

# Estimating Client Needs

## Business Case 2

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# Goal: Recommendation System

We intend to estimate some investments needs for these customers using Data Science techniques.

## Data:

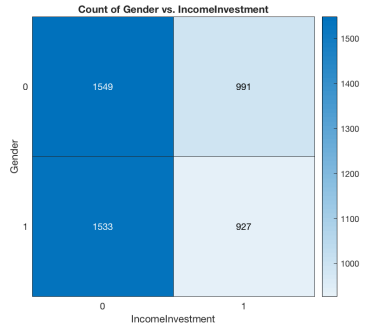
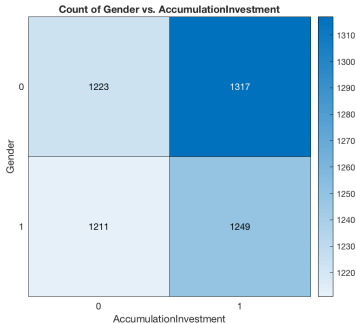
### Needs:

ID	Age	Gender	FamilyMembers	FinancialEducation	RiskPropensity
Income		Wealth	IncomeInvestment	AccumulationInvestment	

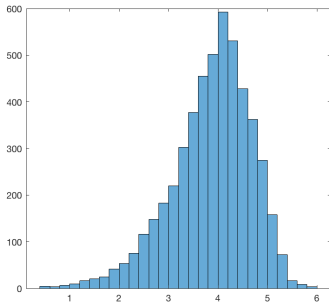
### Products:

IDProduct	Type	Risk
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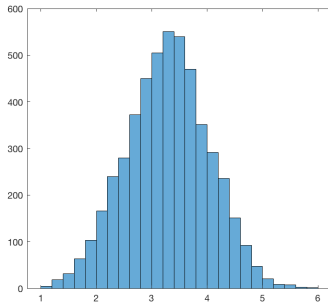
# No significant sex difference



# Data Transformation



(a)  $\log(\text{Income})$

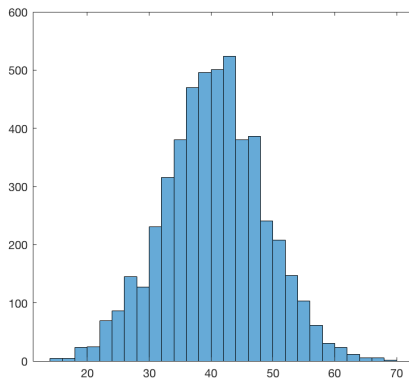


(b)  $\text{Income}^{0.3}$

Figure: Comparison of transformations, we'll go with the second.

# Data Transformation

Using a boxcox transformation,  $\text{NewAge} = (\text{OldAge}^{0.9} - 1)/0.9$ .





# Data Transformation

$$\text{NewFinancialEducation} = \text{OldFinancialEducation}^{0.8}$$

$$\text{NewRiskPropensity} = \text{OldRiskPropensity}^{0.65}$$

$$\text{NewIncome} = \text{OldIncome}^{0.3}$$

# Cross validation

```
nObs = size(Data, 1);  
rng(10)  
idxPermutation = randperm(nObs);  
X = X(idxPermutation,:); % random permutation  
train = 0.75  ;  
cross = 0  ;  
  
nObsTrain = round(train*nObs);  
nObsCross = round(cross*nObs);  
  
XTrain = X(1:nObsTrain,:);  
XCross = X((nObsTrain+1):(nObsTrain+nObsCross), :);  
XTest = X(nObsTrain+1+nObsCross:end,:);
```



