Variable selection

INTRODUCTION TO PREDICTIVE ANALYTICS IN PYTHON

Nele Verbiest, Ph.D
Data Scientist @PythonPredictions

datacamp

Candidate predictors

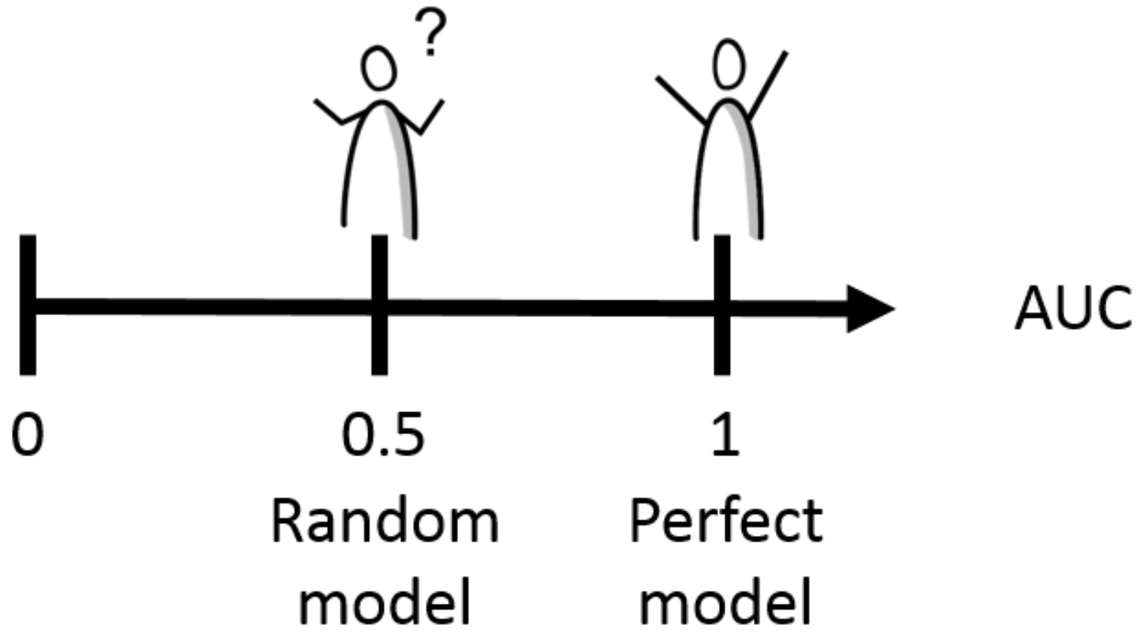
- `age`
- `max_gift`
- `income_low`
- `min_gift`, `mean_gift`, `median_gift`
- `country_USA`, `country_India`, `country_UK`
- `number_gift_min50`, `number_gift_min100`, `number_gift_min150`

Variable selection: motivation

Drawbacks of models with many variables:

- Over-fitting
- Hard to maintain or implement
- Hard to interpret, multi-collinearity

Model evaluation: AUC




```
import numpy as np
from sklearn.metrics import roc_auc_score
roc_auc_score(true_target, prob_target)
```

Let's practice!

INTRODUCTION TO PREDICTIVE ANALYTICS IN PYTHON

Forward stepwise variable selection

INTRODUCTION TO PREDICTIVE ANALYTICS IN PYTHON

Nele Verbiest, Ph.D
Data Scientist @PythonPredictions

datacamp

The forward stepwise variable selection procedure

- Empty set
- Find best variable v_1
- Find best variable v_2 in combination with v_1
- Find best variable v_3 in combination with v_1, v_2
- ...

(Until all variables are added or until predefined number of variables is added)

Functions in Python

```
def function_sum(a,b):
    s = a + b
    return(s)
print(function_sum(1,2))
```

```
3
```

Implementation of the forward stepwise procedure

- Function `auc` that calculates AUC given a certain set of variables
- Function `best_next` that returns next best variable in combination with current variables
- Loop until desired number of variables

Implementation of the AUC function

```
from sklearn import linear_model
from sklearn.metrics import roc_auc_score

def auc(variables, target, basetable):
    X = basetable[variables]
    y = basetable[target]
    logreg = linear_model.LogisticRegression()
    logreg.fit(X, y)
    predictions = logreg.predict_proba(X)[:,1]
    auc = roc_auc_score(y, predictions)
    return(auc)
```

```
auc = auc(["age","gender_F"],["target"],basetable)
print(round(auc,2))
```

```
0.54
```

