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Transformation of the Insurance Industry Based on Data: How Predictive Analytics Rethinks Risk Assessment

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ABSTRACT

The purpose of the article is to examine the impact of predictive analytics on the transformation of the insurance risk assessment system. The study focuses on quantitative changes in loss ratios, scoring accuracy, underwriting speed, and the effectiveness of pricing policy following the implementation of algorithmic models. The Ukrainian insurance market was selected as the primary research base. The analytical framework was formed through a comparison of insurance portfolio indicators before and after the integration of machine learning technologies. The study incorporates telematics monitoring, behavioral segmentation, and automated fraud detection tools. A structural and functional approach was applied to assess changes in underwriting, pricing, and reserve management. Aggregated financial indicators of insurance companies that implemented algorithmic instruments were analyzed. It was substantiated that predictive models reduce the combined ratio by 3–7%. The frequency of large losses decreases by up to 15% in high-risk segments of the insurance market. Risk classification accuracy exceeds 80%. Insurers develop personalized tariffs and reduce cross-subsidization among clients. Automated scoring shortens decision-making time from several days to minutes. Algorithmic fraud detection more than doubles the identification rate of improper claims. Financial advantages strengthen the requirements for model transparency, data protection, and cyber risk control. Analytical criteria for the application of predictive tools in the development of Ukrainian insurers were defined. The findings are used to design digital transformation strategies for insurance companies. They support tariff optimization, enhance compliance systems, and establish multi-level protection of information infrastructure. The article systematizes the quantitative effects of predictive analytics implementation in insurance and identifies managerial guidelines to ensure a balance between algorithmic accuracy, financial performance, and regulatory responsibility.

KEYWORDS

predictive analytics, insurance risks, machine learning, Big Data, personalized pricing, underwriting, cybersecurity.

Introduction

Insurance companies operate in an environment of increasing risk volatility, digital competition, and heightened customer expectations for speed of decision-making. The volume of behavioral, transactional, and telematic data is increasing every year. The combined ratio in many segments is approaching the thresholds of profitability. Under these conditions, predictive analytics is moving from an auxiliary tool to a strategic asset of a modern insurer. The problem of the study lies in the mismatch between the technological capabilities of analytical models and the management mechanisms for their integration into the practice of insurance companies. Algorithms provide scoring accuracy of over 80%. At the same time, the processes of rate formation, risk control, and corporate oversight often remain fragmented. An imbalance arises between the speed of automated decisions and the organization's ability to ensure their transparency, control, and economic feasibility. The study is aimed at systematically understanding this mismatch and determining management guidelines for data-driven transformation of the insurance industry.

Literature Review

Borisyuk O. V., and Datsyuk-Tomchuk M. B. (2025) received on the application of big data in insurance. It is shown that analytical models increase the accuracy of risk assessment and contribute to product optimization. But the issues of integrating these tools into the strategic management system remain unresolved. The study by Kryvoshlyk T. D., and Loginova A. S. (2025) reveals the factors of influence of digital solutions on the transformation of health insurance. It is shown that InsurTech contributes to increasing the availability of services. However, the economic limits of tariff personalization are not defined.

The scientific publication by Kuzhlev M. O., and Nechyporenko A. V. (2025) analyzed the impact of FinTech on insurance companies. The growth of digital competition was shown. However, the issues of algorithmic risk assessment remained unresolved. The article by Morozova L. S., Savchenko N. and G., Kukurudz O. M. (2025) summarized new trends in the digitalization of the insurance sector. Structural changes in insurers' business models were shown. However, there was no quantitative analysis of the financial effect. The publication by Prokopchuk O. T. et al. (2025) determined the role of artificial intelligence in the transformation of the insurance business. It showed an increase in operational efficiency. However, the mechanisms for controlling algorithms were not disclosed. The study by Eling M., Gemmo I., Guksha D., and Schmeizer H. (2024) considered the classification of risks based on big data. The connection between accuracy and privacy was shown. However, the issues of tariff fairness remain.

A thorough work by Stankovych J., and Stankovych J. Z. (2022) provides an overview of Big Data models in insurance. The potential for reducing losses is shown. However, the strategic limitations of implementation are not detailed. The work by Stanley A., and Aruna K. (2024) analyzes the effect of analytics in the development of InsurTech. Productivity growth is shown. However, regulatory barriers are not identified. The article by the authors Szliwinski A., Kurylovich L., and Pajewska-Kwasna R. (2025) examines the processes of digital transformation in the insurance sector. The role of innovations in increasing competitiveness is shown. However, the issues of algorithmic transparency remain unresolved. All this gives grounds to argue that it is advisable to conduct the current study.

