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Abstract

This paper presents a discussion of principal component analysis by alternating least squares optimal scaling (PRINCIPALS) and its application to measure development.

PRINCIPALS was presented by Didow et al (1985) as being capable of improving measure quality. The present paper presents a discussion of the approach advocated by Didow et al (1985) and should prove useful to those contemplating the use of PRINCIPALS in measure development. The data presented by Didow et al (1985) provide a basis for the discussion which follows.

Two examples were presented by Didow et al (1985) each having as dependent measures the tripartite components of attitude (affect, belief and behavioral intention). In both examples, a principal component analysis (with a varimax rotation) was presented which did not provide total support for the convergent and discriminant validity of the measures. This was demonstrated by the fact that a number of variables loaded heavily on components which they were not intended to measure. Cronbach's coefficient alpha for four of the six measures was reported as failing to indicate sufficient reliability for basic research. The authors proceeded to rescale the data by applying the PRINCIPALS algorithm and presented the factor loadings and coefficient alphas for the new "optimal scale values". The resultant factor loading matrices and coefficient alphas demonstrated a greater degree of convergent and discriminant validity and reliability. This apparently makes the point that PRINCIPALS is capable of improving the reliability and validity of deficient data.

The driving force behind PRINCIPALS is to give the data the appearance of being reliable and valid. This is accomplished by rescaling the original values so as to "maximize the variance explained by a one-component principal component analysis" (Didow et al 1985, p. 34). PRINCIPALS will result in larger coefficient alphas and "cleaner" factor structures. Unfortunately, the goal of the method is not to create new scales which best capture the attitudinal state of the respondents. PRINCIPALS' major shortcoming resides in the manner in which it is virtually unconcerned with creating scales which mirror the sentiments of the respondents. Therefore, it's ability to truly increase the validity of measures is greatly hampered.

The Table presents the original 1-7 scale values and PRINCIPALS "Optimal Scale Values" (OSV's) for two measures of affect, AFF1 and AFF5. Responses one through five for AFF5 were all collapsed to a common value of 2.999. PRINCIPALS' rescaling would lead one to believe that there is no difference in the attitudinal state of a respondent who indicated 1 on AFF5 and a respondent who indicated 2, 3, 4 or even 5. Evidence of the fact that the respondents did not differentiate between the first five response categories would be required to legitimately allow such drastic rescaling. PRINCIPALS,

however, is not motivated in this manner.

TABLE
SELECTED OPTIMAL SCALE VALUES^a

Original Values	Optimal Scale Values	
	AFF1	AFF5
1	-3.211	2.999
2	4.482	2.999
3	4.482	2.999
4	5.713	2.999
5	6.312	2.999
6	6.460	6.042
7	6.829	7.648

^a(Didow et al 1985, p. 35)

PRINCIPALS rescaled AFF1 in a manner drastically different than AFF5. One might maintain that such differences are not problematic; that the original Likert scale data were ordinal and therefore any rescaling which maintained order is appropriate. However, the authors point out that analytical results based on the rescaled data are likely to differ from results obtained from the original data. The burden of proof is on the advocates of PRINCIPALS to demonstrate that the rescaled values are indeed more appropriate measures of the respondents' sentiments than are the original values. For AFF1 this would mean that if a respondent chose response category number two s/he did not mean to be one unit from Strongly Agree and five units from Strongly Disagree but rather 7.693 units from Strongly Agree and 2.347 from Strongly Disagree. PRINCIPALS would thus transform the original "agree" response to "disagree". In this sense the algorithm acts as if it knows the respondents' attitudes better than the respondents do. This is a most unfortunate aspect of the method.

PRINCIPALS only improves the apparent reliability and validity of the data by a rescaling approach which is not concerned with capturing the true sentiments of the respondents. The meaning of the rescaled values must therefore be viewed with much suspicion. PRINCIPALS is basically an approach which is concerned with the cosmetic appearance of the data. Such concern for the superficial will not serve to improve the quality of measures.

References

- Didow, Nicholas M., Jr. Kevin Lane Keller, Hiram C. Barksdale, Jr., and George R. Franke 1985, "Improving Measure Quality by Alternating Least Squares Optimal Scaling," Journal of Marketing Research, 22 (February), 30-40.