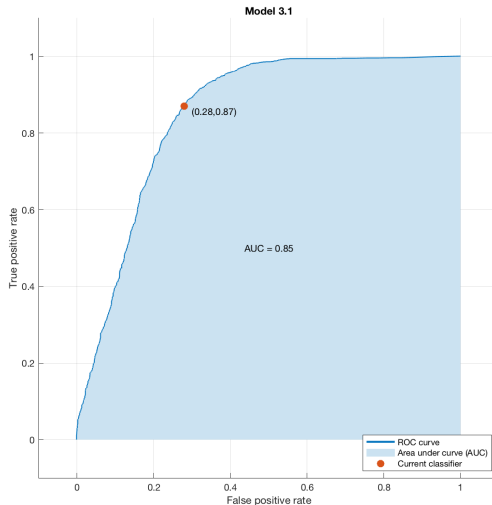
# Added $Y$ permutation equal to $X$

```
YInc = Data.IncomeInvestment;  
YInc = YInc(idxPermutation);  
  
yInvIncTrain = YInc(1:nObsTrain);  
yInvIncCross = YInc((nObsTrain+1):(nObsTrain+nObsCross));  
yInvIncTest = YInc(nObsTrain+nObsCross+1:end);  
  
YAcc = Data.AccumulationInvestment;  
YAcc = YAcc(idxPermutation);  
  
yInvAccTrain = YAcc(1:nObsTrain);  
yInvAccCross = YAcc((nObsTrain+1):(nObsTrain+nObsCross));  
yInvAccTest = YAcc(nObsTrain+nObsCross+1:end);  
  
varNames = {'Age', 'Gender', 'Family', 'FinEdu', 'Risk', 'Income', 'Wealth'};  
XTrainTable=table(XTrain(:,1), XTrain(:,2), XTrain(:,3), XTrain(:,4),  
XTrain(:,5), XTrain(:,6),XTrain(:,7), 'VariableNames',varNames);  
XTestTable=table(XTest(:,1), XTest(:,2), XTest(:,3), XTest(:,4),  
XTest(:,5), XTest(:,6),XTest(:,7), 'VariableNames',varNames);
```

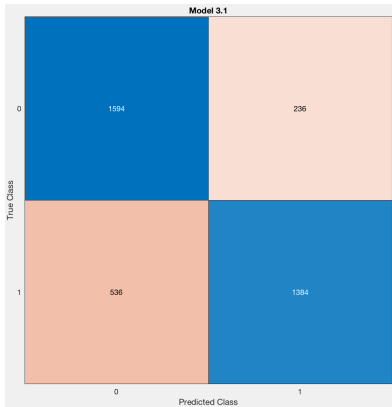
# Classification Learner: model training

1.4 ☆ KNN	Accuracy: 65.7%
Last change: Fine KNN	7/7 features
1.5 ☆ KNN	Accuracy: 69.8%
Last change: Medium KNN	7/7 features
1.6 ☆ KNN	Accuracy: 68.9%
Last change: Coarse KNN	7/7 features
1.7 ☆ KNN	Accuracy: 69.8%
Last change: Cosine KNN	7/7 features
1.8 ☆ KNN	Accuracy: 69.1%
Last change: Cubic KNN	7/7 features
1.9 ☆ KNN	Accuracy: 69.7%
Last change: Weighted KNN	7/7 features
2 ☆ Ensemble	Accuracy: <b>79.4%</b>
Last change: Boosted Trees	7/7 features
3.1 ☆ Ensemble	Accuracy: <b>79.4%</b>
Last change: Boosted Trees	7/7 features
3.2 ☆ Ensemble	Accuracy: 76.6%
Last change: Bagged Trees	7/7 features
3.3 ☆ Ensemble	Accuracy: 62.9%
Last change: Subspace Discrimin...	7/7 features
3.4 ☆ Ensemble	Accuracy: 70.0%
Last change: Subspace KNN	7/7 features
3.5 ☆ Ensemble	Accuracy: 75.0%
Last change: RUSBoosted Trees	7/7 features

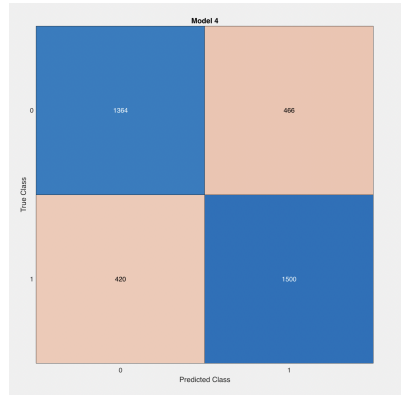
# Classification Learner: Boosted Tree ROC



# Classification Learner: Boosted Tree confusion matrix



(a) Confusion matrix.



(b) Penalized confusion matrix.

