What ROC Curves Can't Do (and Cost Curves Can)

Authors:

Chris Drummond, Institute for Information Technology,
National Research Council of Canada

&

Robert C. Holte, Department of Computing Science,
University of Alberta, Canada

Presented by:

William Elazmeh, Ottawa-Carleton Institute for Computer
Science, Canada

Introduction

- The focus is on visualization of classifier's performance

- ROC curves show the tradeoff between false positive and true positive rates

- We want to know when and by how much a classifier outperforms another

- The analysis is restricted to a two class classifier

Questions ROC Curves Cannot Answer

- Given a specific misclassification cost and class prbabilities, what is the expected cost of classification?

- For what misclassification costs and class probabilities does a classifier outperform the trivial classifiers?

- For what misclassification costs and class probabilities does a classifier outperform another?

- What is the difference in performance between two classifiers?

- What is the average performance of several independent classifiers?

- What is the 90% confidence interval for a particular classifier's performance?

- What is the significance of the difference between the performances of two classifiers?

Matrices

Confusion Matrix

	+	–
Y	T+	F+
N	F–	T–

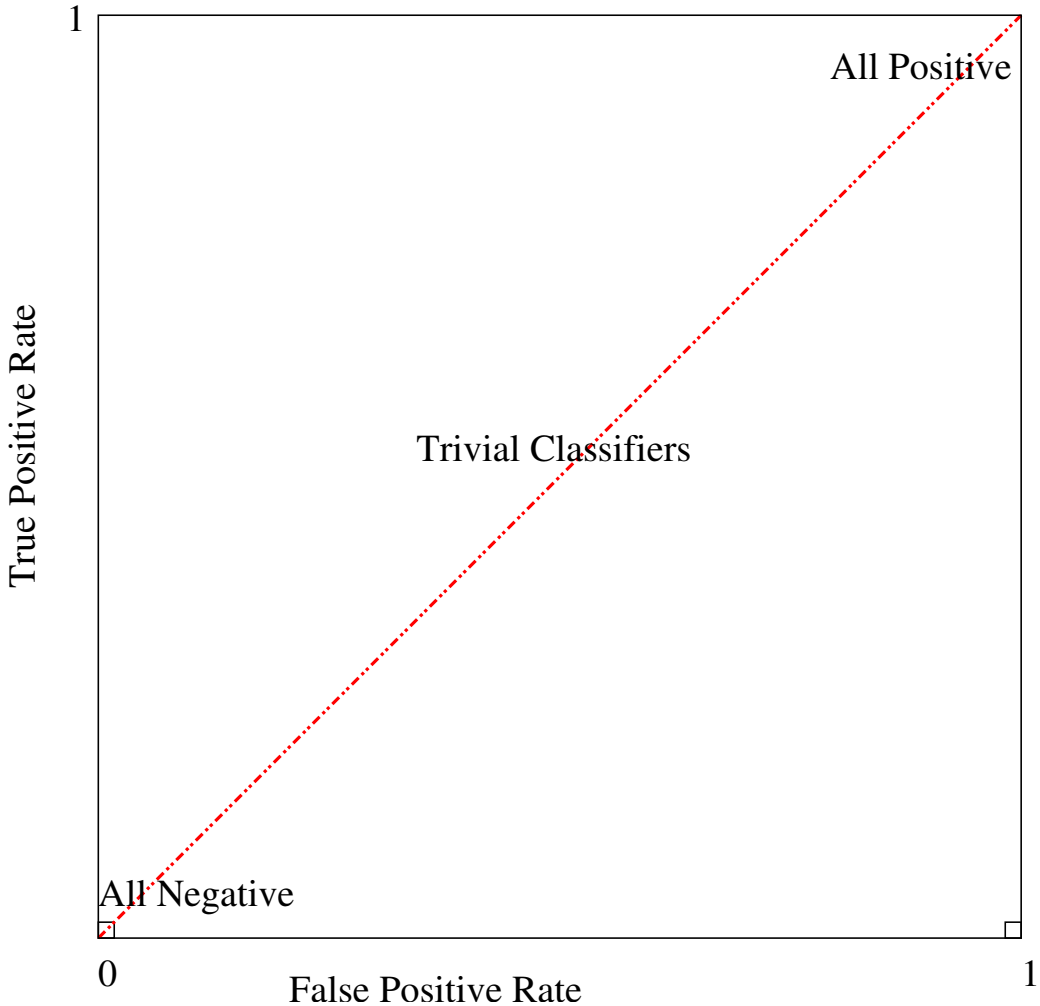$$\text{F+ Rate} = \frac{F+}{-} \qquad \text{T+ Rate (Recall)} = \frac{T+}{+}$$

$$\text{Precision} = \frac{T+}{Y} \qquad \text{Accuracy} = \frac{(T+)+(T-)}{(+)+(-)}$$

