



FOUNDATIONS OF PREDICTIVE ANALYTICS IN PYTHON (PART 1)

Introduction and basetable structure

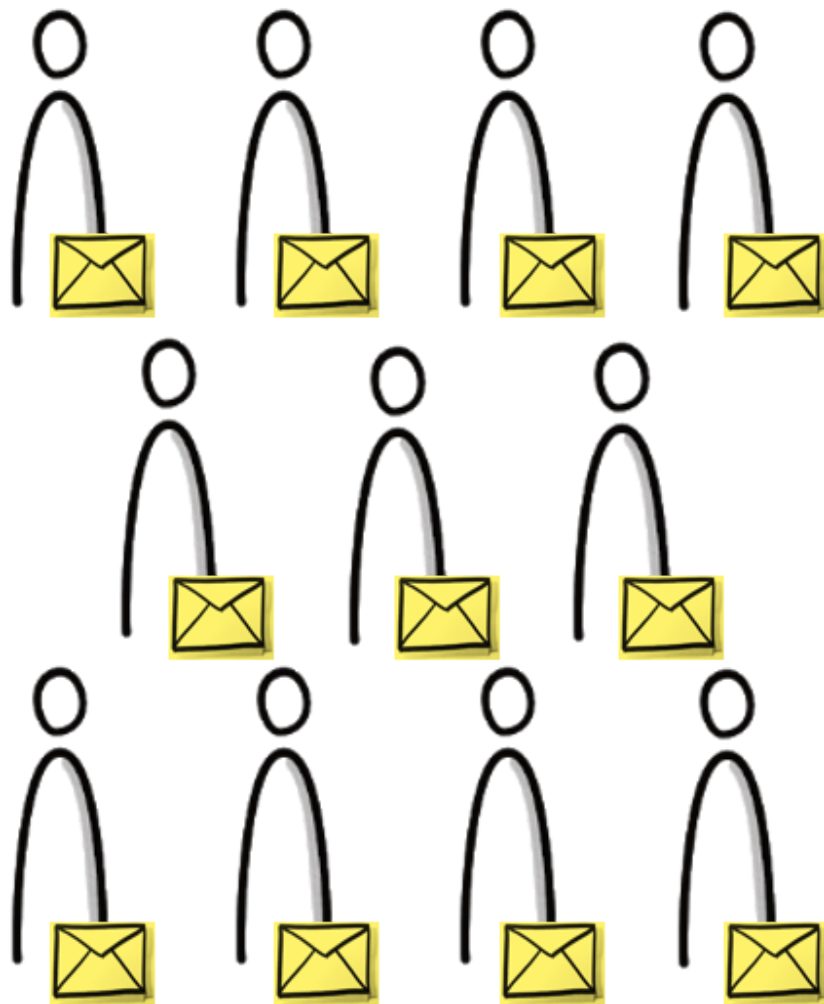
Nele Verbiest, Ph.D

Data Scientist

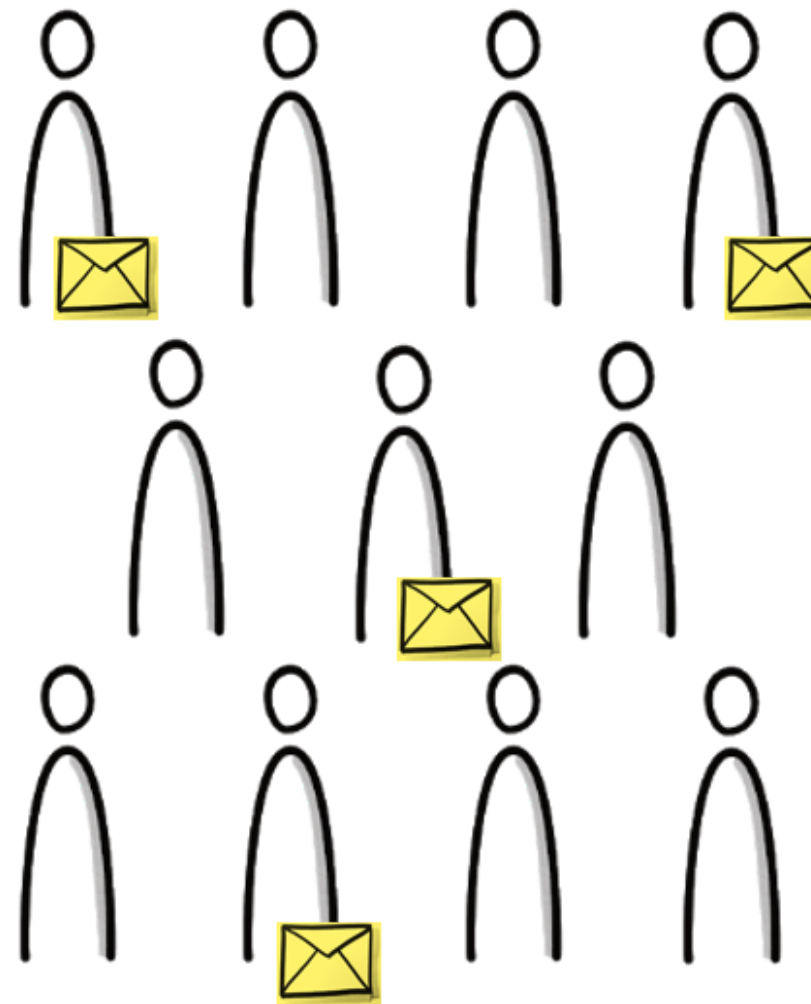
Python Predictions

