Aalto University

HELSINKI INSTITUTE FOR INFORMATION TECHNOLOGY

Accuracy and fairness in binary classification

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Problem setting

- Given a discriminating dataset the goal is to build a classifier
  - as accurate as possible, and
  - obey non-discrimination constraints
- Binary classification, binary protected characteristic

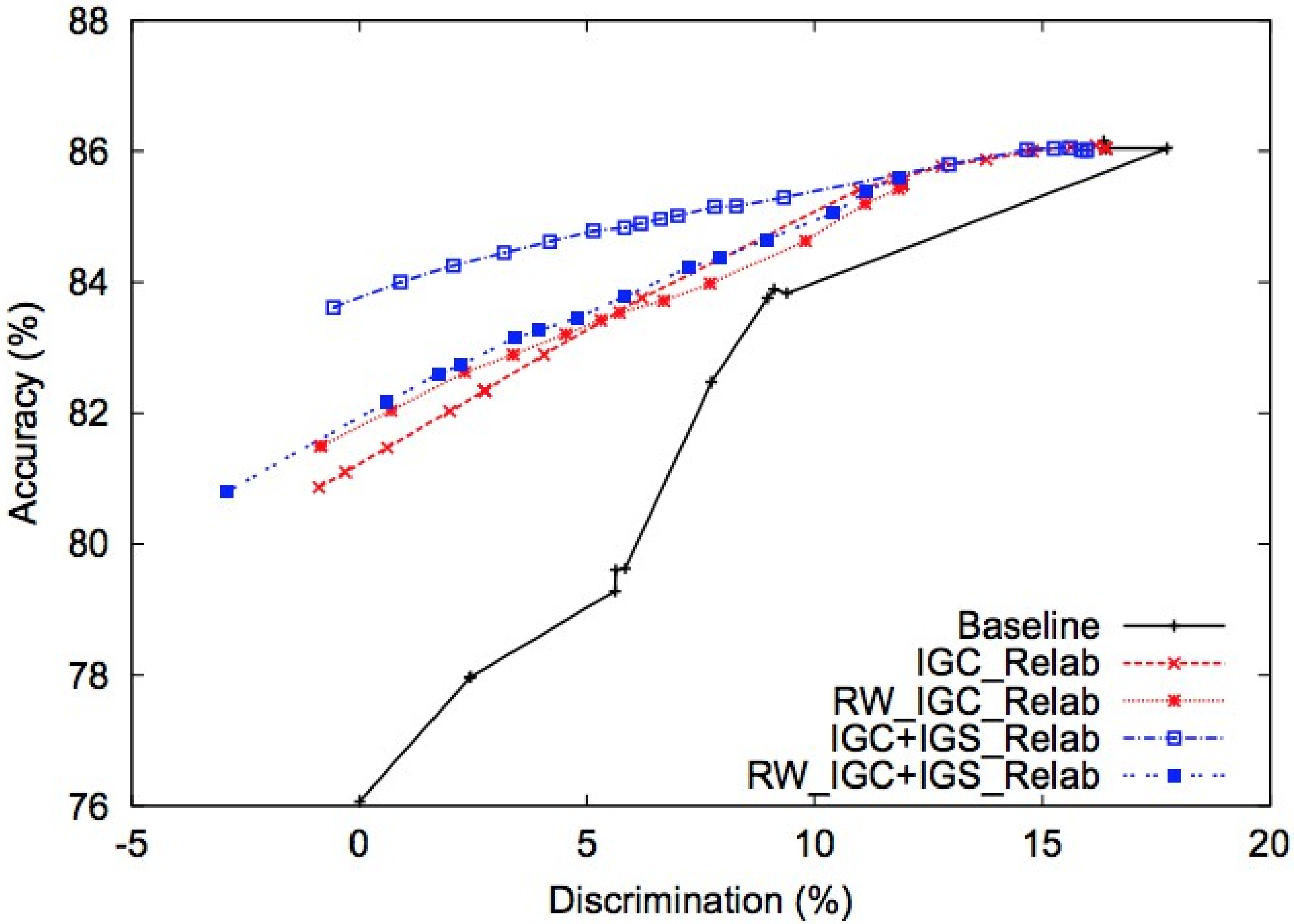
- Assumptions
  - Labels are objectively correct
  - Acceptance rates should be equal for the protected and general groups