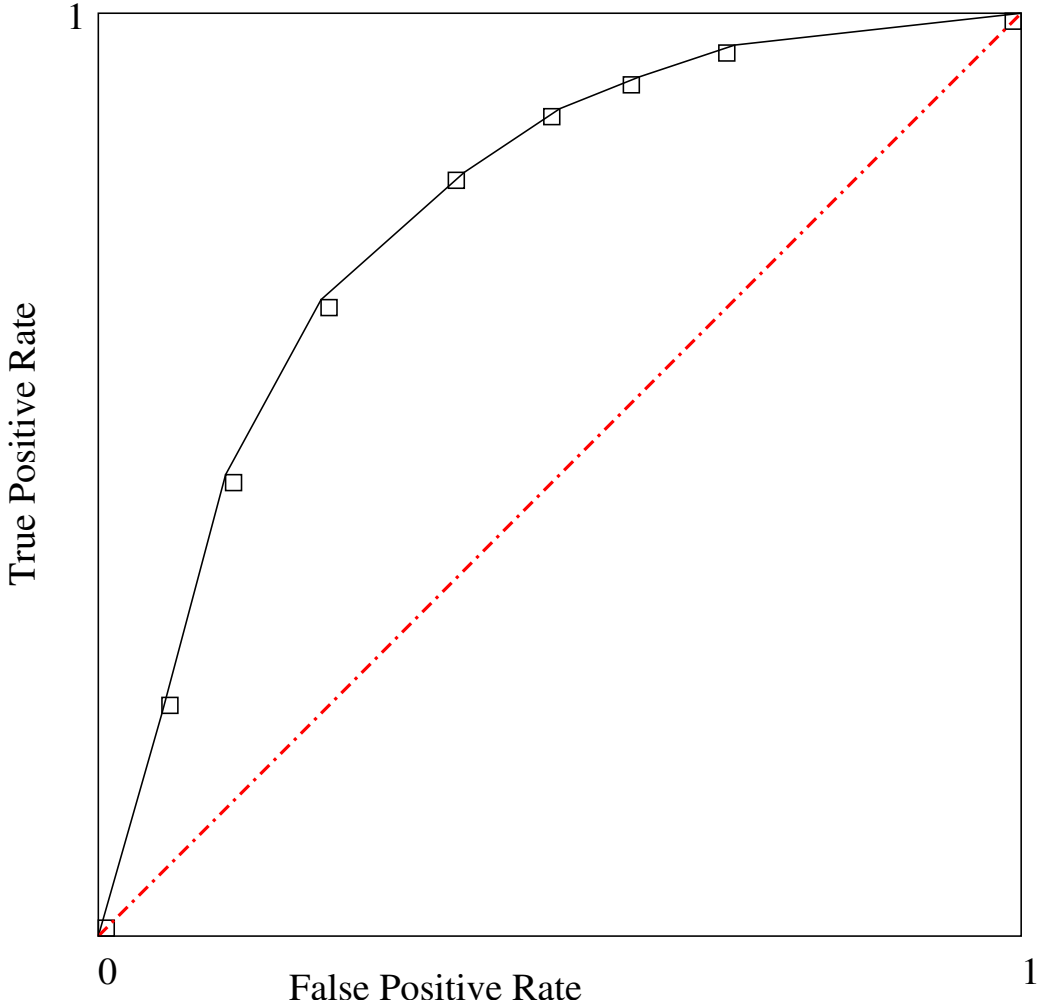$$\text{F-Score} = \text{Precision} \times \text{Recall}$$

