SCIENTIFIC STATEMENT

regarding a dissertation for the award of the scientific degree "Doctor of Science"

on the topic:

CUSTOMER LIFETIME VALUE

(Conceptual, Methodological, and Applied Aspects)

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Professional field 3.8 Economics, Scientific specialty Marketing

I. GENERAL CHARACTERISTICS OF THE DISSERTATION

The dissertation work of Prof. Dr. Todor Borisov Krastevich submitted for review is a large-scale, conceptually consistent and methodologically complex scientific study dedicated to one of the most significant problems in modern marketing science - the assessment and forecasting of the customer's lifetime value (Customer Lifetime Value, CLV). The work contains 318 pages, structured into five thematic chapters, a synopsis, a reflective epilogue and two extensive appendices with reproducible analytical protocols implemented in the R environment. The bibliography includes 264 information and literary sources, and the presentation is illustrated with 31 figures and 29 tables.

In the introductory part (Chapter 0, items 0.1-0.6) the author clearly and precisely formulates the object, subject, goals, sub-goals, tasks and six working hypotheses (H1-H6) of the study, situating them in the context of strategic marketing, customer relationship management and the digital transformation of business models. The research problem is defined with the necessary methodological rigor: to what extent can predictive machine learning approaches improve the prognostic accuracy and business utility of CLV models and how to build a hybrid framework combining probabilistic models and machine learning algorithms.

The structure of the work is logically sound and follows a classic scientific progression—moving from theoretical justification and typologization, through methodological development, to empirical validation and the synthesis of results. The individual chapters do not function as autonomous units; instead, they are organically linked by a clearly traceable research line, culminating in the development of applied analytical prototypes (see Chapter 5; Appendix A; Appendix B). The dissertation is characterized by a high degree of conceptual density, analytical depth, and interdisciplinarity, integrating approaches from marketing, econometrics, statistics, and machine learning into a unified research framework.

II. RELEVANCE AND SCIENTIFIC SIGNIFICANCE OF THE RESEARCH

The relevance of the subject matter is indisputable and convincingly argued by the author through three mutually reinforcing perspectives (see sections 0.2 and 0.3). In the context of increasing digitalization, the ubiquitous availability of high-frequency and heterogeneous data, and the transition toward customer-centric business models, the need for the quantitative measurement and forecasting of customer value has become a key factor for strategic management. The author correctly observes that the multi-channel environment in which the customer journey takes place generates new requirements for analytical models - they must now account for behavioural dynamics, nonlinearities, and interactions that far exceed the capacity of traditional deterministic formulas.

The dissertation correctly positions the concept of Customer Lifetime Value (CLV) as a unifying analytical framework that enables the integration of customer segmentation, marketing budgeting, and performance evaluation (see Chapter 1.3). In this sense, the study not only reflects current trends but also contributes to their systematization and conceptual development. The scientific value of the work is evident in the ambition to bridge the traditional divide between classical probabilistic models and modern predictive approaches by proposing an integrated analytical perspective tailored to the actual demands of business practice. The author positions themselves at the research frontier of the discipline, demonstrating an in-depth knowledge of the international scientific discourse - ranging from the foundational works of Gupta and Lehmann to contemporary developments in the fields of interpretable machine learning and Bayesian CLV modelling.

III. THEORETICAL FRAMEWORK AND DEGREE OF RESEARCH DEVELOPMENT

The theoretical framework of the dissertation is characterized by exceptional systematicity and depth. In Chapter One, the author traces the evolution of the concept of Customer Lifetime Value, analyses various definitions and theoretical interpretations, and builds a methodologically robust conceptual core for the entire study (see sections 1.1–1.2). CLV is formalized not merely as an analytical metric, but as a value stream interpretable within the framework of long-term returns and resource allocation. A significant theoretical achievement is the systematic distinction between CLV, defined as a micro-level construct (the net present value of future cash flows from a specific customer), and Customer Equity as an aggregated portfolio indicator. This distinction is methodologically vital for correctly defining the unit of analysis.