- Discrimination measure: D = p(+|native) - p(+|foreign)

Measuring discrimination

Comparing non-discriminatory classifiers

Baseline Disc=19.3 Acc=76.3

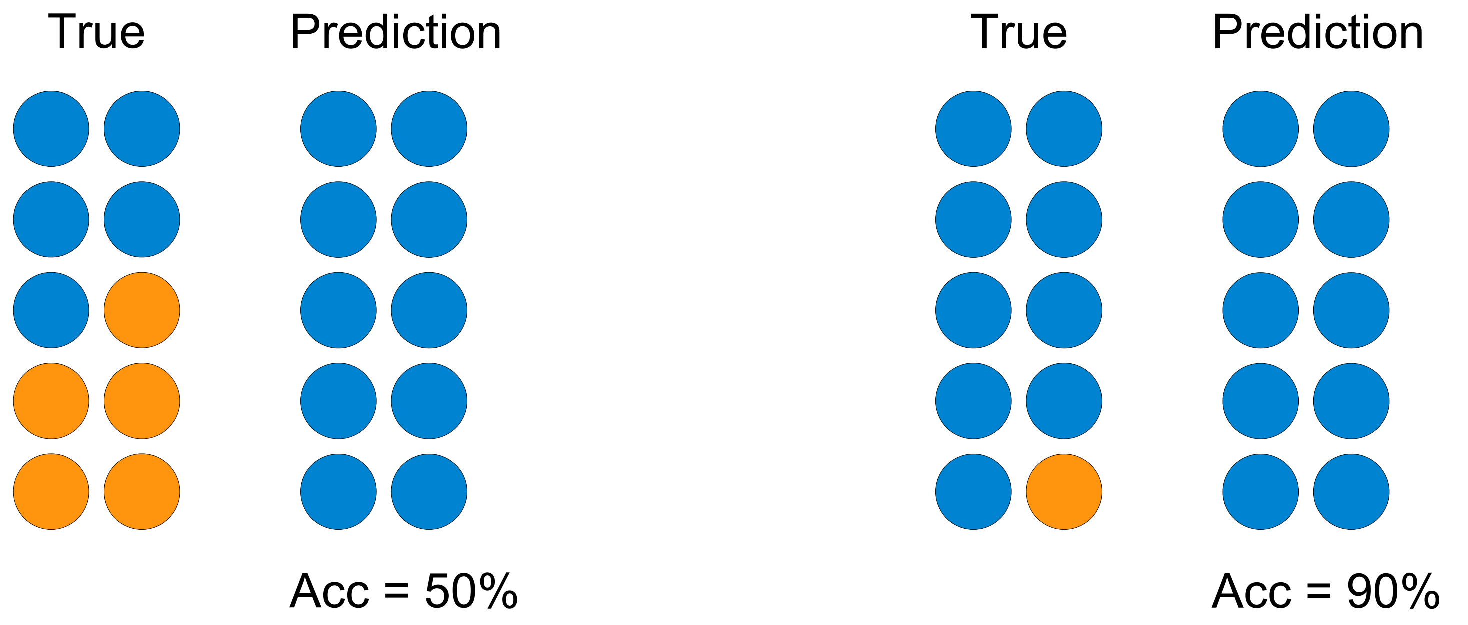


(a) Census Income Data