Predictive analytics in fundraising

Address all donors

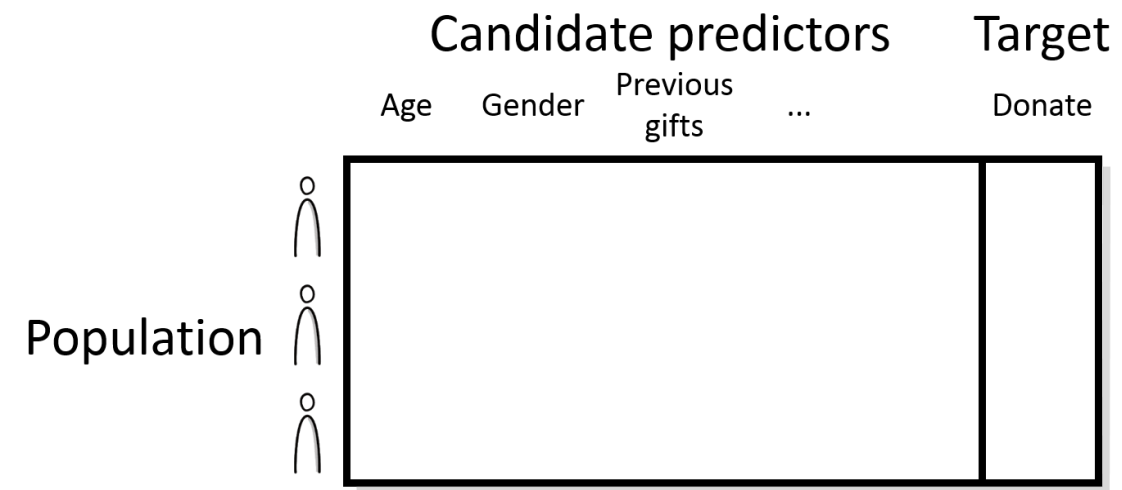


Address donors most likely to donate





The analytical basetable



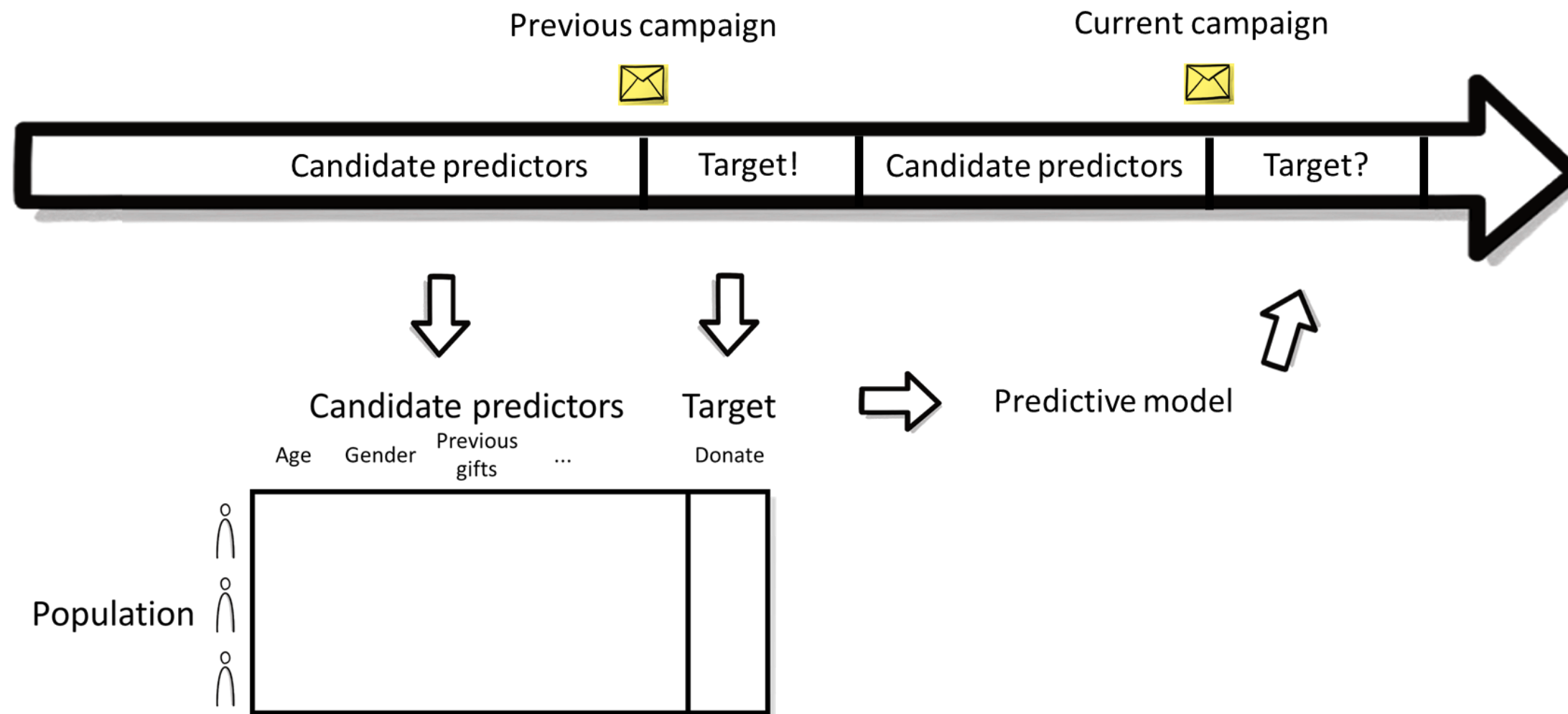
```
import pandas as pd
basetable = pd.DataFrame("import_basetable.csv")

population_size = len(basetable)

targets = sum(basetable["Target"])
```



The timeline





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Let's practice!



