

Estimating a Customer Churn Model in the ADSL Industry in Portugal: The Use of a Semi-Markov Model

by

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Abstract

Customer churn has been stated as one of the main reasons of profitability losses in the telecommunications industry. As such, it seems critical to have an *a priori* knowledge about the risk of a given customer to churn at any moment, in order to take preventive measures to avoid the defection of potentially profitable customers. This study intends to develop a duration model of the residential customer churn in this industry in Portugal. We found empirical evidence that the variables that influence customer churn are the total number of overdue bills since ever, average monthly spending, average value of additional internet traffic, payment method, equipment renting, and the subscription of a flat plan. We also found that the probability of a customer to churn is neither constant over time nor across customers.

Keywords: Duration Models, Semi-Markov Models, Customer Churn, Customer Retention, Customer Management

1. Introduction

The Portuguese market of ADSL services soared in the last decade and, as a consequence, firms focused on customer acquisition and they neglected customer retention. Strong competition and low switching costs have given rise to a phenomenon of customer switching, and, thus, high customer churn rates, which has serious consequences for business performance and, therefore, for the economy.

Nevertheless, firms must change their strategy from customer acquisition to the retention of potentially valuable customers (Hadden *et al.*, 2005; Hung *et al.*, 2006), because the market is becoming saturated and firms cannot lose valuable customers to their competitors. Bolton and Tarasi (2006) suggest that customer retention is often easier and cheaper than customer acquisition in stable markets.

The customer retention became a buzzword in the 1990s, mainly due to the work of Reichheld and Sasser (1990), who firstly provided evidence about the advantages of customer retention. Although their results definitively caused a change in the marketing theory, they are not consensual (see, for example, Carroll, 1991/92; Dowling and Uncles, 1997; Reinartz and Kumar, 2000; East *et al.*, 2006; Gupta *et al.*, 2006; Ranaweera, 2007). Following this new paradigm, many firms have focused on retaining all customers. Nevertheless, many researchers argue that the retention strategy must be strongly linked with the customer lifetime value (*i.e.*, the expected net present value of the future cash flows of the customer -CLV), and, consequently, enterprises should not try to retain all of their current customers, because they are probably investing in unprofitable customers (Gupta and Lehmann, 2003; Jain and Singh, 2002; Malthouse and Blattberg, 2004; Thomas *et al.*, 2004), and, in this way, they are destroying value (Gupta and Lehmann, 2005; Jain and Singh, 2002).

The customer churn issue is present both in studies about CLV as a component of CLV and on specific studies of churn, but in different perspectives. In studies about CLV, customer churn is mainly analysed in a theoretical way, whereas on the later case, the statistical models with empirical data are predominant. Furthermore, most studies which focus on CLV make strong assumptions about customer retention (*i.e.*, the opposite of customer churn), such as customer retention is constant over time (*e.g.*, Berger and Nasr, 1998; Blattberg and Deighton, 1996; Gupta and Lehmann, 2003; Gupta *et al.*, 2004; Hogan *et al.*, 2002) and across customers (Hogan *et al.*, 2002).

Customer churn has been studied in different industries (*e.g.*, banking, insurance, telecommunications), and in different contexts (contractual *vs.* noncontractual settings, continuous *vs.* discrete time). Furthermore, customer churn in the telecommunications industry in contractual settings has been modelled using different techniques, such as logistic regression (*e.g.*, Ahn *et al.*, 2006; Burez and Van den Poel, 2007; Kim and Yoon, 2004; Lemmens and Croux, 2006; Mozer *et al.*, 2000a, 2000b; Neslin *et al.*, 2006; Seo *et al.*, 2007), duration models (*e.g.*, Bolton, 1998; Burez and Van den Poel, 2007; Drew *et al.*, 2001; Jamal and Bucklin, 2006; Mani *et al.*, 1999; Schweidel *et al.*, 2008), and data mining techniques (*e.g.*, Burez and Van den Poel, 2007; Drew *et al.*, 2001; Ferreira *et al.*, 2004; Hung *et al.*, 2006; Lemmens and Croux, 2006; Mani *et al.*, 1999; Mozer *et al.*, 2000a, 2000b; Neslin *et al.*, 2006; Zhang *et al.*, 2006). Buckinx and Van den Poel (2005), Hadden *et al.* (2005), Reinartz and Kumar (2003), Song *et al.* (2004), and Van den Poel and Larivière (2004) present literature reviews of customer churn studies. Ahn *et al.* (2006) point out that the reasons of customer churn and the customer behaviour towards churn need to be more studied.

