

# Business requirements

MACHINE LEARNING FOR BUSINESS



**Karolis Urbonas**

Head of Machine Learning & Science,  
Amazon

# Scoping business needs

1. What is the business **situation**?
  - *The company plans to expand to new markets*
2. What is the business **opportunity** and how big is it?
  - *Identify the right markets with the biggest demand*
3. What are the business **actions** we will take?
  - *Prioritize and invest more in the markets with higher predicted demand*

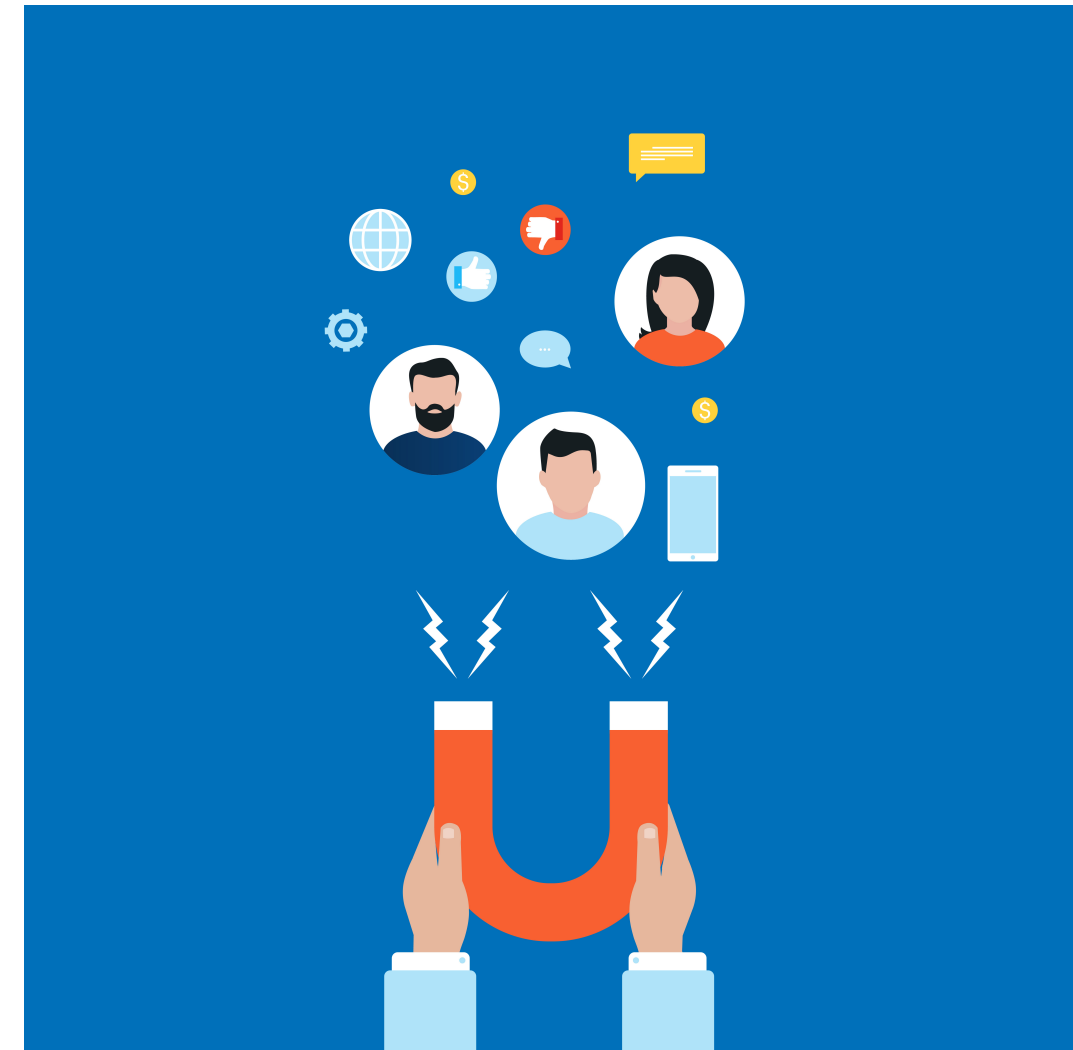
# Business scope - fraud example

1. **Situation** - The fraud rate has started increasing
2. **Opportunity** - Reduce fraud rate by X %, resulting in Y USD savings
3. **Action** - Work on improving fraud detection system, reduce fraud drivers, and manually review transactions at risk



# Business scope - churn example

1. **Situation** - The customers started to churn more
2. **Opportunity** - Reduce churn rate by X %, resulting in Y USD revenue saved
3. **Action** - Work on identifying and improving churn drivers (website errors, too much/little advertising, customer service issues etc.); identify customers at risk and introduce retention campaigns



# Business situation - asking the right question

Always **start with inference questions**

- Why has churn started increasing?
- Which information indicates a potential transaction fraud?
- How are our most valuable customers different from others?

Build on inference question to **define prediction questions**

- Can we identify customers at risk of churning?
- Can we flag potentially risky transactions?
- Can we predict early on which customers are likely to become highly valuable?

# Business opportunity

*Would you spend 1 million USD to earn extra 5000 USD each year? (~200 year return on investment)*

- **Size** up the opportunity
- Once you know the drivers of the outcome, how much will it **cost** changing them, and what will be the value of doing that?
- Finally, how do you know if you can **affect** the predicted outcome? (**hint** - experiments, experiments, and more experiments)

# Actionable machine learning

*Finally, how do you know if you can **affect** the predicted outcome? (hint - experiments, experiments, and more experiments)*

- First, look at historical levels (churn, fraud, # of high value customers)
- Run experiments e.g. target customers at risk with a discount, manually review top 10% riskiest transactions. Repeat experiments multiple times, see if you get a repeated pattern of desired results
- **If yes**, use that to calculate opportunity and make decision if it's a worthwhile investment
- **If no** - 1) collect more data, 2) qualitative research, 3) narrow down business question

