

The Mismeasure of Discrimination

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Issues Covered in Written Paper

- **A. Patterns by Which Standard Measures of Difference between Outcome Rates Tend to be Systematically Affected by the Prevalence of an Outcome**
- **B. A Sound Method of Measuring Discrimination**
- **C. Problematic Appraisal of Demographic Differences Based on the Proportion a Group Comprises of Persons who Could Experience an Outcome and the Proportion the Group Comprises of Persons who Experience the Outcome**
- **D. The Role of Statistical Significance Testing**
- **E. Measuring Disparate Impact**
- **F. Problematic Analyses of Discrimination Issues That Fail to Examine the Entire Universe of Persons Subject to the Decision-Making Process at Issue**

Key References

- “Misunderstanding of Statistics Leads to Misguided Law Enforcement Policies” (*Amstat News*, Dec. 2012)
- United States Department of Justice Measurement Letter (Apr. 23, 2012)
- Harvard University Measurement Letter (Oct. 9, 2012)

Key Points

One: Standard measures of differences between outcome rates (proportions) are problematic for appraising the comparative situation of groups reflected by a pair of rates because each measure tends to be systematically affected by the prevalence of an outcome.

Two: Efforts to appraise differences in the circumstances of two groups reflected by a pair of outcome rates in the law and the social and medical sciences have been universally undermined by failure to recognize the way the chosen measures tend to be affected by the prevalence of an outcome.

Three: That difference in circumstances reflected by a pair of rates can be divined, albeit imperfectly, by deriving from pairs of outcome rates the difference between means of the underlying risk distributions.

**Interpretive Rule 1 (IR1):
The Two Relative Differences
(Heuristic Rule X (HRX), Scanlan's Rule)**

The rarer an outcome

(a) the greater tends to be the relative difference in experiencing it and

(b) the smaller tends to be the relative difference in avoiding it.

IR1 Implications

- Test pass/test fail (proficiency/non-proficiency)
- Poverty/non-poverty (Feminization of Poverty)
- Mortality/survival (Mortality and Survival)
- Immunization/no immunization (Immunization Disparities)
- Hypertensive/normal (NHANES Illustrations, ICHPS 2008)
- Low folate/adequate folate (NHANES Illustrations, Comment on Dowd IJE 2008)
- Loan rejection/loan approval (Lending Disparities)
- Expulsion/retention (Discipline Disparities)

Table 1. Explanation of Terms

(a) AG Fav Rt	(b) DG Fav Rt	(c) AG Adv Rt	(d) DG Adv Rt	(1) RR Fav	(2) RR Adv	(3) Abs Df	(4) Odds Ratio
90%	80%	10%	20%	1.125	2.00	0.10	2.25

RR = “relative risk” aka “rate ratio”; relative difference = RR -1

(1) RR Fav = a/b (1.125; relative difference is 12.5%)

(2) RR Adv = d/c (2.00; relative difference is 100%)

(3) Abs Df = $a-b$ (10 percentage points)

(4) Odd Ratio = $(a/c)/(d/b)$ (2.25)

Table 2: Simplified Illustration of Effects of Lowering Test Cutoff

Cut Point	Outcome	AG	DG	RR Pass	RR Fail
High	Pass	80%	63%	1.27	
High	Fail	20%	37%		1.85
Low	Pass	95%	87%	1.09	
Low	Fail	5%	13%		2.60

Fig. 1. Ratios of (1) DG Fail Rate to AG Fail Rate and (2) AG Pass Rate to DG Pass Rate at Various Cutoff Points Defined by AG Fail Rate