Despite the large amount of research done on customer churn, there are few studies applied to the ADSL industry. The majority of published research about customer churn prediction in the telecommunications industry analyse the mobile telecommunications. This issue has never been studied in Portugal. Many studies focus on model accuracy or comparison of techniques rather than on testing the effect of churn covariates. Lastly, most of them model whether (or not) a customer is likely to churn in a pre-specified time period, rather than the longitudinal churn pattern over the duration of the relationship.

In this context, it seems relevant to do a more detailed study of the customer churn in the ADSL industry. Moreover, considering that the customer churn behaviour may be influenced by the customer culture, it is pertinent to examine different markets, like the Portuguese one. In this context, the aim of this study is to develop a model of the residential customer churn in the ADSL industry in Portugal. It also intends to analyse the assumptions of constant retention rate over time and across customers.

2. Methodology

A continuous duration model will be used to understand the residential customer churn in the ADSL industry (contractual settings) in Portugal. Let T be a continuous non-negative random variable, which represents the survival time in days. Two key concepts in duration analysis are the survival and the hazard function. The survival function is the probability of an individual to survive beyond time t and the hazard function is the instantaneous potential per unit time for the event occurrence (customer churn), given that the individual has survived up to time t . Duration models can accommodate both the proportional hazards (PH) and the accelerated failure time (AFT) forms. PH models assume that the hazard rates of any two individuals are proportional over time and, as such, the effect of any covariate in the hazard function is constant over time. AFT models assume that there is a constant acceleration factor that stretches out or shrinks survival times. AFT models are linear models of $\ln(T)$.

The model is developed by using large-scale data with almost 80.000 customers (both active and inactive) from an internal database of a Portuguese ADSL service provider. The available data contains a large number of covariates, which include customer's basic information, demographics, churn flag, customer historical information about usage, billing, subscription, credit, and other.

3. Results

Model estimation

A Cox model was estimated in order to test the PH assumption based on Schoenfeld residuals. We found statistical evidence that the PH assumption does not hold ($p = 0.000$); so, AFT models will be used instead. A comparison of the AIC of the different parametric models provides evidence that the parametric form that best fit our data is the log-logistic.

A log-logistic model with gamma-distributed frailty was estimated in order to test the unobserved individual heterogeneity. There is statistical evidence that this effect is presented ($H_0: \theta = 0$; $p = 0.000$), and thus, this effect was included in the model, since it improves the results. The final model is presented in table 1.

Our results show that the total number of overdue bills since the beginning of the contract negatively affect the survival time. Thus, for each additional invoice in debt, the contract lifetime reduces about 34%. In fact, this is the variable with greater impact on ADSL contract lifetime. The results of the present study also indicate that customers with greater average monthly spending with the service provider have shorter contract lifetimes. To the best of our knowledge, Madden *et al.* (1999) is the unique published study about customer churn on the ADSL industry and they also found that the monthly spending of customers with the service provider has a negative effect on the duration of the relationship. This indicates that customers are very sensitive to pricing. Contracts paid by direct debit also last longer than contracts paid by other methods. Zhang *et al.* (2006) also found that the probability of churn increases for more difficult payment methods. There is also empirical evidence that ADSL contracts with a flat plan have larger survival times than those without any flat plan. Furthermore, the contracts of those customers who buy the equipment for the installation of the service have longer survival times than those of customers who rent the equipment.

Table 1 Estimates of the Log-Logistic Model with Gamma-Distributed Unshared Frailty

	Log-logistic
N_total_dunning	-.417 ***
Mean_overall_revenues	-.008 ***
Mean_value_additional_traffic	.027 ***
Payment_method	-.379 ***
Equipment_renting	-.130 ***
Flat_plan_ADSL_1	.124 **
Constant	8.468 ***
Ln gamma	-.854 ***
Ln theta	-14.302 ***
Log Likelihood	-
AIC	20,475.57
	40,969.14

*** significant at the 1% level

The results of the present study indicate that despite the traffic on the internet (that measures the internet usage) is not a significant covariate, the value that customers spend on additional traffic is. This suggests that customers with different levels of internet usage do not have different probabilities of churn, but customers with more additional usage have longer relationships with the service provider.

