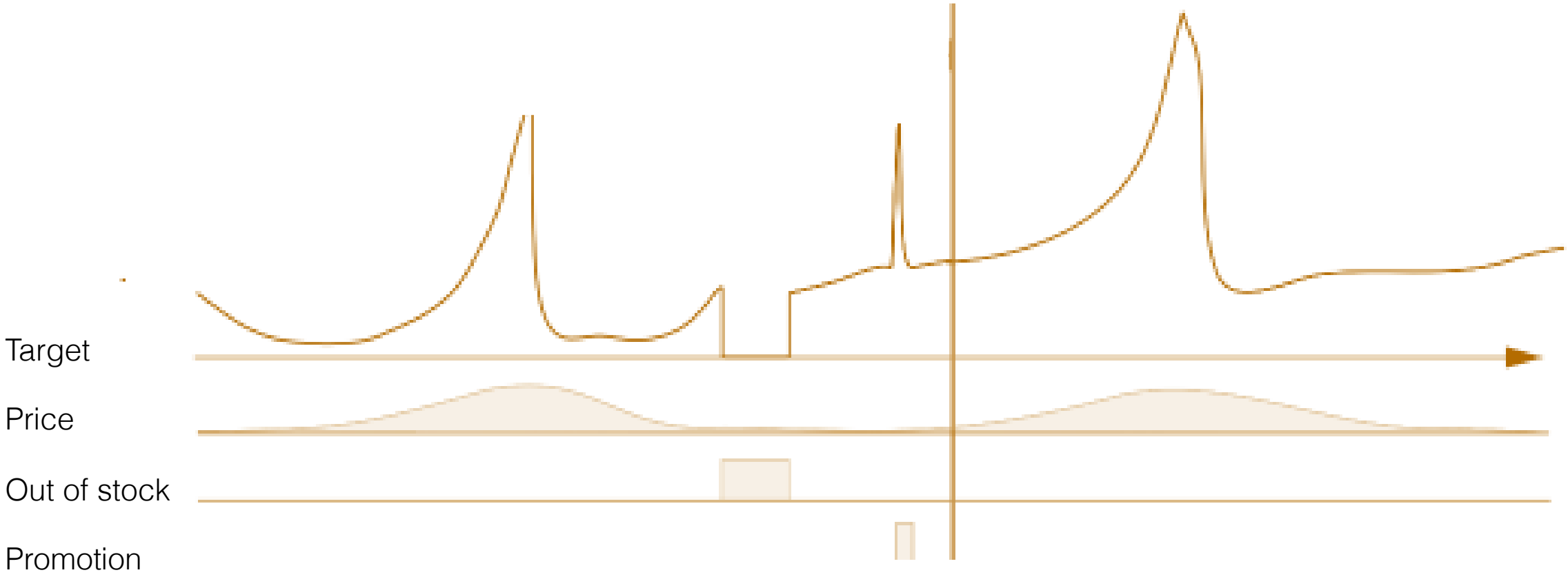


2 – Real-world time series are not well-behaved…

Target

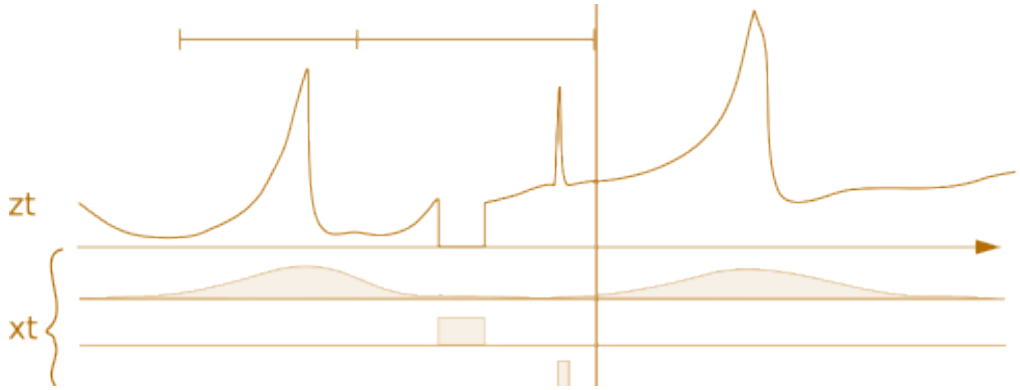


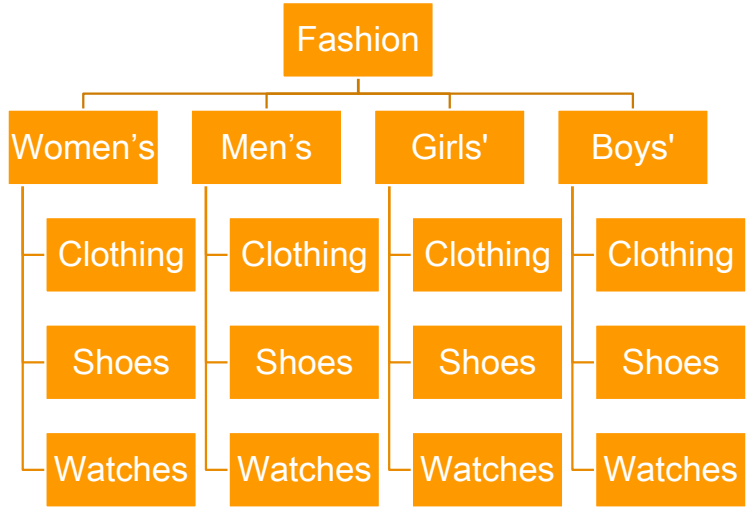
… but using additional inputs helps to figure them out