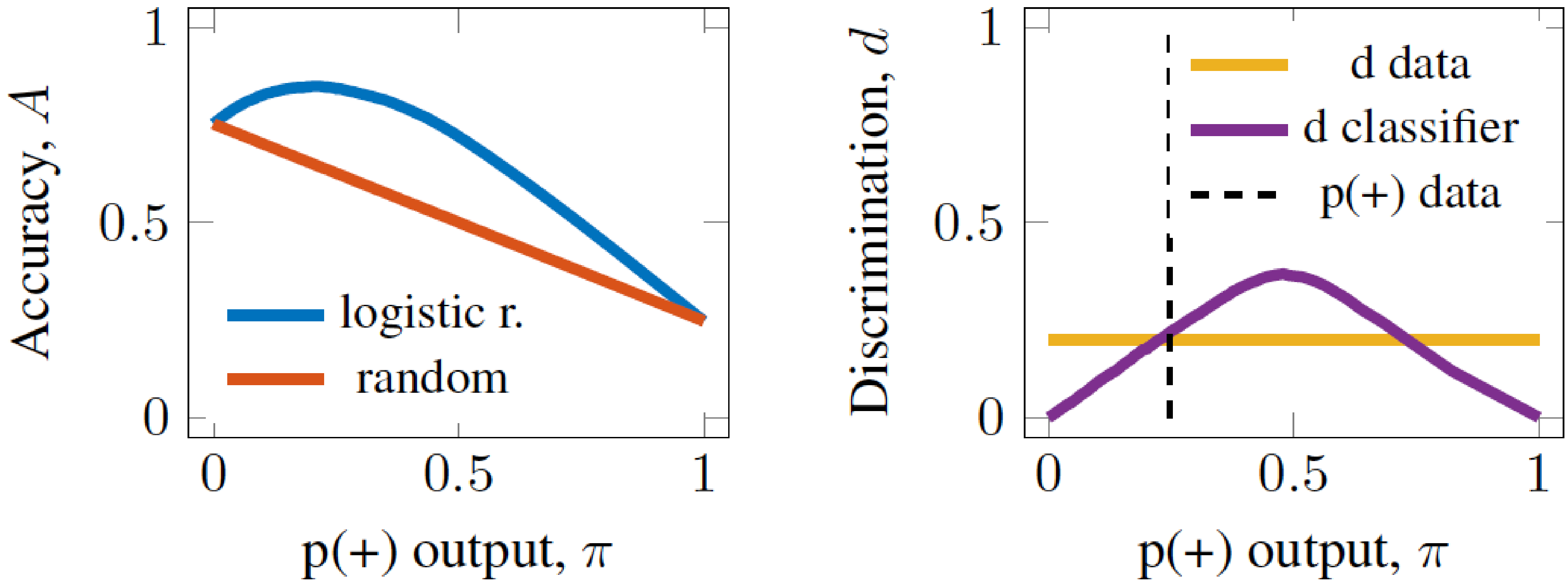
Kamiran et al 2010

Problem

- Baseline accuracy and baseline discrimination varies with varying overall acceptance rate
- Classifiers with different overall acceptance rates are not comparable