# Let's practice!

MACHINE LEARNING FOR BUSINESS



# Model training

MACHINE LEARNING FOR BUSINESS



**Karolis Urbonas**

Head of Machine Learning & Science,  
Amazon

# Modeling dataset

Input A	Input B	Input ... X	Target Y

# Full dataset

Input A	Input B	Input ... X	Target Y

Full dataset

# Splitting data for training

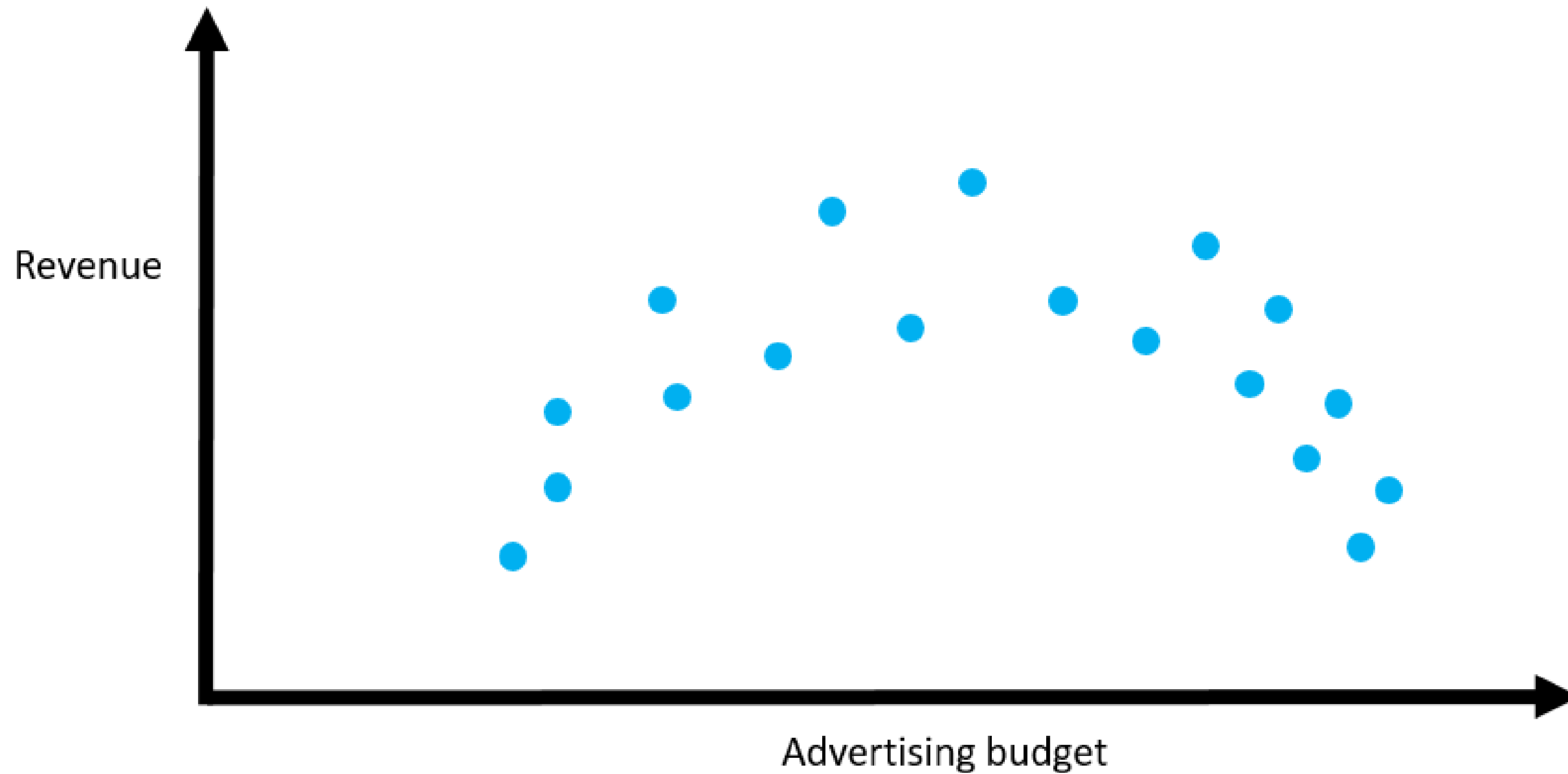
Input A	Input B	Input ... X	Target Y

Randomly sampled dataset for model **training**

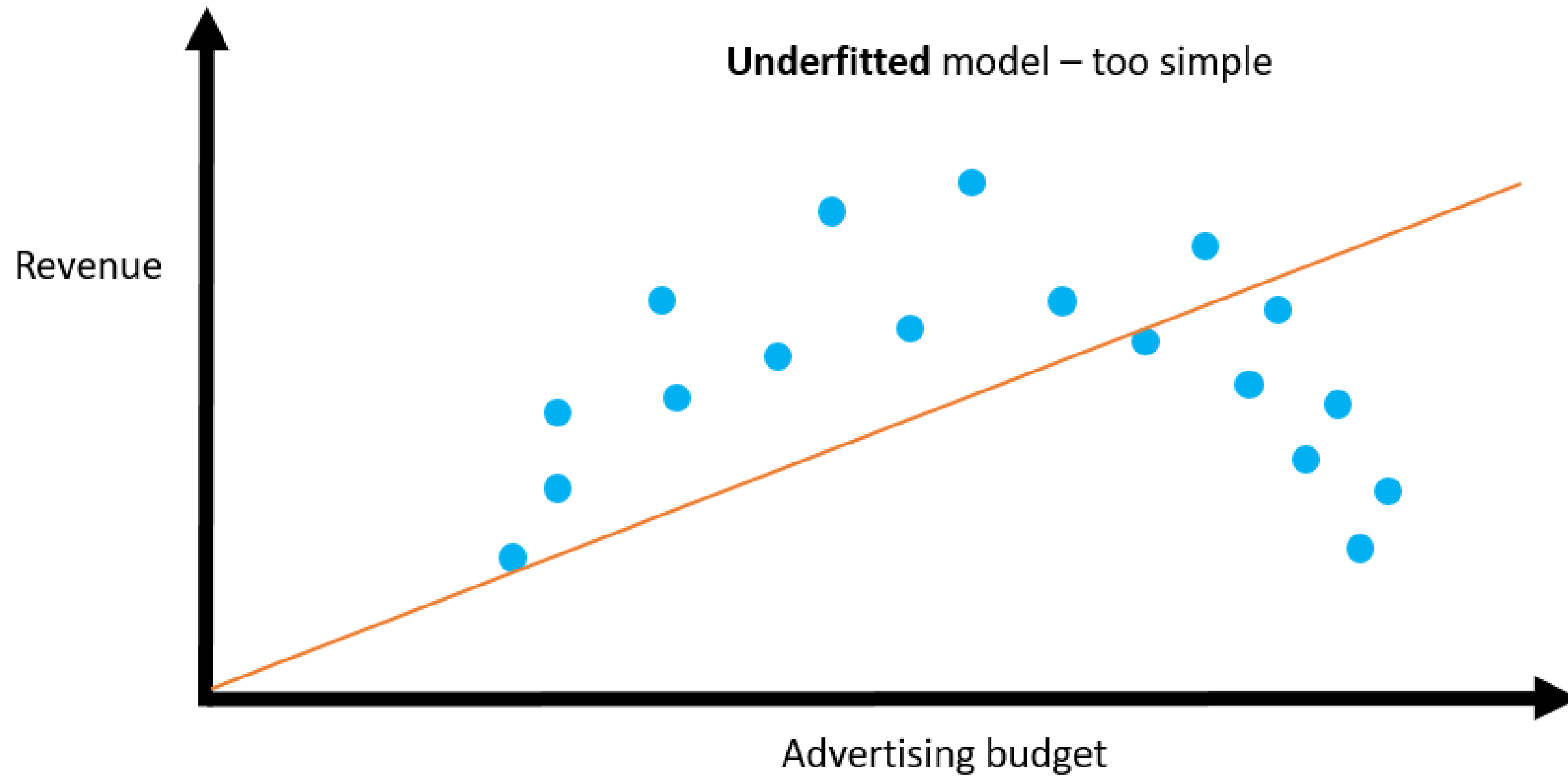
# Test

Input A	Input B	Input ... X	Target Y	
				Randomly sampled dataset for model <b>training</b>
				Randomly sampled dataset for model <b>performance</b> measurement