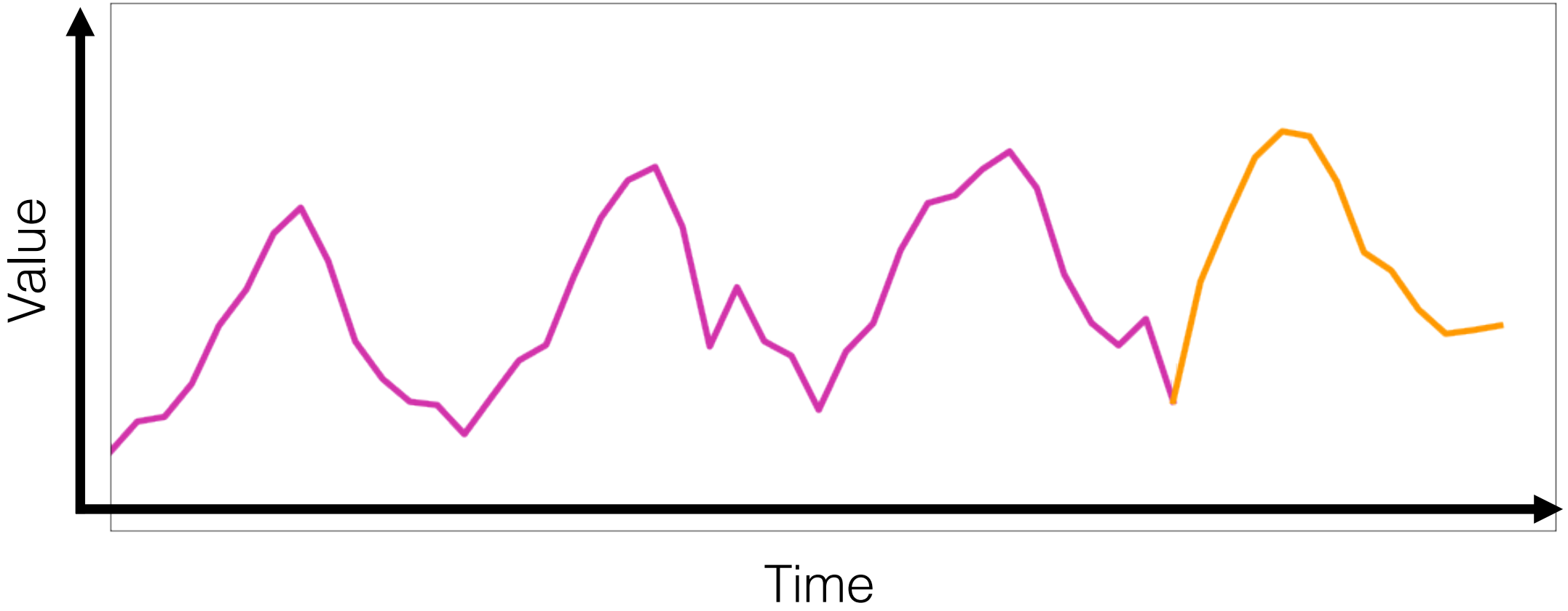
Using additional inputs

- 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

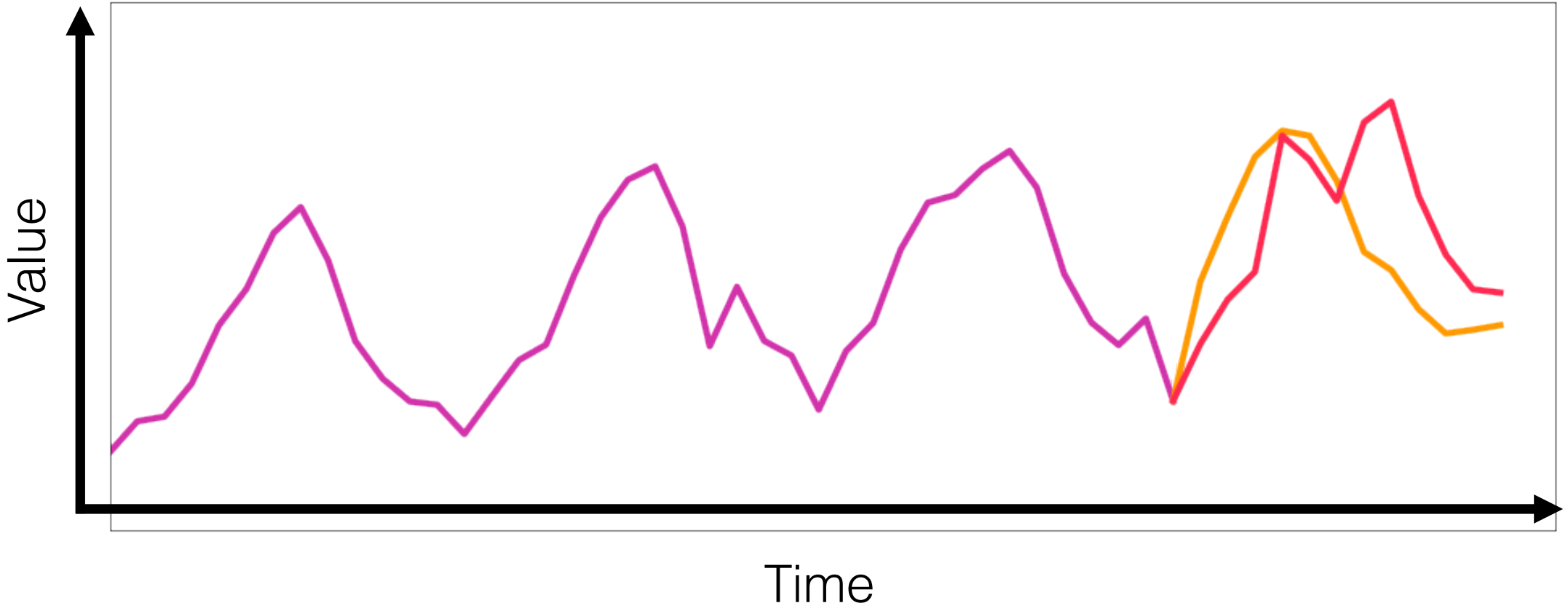




