ASSOCIATION FOR CONSUMER RESEARCH

Labovitz School of Business & Economics, University of Minnesota Duluth, 11 E. Superior Street, Suite 210, Duluth, MN 55802

Covariation Learning, Quality Expectation and Product Valuation Under Homoscedastic and Heteroscedastic Uncertainty

Bart de Langhe, Erasmus University Rotterdam, The Netherlands

Stefano Puntoni, Erasmus University Rotterdam, The Netherlands

Ann L. McGill, University of Chicago, USA

Stijn van Osselaer, Erasmus University Rotterdam, The Netherlands

We establish that cue-outcome (e.g., price-quality) learning depends on whether outcome uncertainty is the same (homoscedastic) or varies (heteroscedastic) for different cue values. Specifically, a series of experiments shows stronger perceived cue-outcome association under heteroscedastic than under homoscedastic outcome uncertainty and demonstrates implications for consumers' quality expectations and product valuations.

[to cite]:

Bart de Langhe, Stefano Puntoni, Ann L. McGill, and Stijn van Osselaer (2011) ,"Covariation Learning, Quality Expectation and Product Valuation Under Homoscedastic and Heteroscedastic Uncertainty", in NA - Advances in Consumer Research Volume 38, eds. Darren W. Dahl, Gita V. Johar, and Stijn M.J. van Osselaer, Duluth, MN : Association for Consumer Research.

[url]:

http://www.acrwebsite.org/volumes/15803/volumes/v38/NA-38

Covariation Learning, Quality Expectation and Product Valuation Under Homoscedastic and Heteroscedastic Uncertainty

Bart de Langhe, Erasmus University Rotterdam, The Netherlands
Stefano Puntoni, Erasmus University Rotterdam, The Netherlands
Ann L. McGill, University of Chicago, USA
Stijn van Osselaer, Erasmus University Rotterdam, The Nethelands

EXTENDED ABSTRACT

Over the past four decades, a substantial amount of research has been conducted to study how people acquire cue-outcome relations, including literature on contingency learning (Allan 1993; van Osselaer et al. 2004), covariation judgments (Baumgartner 1995; Pechmann and Ratneshwar 1992), category representations (Erickson and Kruschke 1998), and function learning (DeLosh et al. 1997; Juslin et al. 2008) . Despite the important insights gained into how humans detect systematic cue-outcome associations against a background of uncertainty, no research has investigated if cue-outcome learning depends on whether the degree of uncertainty is the same (i.e., homoscedastic) or varies (i.e., heteroscedastic) across different ranges of the cue. To illustrate this distinction in the nature of randomness, consider consumers' price-quality beliefs for restaurants. Prior research on cue-outcome learning assumes no differences between a *homoscedastic* world where high-end restaurants display the same medium level of variance in quality as do inexpensive restaurants and a *heteroscedastic* world where quality can vary wildly among inexpensive restaurants but instead tends to be consistently high among high-end restaurants.

According to linear statistical theory, the correlation coefficient is a function of overall error variance and it is not affected by where, in the range of the cue, the uncertainty is located (Cohen et al. 2003). Therefore, if the overall cue-outcome association strength (i.e., the correlation coefficient) is the critical input for covariation inferences (e.g., Brehmer 1973), then the nature of the error (homoscedastic vs. heteroscedastic) may not matter, as long as the overall level of uncertainty remains the same. However, the distinction between homoscedastic and heteroscedastic uncertainty may be crucial if covariation judgments are in fact influenced by local variations in cue-outcome association strength (i.e., local correlations).

The current research proposes that (a) local correlations are taken into account when expressing overall judgments of covariation and (b) that local correlations are influenced by the nature of outcome uncertainty (heteroscedastic vs. homoscedastic). We theorize that homo- versus heteroscedasticity determines the perception of local correlations according to a two-step process. The first step entails a statistical nonlinear decreasing effect of error variance on local correlations (Doksum et al. 1994), whereas the second entails a psychophysical nonlinear increasing effect of objective correlation on perceived correlation (Jennings et al. 1982). The result of this process is that, all else being equal, the reduction in error variance in the low uncertainty range of heteroscedastic environments has a disproportionately large impact (relative to the impact of the increase in error variance in the high uncertainty range) on perceived local cue-outcome association strengths.

The first two experiments in this paper establish that heteroscedastic error variance, relative to homoscedastic error variance, results in more extreme judgments of cue-outcome association strength. In Study 1, we presented participants with cue-outcome pairs in tabular format and asked them to judge the overall cue-outcome association strength. We manipulated homo- versus heteroscedasticity within-participants via an elaborate procedure that varies across tables the nature of the error while holding constant other factors that may influence judgments of covariation (overall correlation, regression slope, intercept of the regression, mean, etc.). To avoid that any effect of homo- versus heteroscedasticity could be attributed to the existence of prior theories about the association between cue and outcome, we used X and Y as cue-outcome labels in this first study (e.g., Baumgartner 1995). The results show that overall judgments of cue-outcome association strength are more extreme when error variance is heteroscedastic.

In Study 2, participants learned first about the prices and quality scores of several brands in a fictive product category. Homo- versus heteroscedastic uncertainty about quality was manipulated between-participants. Subsequently, we asked participants to indicate to what extent they thought it was difficult to predict quality at different price levels (to measure the perceived local correlations). The results show that participants found it less difficult to predict quality in the low uncertainty range of the heteroscedastic condition than in the homoscedastic condition, while there was no difference between the high uncertainty range of the heteroscedastic condition and the homoscedastic condition. This study shows that error variance has a nonlinear decreasing impact on the perceived local correlations.