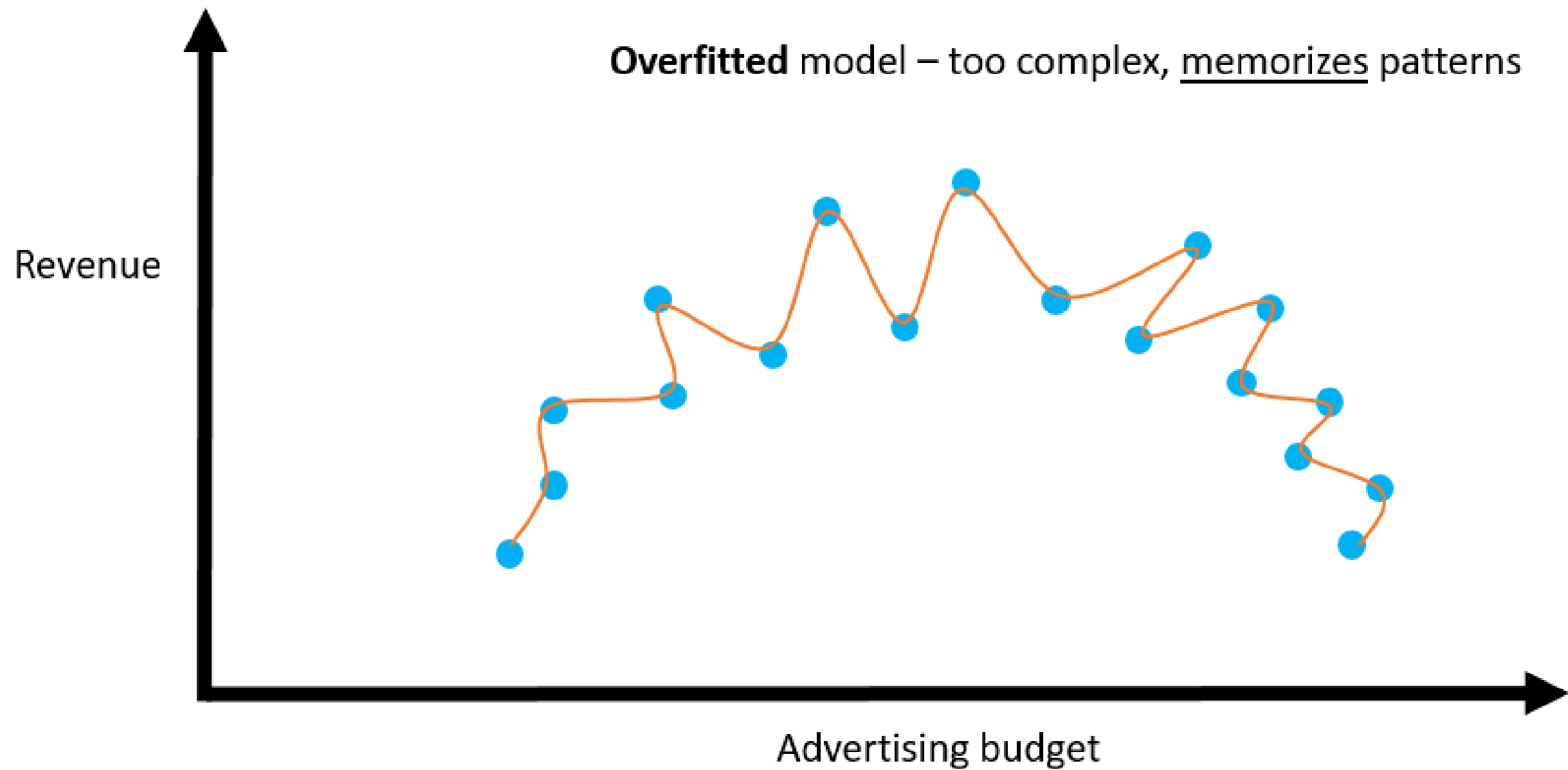
# Overfitting and underfitting



# Underfitting

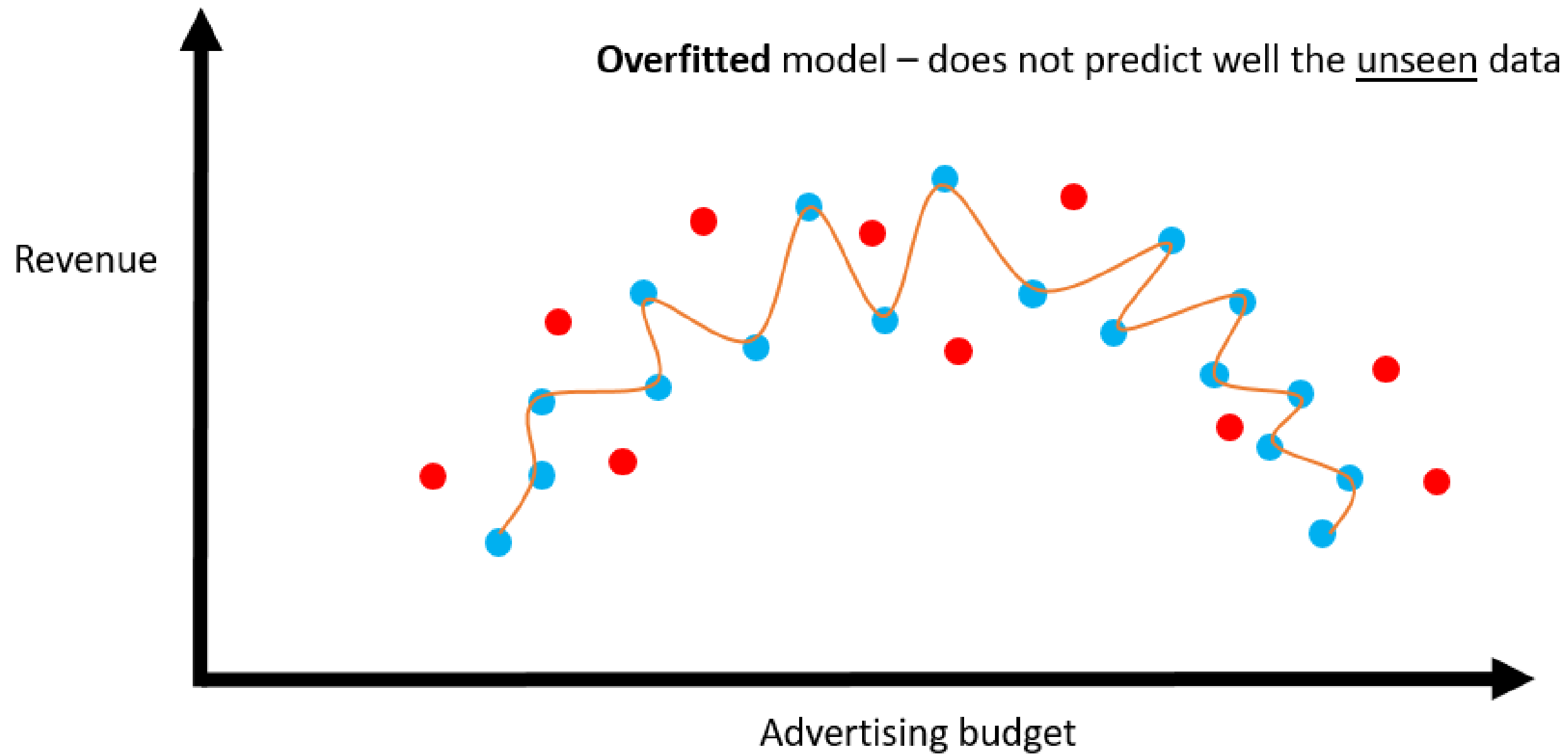


# Overfitting 1

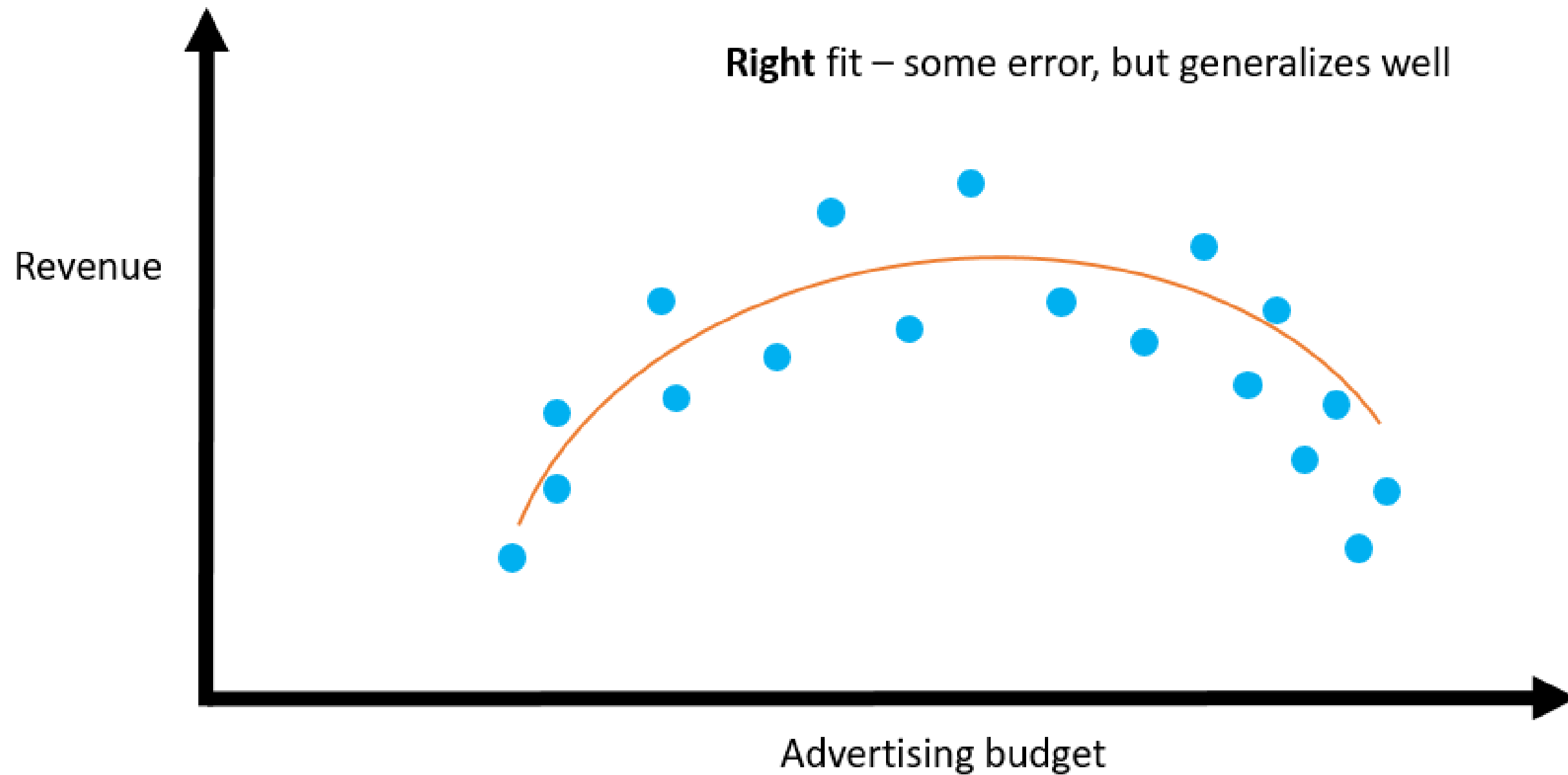




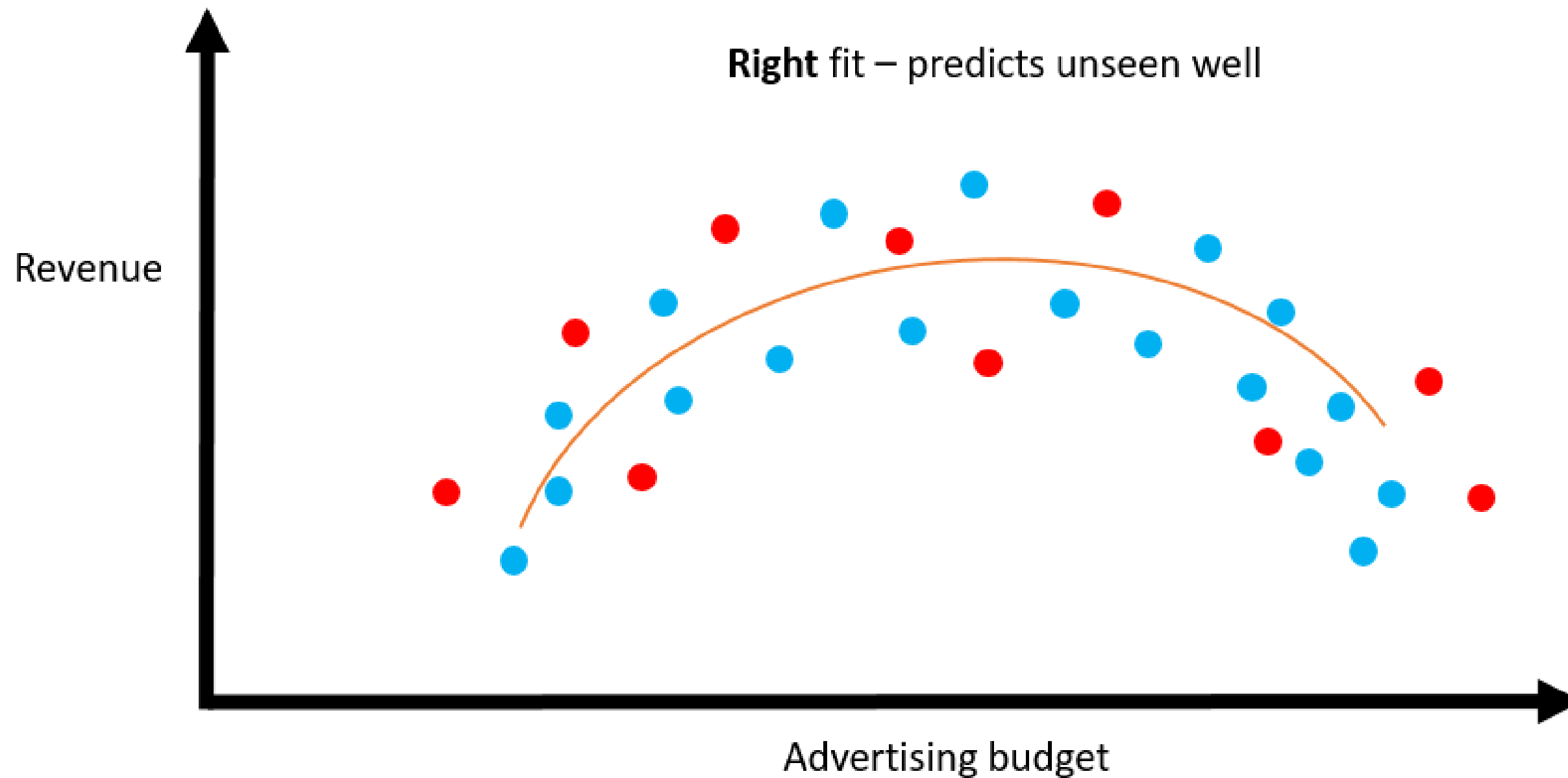
# Overfitting 2



# Right model fit 1



# Right model fit 2

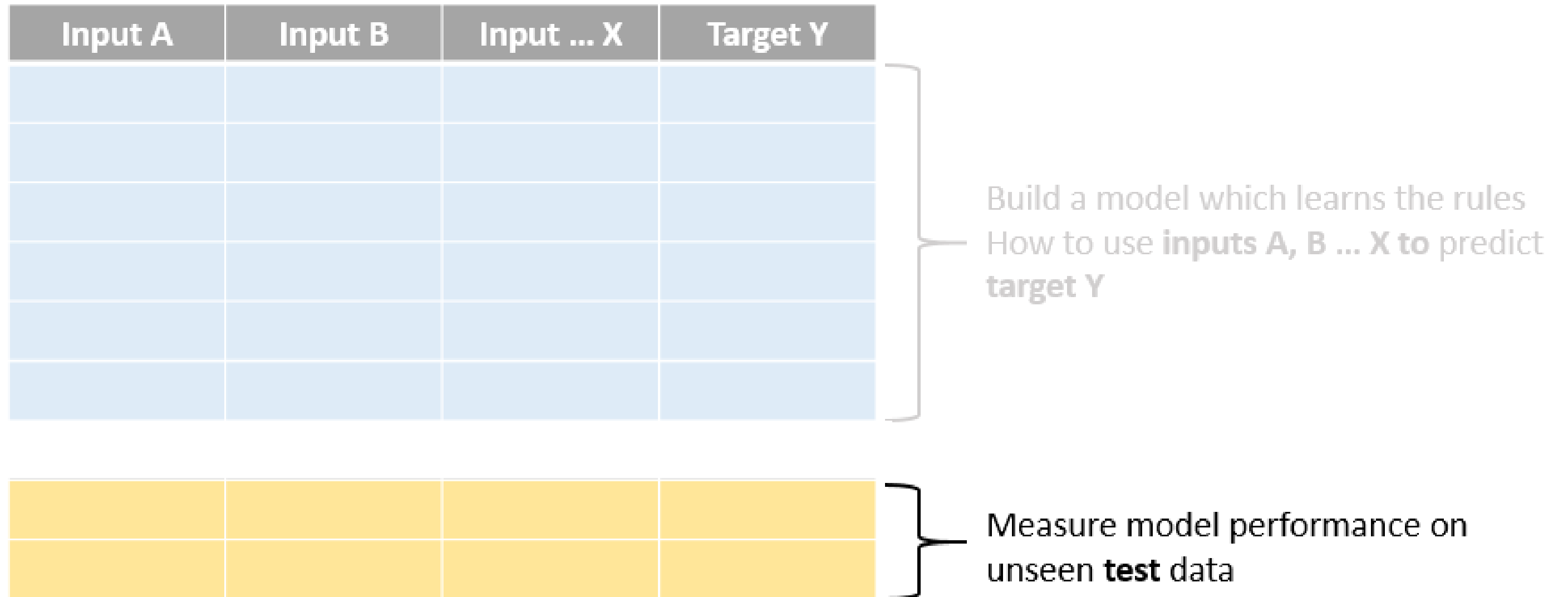


# Model training

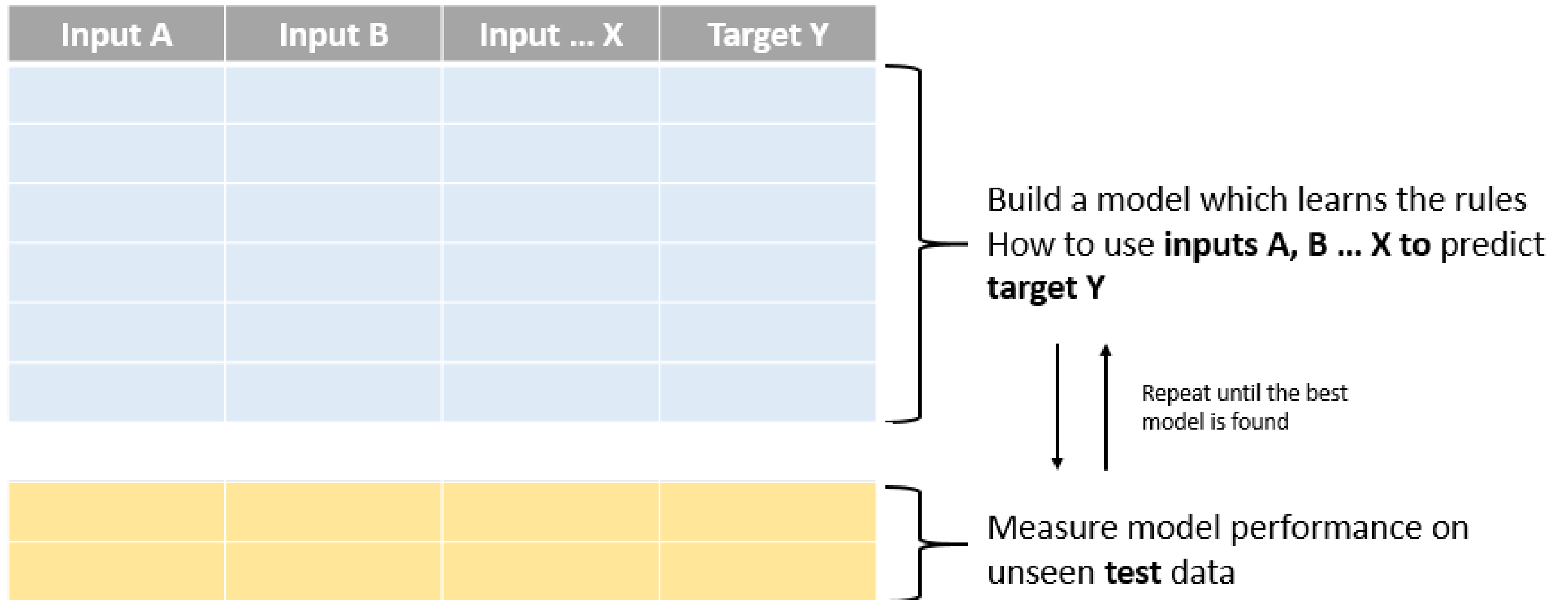
Input A	Input B	Input ... X	Target Y