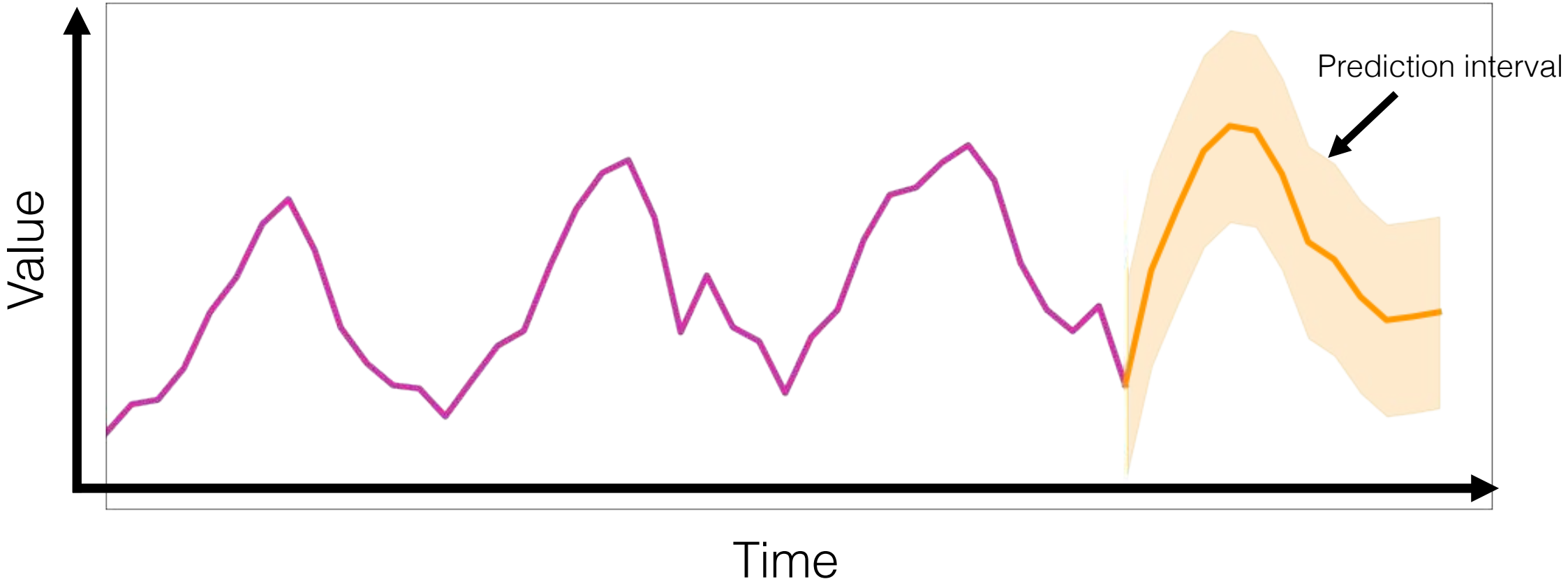
3 – The future could look like this…



Or like this.. So how confident are we?

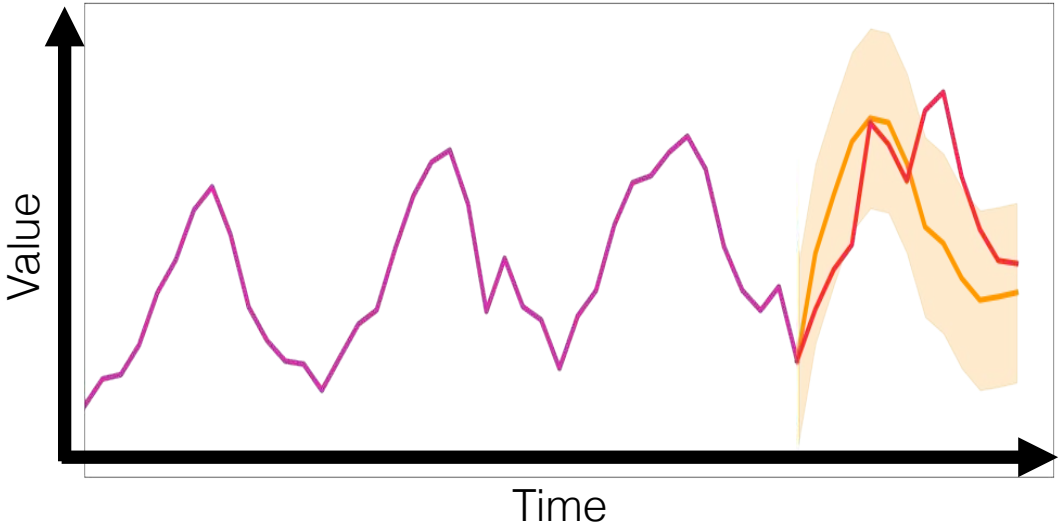


Probabilistic forecasts: intervals and confidence



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 with be lower
p50: the mean value
p90: 90% of predictions with 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

