A crossover coefficient for quantifying disagreement in product ranks between individual panelists and the panel

P2.24

J. C. Castura*, M. Truong, C. J. Findlay
Compusense Inc., Guelph, Canada
Contact: jcastura@compusense.com

Compusense.

Goal

Quantify rank order differences between panelist *j* and a sensory panel.

Solution

We propose a univariate crossover coefficient (XC_j) which takes values between 0 and 100.

Crossover coefficient

1. Panel data are analysed. An appropriate multiple comparison test is used to separate k products into homologous subsets.

2. The panel's product rankings become the standard against which each panelist's product rankings are evaluated. Panelist j evaluates q of k products; 1≤q≤k, where q=k in a complete block design without missing data. D_j is the number of statistically different pairs and omits any pair not discriminated by the panel; $0 \le D_j \le q(q-1)/2$. If all $D_j=0$ then the panel is non-discriminating at the required level of significance and crossover is not considered meaningful. N_j incorporates the pair inversions for panelist *j*, penalizing only crossovers for statistically significant product pairs.

3. Crossover is quantified $XC_j = 100\% \times N_j / D_j$.

Discussion

Higher values indicate greater crossover. XC obtained from random panel rankings can contextualize the XC_j values.

The procedure is nonparametric if the panel data are analysed nonparametrically, and semiparametric if the panel data are analysed parametrically. The XC procedure can be extended to incorporate penalties based on the sum of squares of deviances for relevant pairs rather than the sum of absolute deviances. XC can be evaluated on a leave-one-out basis, i.e. contrasting *j* with the other panellists. Panel-to-panel or other comparisons are also possible.

The XC supports a complex overlapping tie structure differentiates it from statistics due to Kendall, which requires a simpler tie structure.

Example: trained description analysis on fried noodles

We illustrate the procedure using results from a trained descriptive panel (n=12) which developed a lexicon of 29 sensory attributes to evaluate 6 fried noodle products which were either sold in or being developed for the Chinese market. Products included 4 prototypes that had different levels of protein (high, low) and of protein supplementation (+5%, +15%).

For illustrative purposes, we analyze data for the attribute *Firmness* using Tukey's HSD (10%). Products are separated into three groups. For the tie structure indicated D_j=7. Rank orders are given for 3 of the 12 panelists (who are coded P4, P5, and P6).

Product	Panel Mean	Group	P4	P5	P6
high+15%	42.24	a	1	1	5
low+15%	41.36	a	2	4	2
low+5%	40.44	ab	4	5	1
high+5%	40.31	ab	3	6	3
Doll brand (公仔面)	38.08	b	5	2	4
Master Kong (康师傅)	33.84	c	6	3	6

Result: Panelist 4

XC_{P4}=0%. There are 0/7 reversals. Ranking *high+5%* ahead of *low+5%* is not penalized.
For random data XC≤0% with probability 0.06.
Conclusion: P4 has **no crossover**. Data are fully aligned with the panel's product rankings.

Result: Panelist 5

XC_{P5}=57%. There are 4/7 reversals: ranking *Doll* 公仔面 ahead of *low+15%*, and ranking *Master Kong* 康师傅 ahead of *low+15%*, *low+5%*, and *high+5%*.
For random data XC≤57% with probability 0.67.
Conclusion: P5 has **high crossover**. Data are consistent with random product rankings.

Result: Panelist 6

XC_{P6}=14%. There is 1/7 reversals: ranking *Doll* 公仔面 ahead of high+15%.
Conclusion: P6 has **low crossover**. Data are somewhat aligned with the panel's product rankings.
For random data XC≤14% with probability 0.17.

Summary

The proposed coefficient provides a useful, objective coefficient for quantifying crossover.
Unlike most conventional approaches, XC works with a complex ties structure and isolates ranking disagreement from scale usage differences.