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Logistic regression

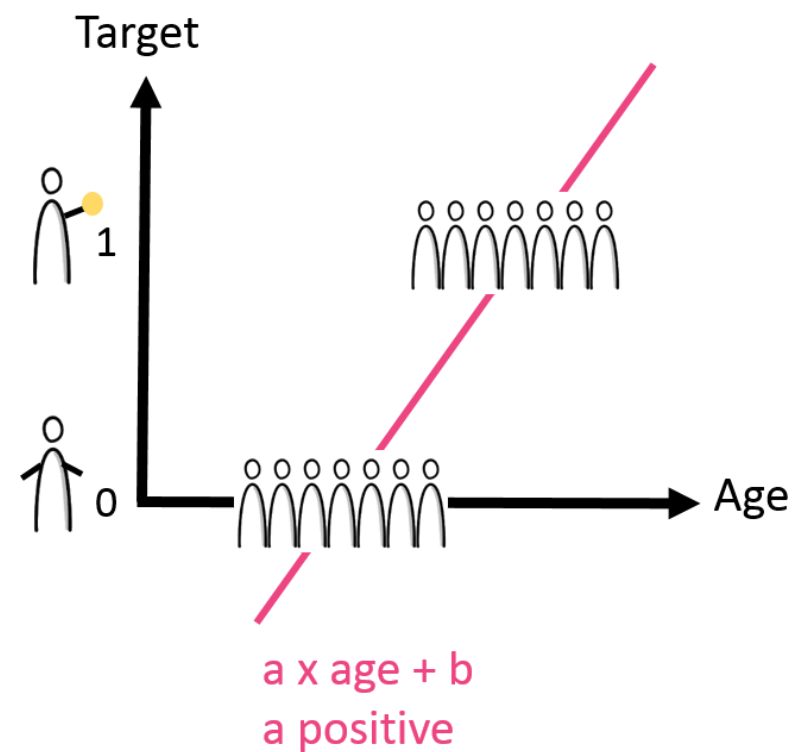
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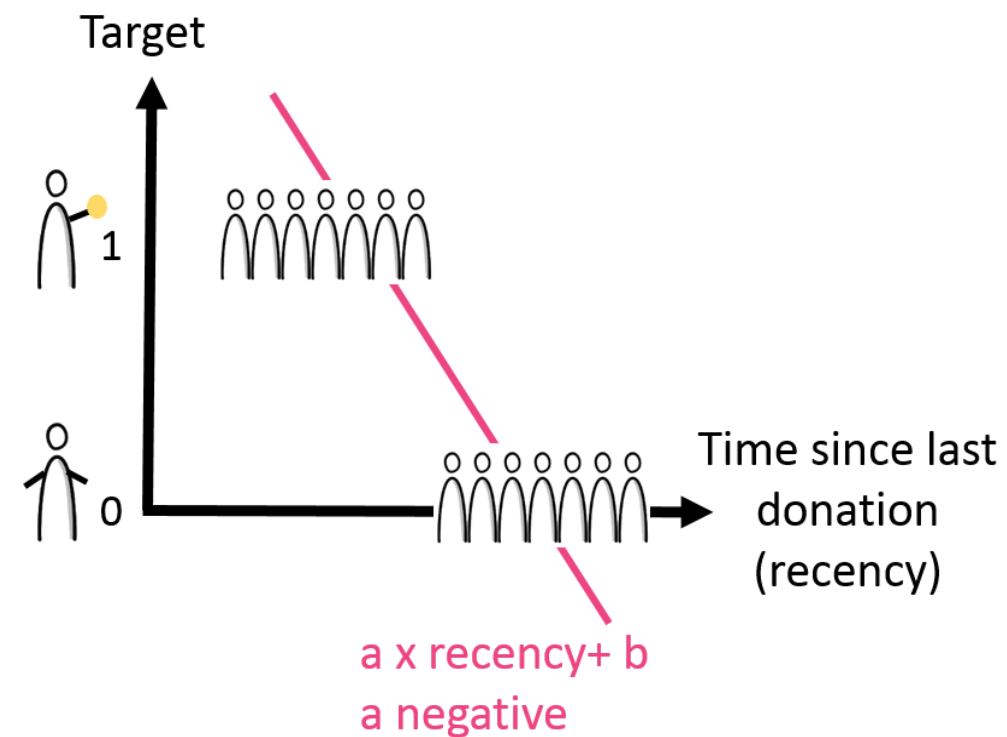