Build a model which learns the rules  
How to use **inputs A, B ... X** to predict  
**target Y**


# Assess model performance on test



# Try a few models



# Let's practice!

MACHINE LEARNING FOR BUSINESS

# Model performance measurement

MACHINE LEARNING FOR BUSINESS



**Karolis Urbonas**

Head of Machine Learning & Science,  
Amazon



# Performance measurement types

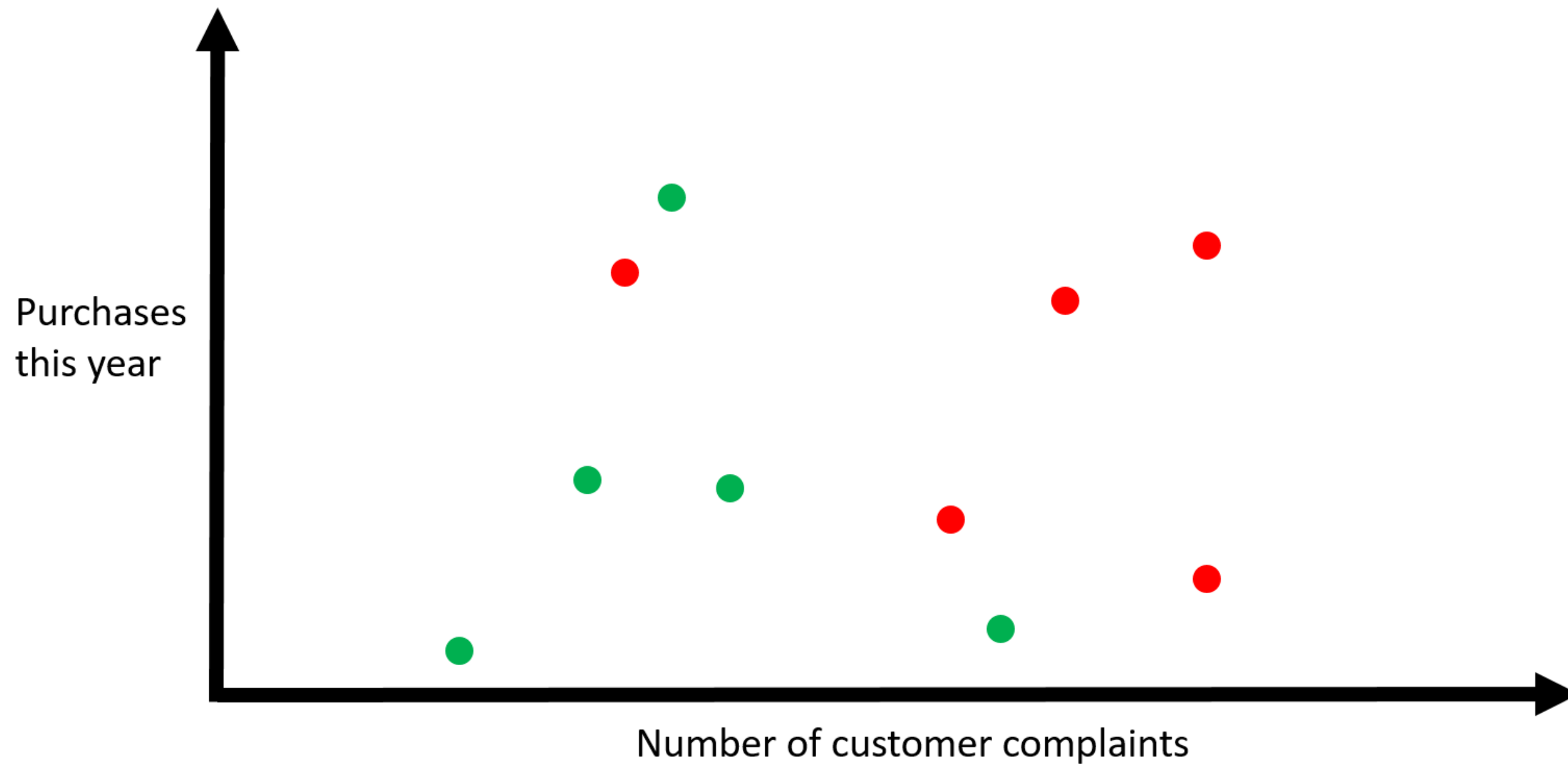
Two key supervised learning metrics:

1. **Accuracy** --> classification
2. **Error** --> regression

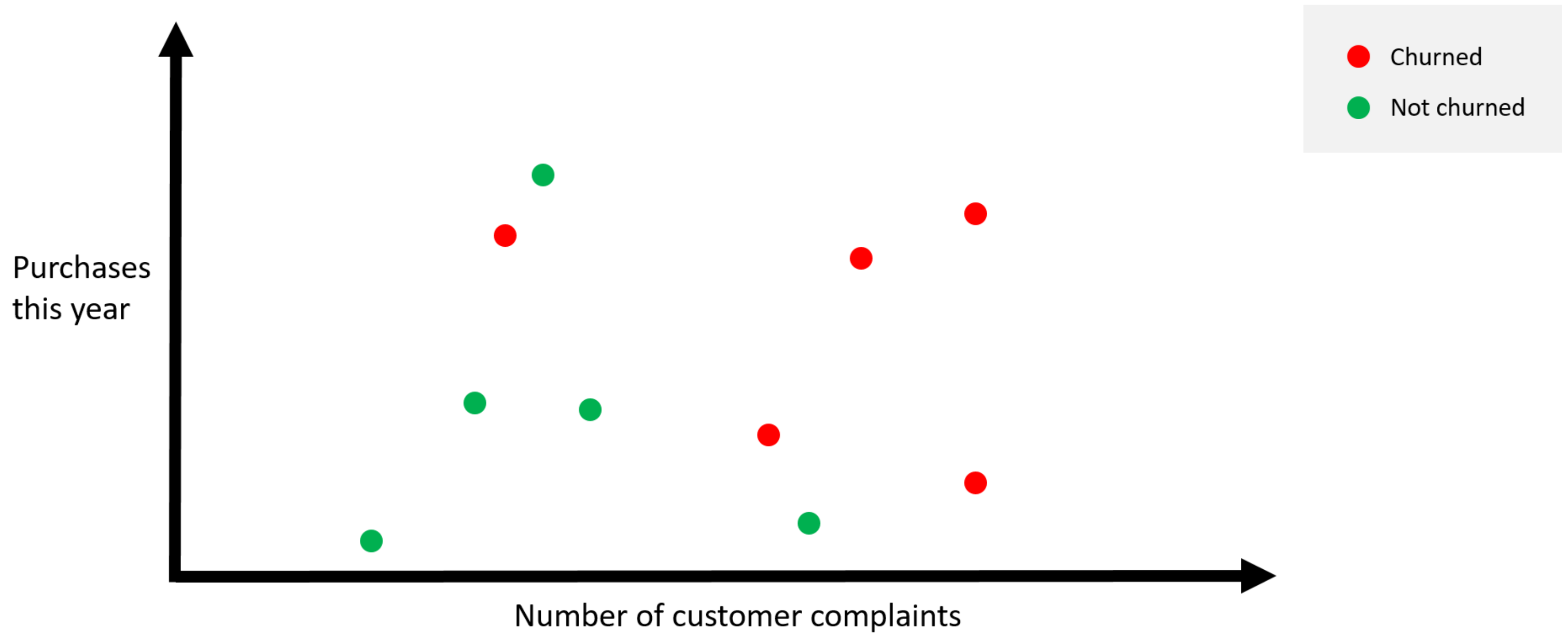
# Classification performance

- Accuracy
- Recall
- Precision

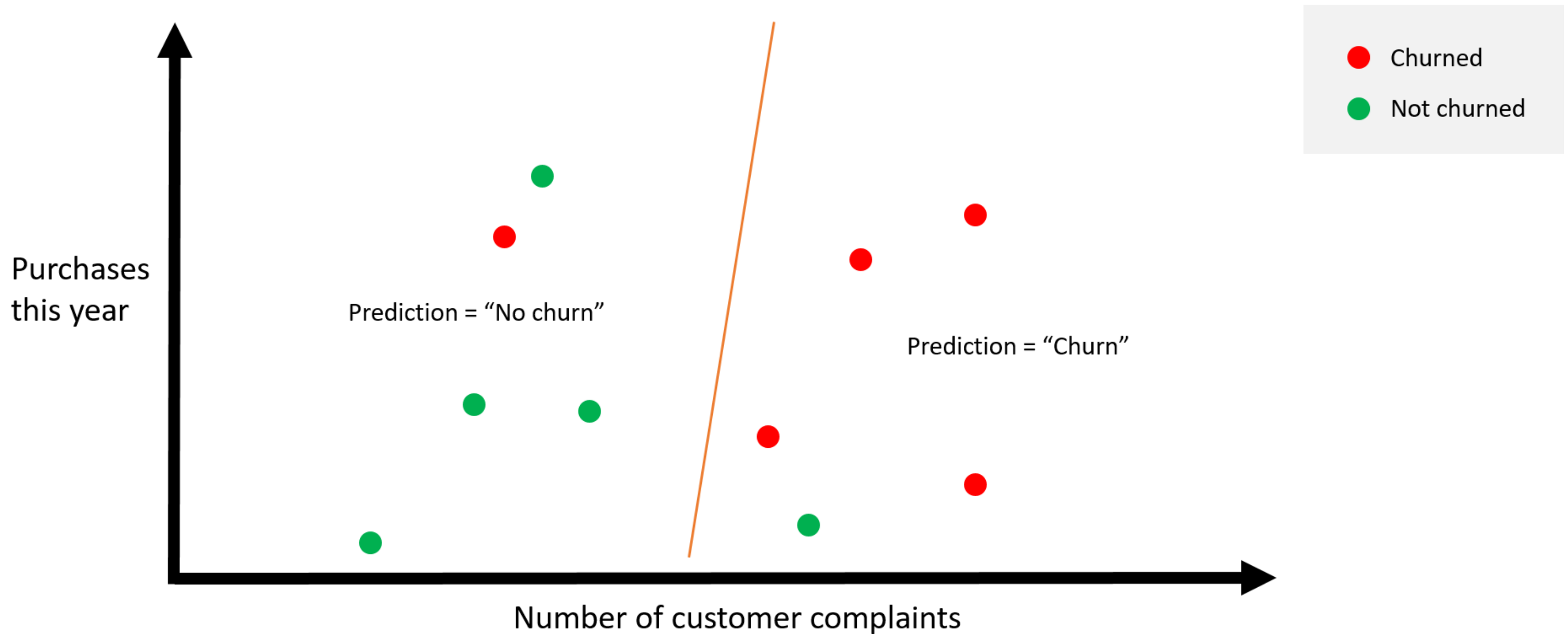
# Churn example



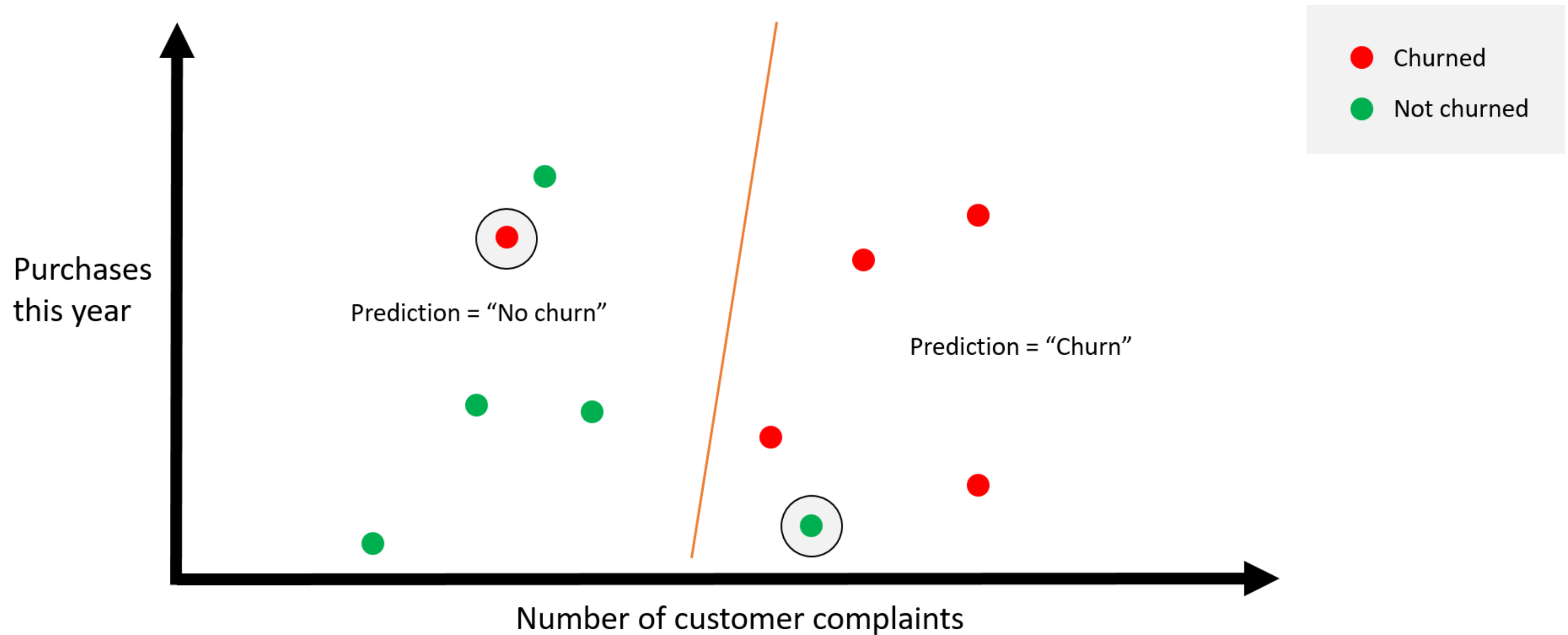
# Churn example



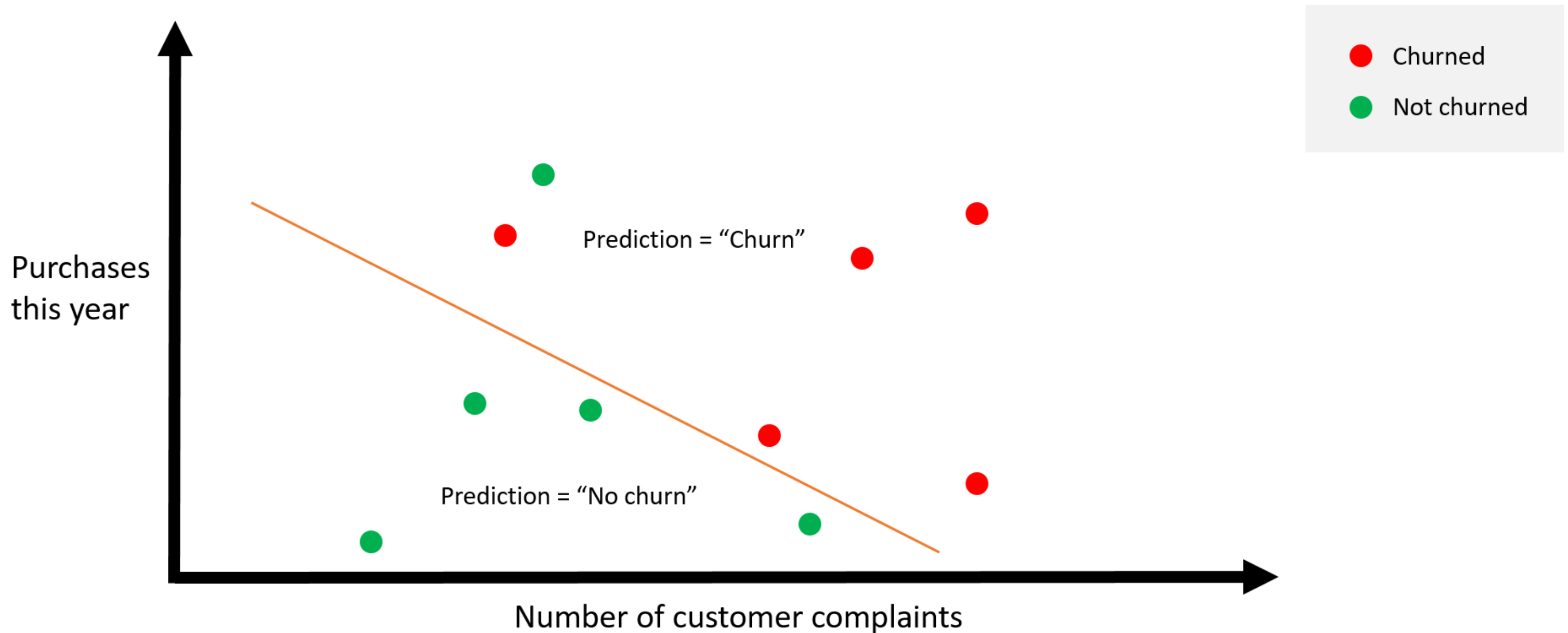
# Churn prediction



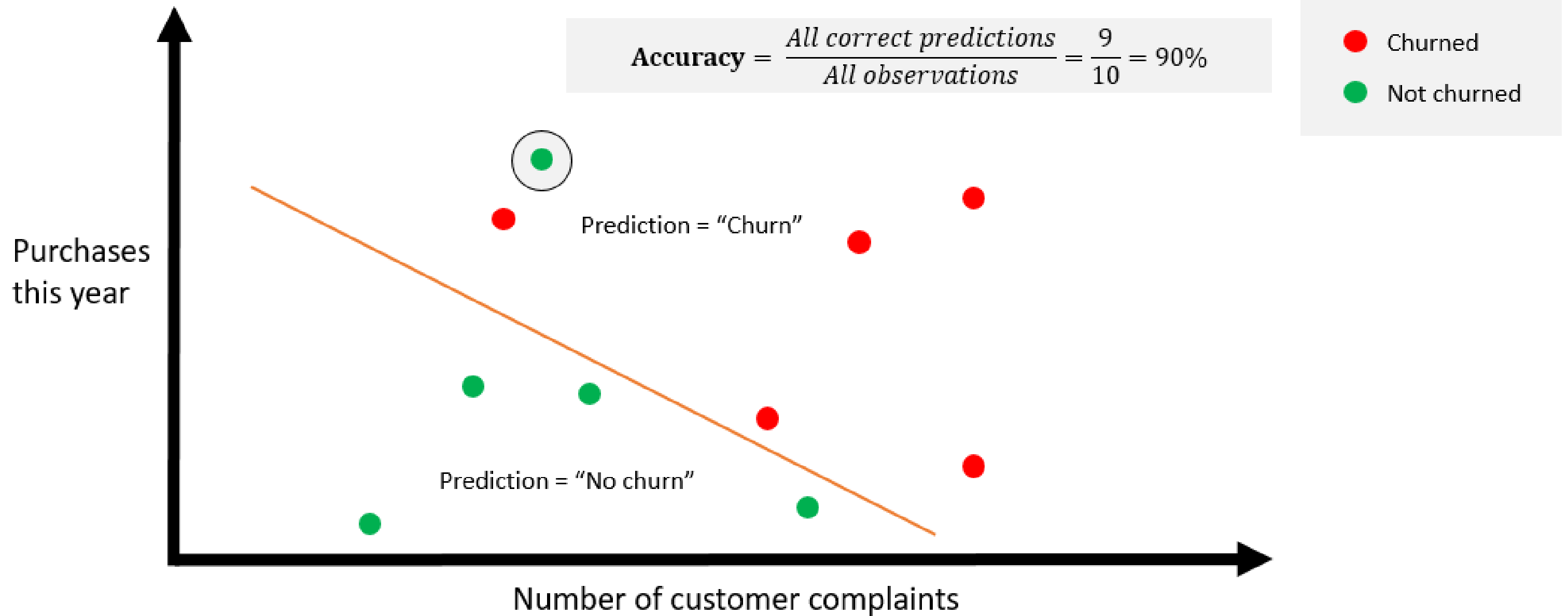
# Mis-classified items



# Another churn prediction

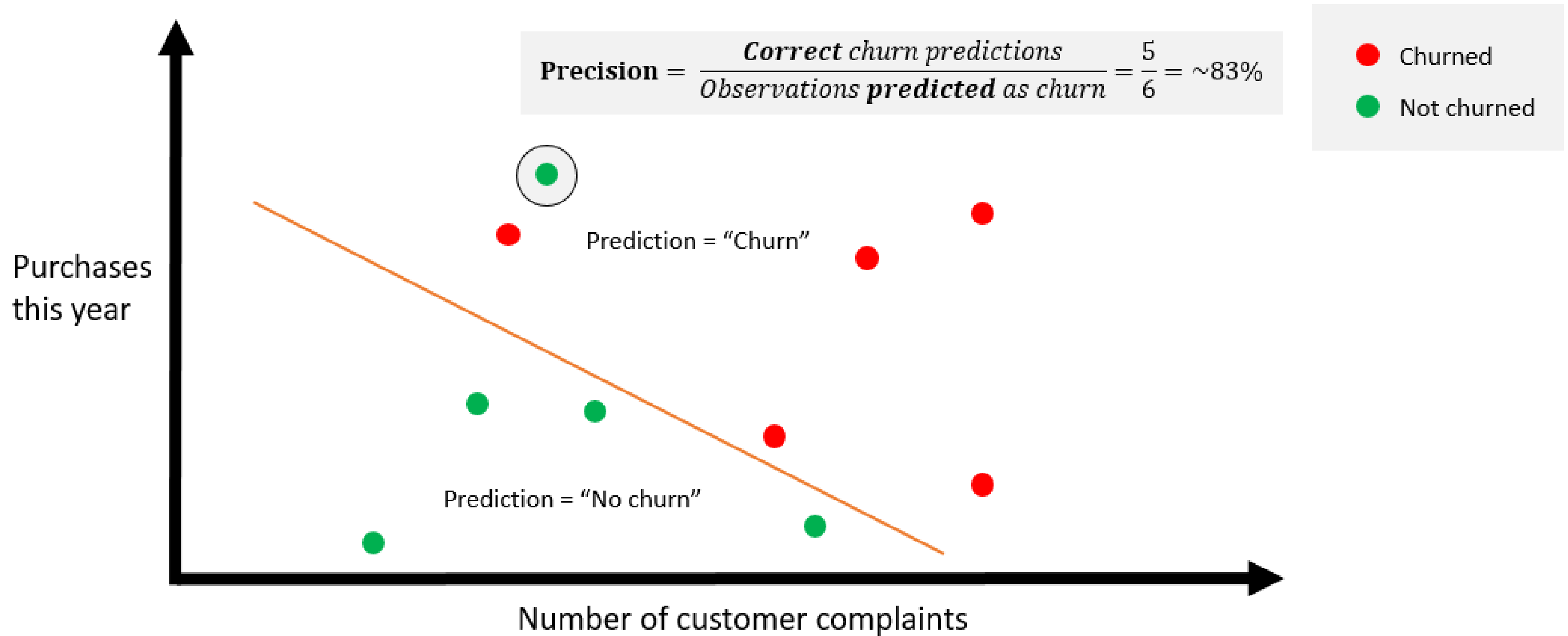


# Accuracy

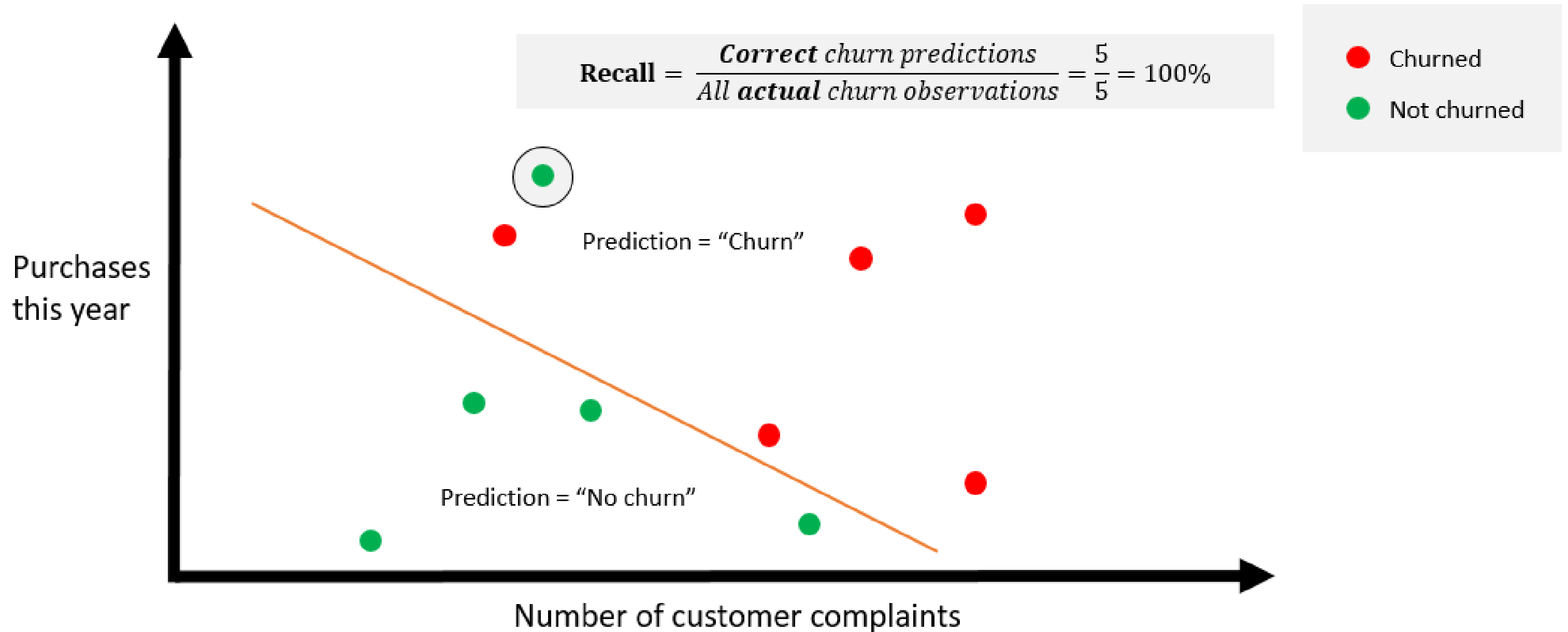




# Precision



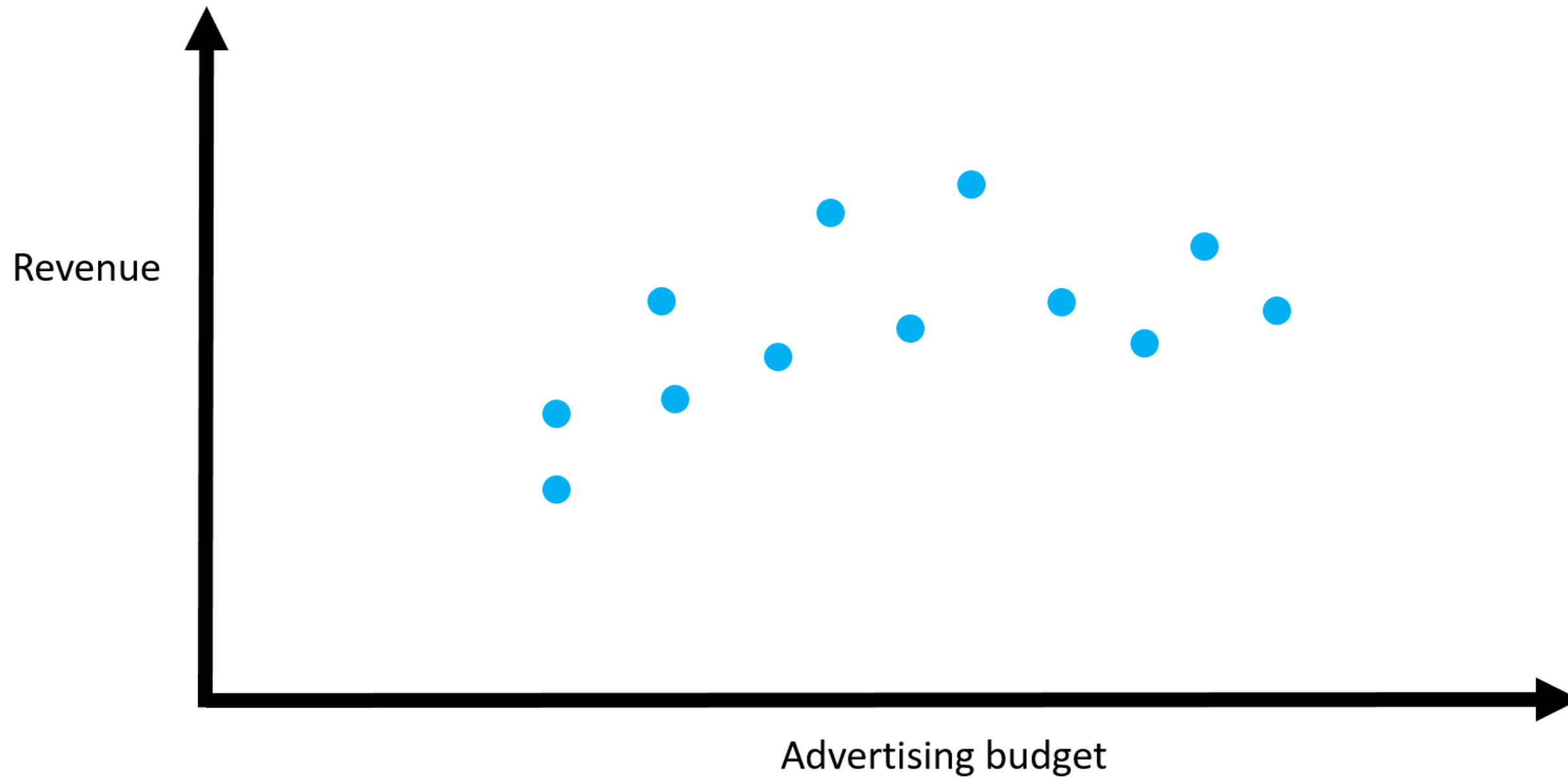
# Recall



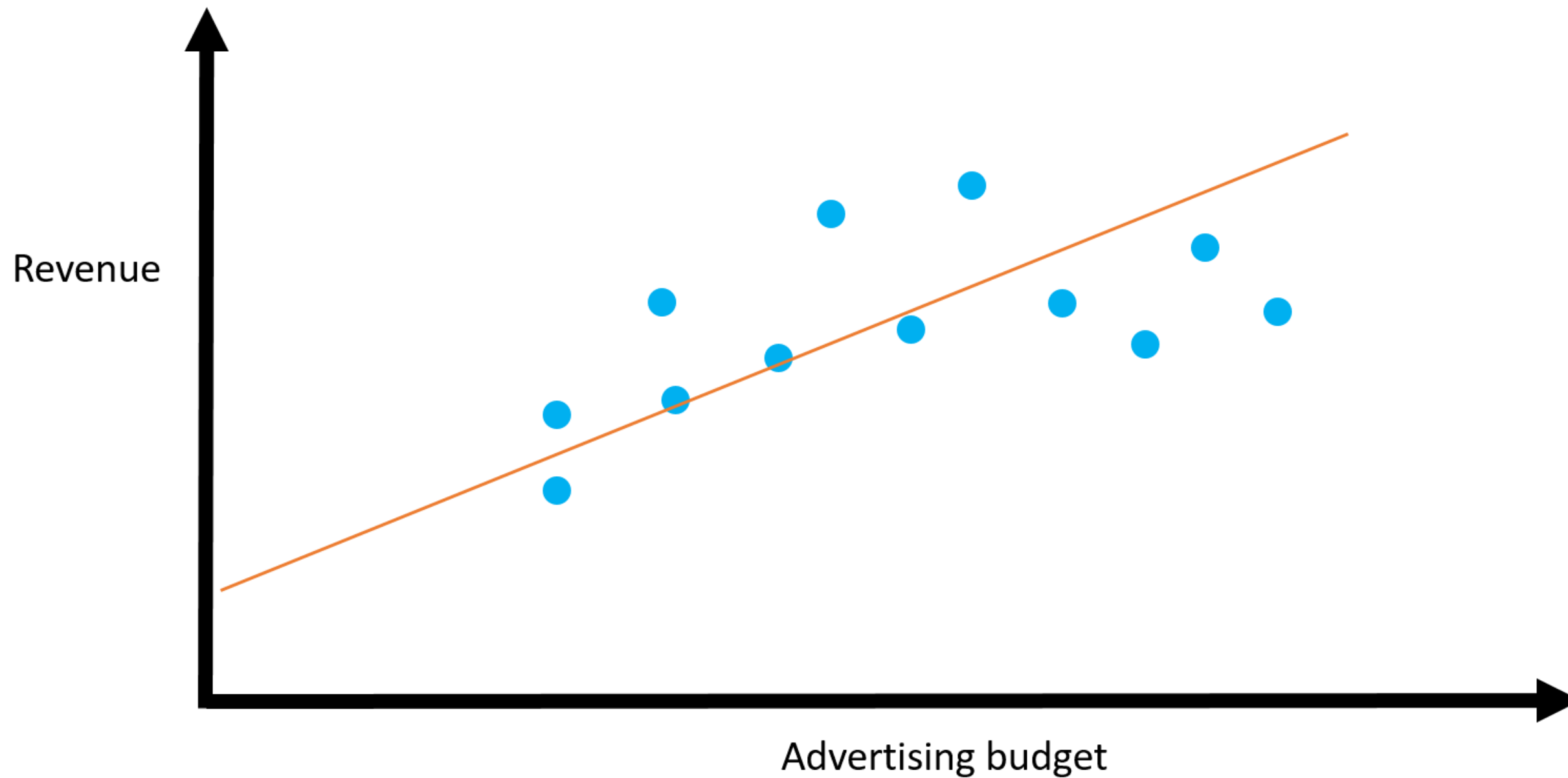
# Regression performance

- Error

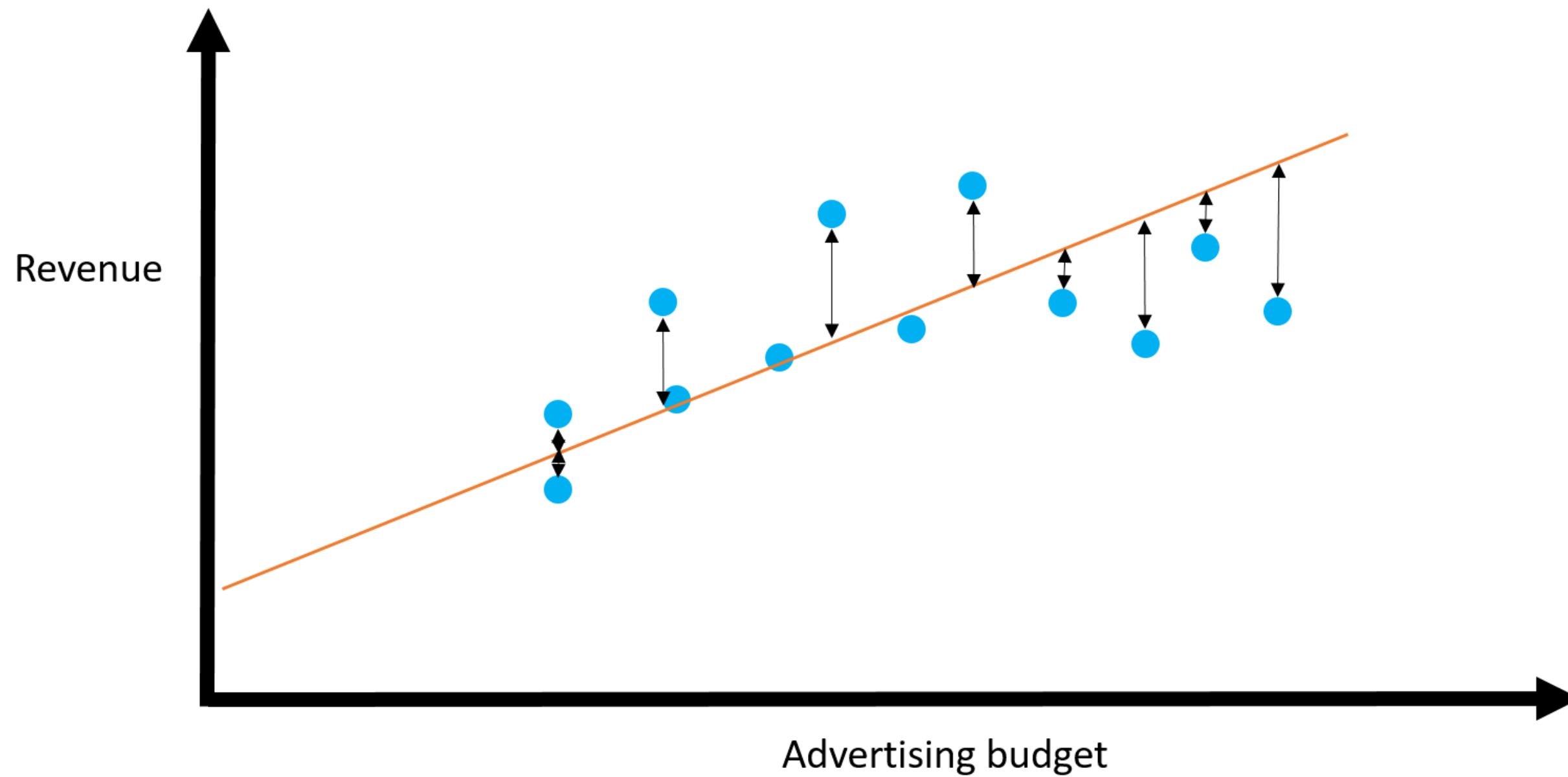
# Regression example



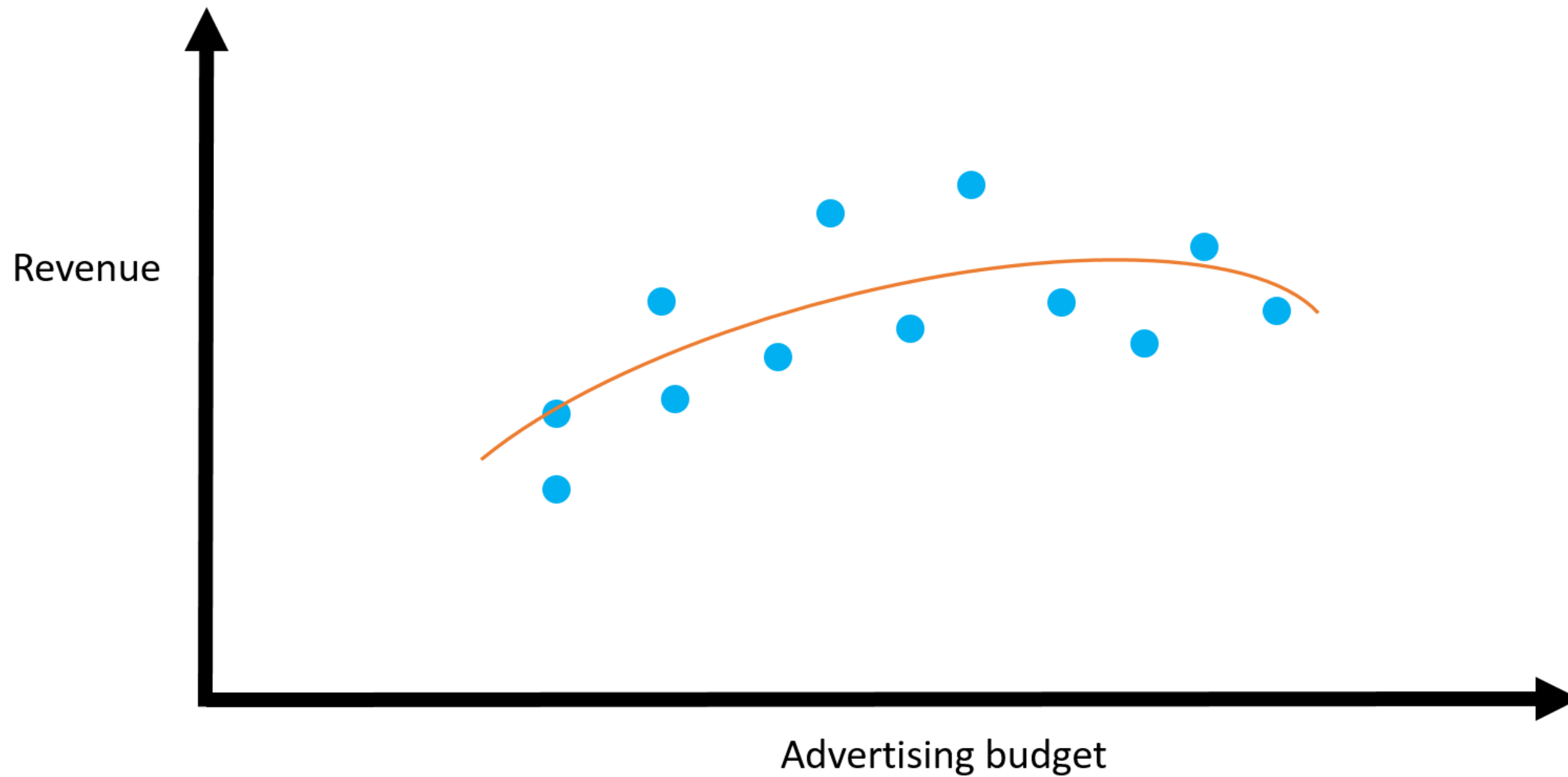