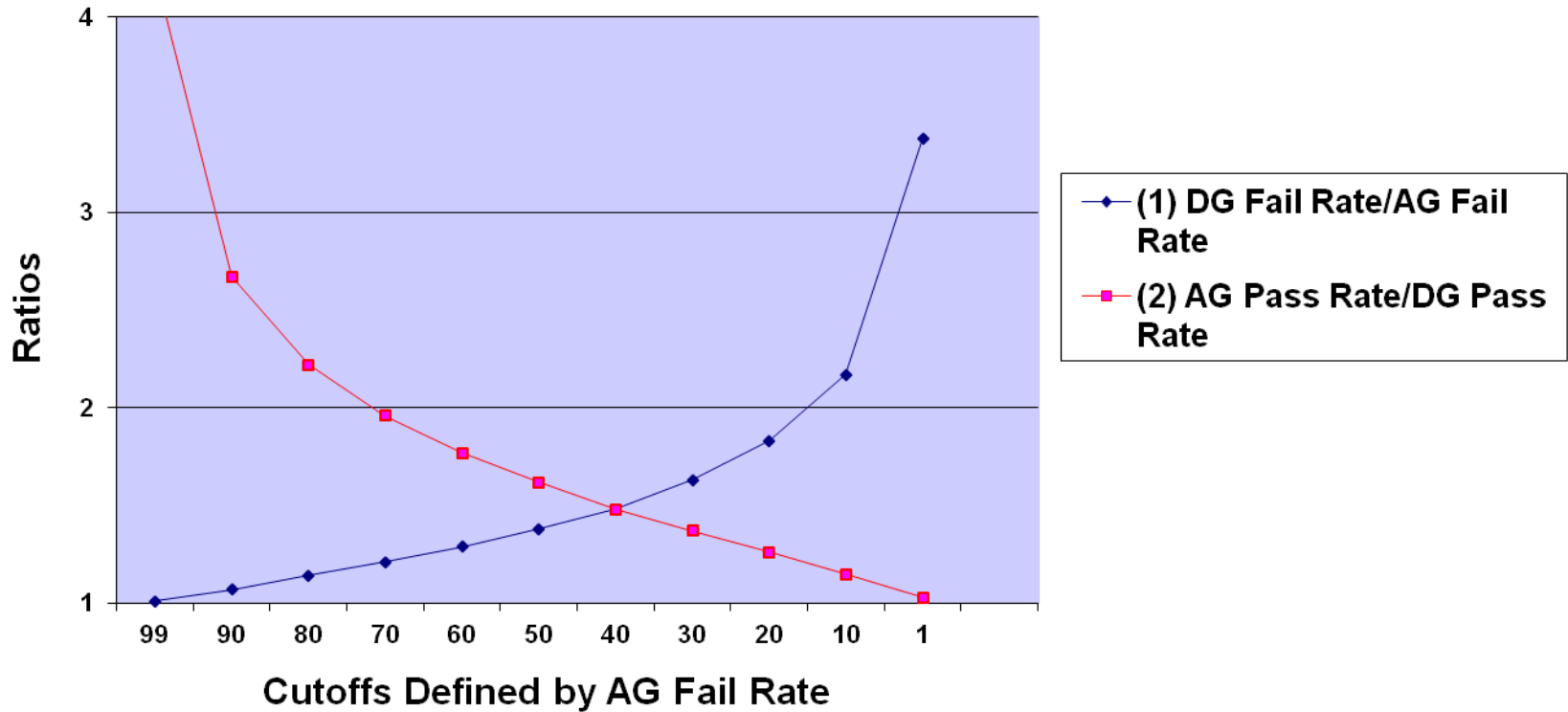


Fig. 2: Ratios of (1) DG Fail Rate to AG Fail Rate, (2) AG Pass Rate to DG Pass Rate, (3) DG Failure Odds to AG Failure Odds; and (4) Absolute Difference Between Rates