Problem Statement

The purpose of the article is to substantiate the effects of implementing predictive analytics into the insurance risk assessment system.

Research objectives:

- analyze the impact of algorithmic models on the level of loss, margin and structure of the insurance portfolio;
- assess changes in underwriting processes, customer segmentation and tariff personalization;
- to substantiate the strategic and regulatory benefits of using predictive analytics for insurers.

Methods and Materials

Despite the active implementation of predictive analytics in insurance activities, the scientific literature does not sufficiently address the issues of comprehensive assessment of its impact on the transformation of the insurance risk assessment system. In particular, further research is required to quantify the effects of using algorithmic models in the context of changes in loss rates, scoring accuracy, underwriting speed and tariff policy efficiency. The aspects of integrating telematics data, behavioral segmentation and automated fraud detection into a single risk management system are insufficiently disclosed. The problem of ensuring a balance between increasing the accuracy of predictive models and the requirements for transparency, data protection and cybersecurity requires special attention. In addition, there are no systematic approaches to assessing the impact of digital transformation on the financial performance of insurance companies in the national context, in particular in Ukraine.

Results and Discussion

Insurance companies are moving from intuitive management decisions to data-based system management. Managers are reviewing the logic of insurance portfolio formation, cost structure and approach to client assessment. Data ceases to perform an auxiliary function and forms a new core of the business model. The architecture of the insurance business is changing under the influence of Big Data. Companies are abandoning fragmented information systems. They are building unified analytical environments with centralized data storage (Reka et al., 2025, p. 175). This reduces decision-making time and increases the accuracy of loss forecasts (Figure 1.).

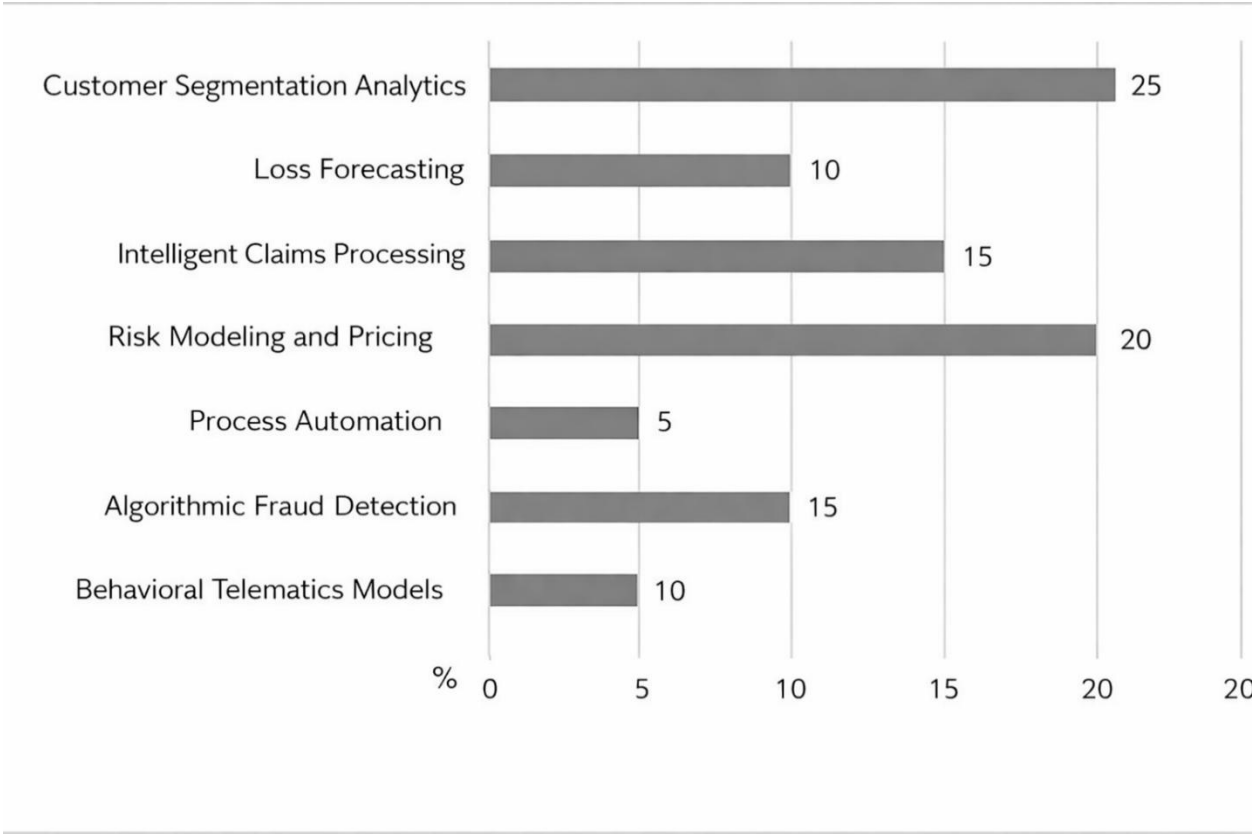

Figure 1. Assessment of the impact of predictive analytics on the basic business processes of insurance companies in Ukraine