# Predicting revenue with a line



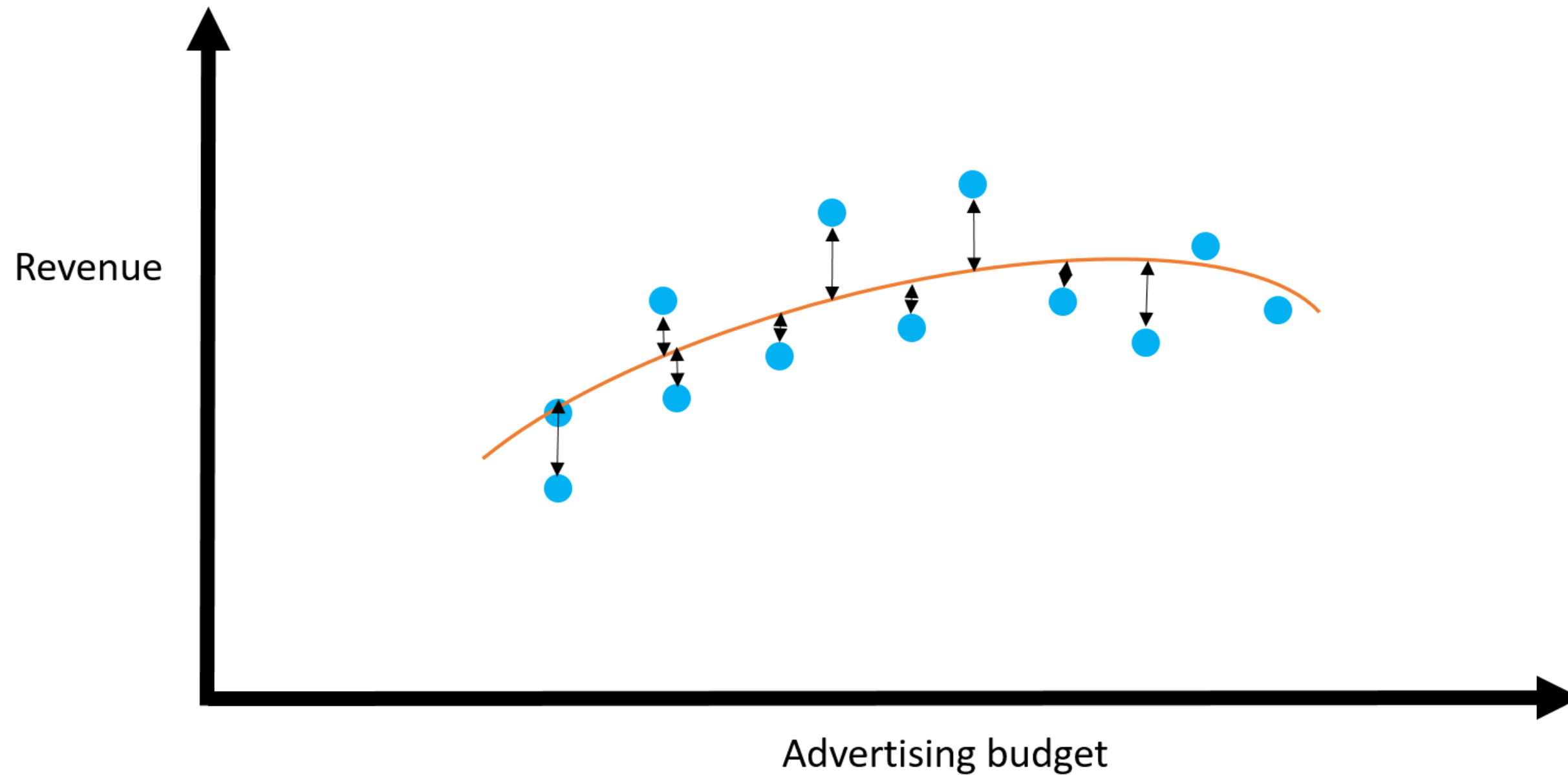
# Regression error



# Testing non-linear models



# Error improvements





# Actionable models - A/B testing

Good models are not always actionable:

- Churn prediction, purchase prediction, machine failure prediction

Test if using models helps improve outcomes:

- Target customers predicted to churn with incentives (discounts, coupons, promotions)

- Send reminder emails and product details to customers likely to purchase

\_Did this result in decreased churn, increased purchase rate and reduced machine failures? If **yes**, build into automated process. If **no**, collect more data, improve models, and test again. \_

# Let's practice!

MACHINE LEARNING FOR BUSINESS