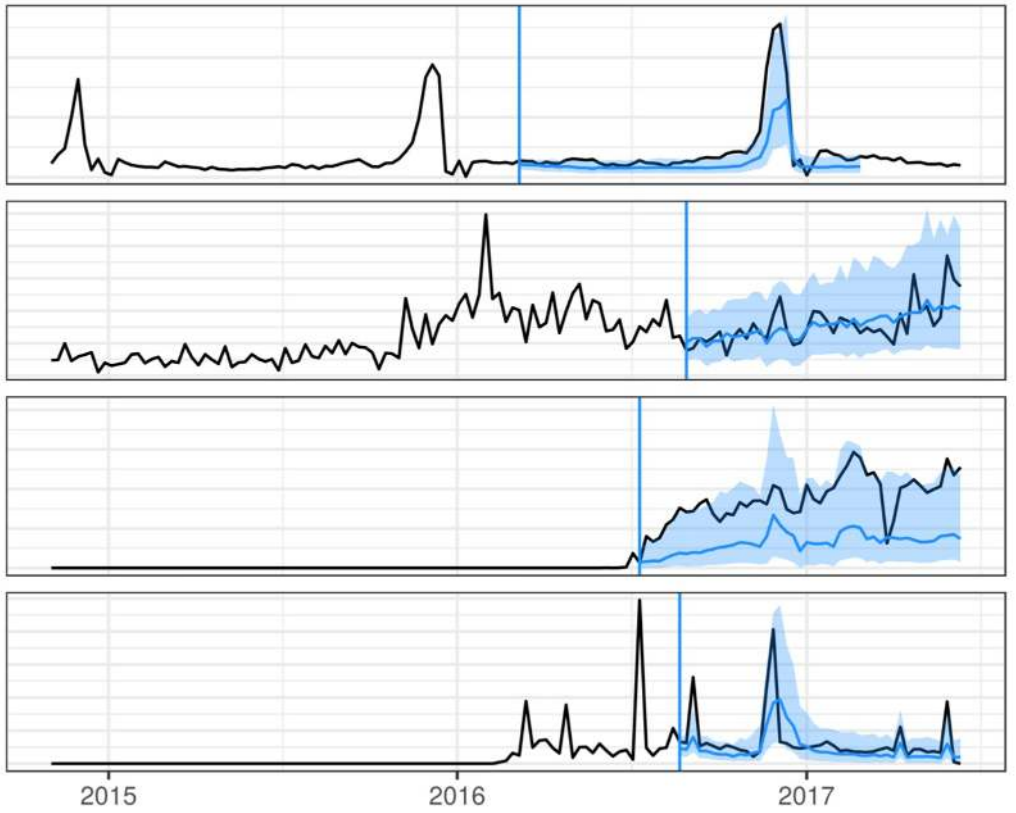
Algorithms

mxnet

- Autoregressive LSTM (DeepAR)
- Spline Quantile Forecaster (SQF)
- Multi-Horizon Quantile Recurrent Forecaster (MQ-RNN)
- Mixture Density Network RNN (MDN)

Using deep learning increases forecast accuracy

- Deep learning-based MQ-RNN performs best on Amazon.com retail demand data compared to other methods
- The figure illustrates four different products sold on Amazon.com; bottom two graphs relate to brand new products (cold start) and how the algorithm can handle spikes



https://arxiv.org/pdf/1711.11053.pdf

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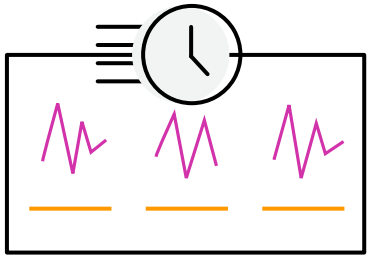
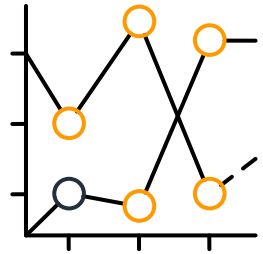
Amazon Forecast