A particularly significant contribution is the development of a detailed and functional typology of CLV models (see Chapter 2), encompassing deterministic, heuristic (RFM and rules-based), probabilistic BTYD approaches, Machine Learning (ML) models, Deep Neural Networks, and hybrid/ensemble constructions. This typology is not merely descriptive; for each class, the author has identified prerequisites, data requirements, mathematical formulations, advantages, and limitations. Furthermore, the comparative tables (see Tables 11 and 12) structure this diversity of approaches into a system suitable for making an informed choice of model based on specific contexts and managerial objectives.

A significant theoretical contribution is observed in Chapter 3 as well, where the author formalizes the methodologically vital distinction between contractual and non-contractual

customer relationships and its implications for the observability of churn rate. The conceptual development in Chapter 4—the multi-component structure of CLV, comprising operational, potential, relational, and contextual components (see section 4.1)—expands upon traditional approaches and creates a theoretical prerequisite for integrating behavioural and contextual factors. Finally, the examination of ethical aspects (see section 1.6)—such as the risks of commodification, privacy issues, and transparency requirements—demonstrates a high degree of scientific maturity and an awareness of the social implications of analytical models.

IV. METHODOLOGY AND RESEARCH APPROACH

The methodological framework is among the strongest aspects of the study. The author demonstrates a profound understanding of the various paradigms in CLV modeling and proposes their integration into a unified analytical system. This system is organized around the methodologically significant distinction between contractual versus non-contractual relationships and the continuous versus discrete occurrence of transactional opportunities.

Chapter 4 provides an in-depth examination of the core assumptions and modeling challenges, including customer heterogeneity, stationarity, data censoring, data leakage, cohort effects, and the cold-start problem (see sections 4.2 and 4.3). The systematic review of evaluation metrics—MAE, RMSE, MAPE, R2, ranking and classification indicators, calibration measures, and return-based metrics (see section 4.4)—demonstrates a high level of methodological proficiency.

The development of a systematic CLV modeling protocol (see sections 5.1–5.5), which includes operationalization, data preparation, feature engineering, time-oriented validation, and interpretation, represents a substantial contribution. Furthermore, the use of R as the analytical environment enhances the reproducibility and transparency of the results.

The integration of probabilistic models (BG/NBD, Pareto/NBD, Gamma-Gamma), machine learning algorithms (Random Forest, XGBoost), and Bayesian approaches (see sections 5.2–5.4) represents a significant methodological contribution that transcends the traditional frameworks of CLV analysis. Particularly valuable is the implementation of a Bayesian formulation of the BG/NBD model, where posterior distributions and uncertainty intervals provide additional analytical value for risk management, especially when dealing with sparse data or small cohorts. The interpretability of the ML results is ensured through SHAP values, partial dependence plots, and feature importance—methods that transform the "black box" into a transparent managerial tool.

V. EMPIRICAL RESULTS AND THEIR INTERPRETATION

The empirical validation of the work is characterized by a high degree of analytical precision, methodological consistency, and clarity. The author does not limit the study to the application of individual models but instead conducts a comparative analysis of their predictive performance under strictly controlled validation conditions (see Tables 20 and 21). The results indicate that Random Forest achieves the highest predictive accuracy, with $R2>0.84$ and an RMSE of approximately 1.0 under 5-fold cross-validation, while both the frequentist and Bayesian BG/NBD models demonstrate similar and stable error rates (RMSE approx. 1.77–1.80, MAE approx. 0.81) alongside high internal consistency.

An interesting aspect is the nuanced discussion regarding the differentiated behavior of the models across various customer profiles: for highly active customers, Random Forest tends to overestimate expected value, whereas BG/NBD remains conservative; for passive customers, probabilistic models provide more realistic forecasts with a lower sensitivity to noise. This interpretation moves beyond the simplistic notion that a more complex model is necessarily superior and instead establishes a methodologically sound framework for contextual selection. The visual and statistical verification of the results (see Figs. 24–26), including posterior predictive checks and convergence diagnostics for the Markov chains, contributes to their reliability. The interpretation is directed not only toward academic conclusions but also toward practical managerial applications—such as segmentation, marketing strategy optimization, and budget allocation.

VI. SCIENTIFIC CONTRIBUTIONS

The scientific contributions of the dissertation can be systematized into three main directions, reflected in the seven officially stated claims for contribution.