Calculating the next best variable

```
def next_best(current_variables,candidate_variables, target, basetable):
    best_auc = -1
    best_variable = None
    for v in candidate_variables:
        auc_v = auc(current_variables + [v], target, basetable)
        if auc_v >= best_auc:
            best_auc = auc_v
            best_variable = v
    return best_variable
current_variables = ["age","gender_F"]
candidate_variables = ["min_gift","max_gift","mean_gift"]
next_variable = next_best(current_variables, candidate_variables, basetable)
print(next_variable)
```

```
min_gift
```

The forward stepwise variable selection procedure

```
candidate_variables = ["mean_gift","min_gift","max_gift",
"age","gender_F","country_USA","income_low"]
current_variables = []
target = ["target"]
max_number_variables = 5
number_iterations = min(max_number_variables, len(candidate_variables))
for i in range(0,number_iterations):
    next_var = next_best(current_variables,candidate_variables,target,basetable)
    current_variables = current_variables + [next_variable]
    candidate_variables.remove(next_variable)
print(current_variables)
```

```
['max_gift', 'mean_gift', 'min_gift', 'age', 'gender_F']
```

Let's practice!

INTRODUCTION TO PREDICTIVE ANALYTICS IN PYTHON

Deciding on the number of variables

INTRODUCTION TO PREDICTIVE ANALYTICS IN PYTHON

Nele Verbiest, Ph.D
Data Scientist @PythonPredictions

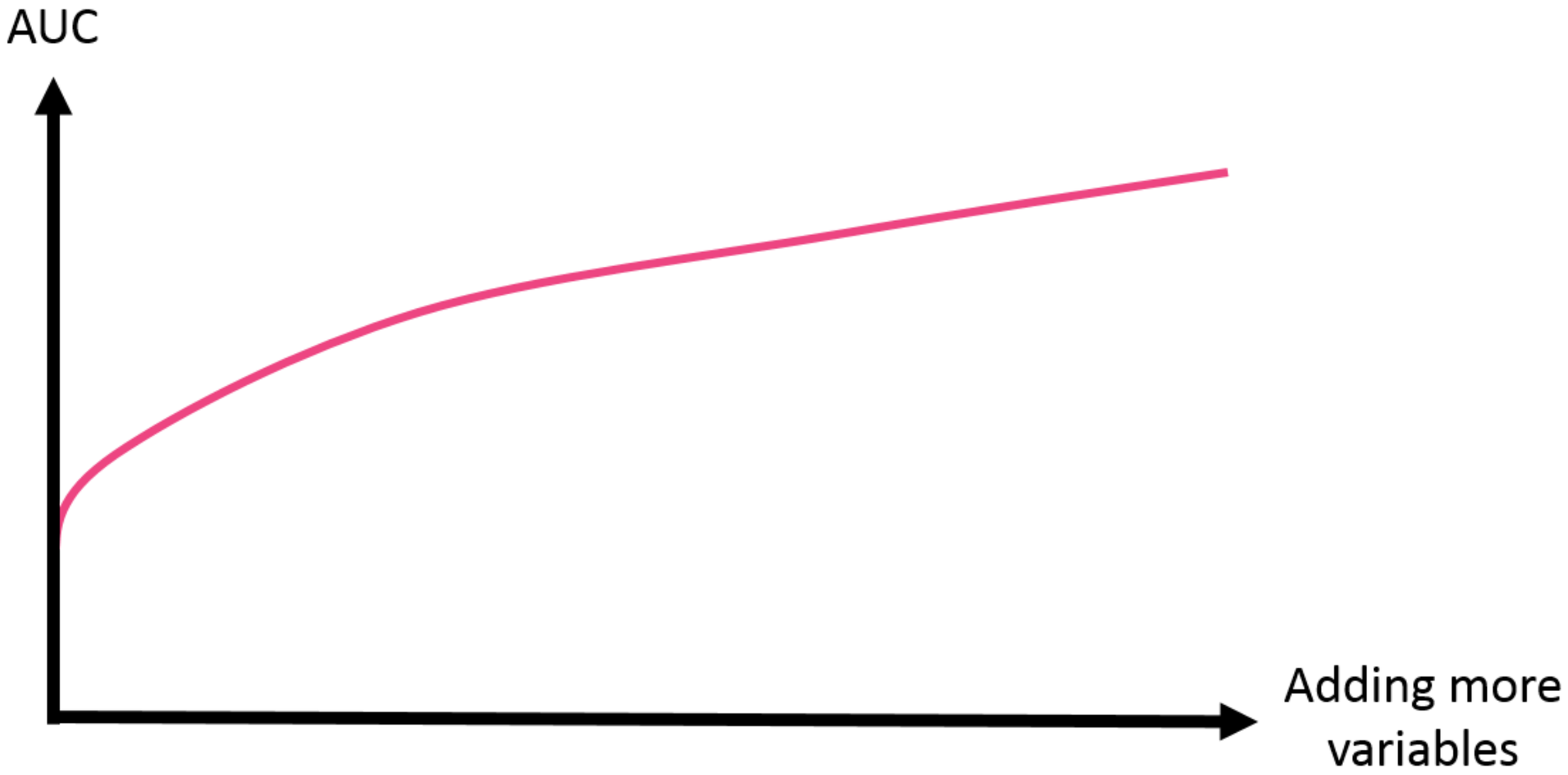
datacamp

Evaluating the AUC

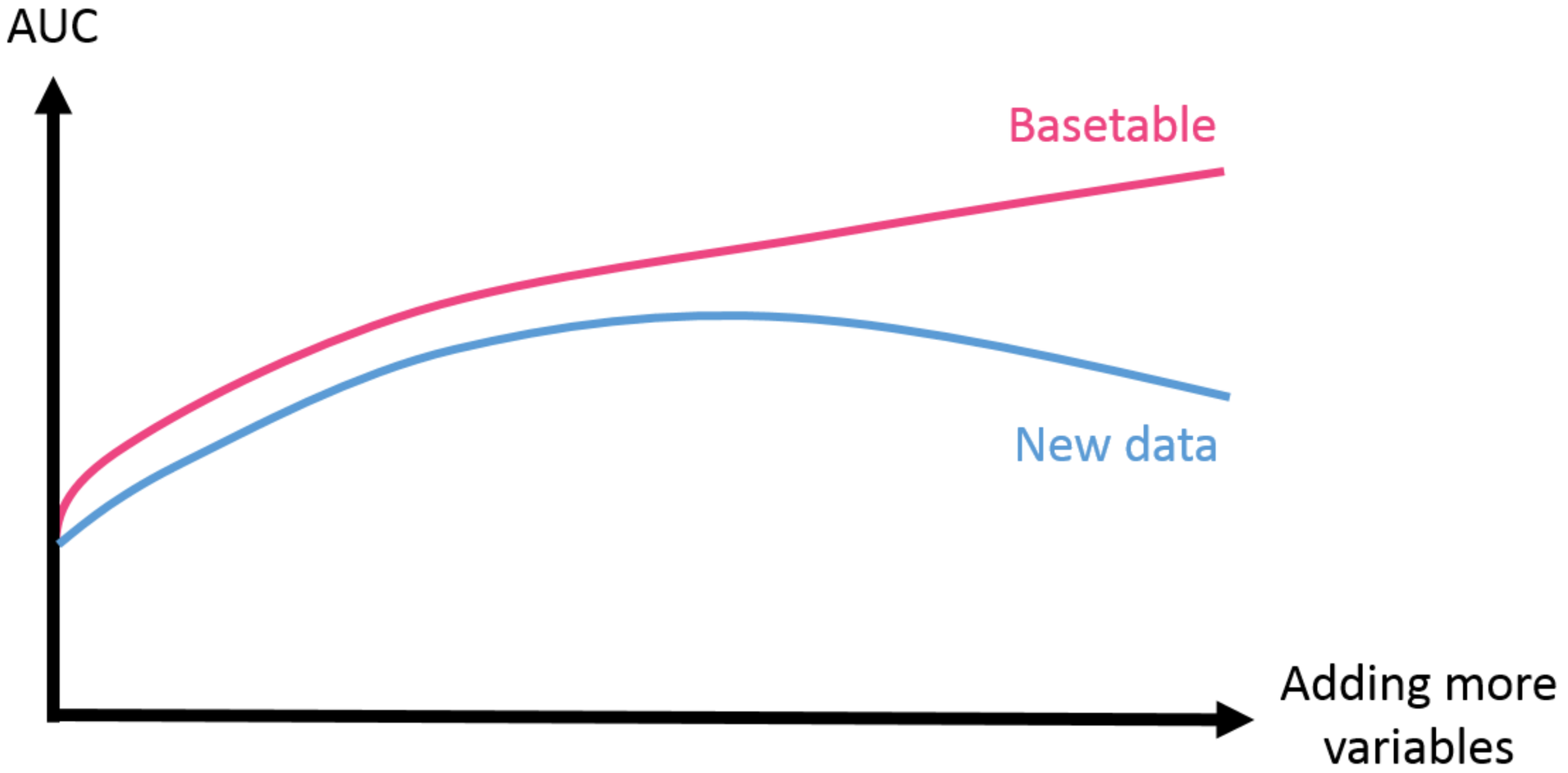
```
auc_values = []
variables_evaluate = []

for v in variables_forward:
    variables_evaluate.append(v)
    auc_value = auc(variables_evaluate, ["target"], basetable)
    auc_values.append(auc_value)
```