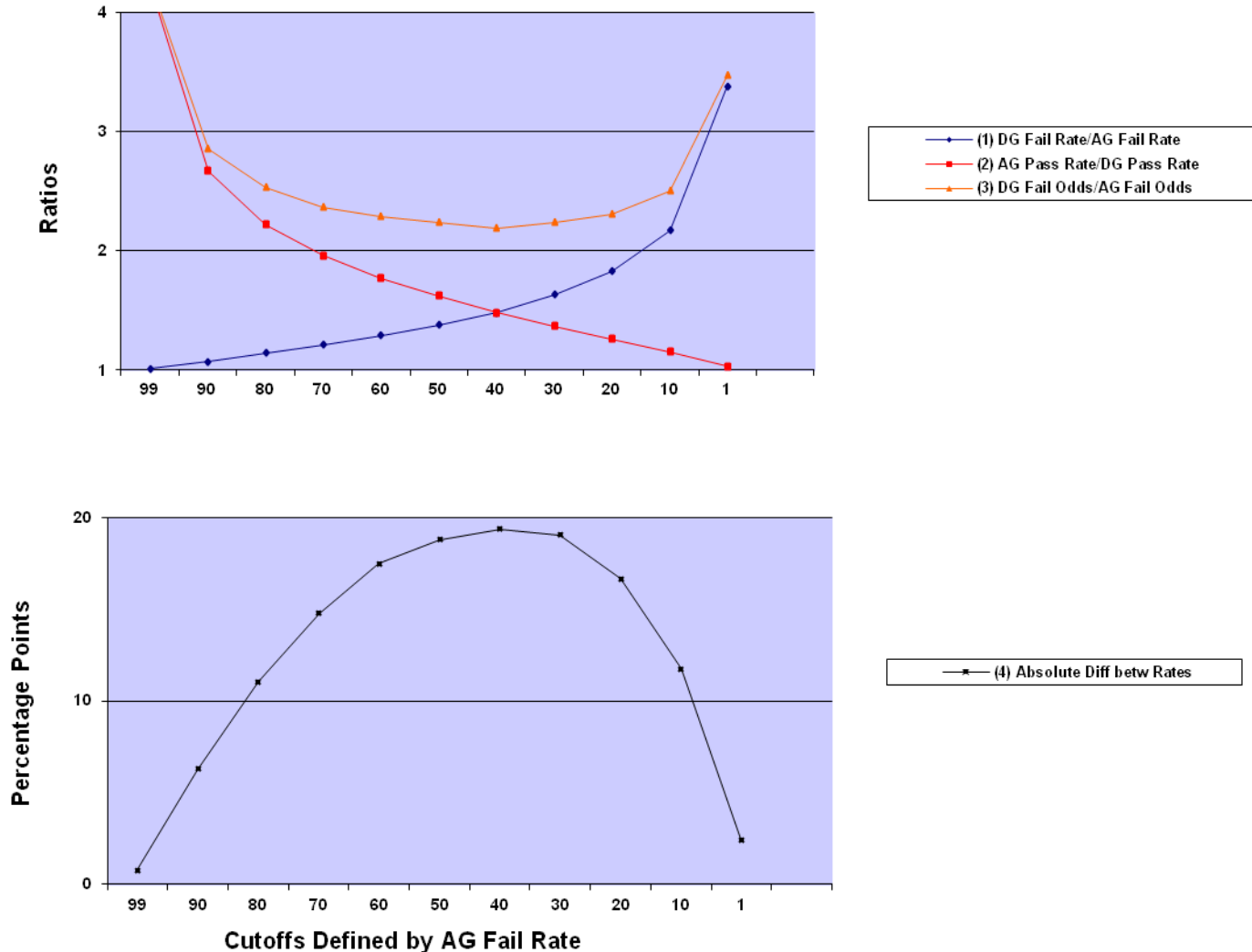


Figure 3: Two Normal Distributions

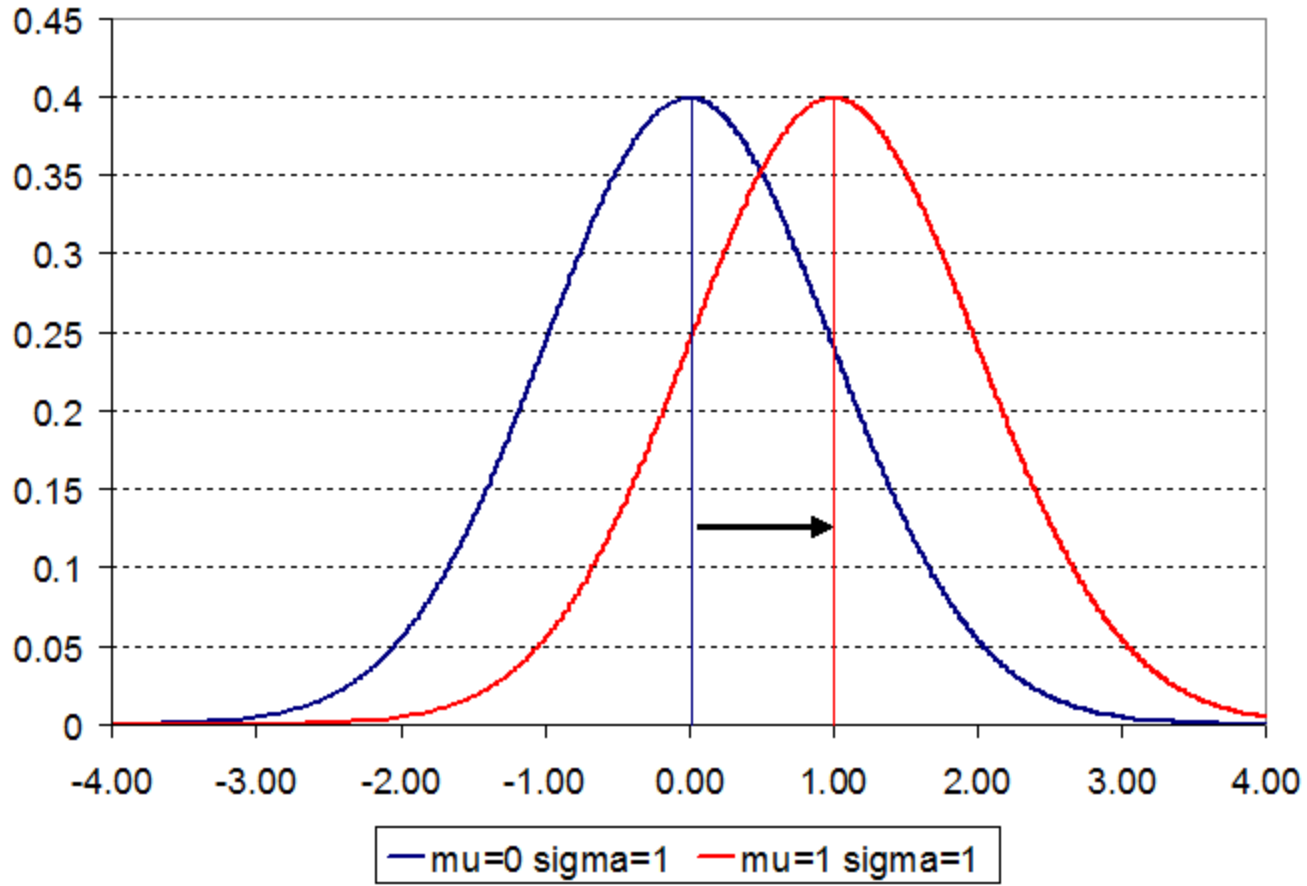


Table 3: Illustration of Appraisals of the Comparative Degree of Employer Bias Using Different Measures of Disparities in Selection/Rejection
(Table 1 in paper)