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

Accurate forecasts



Get to results quickly



Works with any historical time-series

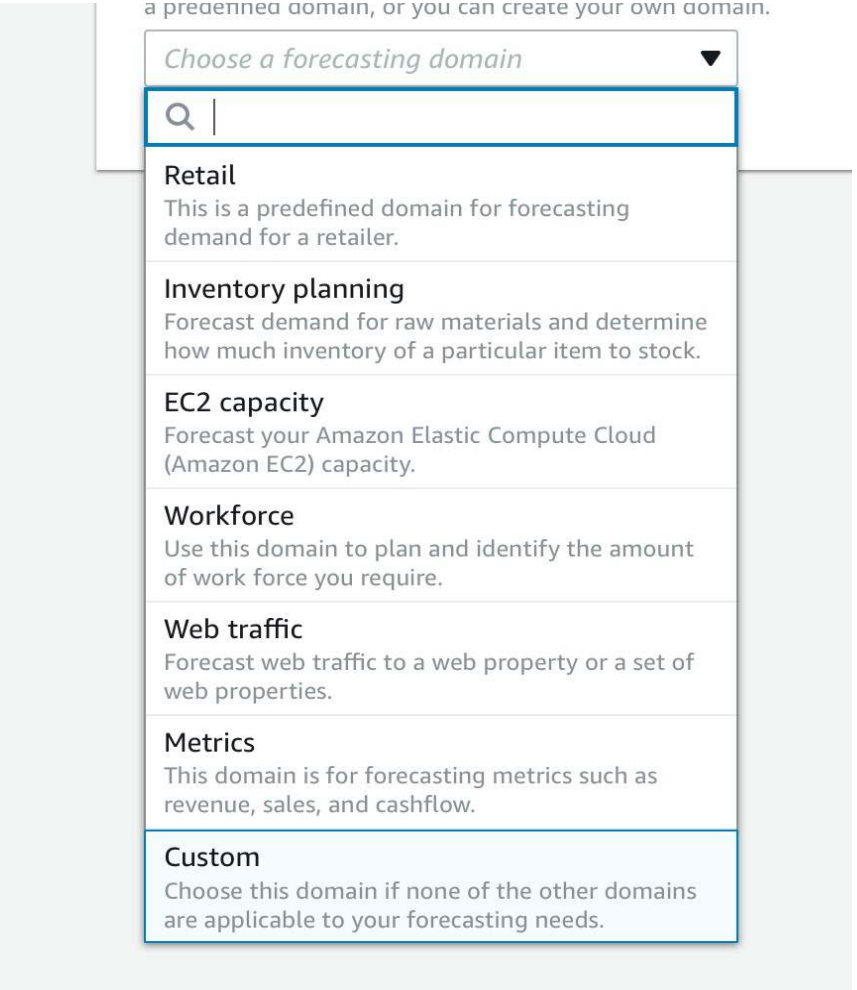
KEY FEATURES

Consider multiple time-series at once	Automatic machine learning	Evaluate model accuracy	Visualize forecasts & import results into business apps	Schedule forecasts and model retraining

mercado libre

CJ GLS

Pre-defined schemas for different business domains



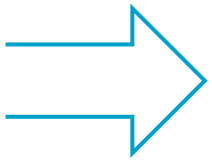
- Amazon Forecast is applicable across multiple domains
- You can set your domain using the AWS Management Console or via the API
- You upload datasets with different schemas based on the domain

