

STATISTICS COLLOQUIUM

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“Estimating Consumer Lifetime Value with Multivariate Poisson Process Regression”

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ABSTRACT

How much should a company be willing to pay to acquire a customer given her background characteristics? This price is often linked to the revenue she can be expected to generate over her lifetime. Inferring lifetime outcomes is not possible with standard regression models, however, since only partial purchase histories of varying duration are observed. We present Poisson Process Regression (PPR), a joint model for the lifetime value of a customer and the relative intensity of purchases over time. We then extend this model to multiple types of outcomes, including those that measure customer engagement but do not directly produce value. Using the assumption that coefficients for the same predictor across regressions follow a multivariate Gaussian distribution, we obtain better predictive performance by fitting the regressions jointly. This performance is assessed in a sequential prediction task that replicates real world application of the model where customer purchase histories available before a given day are used to predict the outcomes for customers acquired on that day. Finally, we show that Pareto/NBD and other “exit time” models popular for customer lifetime value estimation are a special case of PPR where the intensity function is defined as a mixture of Uniforms. We demonstrate that PPR is not only more flexible but can have much smaller data storage requirements and computational complexity by directly parameterizing the intensity function.