Employer/ Setting	AG Sel Rate	DG Sel Rate	RR Selection	RR Rejection	AbsDf	OR
A	20.0%	9.0%	2.22 (1)	1.14 (4)	0.11 (4)	2.53 (1)
B	40.1%	22.7%	1.77 (2)	1.29 (3)	0.17(2)	2.29 (3)
C	59.9%	40.5%	1.48 (3)	1.48 (2)	0.19 (1)	2.19 (4)
D	90.0%	78.2%	1.15 (4)	2.18 (1)	0.12 (3)	2.50 (2)

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Approach 1 (relative favorable): A,B,C,D
 Approach 2 (relative adverse): D,C,B,A
 Approach 3 (absolute difference: C,B,D,A
 Approach 4 (odds ratio): A,D,B,C

Table 4. Simplified Illustration of Meaning of EES
(see page 22 of paper)

Setting	AG Fav Rt	DG Fav Rt	RR Fav	RR Adv	Abs DF	EES	Perc DG Above AG Mean
A	30.00%	10.00%	3.00	1.29	0.20	0.76	22.00%
B	15.00%	5.00%	3.00	1.12	0.10	0.61	27.00%

Table 5. Illustrations of Meaning of EES vis a vis Four-Fifths Rule

EES	DG Pass Rat	AG Pass Rate	RR Pass	RR Fail	%DG>AGMea n
0.1	2.87%	3.59%	.80/1.25	1.01	46.41%
0.2	28.43%	35.57%	.80/1.25	1.11	42.47%
0.3	46.41%	57.93%	.80/1.25	1.27	38.59%
0.4	58.32%	72.91%	.80/1.25	1.54	34.83%
0.5	64.80%	81.06%	.80/1.25	1.86	31.21%
0.6	69.15%	86.43%	.80/1.25	2.27	27.76%
0.7	71.91%	89.97%	.80/1.25	2.80	24.51%
0.8	73.89%	92.51%	.80/1.25	3.48	21.48%
0.9	75.49%	94.41%	.80/1.25	4.38	18.67%
1	76.42%	95.73%	.80/1.25	5.52	16.11%

Table 6. Illustration of Effects of Convictions on
 Callback Rates by Race
 (Table 3 of paper)

Race	No Conv CB Rt	Conv CB Rt	RR CB	RR No CB	EES
W	34.00%	17.00%	2.00	1.26	0.542
B	14.00%	5.00%	2.80	1.10	0.565

Table 7: Changes in Total and Black Rates of Pneumococcal and Influenza Vaccination Rates, 1989-1995
(HHS Progress Review: Black Americans, Oct. 26, 1998)

Type	Yr	Total	Blk	RR Fav	RR Adv	AbsDf	EES
Pneumo	1989	15%	6%	2.50	1.11	0.09	0.53
Pneumo	1995	34%	23%	1.48	1.17	0.11	0.33
Influenza	1989	33%	20%	1.65	1.19	0.13	0.42
Influenza	1995	58%	40%	1.45	1.43	0.18	0.47

Table 8: Changes in Black and White Hepatitis-B Vaccination Rates Before and After School-Entry Vaccination Requirement (see [Comment on Morita](#))

Period	Grade	Year	White Rate	Black Rate	Fav Ratio	Adv Ratio	AbsDf	EES
PreRq	5	1996	8%	3%	2.67	1.05	0.05	0.47
Post 1	5	1997	46%	33%	1.39	1.24	0.13	0.34
Post 2	5	1998	50%	39%	1.28	1.22	0.11	0.29
PreRq	9	1996	46%	32%	1.44	1.26	0.14	0.37
Post 1	9	1997	89%	84%	1.06	1.45	0.05	0.24
Post 2	9	1998	93%	89%	1.04	1.57	0.04	0.26

Table 9. Illustration of Problematic Nature of Representational Comparisons

DG Proportion Pool	DG Proportion Selection	AG/DG Selection Ratio
20%	10%	2.25
30%	20%	1.71
50%	30%	2.33
10%	5%	2.11
50%	25%	3.00