7 - Kappa

Inter-Rater Reliability

- Dialogue Act Classification
  - can be straightforward, i.e. question, declaration, apology
  - can be subject to interpretation
    - yeah, right - agreement or sarcasm?
    - what!? - question, exclamation, or reaction?
  - **solution** - test how well two people agree on given dialogue acts
    - **inter-rater reliability**
- **inter-rater reliability** - degree of agreement between raters where raters work independently of each other
  - application - *validation* of rating protocols
- useful when rating protocols are ambiguous
  - applying dialogue act tags
  - codes from thematic analysis
  - judging the quality of something

Agreement Calculations

- **agreement** - probability that you and your partner selected the same tag for an item on the list
  - $agreement = \frac{count(item\ rated\ the\ same)}{count(item)}$
- **observed vs. expected agreement** - determine what agreement was likely due to chance
  - **observed agreement** - probability that items were rated the same $P(items\ rated\ the\ same)$
  - **expected agreement** - sum over all ratings
    - $P(item\ rated\ by\ both\ as\ X)$
    - $= P(judge\ 1\ rated\ X \cap judge\ 2\ rated\ X)$
  - if judges rated independently
    - $P(judge\ 1\ rated\ X) * P(judge\ 2\ rated\ X)$
- example

  - rate 20 items good or bad

  - rater 1 rated 1 item bad rest good

  - rater 2 rated 2 items bad rest good

  - all the bad rates, the other rater rated that item as good

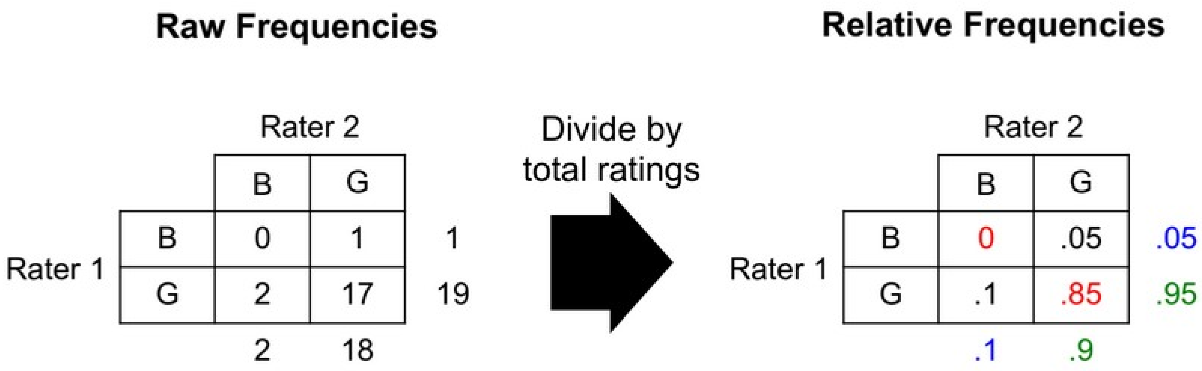
  - observed agreement = 17 / 20 = 0.85
  - expected agreement - make table where entry is the count that the rater rated items that class out of all items

	Rater 1	Rater 2
Bad	0.05	0.10
Good	0.95	0.90

  - bad = 0.05 x 0.10 = 0.005
  - good = 0.95 x 0.90 = 0.855
  - total = 0.855 + 0.005

Cohen's Kappa

- measures the degree to which two raters' agreement exceeds chance
  - $k = \frac{O-E}{1-E}$
- O is observed agreement, E expected agreement
- from previous example