For Cost Curves

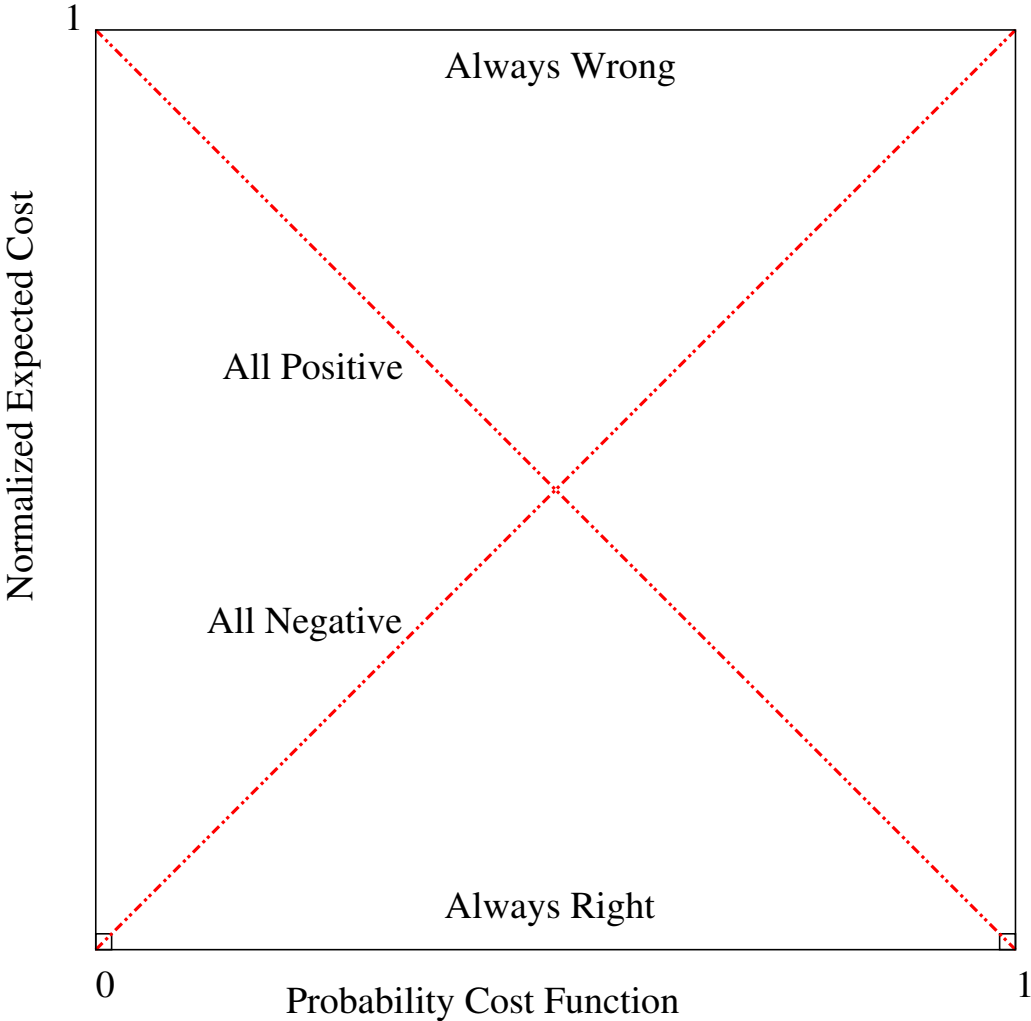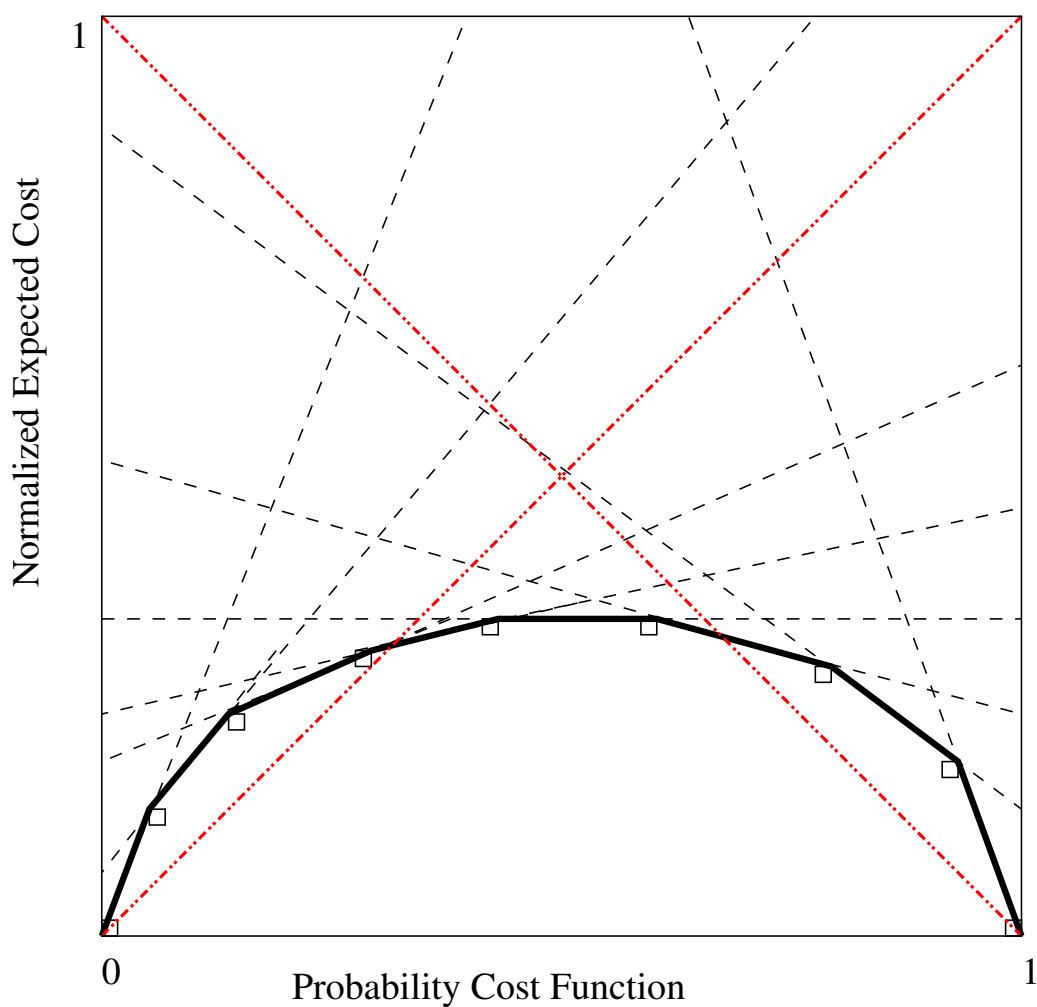$$\text{PCF(+)} = \frac{p(+)C(N|+)}{p(+)C(N|+)+p(-)C(Y|-)}$$