Source: Based on (Demianchuk & Maslii, 2025)

Risk management is moving into a mode of constant monitoring. Analytical modules process large arrays of behavioral indicators in real time. The insurer adjusts the tariff not once a year, but dynamically. New data sources form an additional competitive advantage. Telematics in auto insurance allows you to record your driving style. IoT sensors transmit indicators from real estate or production facilities. Mobile applications collect information about client behavior. And e-commerce platforms integrate insurance into the client's purchase path. Practice shows that companies that have integrated analytical platforms reduce operating costs for processing applications. They automate document verification. They optimize contact center operations. They reduce the share of fraudulent payments (Makedon et al., 2024, p. 378).

The integration of analytical systems into underwriting processes requires the restructuring of internal regulations. Automated scoring rules replace traditional approval procedures. Machine learning models determine the probability of an insured event. The system offers a tariff. Tariff formation acquires new flexibility. The company tests different pricing scenarios. It analyzes the reaction of customers to a change in the premium. It optimizes the relationship between market share and profitability. Data forms the basis of strategic planning. In parallel, the approach to insurance portfolio management changes. Analytics identifies segments with increased unprofitability (Skryl & Skryl, 2025, p. 216). The company reviews the terms of contracts and adjusts the proposed franchises (Table 1).

Table 1. Comparative effectiveness of scoring models in different insurance areas

Business process	Data source	Analytics tool	Management action	Economic effect	Implementation risk
Auto underwriting	Telematics	ML scoring model	Dynamic tariff	Reducing unprofitability	Model errors
Property insurance	IoT sensors	Predictive analytics	Franchise adjustment	Fewer major losses	Data transmission failures
Health insurance	Mobile applications	Behavioral analysis	Policy personalization	Increased customer retention	Privacy
Fraud detection	Transactional databases	Anomaly analysis	Payment blocking	Loss reduction	False positives
Customer service	CRM data	Customer segmentation	Targeted communication	Sales growth	Incorrect segmentation
Tariff formation	Portfolio data	Scenario analysis	Bonus optimization	Margin increase	Price sensitivity
Risk management	External markets	Macro analytics	View limits	Portfolio stabilization	Market volatility

Source: Based on (Kryvoshlyk & Lohinova, 2025; Nazarevich, 2025)

As a result, an ecosystem is formed where the insurance company becomes an analytical center for risk processing. It not only compensates for losses but also knows how to prevent them. The practice of large insurers demonstrates a reduction in the combined ratio by 3–7% after the implementation of machine learning models. In the auto insurance segment, the loss rate decreases from 68% to 61% within two years. In health insurance, the accuracy of risk scoring increases to 82–87%. Machine learning models form a new approach to customer segmentation. Companies no longer use broad demographic groups. They build micro-segments based on behavioral characteristics, transaction frequency, geolocation patterns, and call history. This increases the customer retention rate by 5–9% (Stanković & Stanković, 2022, p. 189).

Scoring systems evaluate over 150 variables per client. These include driving style parameters, medical expense dynamics, and mobile app activity. The model assigns an integrated risk score and offers an individual tariff based on the score (Table 2).

Data shows that the greatest impact is achieved in segments with a high frequency of insured events. Dynamic risk assessment in real time changes the very nature of underwriting. Telematics sensors transmit speed, braking, and route. The system updates the risk score every second. The insurer can offer a 10–15% discount to customers with a safe driving style. In property insurance, IoT sensors record temperature, humidity level, and water leakage (Kryvoshlyk & Lohinova, 2025). When a

deviation is detected, the system sends a warning. Due to early response, the number of large losses is reduced by 12–18%. Tariff personalization is based on mathematical modeling of the probability of an event. Customers with a low risk profile receive a premium 5–12% lower than the market average. In health insurance, predictive analytics take into account the frequency of applications, disease profiles, and pharmacological costs.