Lastly, the results seem to contradict a common assumption made by several researchers on the CLV computation that the customer retention rate is constant over time and across customers, as the hazard function of ADSL contracts is neither constant over time (because the exponential model is the only one for which the hazard function is constant and this model does not definitely adequately fits the data) nor across customers (because the PH assumption is not satisfied).

Figures 1 and 2 show the hazard and survival curves, respectively. The hazard curve indicates the existence of positive duration dependence because the probability that a customer cancels an ADSL contract with the service provider increases as the contract lifetime increases.

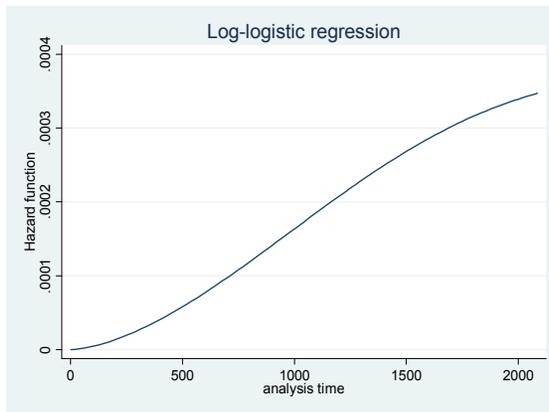


Figure 1 Hazard Curve

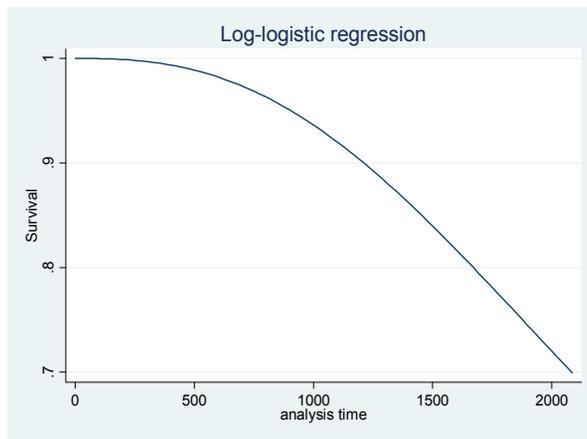


Figure 2 Survival Curve

Goodness-of-fit

The Nelson-Aalen cumulative hazard estimator for Cox-Snell residuals indicates that the model adequately fits the data, because the line of the Nelson-Aalen cumulative hazard estimator for Cox-Snell residuals shows a slope of approximately 1 (see Figure 3).

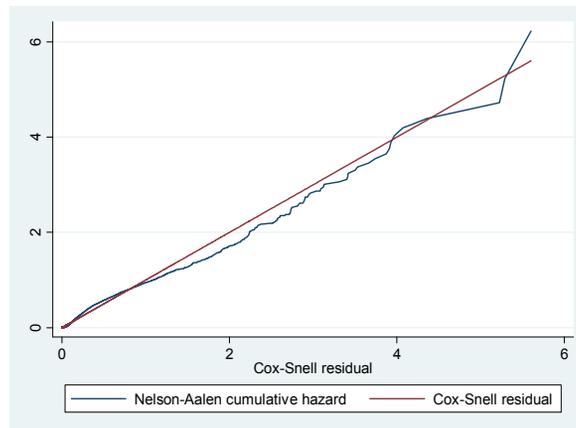


Figure 3 Cumulative Hazard of Cox-Snell Residuals

4. Conclusion

This study sheds new light on the crucial issue of customer churn in the ADSL industry in Portugal. Considering that it is crucial to prevent the churn of profitable customers in order to ensure the financial performance of these firms, the results of this study are very valuable mainly when complemented with an analysis of the CLV for each individual.

These results have a number of managerial implications, namely that (i) firms cannot make decisions about customer management based on the average churn rates, and (ii) it appears that firms should focus on pricing strategy.

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