

**López-Díaz, M. C.; López-Díaz, M.; Martínez-Fernández, S.**

**A stochastic comparison of customer classifiers with an application to customer attrition in commercial banking.** (English) Zbl 1402.91267

Scand. Actuar. J. 2017, No. 7, 606-627 (2017).

Summary: The classification of clients is an essential matter in commercial banking, insurance companies, electrical corporations, communication business, etc. Those companies frequently classify their customers by means of the information provided by the so-called classifier. Motivated by the need to compare systems of classification, we introduce a new stochastic order which permits the comparison of classifiers. The stochastic order is analysed in detail, providing characterizations and properties as well as connections with other stochastic orders and other classification systems. Such an order is applied to compare some classifiers used by a Spanish commercial banking to analyse the key problem of customer churn, obtaining conclusive results by means of real databases. Namely, the optimal classifier among them in the new stochastic order is obtained.

**MSC:**

[91B42](#) Consumer behavior, demand theory

[60E15](#) Inequalities; stochastic orderings

[06A06](#) Partial orders, general

Cited in 1 Document

**Keywords:**

[churn rate](#); [classifier](#); [copula](#); [logistic regression](#); [stochastic order](#); [target](#)

**Full Text:** [DOI](#)

**References:**

- [1] Bamber, D. (1975). The area above the ordinal dominance graph and the area below the receiver operating characteristic graph. *Journal of Mathematical Psychology* 12, 387-415. · [Zbl 0327.92017](#)
- [2] Belzunce, F., Martínez-Riquelme, C. & Mulero, J. (2016). *An introduction to stochastic orders*. Amsterdam: Elsevier/Academic Press. · [Zbl 1366.60001](#)
- [3] Billingsley, P. (1999). *Convergence of probability measures*. Wiley, New-York: Wiley series in probability and statistics. · [Zbl 0944.60003](#)
- [4] Breiman, L. (1968). *Probability*. Reading, MA: Addison-Wesley Publishing Company. · [Zbl 0174.48801](#)
- [5] Breiman, L. (2001). Random forests. *Machine Learning* 45, 5-32. · [Zbl 1007.68152](#)
- [6] Buckinx, W. & Van den Poel, D. (2005). Customer base analysis: partial defection of behaviourally loyal clients in a non-contractual FMCG retail setting. *The European Journal of Operational Research* 164, 252-268. · [Zbl 1132.90349](#)
- [7] Cherubini, U., Luciano, E. & Vecchiato, W. (2004). *Copula methods in finance*. Wiley, Chichester: Wiley Finance Series. · [Zbl 1163.62081](#)
- [8] Engelmam, B., Hayden, E. & Tasche, D. (2003). *Measuring the discriminative power of rating systems*. Discussion Paper Series 2: Banking and Financial Supervision No 01/2003. Frankfurt am Main: Deutsche Bundesbank.
- [9] Figini, S. & Giudici, P. (2010). Bayesian churn models. *The Advances and Applications in Statistical Science* 1, 285-310. · [Zbl 1260.62020](#)
- [10] Govindarajulu, Z. (1977). A class of distributions useful in life testing and reliability with applications to nonparametric testing. Vol. I, *The theory and applications of reliability, with emphasis on Bayesian and nonparametric methods*, pp. 109-129. New York: Academic Press. Conf., Univ. South Florida, Tampa, Fla., (1975).
- [11] Günther, C. C., Tvet, I. F., Aas, K., Sandnes, G. I. & Borgan, O. (2014). Modelling and predicting customer churn from an insurance company. *Scandinavian Actuarial Journal* 2014(1), 58-71. · [Zbl 1401.91144](#)
- [12] Harzheim, E. (2005). *Ordered sets*. Advances in mathematics. New York: Springer. · [Zbl 1072.06001](#)
- [13] Hung, S., Yen, D. C. & Wang, H. (2006). Applying data mining to telecom churn management. *Expert Systems with Applications* 31, 515-524.
- [14] Hwang, H., Jung, T. & Suh, E. (2004). An LTV model and customer segmentation based on customer value: a case study on the wireless telecommunication industry. *Expert Systems with Applications* 26, 181-188.
- [15] Kumar, D. A. & Ravi, V. (2008). Predicting credit card customer churn in banks using data mining. *International*

Journal of Data Analysis Techniques} 1, 4-28.

- [16] Larivière, B. & Van den Poel, D. (2005). Predicting customer retention and profitability by using random forests and regression forests techniques. \textit{Expert Systems with Applications} 29, 472-484.
- [17] Miguéis, V. L., Van den Poel, D., Camanho, A. S. & Falcão e Cunha, J. (2012). Predicting partial customer churn using Markov for discrimination for modeling first purchase sequences. \textit{Advances in Data Analysis and Classification} 6, 337-353. · [Zbl 1282.62249](#)
- [18] Morik, K. & Kpcke, H. (2004). Analysing customer churn in insurance data: a case study. In J. F. Boulicaut, F. Esposito, F. Giannotti, and D. Pedreschi, eds, \textit{Knowledge discovery in databases}(Lecture notes in computer science). Vol. 3202, pp. 325-336. Italy: Springer.
- [19] Müller, A. & Stoyan, D. (2002). \textit{Comparison methods for stochastic models and risks}. Chichester: Wiley.
- [20] Nair, N. U., Sankaran, P. G. & Vinesh Kumar, B. (2012). Characterization of distributions by properties of truncated Gini index and mean difference. \textit{Metron} 70, 173-191. · [Zbl 1302.62025](#)
- [21] Neggers, J. & Kim, H. S. (1998). \textit{Basic posets}. Singapore: World Scientific Publishing. · [Zbl 0928.06001](#)
- [22] Nelsen, R. B. (2009). \textit{An introduction to copulas}. Springer series in statistics. 2nd ed. New York: Springer.
- [23] Pollard, D. (1984). \textit{Convergence of stochastic processes}. Springer series in statistics. New York: Springer-Verlag.
- [24] Qi, J., Zhang, L., Liu, Y., Li, L., Zhou, Y., Shen, Y., Liang, L. & Li, H. (2009). ADTreesLogit model for customer churn prediction. \textit{Annals of Operations Research} 168, 247-265. · [Zbl 1179.90037](#)
- [25] Schröder, B. S. W. (2003). \textit{Ordered sets}. \textit{An introduction}. Boston: Birkhäuser.
- [26] Shaked, M. & Shanthikumar, J. G. (2007). \textit{Stochastic orders}. New York: Springer. · [Zbl 0806.62009](#)
- [27] Shorack, G. R. & Wellner, J. A. (1986). \textit{Empirical processes with applications to statistics}. Wiley series in probability and mathematical statistics. New York: Wiley. · [Zbl 1170.62365](#)
- [28] Verbeke, W., Martens, D., Mues, C. & Baesens, B. (2011). Building comprehensible customer churn prediction models with advanced rule induction techniques. \textit{Expert Systems with Applications} 38, 2354-2364.
- [29] Wei, C. & Chiu, I. (2002). Turning telecommunications call details to churn prediction: a data mining approach. \textit{Expert Systems with Applications} 23, 103-112.

This reference list is based on information provided by the publisher or from digital mathematics libraries. Its items are heuristically matched to zbMATH identifiers and may contain data conversion errors. It attempts to reflect the references listed in the original paper as accurately as possible without claiming the completeness or perfect precision of the matching.