# Reducing data

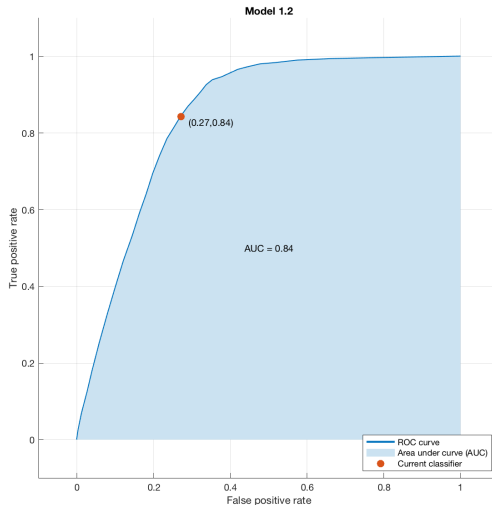
## We remove Gender and FamilySize

```
Xsmall = [rescale(IncomeWealthRatio) rescale(pAge) rescale(pFin) rescale(pIncome) rescale(pWealth)];  
Xsmall = Xsmall(idxPermutation,:);  
XsmallTrain = Xsmall(1:nObsTrain,:);  
XsmallTest = Xsmall(nObsTrain+1:end,:);  
XsmallTrainTable=table(XsmallTrain(:,1), XsmallTrain(:,2), XsmallTrain(:,3),  
XsmallTrain(:,4), XsmallTrain(:,5), 'VariableNames',xnames);
```

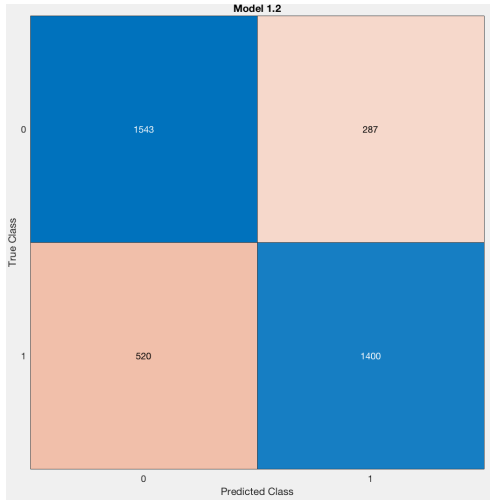
# Classification Learner: model training

1.1	☆ Ensemble	Accuracy: 78.3%
Last change: Boosted Trees		5/5 features
1.2	☆ Ensemble	Accuracy: <b>78.5%</b>
Last change: Bagged Trees		5/5 features
1.3	☆ Ensemble	Accuracy: 65.9%
Last change: Subspace Discrimin...		5/5 features
1.4	☆ Ensemble	Accuracy: 73.4%
Last change: Subspace KNN		5/5 features
1.5	☆ Ensemble	Accuracy: 76.3%
Last change: RUSBoosted Trees		5/5 features
2.1	☆ Tree	Accuracy: 78.0%
Last change: Fine Tree		5/5 features
2.2	☆ Tree	Accuracy: 76.1%
Last change: Medium Tree		5/5 features
2.3	☆ Tree	Accuracy: 68.0%
Last change: Coarse Tree		5/5 features
2.4	☆ KNN	Accuracy: 70.5%
Last change: Fine KNN		5/5 features

# Classification Learner: Bagged Tree ROC



# Classification Learner: Bagged Tree confusion matrix

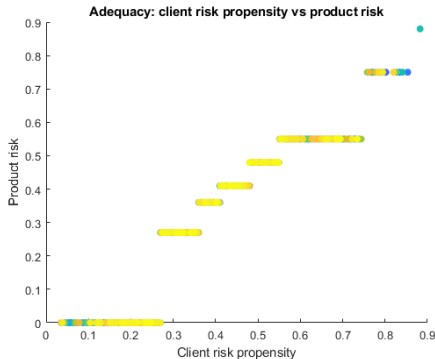




# Recommending products

Using Bayesian optimization we decide to use the Bagged Tree model after evaluating 30 alternatives.

# Product recommendation based on Risk Propensity



- more data cleaning to improve model accuracy;
- better data visualization for product recommendation.