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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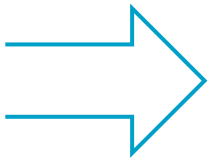
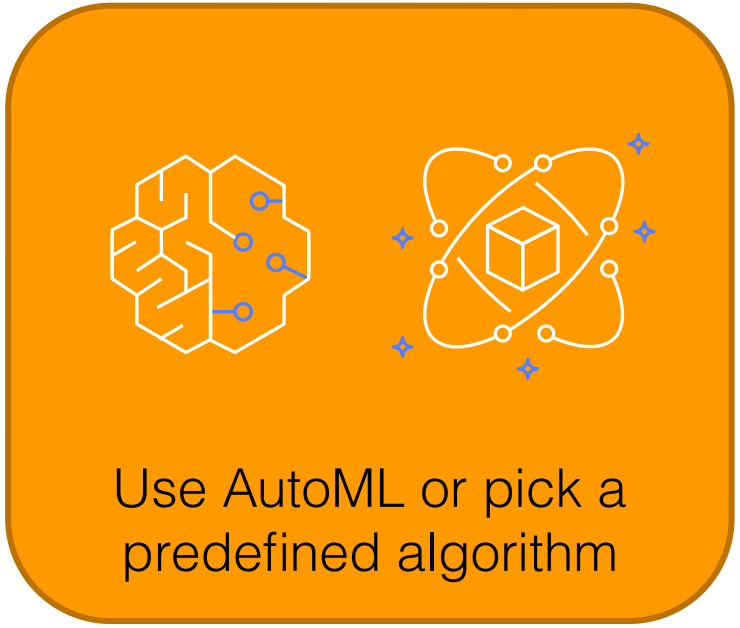
Amazon Forecast



Private Customized Forecasting API

Train custom models once you ingest data



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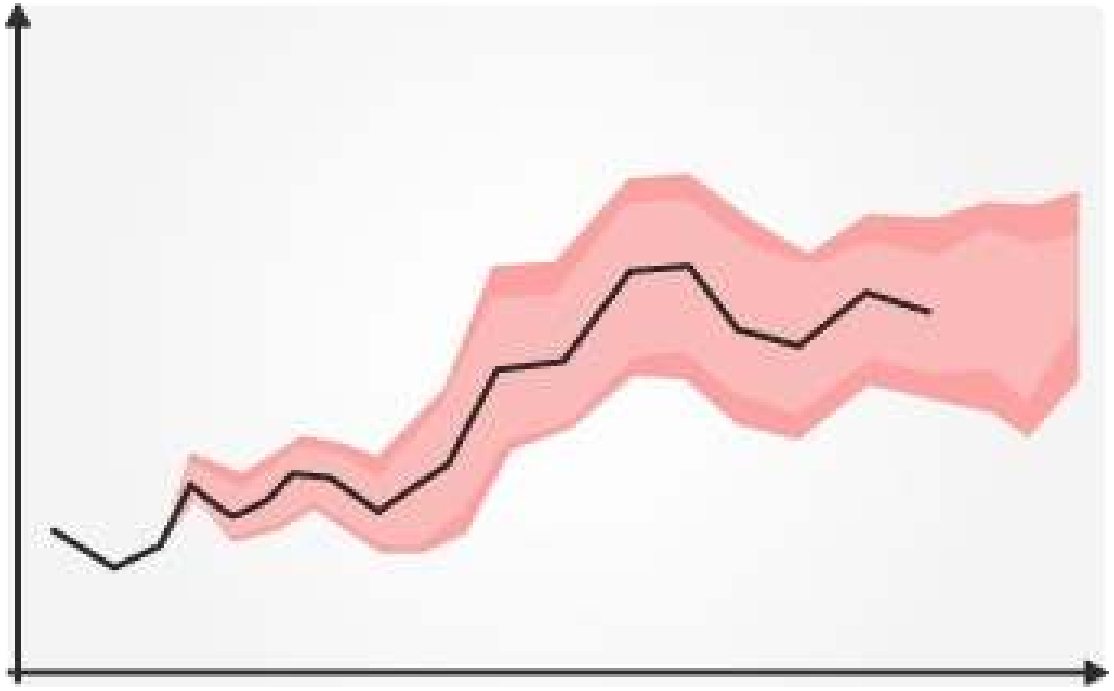
- Amazon Forecast can use Hyper Parameter Optimization to tune models automatically.

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.training/machinelearning

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

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

DEV DAY

Thank you!

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