# Machine learning risks

MACHINE LEARNING FOR BUSINESS



**Karolis Urbonas**

Head of Machine Learning & Science,  
Amazon

# Poor performance

Some models perform poorly (make sure you review **test** performance, not **training**):

- Low precision
- Low recall
- Large error

# Low precision

**Low precision** - a lot of misclassified items in the class of interest = a lot of **false positives**

Example - only 10% of customers identified as likely to purchase actually purchased the product

# Low recall

**Low recall** - only a small fraction of all observations in the class have been correctly captured (recalled) by the model

Example - only 25% of all fraudulent transactions identified by the model

# Large error

**Large error** - large differences between predicted and actual values

Example - the average error for the customer satisfaction rating prediction is 3.5 units or 70% in percentage points

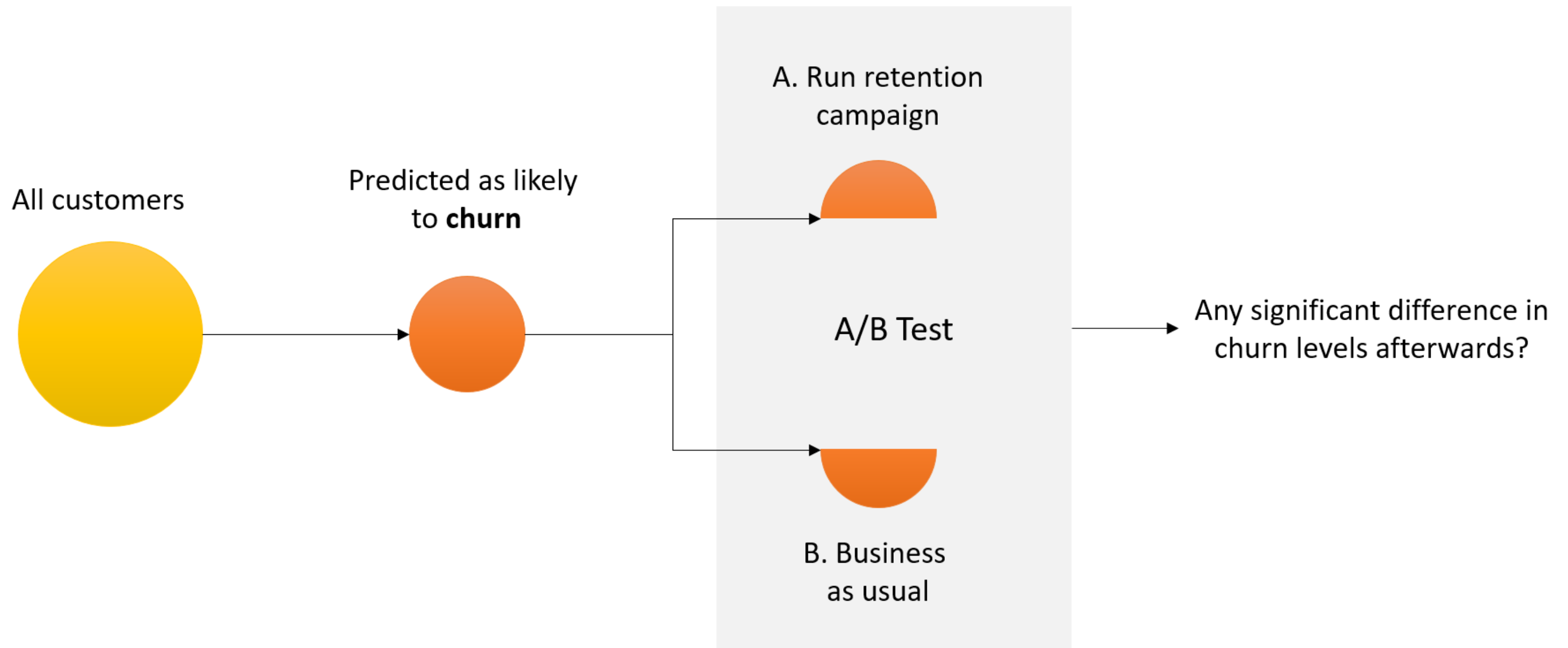
# Non-actionable model use cases

**Q:** How to test the models correctly?

**A:** Run tests / experiments to validate their performance e.g. churn prevention emails, product promotions, manual machine maintenance, manual transaction review



# A/B testing



# What if tests don't work?

- Get more data - business has to be involved
- Build causal models to understand drivers
- Run qualitative research (surveys etc.)
- Change the scope of the problem
  - Narrow
  - Widen
  - Different question

# Let's practice!

MACHINE LEARNING FOR BUSINESS