In the theoretical aspect, the contribution is expressed in: (1) The conceptual and historical consolidation of Customer Lifetime Value as an economic and managerial construct, including a precise systematization of definitions and the distinction between CLV and Customer Equity; (2) The development of a functional typology of CLV models, providing criteria for methodologically reasoned selection; (3) The contextual framework for contractual and non-contractual relationships and their operational consequences for model specification.

In methodological terms, the significant contributions include: (4) The structured modeling and validation framework, oriented toward time-consistent validation, calibration, and interpretability; (5)The empirical comparison of probabilistic and ML approaches under unified conditions, deriving criteria for contextual selection; (6) The establishment of the Bayesian perspective for uncertainty management, shifting the focus from point-estimates to probabilistic assessment for decision-making under risk.

The most directly applicable contribution is observed in the practical aspect: (7) The reproducible analytical protocols developed in two contrasting contextual environments. Appendix A provides a complete protocol integrating BG/NBD + Gamma-Gamma modeling, ML classification, and a hybrid strategy with managerial rules for targeting and budgeting in a non-contractual omnichannel environment. Appendix B addresses a contractual SaaS environment, integrating survival analysis (Kaplan-Meier, Cox regression), classification models for churn risk, and a risk-value matrix for differentiated interventions. These appendices are not merely illustrations but are ready-to-adapt analytical solutions, which significantly enhances the practical value of the author's work.

VII. EVALUATION ACCORDING TO CORE CRITERIA

From the standpoint of originality, the work demonstrates a high degree of scientific novelty, particularly through the integration of diverse methodological paradigms into a unified analytical framework, the development of hybrid models, and the reflexive positioning of CLV within the context of Artificial Intelligence and analytical capitalism. The methodological justification is of an exceptionally high standard—the author demonstrates a profound command of contemporary analytical techniques, their underlying assumptions and limitations,

and the ability to apply them critically. The research design—comparative, integrative, and protocol-oriented—ensures the internal validity of the results and their reproducibility.

VIII. CRITICAL REMARKS AND RECOMMENDATIONS

Despite the high quality of the author's work, academic precision requires the notation of several aspects that outline prospects for further research.

First, the discussion of models based on Deep Neural Networks (see section 2.5) could be supplemented with a more detailed analysis of specific architectural solutions suitable for CLV modeling—for example, LSTM (Long Short-Term Memory) networks for capturing the temporal dynamics of transaction sequences, or Transformer architectures for multimodal customer data. Including practical implementation considerations (e.g., data volume requirements, regularization strategies, interpretability, etc.) would strengthen the applied value of this section.

Second, the use of synthetic data, while methodologically justified, implies a need for future validation with real-world transactional data. The question of the External Validity of the developed protocols—specifically against real databases containing imperfections such as missing values, irregular cohort effects, and seasonal anomalies—remains open and represents a natural continuation of the research program.

Third, causal incremental modeling (uplift modeling) for assessing the impact of specific marketing interventions on CLV, touched upon in section 4.6.4, could be developed into an independent line of research. The distinction between correlational prediction and causal effect is essential for the practical use of CLV in optimizing marketing expenditures.

These remarks are intended as guidelines for future research within a rich and promising scientific program, rather than as weaknesses that diminish the scientific value of the achieved results.

IX. CONCLUSION

The dissertation of Prof. Dr. Todor Borisov Krastevich represents a significant and complete contribution to marketing science, executed with the necessary scientific rigor, methodological depth, and practical orientation. The work convincingly demonstrates the author's ability to independently conduct large-scale scientific research, to integrate diverse methodological approaches, and to synthesize theoretical and empirical knowledge into a unified, consistent analytical framework.

The study fully meets the requirements for dissertations for the award of the scientific degree "Doctor of Science" in the scientific specialty of Marketing, Professional Field 3.8 Economics. The formulated scientific contributions are real, original, and verified—theoretically justified, methodologically sound, and practically applicable.

Based on the detailed analysis of the dissertation, the abstract (avtoreferat), the attached analytical protocols, and the author's prior publication record, I give my positive evaluation. I recommend that the distinguished scientific jury also give a **positive evaluation** of the dissertation entitled "CUSTOMER LIFETIME VALUE (Conceptual, Methodological, and

Applied Aspects)" and award **Prof. Dr. Todor Krastevich** the scientific degree of "Doctor of Science" in Professional Field 3.8 "Economics," Scientific Specialty "Marketing."

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Author of the scientific opinion:

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