Logistic regression: intuition

Older people are more likely to donate

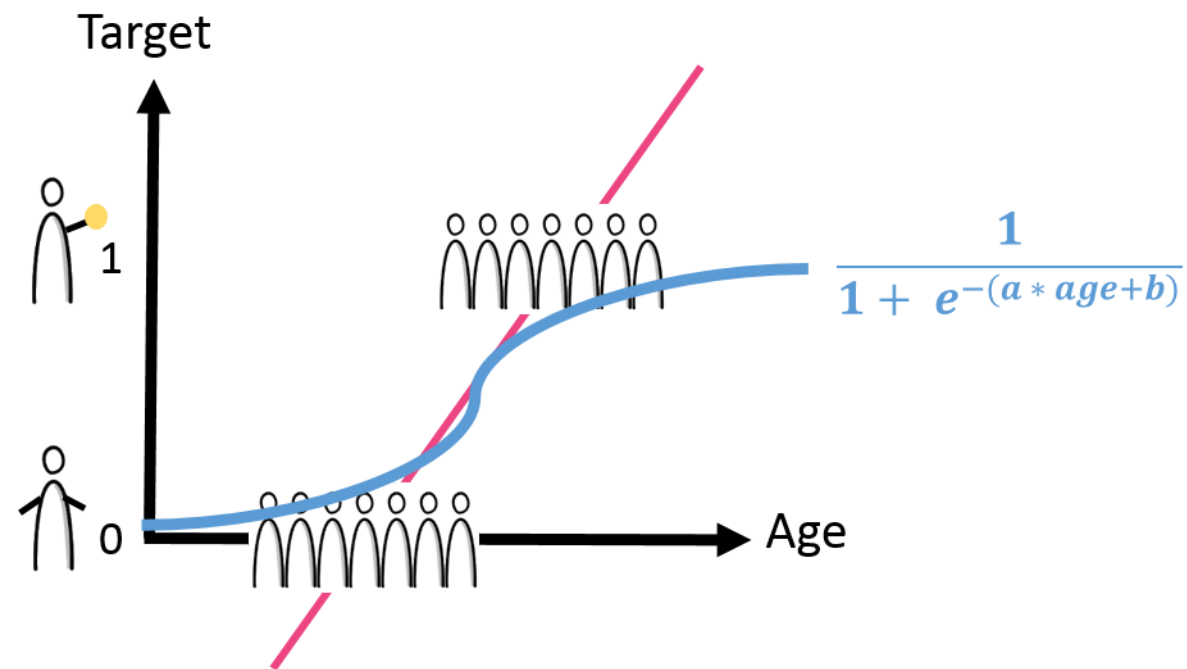


People who donated long time ago are less likely to donate



Logistic regression: the logit function

- Output of $a * age + b$ is a real number
- We want to predict a 0 or a 1
- Logit function transforms $a * age + b$ to a probability





Logistic regression in Python

```
from sklearn import linear_model

logreg = linear_model.LogisticRegression()

X = basetable[["age"]]
y = basetable[["target"]]

logreg.fit(X,y)

print(logreg.coef_)

[[ 0.02449202]]

print(logreg.intercept_)

[-4.3299131]
```



Multivariate logistic regression

Univariate: $ax + b$

Multivariate: $a_1x_1 + a_2x_2 + \dots + a_nx_n + b$

```
X = basetable[["age", "max_gift", "income_low"]]
y = basetable[["target"]]

logreg.fit(X, y)

print(logreg.coef_)

[[ 0.0243308  0.03906065 -0.76793773]]

print(logreg.intercept_)

[-8.80643545]
```



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Using the logistic regression model

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The logistic regression function

```
0.545 * gender_F  
+ 0.021 * age  
-0.001 * time_since_last_gift  
-3.39
```

- Female (gender_F=1)
- age 72
- 120 days since last gift

```
0.545 * 1  
+ 0.021 * 72  
-0.001 * 120  
-3.39  
= -1.45
```

$$\frac{1}{1+e^{-(-1.45)}} = 0.19$$



Making predictions in Python

- Female (gender_F=1)
- Age 72
- 120 days since last gift

```
logreg.predict_proba([1, 72, 120])  
array([[ 0.8204144,  0.1795856]])
```



Making predictions in Python

```
new_data = current_data[["gender_F", "age", "time_since_last_gift"]]  
predictions = logreg.predict_proba(new_data)
```



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