Raw Frequencies

		Rater 2		
		B	G	
Rater 1	B	0	1	1
	G	2	17	19
		2	18	

Divide by
total ratings

Relative Frequencies

		Rater 2		
		B	G	
Rater 1	B	0	.05	.05
	G	.1	.85	.95
		.1	.9	

  - O = 0 + 0.85 = 0.85
  - E = (0.05 x 0.1) + (0.95 x 0.9) = 0.86
  - k = (0.85 - 0.86) / (1 - 0.86) = -0.071, poor agreement
- kappa ranges from -1 to 1
  - k > 0 indicates agreement better than chance
    - k = 1 perfect agreement
  - k < 0 indicates agreement worse than chance
    - k = -1 perfect disagreement and 50% expected agreement
  - applicable when data are *nominal* and *unordered*
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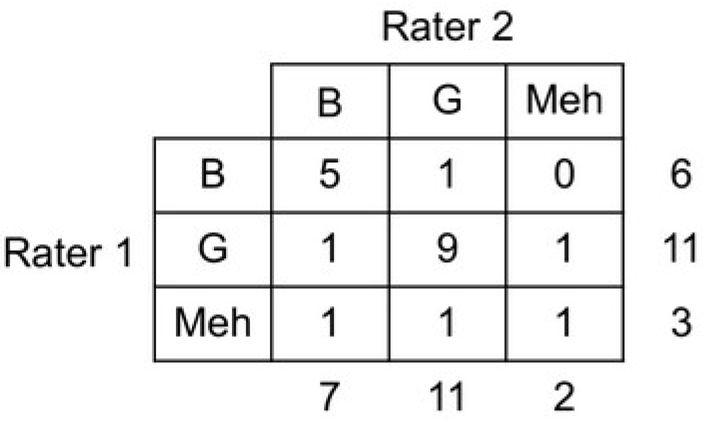
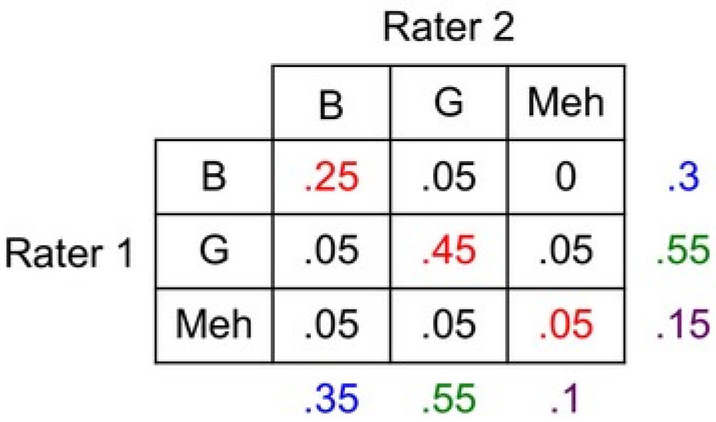
Score	Interpretation
< 0	poor

Score	Interpretation
0 - 0.2	slight
0.2 - 0.4	fair
0.41 - 0.6	moderate
0.61 - 0.8	substantial
0.81 - 1	almost perfect

- example



		Rater 2			
		B	G	Meh	
Rater 1	B	5	1	0	6
	G	1	9	1	11
	Meh	1	1	1	3
		7	11	2	



		Rater 2			
		B	G	Meh	
Rater 1	B	.25	.05	0	.3
	G	.05	.45	.05	.55
	Meh	.05	.05	.05	.15
		.35	.55	.1	

  - O = 0.25 + 0.45 + 0.05 = 0.75
  - E = (0.3 x 0.35) + (0.55 x 0.55) + (0.15 x 0.1) = 0.4225
  - k = (0.75 - 0.4225) / (1 - 0.4225) = 0.57, moderate agreement

Applications

- dialogue act classification
  - define a set of dialogue tags and detailed descriptions for each one
  - train secondary annotators on how to use your tagging scheme
  - calculate kappa on subset of data (generally around 20%)
  - if kappa is too low, retrain and repeat

- standard practices for corpus-based research
    - one or more annotators tag entire corpus split across each annotator
    - kappa computed on double-tagged portion of corpus, around 20%
    - kappa of around 0.8 is generally acceptable for dialogue act tags
        - lower kappas are acceptable depending on the task
        - tagging uncertainty, disengagement, etc

Weighted Kappa

- **weighted kappa** - accounts for degree of disagreement
- useful when ratings are ordered
    - i.e. disagreement between good and bad should have more weight than disagreement between good and meh
- consists of **3 matrices**
    - observed agreement matrix
    - expected agreement matrix
    - weight matrix
- **observed agreement matrix** - same as the contingency matrix = X
- **expected agreement matrix** - probabilities for each pair of ratings = M
    - $m_{ij} = \frac{(rater\ 1's\ i\ ratings) \times (rater\ 2's\ j\ ratings)}{total\ data\ points}$
- **weight matrix** - each cell in the contingency matrix = W
    - matrix diagonal is zero, no penalty for agreement
    - other weights determined by distance between ratings
        - good/meh and meh/bad = 1, good/bad = 2
- $k = 1 - \frac{\sum\sum w_{ij}x_{ij}}{\sum\sum w_{ij}m_{ij}}$
    - sum of products of weight and observed agreement matrices divided by sum of products of weight and expected agreement matrices

Other Inter-Rater Reliability Methods

- **Fleiss' kappa** - multiple raters, ordinal data
    - alternative - average pairwise Cohen's kappa
- **Pearson's correlation coefficient and Spearman's rank correlation coefficient** - used for continuous data
- **Krippendorff's alpha** - generalizable to multiple raters and data types
- **Cronbach's alpha** - validating psychometric test items