Experiment



Adult dataset from UCI

Baseline discrimination

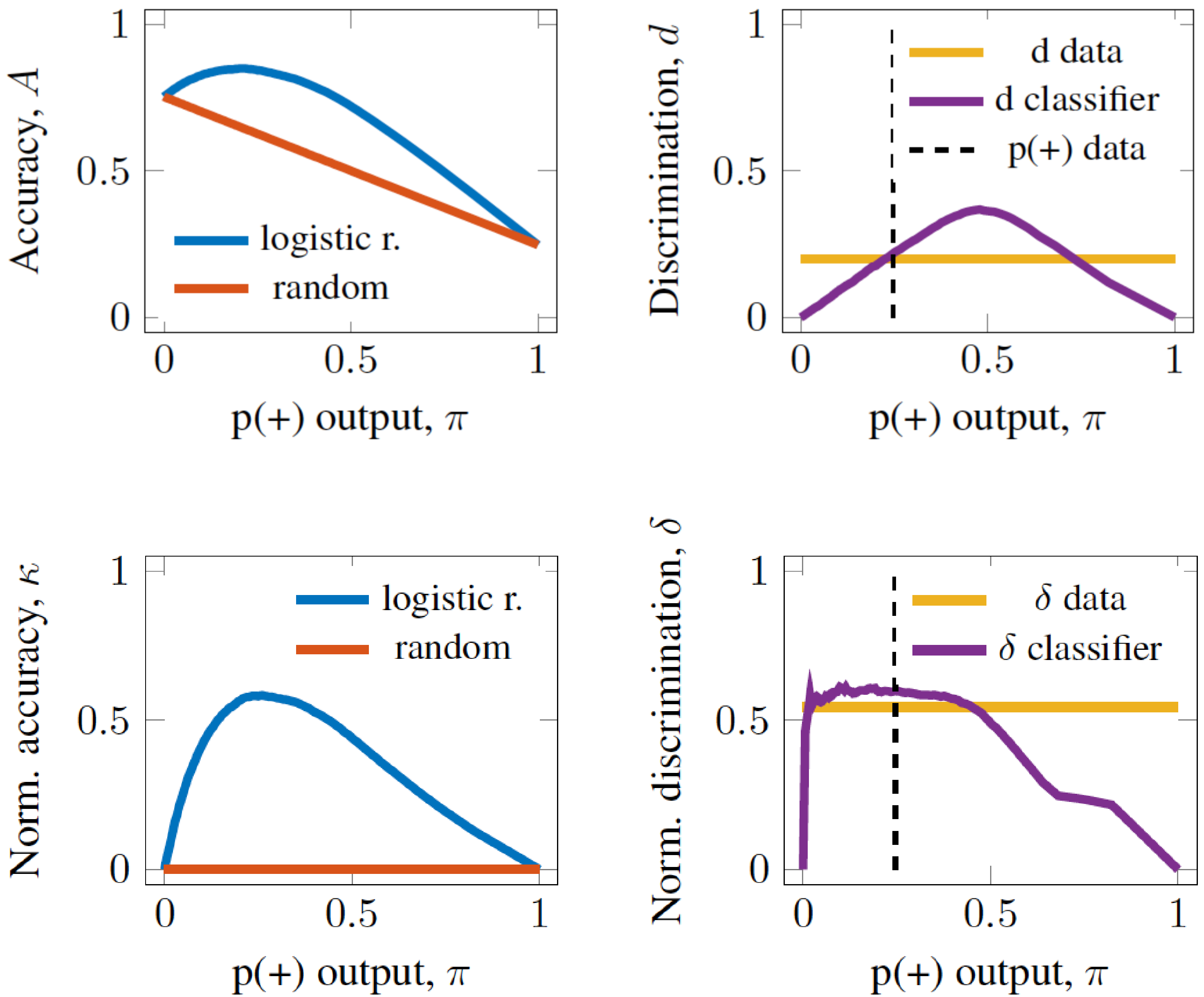
- Maximum discrimination when first everyone from the favored community is accepted, only then members of protected community start to get accepted

Normalized measures

- We propose to normalize discrimination by dmax
  - d = D/dmax, where $d_{max} = \min\left(\frac{\pi}{\alpha}, \frac{1-\pi}{1-\alpha}\right)$ acceptance rate p(+) proportion of natives p(native)
    - 1 max, 0 no discrimination, <0 reverse discrimination

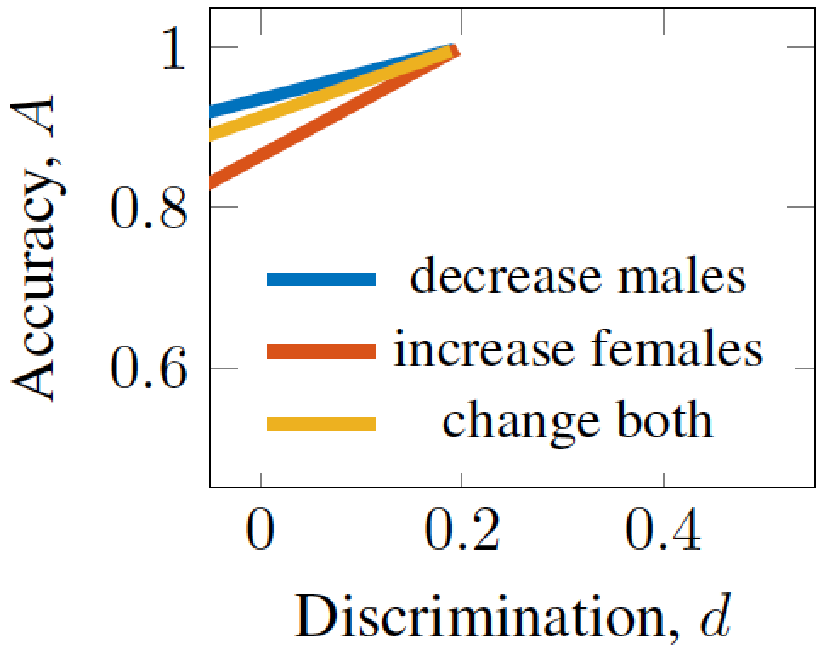
- We recommend normalizing accuracy – Cohen's kappa
  - k = (Acc – RAcc) / (1 – Racc)
    - 1 max, 0 like random, <0 very bad

