* General problem (summary, uncertainty ist wichtig in versch disziplinen, bei … vernachlässigt - plakativ)
* Previous Research (in anderen disziplinen sehr populär)
* Research gap (contributions dieses papers, Zweck)
* What solution is presented in this work and what are the results? (wie ich das mache, Mittel zum Zweck)
* Structure of the paper

For successful businesses, it has always been important to understand their customers in dimensions like their wishes, behavior or composition of the whole body of customers. Having this understanding gives companies a competitive advantage over their competitors when planning marketing campaigns or pricing initiatives. To claim the necessary resources for such campaigns, it is vital for marketing managers to have an accurate understanding of the individual value of each customer. Accordingly, several methods have evolved like RFM models which order customers according to their individual value but do not provide actual dollar predictions. More sophisticated tools have been developed which fill this gap like the PNBD or BG/BB model. However, also these models are subject to uncertainty that needs to be assessed.

Even though there has been a lot of research about model uncertainty in numerous domains and numerous models, there has unfortunately been little effort to apply these concepts in marketing models and especially CLV prediction. 1L derived a closed-form expression of the variance of the customer lifetime value, V(CLV), for the BG/BB model on an individual customer level. However, they state that it would be far more complex to derive the same for the more broadly established PNBD model and it remains unclear whether a closed-form solution is at all possible for this model. \CLVTools provide a state-of-the-art implementation of the PNBD model in R that offers an implementation for prediction intervals of individual CLVs that is based on a bootstrap procedure.

This work will examine the previously mentioned implementation \CLVTools of the PNBD model and assess the derived prediction intervals. In addition, established methods and variations will be implemented to benchmark the bootstrap approach of \CLVTools and suggest alternatives. The core objective of this work is to introduce a valid opportunity to correctly assess uncertainty coming from the PNBD model and close this gap in research. This work will also attempt to use the resulting PIs and the associated information about individual uncertainties to help identify particularly valuable customers.

To achieve this and identify robust and applicable prediction interval (PI) deriving methods, a literature review across domains and scientific fields beyond marketing has been conducted. The resulting methods were deployed on four real-world datasets and their resulting PIs benchmarked against the bootstrap using several key metrics.

* Allocating marketing resources essential for justification and success
* RFM models widely used
* More sophisticated models like pnbd or Beta Geometric/Beta Binomial (BG/BB) are also known since 70s but still inaccurate
* Little research about uncertainty in clv estimation or uncertainty
* BG/BB: Variance derivation by 1L
* Pnbd: Prediction intervals by CLVTools
* No closed form for pnbd
* Unclear which uncertainty is involved in these predictions and where it comes from
* Focus on pnbd model
* Assess prediction intervals with several measures
* Suppose other methods than bootstrap and introduce them in the pnbd context
* Benchmark bootstrap against the other methods
* Identify their usefulness in customer selection
* Literature review: Role and sources of uncertainty, known methods to derive PIs
* Main part:
  + Adaptation of methods and their use in the pnbd context
  + Application with real-world datasets
  + Results: Benchmarking and identification of method strengths and weaknesses
  + Application in marketing
* Discussion and conclusion
* “Limitations and future research”