Two additional experiments attest to the managerial importance of these findings by establishing systematic differences in product quality expectations and product valuation between homoscedastic and heteroscedastic environments. Study 3 shows that quality expectations are more sensitive to price under heteroscedastic outcome uncertainty than under homoscedastic outcome uncertainty. When heteroscedasticity is manipulated by increasing uncertainty at higher price levels, participants in the homo- and heteroscedastic condition expect similar quality for low-priced brands. However, for higher-priced brands, participants in the heteroscedastic condition expect higher quality than participants in the homoscedastic condition.

Finally, Study 4 investigates consumers' product ratings (value for money) when they are provided with objective information about product price and quality. If, compared to participants in a homoscedastic condition, participants in a heteroscedastic condition with increasing variance over the price range expect higher quality for higher-priced products, they should also rate a high-priced product with a specific quality to be of less value for money. The findings confirm this prediction.

REFERENCES

Aiken, Leona S. and Stephen G. West (1991), *Multiple Regression: Testing and interpreting interactions.* Newbury Park, CA: Sage.

Allan, Lorraine G. (1993), "Human Contingency Judgments-Rule-Based or Associative," *Psychological Bulletin*, 114 (3), 435-48.

Baumgartner, Hans (1995), "On the Utility of Consumers Theories in Judgments of Covariation," *Journal of Consumer Research*, 21 (4), 634-43.

Bjerve, Steinar and Kjell Doksum (1993), "Correlation Curves-Measures of Association as Functions of Covariate Values," *Annals of Statistics*, 21 (2), 890-902.

Brehmer, Berndt (1973), "Single-Cue Probability Learning as a Function of the Sign and Magnitude of the Correlation between Cue and Criterion," *Organizational Behavior and Human Performance*, 9, 377-95.

Cohen, Jacob, Patricia Cohen, Stephen G. West, and Leona S. Aiken (2003), *Applied Multiple Regression / Correlation Analysis for the Behavioral Sciences (3rd ed.)*. Mahwah, NJ: Lawrence Erlbaum Associates, inc.

DeLosh, Edward L., Jerome R. Busemeyer, and Mark A. McDaniel (1997), "Extrapolation: The sine qua non for abstraction in function learning," *Journal of Experimental Psychology: Learning Memory and Cognition*, 23 (4), 968-86.

Doksum, Kjell, Stephen Blyth, Eric Bradlow, Xiao-Li Meng, and Hongyu Zhao (1994), "Correlation Curves as Local Measures of Variance Explained by Regression," *Journal of the American Statistical Association*, 89 (426), 571-82.

Einhorn, Hillel J., Don N. Kleinmuntz, and Benjamin Kleinmuntz (1979), "Linear Regression and Process-Tracing Models of Judgment," *Psychological Review*, 86 (5), 465-85.

Erickson, Michael A. and John K. Kruschke (1998), "Rules and exemplars in category learning," *Journal of Experimental Psychology: General*, 127 (2), 107-40.

Hagafors, Roger and Berndt Brehmer (1983), "Does Having to Justify One's Judgments Change the Nature of the Judgment Process?," *Organizational Behavior and Human Decision Processes*, 31, 223-32.

Jennings, Dennis L., Teresa M. Amabile, and Lee Ross (1982), "Informal Covariation Assessment: Data-based versus Theory-based Judgments," in *Judgment under Uncertainty: Heuristics and Biases*, Daniel Kahneman and Paul Slovic and Amos Tversky, Eds. New York: Cambridge University Press.

Juslin, Peter, Linnea Karlsson, and Henrik Olsson (2008), "Information integration in multiple cue judgment: A division of labor hypothesis," *Cognition*, 106 (1), 259-98.

Kalish, Michael L., Stephan Lewandowsky, and John K. Kruschke (2004), "Population of linear experts: Knowledge partitioning and function learning," *Psychological Review*, 111 (4), 1072-99.

Karelaia, Natalia and Robin M. Hogarth (2008), "Determinants of linear judgment: A meta-analysis of lens model studies," *Psychological Bulletin*, 134 (3), 404-26.

Lane, David M., Craig A. Anderson, and Kathryn L. Kellam (1985), "Judging the Relatedness of Variables: the Psychophysics of Covariation Detection," *Journal of Experimental Psychology: Human Perception and Performance*, 11(5), 640-649.

Lewandowsky, Stephan, Michael L. Kalish, and S. K. Ngang (2002), "Simplified learning in complex situations: Knowledge partitioning in function learning," *Journal of Experimental Psychology: General*, 131 (2), 163-93.

Olsson, Anna-Carin C., Tommy Enkvist, and Peter Juslin (2006), "Go with the flow: How to master a nonlinear multiple-cue judgment task," *Journal of Experimental Psychology: Learning Memory and Cognition*, 32 (6), 1371-84.

Pechmann, Cornelia and S. Ratneshwar (1992), "Consumer Covariation Judgments-Theory or Data Driven," *Journal of Consumer Research*, 19 (3), 373-86.

Rao, Akshay R. and Kent B. Monroe (1989), "The Effect of Price, Brand Name, and Store Name on Buyers Perceptions of Product Quality-an Integrative Review," *Journal of Marketing Research*, 26 (3), 351-57.

Sheets, Charles A. and Monroe J. Miller (1974), "The Effect of Cue-Criterion Function Form on Multiple-Cue Probability Learning," *American Journal of Psychology*, 87 (4), 629-41.

van Osselaer, Stijn M. J., Chris Janiszewski, and Marcus Cunha (2004), "Stimulus generalization in two associative learning processes," *Journal of Experimental Psychology: Learning Memory and Cognition*, 30 (3), 626-38.