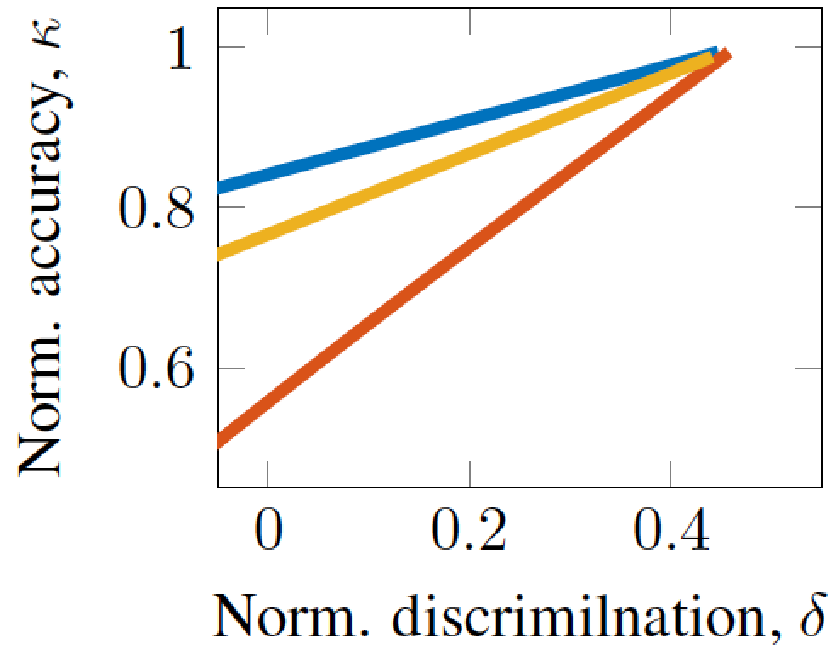
Experiment cont.



Discrimination prevention

What is the best we can do?





If data is correct, reducing discrimination will always reduce accuracy

Performance of discrimination prevention strategies

	p(+) π	Acc. A	Disc. d	N. acc. κ	N. disc. δ
Data/oracle	24.7	100	19.9	100	54.4
Logistic with s	20.2	84.9	18.3	56.7	**61.4**
Logistic no s	20.1	84.9	17.6	56.6	**59.6**
Logistic massage	22.1	83.5	6.9	53.9	21.3
NB with s	15.4	81.9	13.5	44.2	**59.7**
NB no s	14.4	81.4	10.9	41.7	51.3
NB massaged	15.4	81.5	6.8	43.3	29.7
Tree J48 with s	19.6	85.1	17.9	56.9	**61.9**
Tree J48 no s	19.6	85.0	17.9	56.7	**61.8**
Tree massage	22.9	83.5	6.1	54.6	18.1

Removing s does not solve the problem
Decreasing acceptance rates may show lower nominal discrimination