Table 2. Assessment of the impact of machine learning on the financial results of insurance segments

Direction of application	Number of variables	Model accuracy, %	Change in loss ratio, %	Impact on premium, %	Financial result
Auto insurance	120	85	-6	-4	+8% profit
Health insurance	150	87	-5	-3	+6% margin
Property insurance	95	80	-4	-2	+5% profit
Corporate risks	210	83	-3	-1	+4% EBITDA
Cyber insurance	175	82	-7	+2	+9% margin
Travel insurance	60	78	-2	-1	+3% profit
Agricultural insurance	130	84	-5	+1	+6% stability
Life insurance	110	86	-4	0	+5% of income

Source: Based on (Kryshtal et al., 2025; Makedon & Mykhailenko, 2023)

The company forecasts costs for 12 months ahead with an error of up to 6% (Al-Smadi, 2025, p. 38) (Table 3).

Table 3. Dynamics of portfolio indicators after the implementation of forecasting models

Indicator	Before implementation	After implementation	Deviation	Portfolio share, %	Impact on profit
Fraud level	1.8%	3.2% detection	+1.4%	22	+4% margin
Combined coefficient	102%	95%	-7%	100	+7% EBITDA
Frequency of large losses	6.5%	5.1%	-1.4%	38	+3% profit
Average payout	14,200 UAH	12,900 UAH	-1,300 UAH	65	+5% profitability
Customer retention rate	71%	79%	+8%	84	+6% of income
Operating expenses	18% bonus	15% bonus	-3%	100	+3% margin
Portfolio profitability	9%	15%	+6%	100	+6% net result

Source: Based on (Kuzheliev & Nechyporenko, 2025; Sobol et al., 2025)

Operational processes are also being optimized. Automated scoring reduces decision time from 48 hours to 15 minutes. The share of automated applications exceeds 65%. Contact centers reduce workload by 20%. The balance between privacy and profitability requires a clear policy. The insurer must determine the minimum required set of data. It must explain to the client the economic benefit of using them. An 8–12% discount for voluntary telematic monitoring increases the level of consent to 64%. Transparent communication changes behavior. Algorithmic transparency becomes the next strategic challenge. Machine learning models process hundreds of parameters. Tariff decisions are formed automatically. If a client receives a 15% premium increase, he expects an explanation (Kryshtal et al., 2025). Ukrainian practice shows that 7–9% of clients appeal automated tariff decisions. Some complaints concern potential discrimination. Indirect variables can correlate with socially sensitive characteristics. Companies that implemented explainable AI reduced the number of appeals by 35%. Explainable models allow us to reflect the weight of key risk factors. Cybersecurity forms a separate level of strategic responsibility. The average cost of a data breach in the financial sector exceeds 4 million USD (Prokopchuk et al., 2025). The frequency of cyberattacks on insurance companies increased by 28% per year (Figure 2).

