Comparison of Null-Invariant Measures

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❑ Not all null-invariant measures are created equal

❑ Which one is better?

   ❑ D_4—D_6 differentiate the null-invariant measures

   ❑ Kulc (Kulczynski 1927) holds firm and is in balance of both directional implications

	milk	¬milk	Σ_{row}
coffee	mc	¬mc	c
¬coffee	m¬c	¬m¬c	¬c
Σ_{col}	m	¬m	Σ

All 5 are null-invariant

Data set	mc	¬mc	m¬c	¬m¬c	AllConf	Jaccard	Cosine	Kulc	MaxConf
D_1	10,000	1,000	1,000	100,000	0.91	0.83	0.91	0.91	0.91
D_2	10,000	1,000	1,000	100	0.91	0.83	0.91	0.91	0.91
D_3	100	1,000	1,000	100,000	0.09	0.05	0.09	0.09	0.09
D_4	1,000	1,000	1,000	100,000	0.5	0.33	0.5	0.5	0.5
D_5	1,000	100	10,000	100,000	0.09	0.09	0.29	0.5	0.91
D_6	1,000	10	100,000	100,000	0.01	0.01	0.10	0.5	0.99

Subtle: They disagree on those cases

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Imbalance Ratio with Kulczynski Measure

❑ IR (Imbalance Ratio): measure the imbalance of two itemsets A and B in rule implications:

$$IR(A, B) = \frac{|s(A) - s(B)|}{s(A) + s(B) - s(A \cup B)}$$

❑ Kulczynski and Imbalance Ratio (IR) together present a clear picture for all the three datasets D_4 through D_6

  ❑ D_4 is neutral & balanced; D_5 is neutral but imbalanced

  ❑ D_6 is neutral but very imbalanced

Data set	mc	$\neg mc$	$m\neg c$	$\neg m\neg c$	Jaccard	Cosine	Kulc	IR
D_1	10,000	1,000	1,000	100,000	0.83	0.91	0.91	0
D_2	10,000	1,000	1,000	100	0.83	0.91	0.91	0
D_3	100	1,000	1,000	100,000	0.05	0.09	0.09	0
D_4	1,000	1,000	1,000	100,000	0.33	0.5	0.5	0
D_5	1,000	100	10,000	100,000	0.09	0.29	0.5	0.89
D_6	1,000	10	100,000	100,000	0.01	0.10	0.5	0.99

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Example: Analysis of DBLP Coauthor Relationships

Recent DB conferences, removing balanced associations, low sup, etc.

ID	Author A	Author B	$s(A \cup B)$	$s(A)$	$s(B)$	Jaccard	Cosine	Kulc
1	Hans-Peter Kriegel	Martin Ester	28	146	54	0.163 (2)	0.315 (7)	0.355 (9)
2	Michael Carey	Miron Livny	26	104	58	0.191 (1)	0.335 (4)	0.349 (10)
3	Hans-Peter Kriegel	Joerg Sander	24	146	36	0.152 (3)	0.331 (5)	0.416 (8)
4	Christos Faloutsos	Spiros Papadimitriou	20	162	26	0.119 (7)	0.308 (10)	0.446 (7)
5	Hans-Peter Kriegel	Martin Pfeifle	18	146	18	0.123 (6)	0.351 (2)	0.562 (2)
6	Hector Garcia-Molina	Wilburt Labio	16	144	18	0.110 (9)	0.314 (8)	0.500 (4)
7	Divyakant Agrawal	Wang Hsiung	16	120	16	0.133 (5)	0.365 (1)	0.567 (1)
8	Elke Rundensteiner	Murali Mani	16	104	20	0.148 (4)	0.351 (3)	0.477 (6)
9	Divyakant Agrawal	Oliver Po	12	120	12	0.100 (10)	0.316 (6)	0.550 (3)
10	Gerhard Weikum	Martin Theobald	12	106	14	0.111 (8)	0.312 (9)	0.485 (5)

Advisor-advisee relation: Kulc: high, Jaccard: low, cosine: middle

❑ Which pairs of authors are strongly related?

   ❑ Use Kulc to find Advisor-advisee, close collaborators