ROC Space

ROC Curves

Cost Space

Plot titled with axes: vertical axis labeled "Normalized Expected Cost" with values from 0 to 1, horizontal axis labeled "Probability Cost Function" with values from 0 to 1. Regions labeled: "Always Wrong" (top), "All Positive", "All Negative", "Always Right" (bottom).
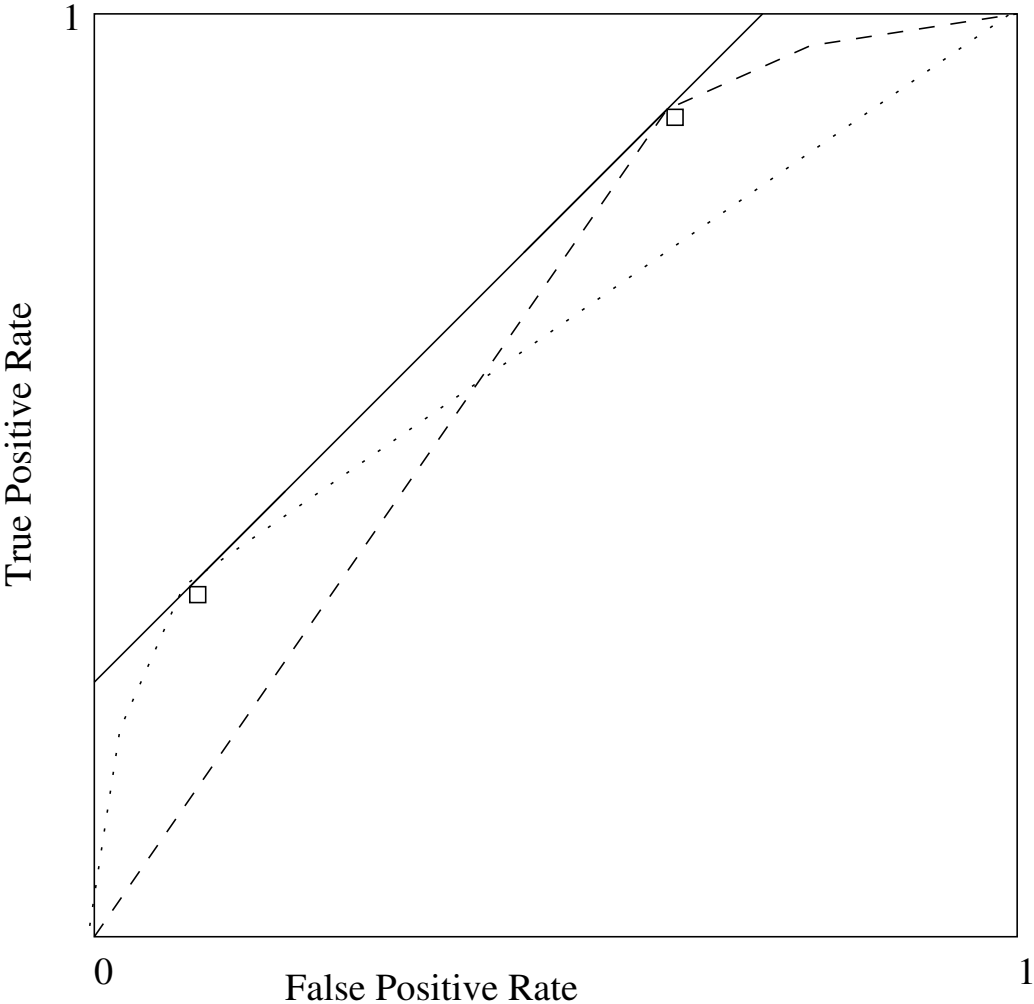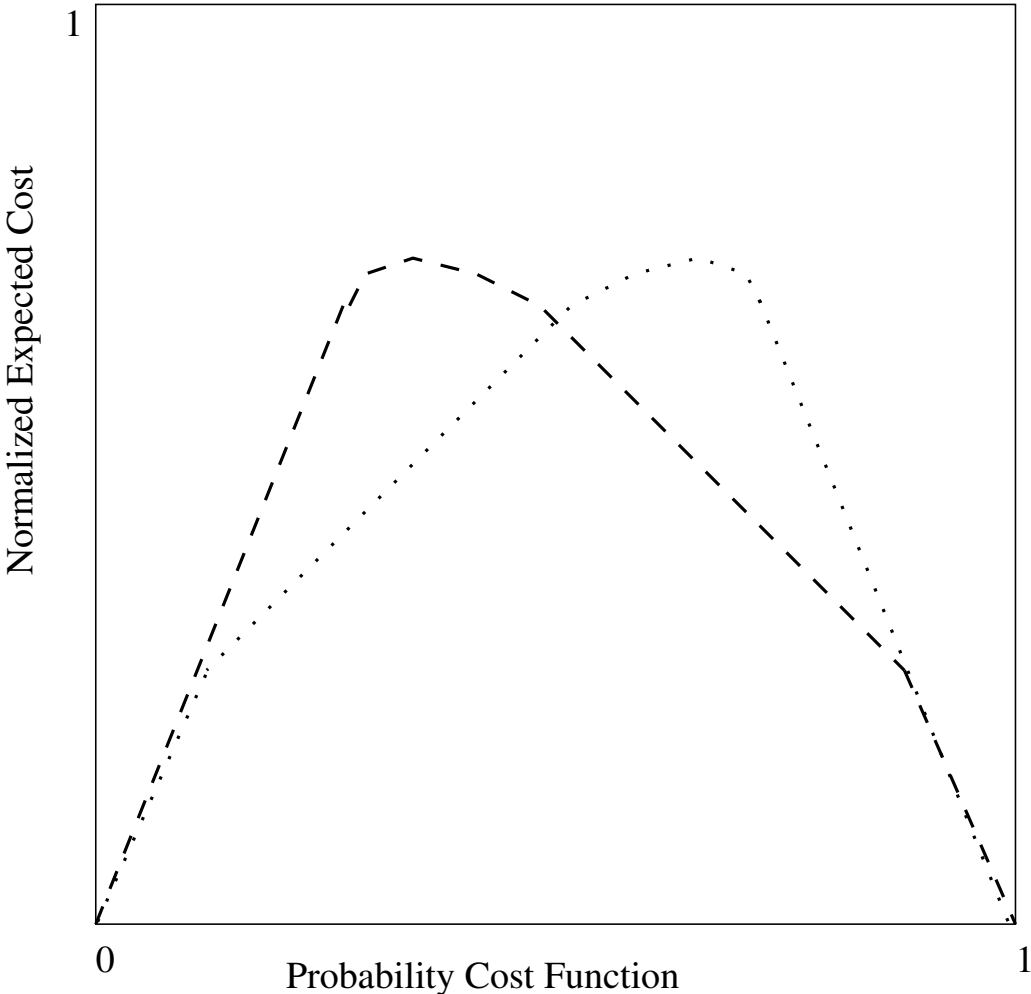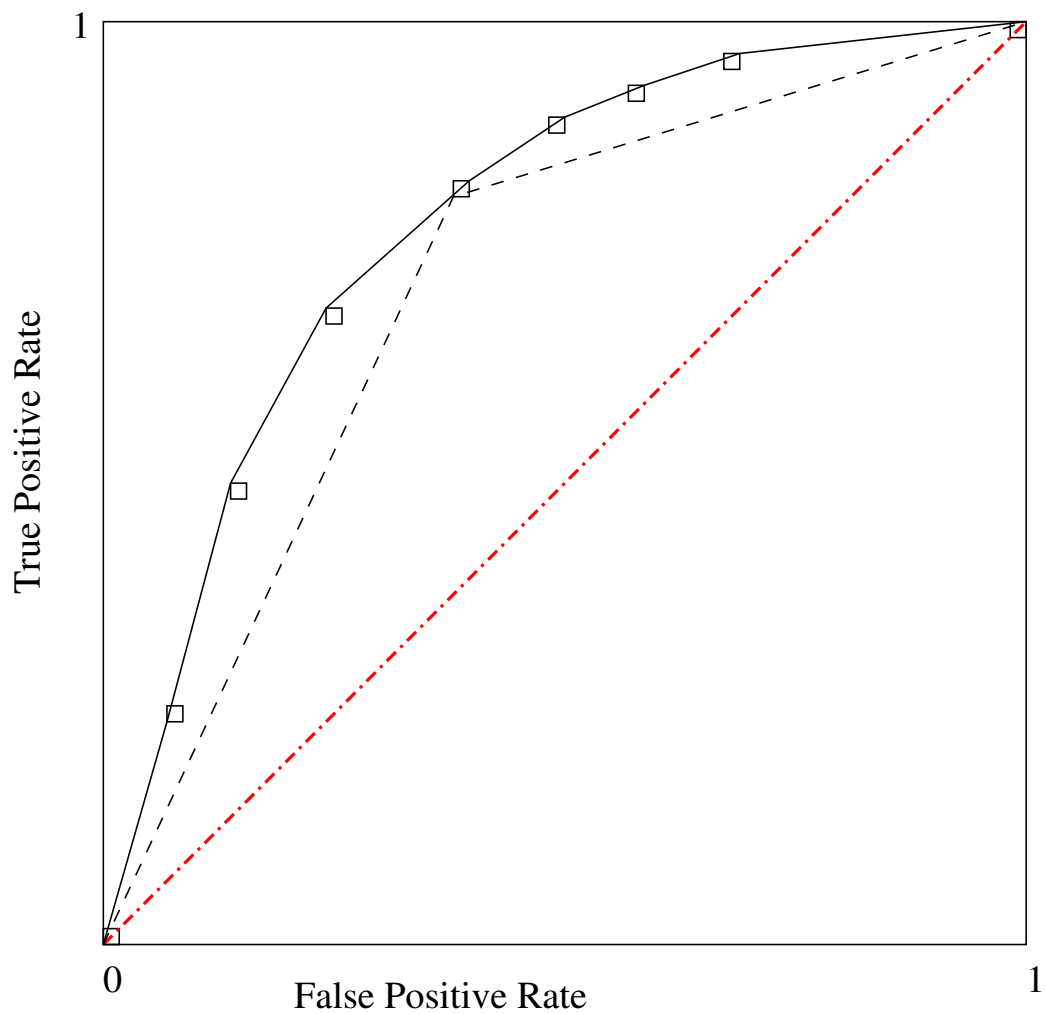
Cost Curves

Choosing Between Classifiers ROC

Choosing Between Classifiers COST

Comparing Classifier Performance
ROC

Comparing Classifier Performance
COST