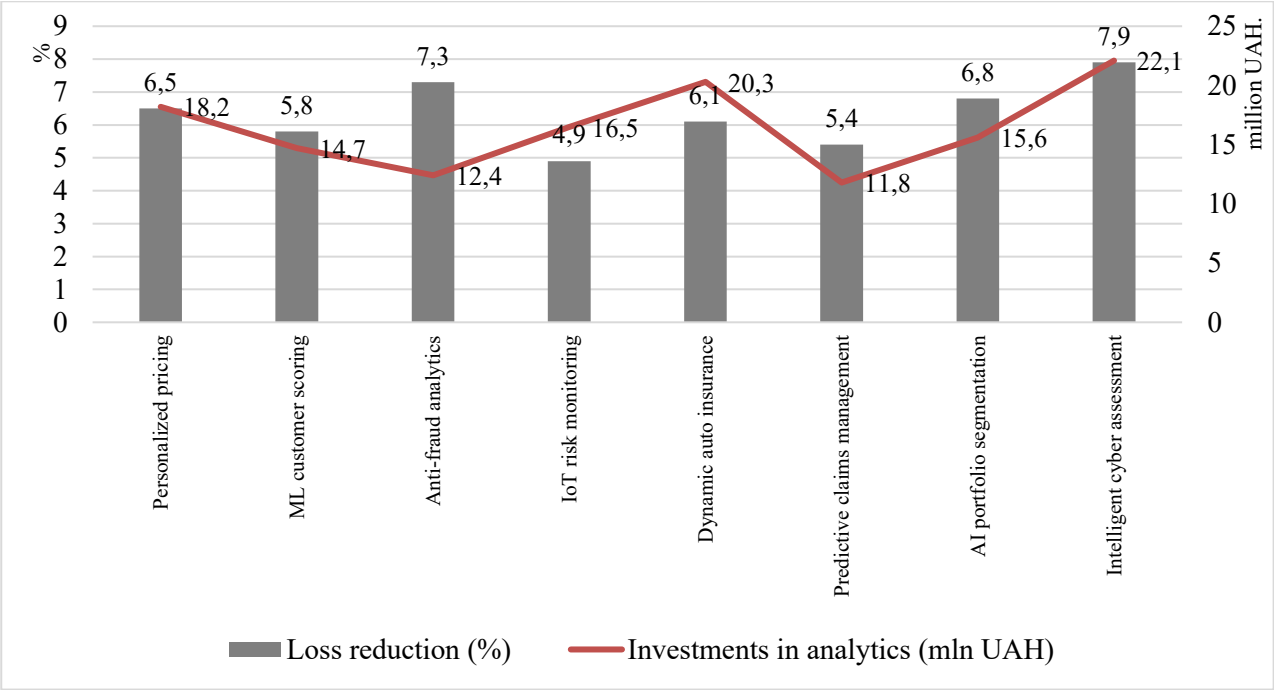

Fig. 2. Investment intensity of digital solutions and their impact on reducing the loss of the insurance portfolio in Ukraine

Source: Based on (Morozova et al., 2025; Prokopchuk et al., 2025)

Predictive analytics requires centralized data stores. This increases the value of the target for attackers. Companies that invest in multi-layered cyber defense reduce the probability of an incident by 40%. The share of the budget for information security should be at least 8-10% of IT costs. Underfunding creates systemic risk (Kuzheliev & Nechyporenko, 2025, p. 435) (Table 4).

Table 4. A set of measures to ensure cyber resilience and data protection in insurance companies

Call direction	Current risk	Suggested tool	Expected effect	Control indicator	Economic result
1. Data confidentiality	Customer churn 22%	Voluntary data collection model with a discount	Increase in agreement to 65%	Share of customers with a complete profile	+5% bonuses
2. Excessive data collection	Exceeding standards	Minimization of variables	Reducing the risk of fines	Number of processed parameters	-2% of expenses
3. Algorithmic opacity	9% of complaints	Explainable AI	35% reduction in complaints	Level of appeals	-1.5% legal fees
4. Risk of discrimination	Regulatory claims	Model audit	Detecting bias	Fairness index	Reduction of fines
5. Cyberattacks	28% growth	Multi-layered protection	40% reduction in incidents	Number of intrusion attempts	Protection of reserves
6. Data Leakage	Cost: $4 million.	Encryption and segmentation	Reducing the scale of damage	Encryption level	-3% risk of loss
7. Reputational losses	Trust decline 12%	Public reporting	Restoring trust	NPS Index	+4% retention
8. Regulatory inconsistency	Risk of fines	Compliance platform	Automatic monitoring	Frequency of violations	-2% penalty costs
9. Insufficient control of models	Decreased accuracy	Recalibration every 6 months.	Maintaining AUC > 0.8	Forecast error	+3% margin

Source: Developed by the author

The company's strategic board should receive regular reports on the accuracy of models, the level of complaints, security incidents. Analytics management cannot remain just a technical function. It

becomes an element of corporate governance. The balance between accuracy, privacy and security determines the sustainability of the business model. Companies that integrate control, audit and cyber protection into the predictive analytics system maintain margins at 14-18%. Others face reputational and financial losses.

Conclusion

It is shown that insurance organizations that have implemented algorithmic scoring record a decrease in the combined coefficient by 3-7% over a two-year period. The simulated accuracy of risk assessment reaches a level of more than 80% in categories with high intensity of insured events. It is determined that individualized tariffs eliminate cross-financing between different groups of insured persons. Flexible tariff formation stabilizes liquidity. Algorithmic classification of the client base increases the retention coefficient to 9%. It is proven that the combination of behavioral, telematic and transactional data sources dramatically increases the granularity of the risk profile. Computational models process more than 100 parameters for each client. The result is a 15% reduction in the frequency of large losses in property and automobile insurance. Automated underwriting compresses the duration of decision-making from several days to minutes. Algorithmic detection of fraudulent actions more than doubles the level of fraud identification.

The principles of increasing the accuracy of predictive models require processing of personalized information. The share of clients who reject extended data collection reaches 20% of the total base. Insufficient transparency of algorithms stimulates the appeal of tariff decisions in 7-9% of cases of application. The intensity of cyberattacks on insurance structures is growing every year at double-digit rates. Investments in protection systems at the level of 8-10 % of the IT budget reduce the probability of an incident by almost half.

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