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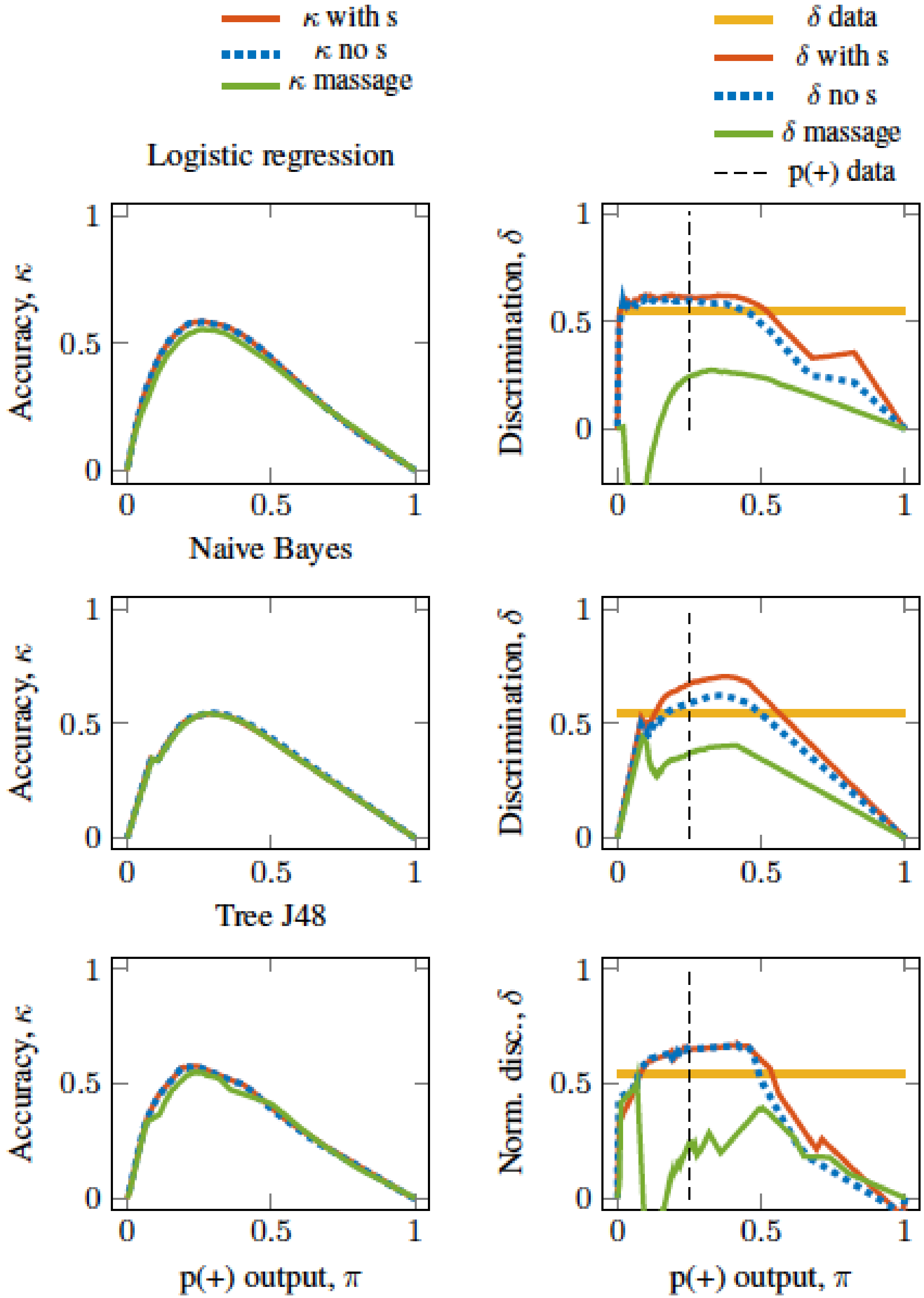
Massaging



κ with s
κ no s
κ massage
δ data
δ with s
δ no s
δ massage
p(+) data
Logistic regression
Naive Bayes
Tree J48
Accuracy, κ
Discrimination, δ
Norm. disc., δ
p(+) output, π
0
0.5
1

Concluding remark

- Evaluation of non-discriminatory classifiers needs to take into account acceptance rates, otherwise the results of different classifiers (or even different parameter settings) are not comparable

Thanks!