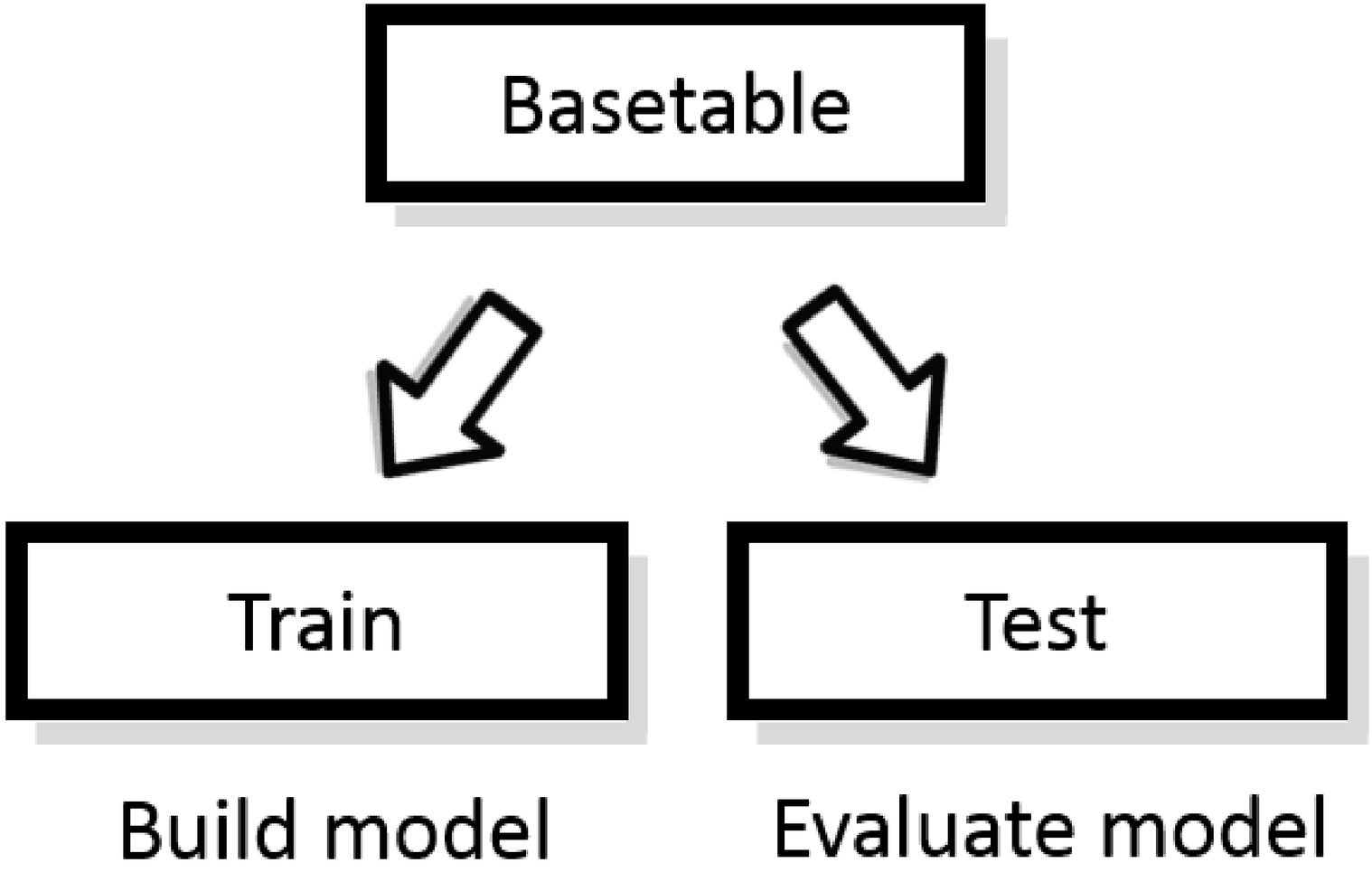
Evaluating the AUC



Over-fitting



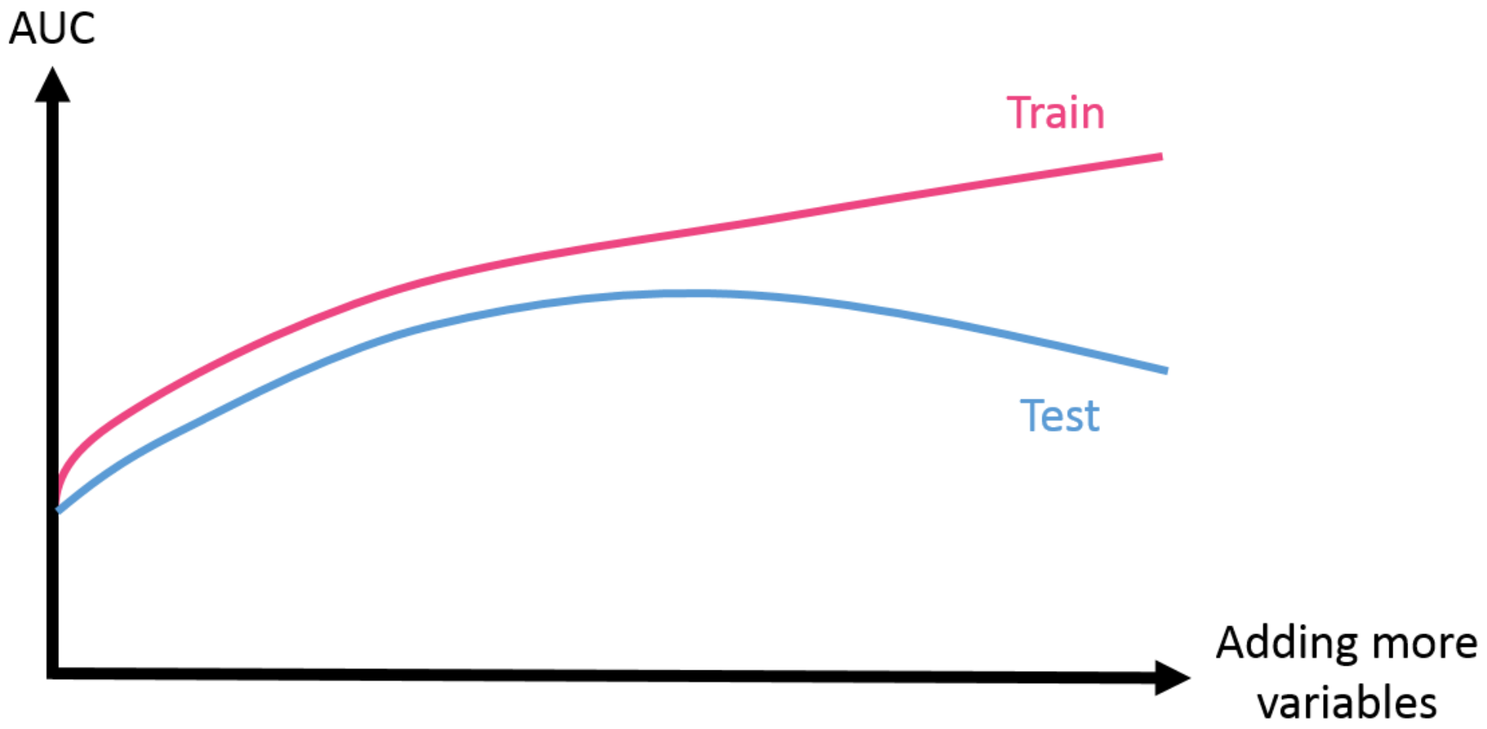
Detecting over-fitting



Partitioning

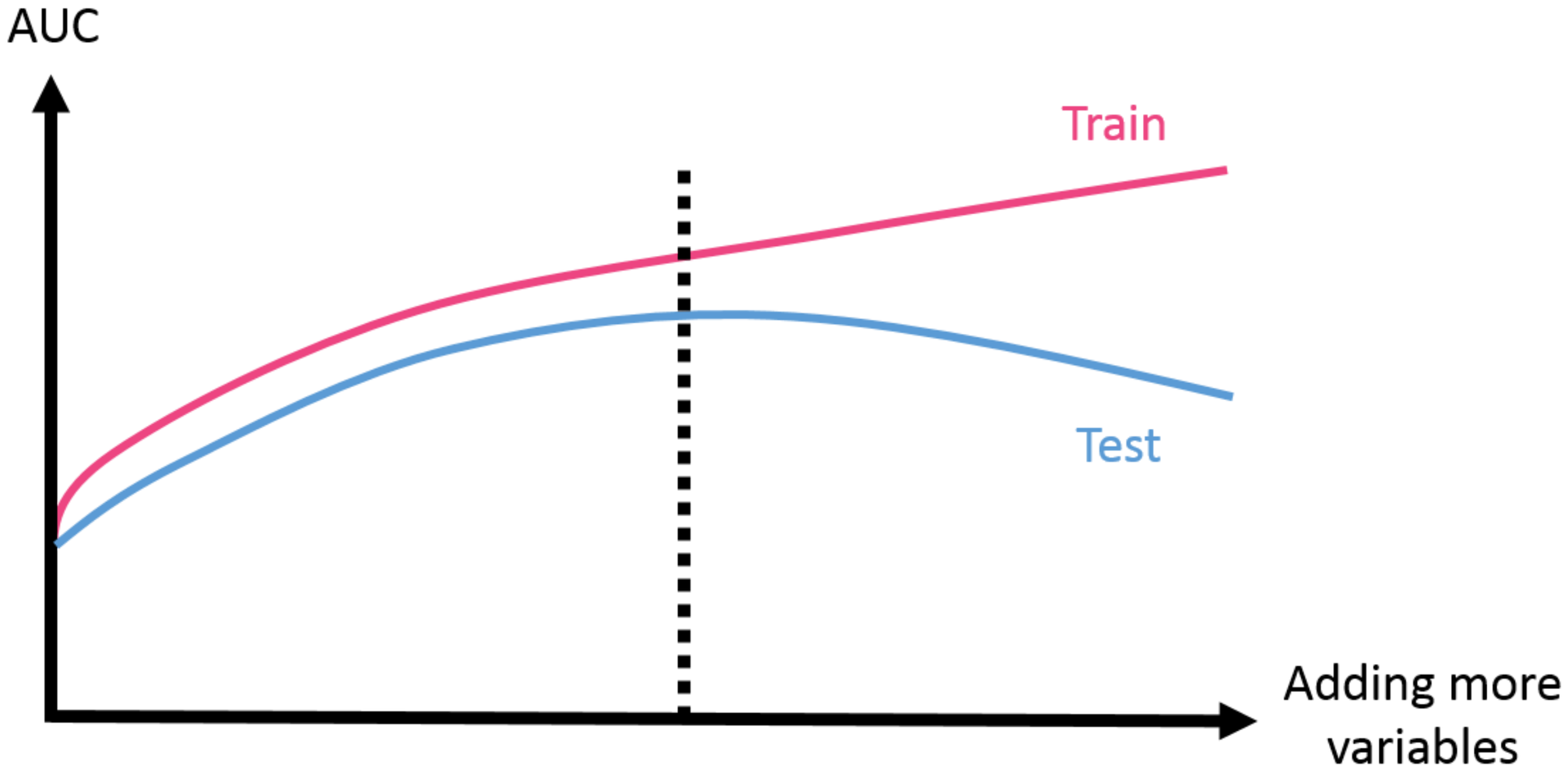
```
from sklearn.cross_validation import train_test_split
X = basetable.drop("target", 1)
y = basetable["target"]
X_train, X_test, y_train, y_test =
    train_test_split(X, y, test_size=0.4, stratify = Y)
train = pd.concat([X_train, y_train], axis=1)
test = pd.concat([X_test, y_test], axis=1)
```

Deciding the cut-off



- High test AUC
- Low number of variables

Deciding the cut-off



Let's practice!

INTRODUCTION TO PREDICTIVE ANALYTICS IN PYTHON