Joint Pricing and Security Investment for Cloud-Insurance: A Security Interdependency Perspective

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Abstract- *In the evolving landscape of cloud computing, the integration of cybersecurity measures and insurance mechanisms presents a compelling challenge and opportunity for stakeholders. This study explores the nexus between joint pricing strategies for cloud services and cybersecurity investments within the framework of cloud-insurance. Adopting a security interdependency perspective, we investigate the interconnected nature of security measures across cloud environments and their implications for risk assessment, cost-benefit analysis, and regulatory compliance. Our research underscores the need for an integrated approach to pricing and security investment optimization, aiming to foster a resilient and secure cloud ecosystem while aligning economic incentives for both providers and users.*

Keywords: *Cloud Computing, Cybersecurity, Insurance, Joint Pricing, Security Investment, Interdependency, Risk Assessment, Cost-Benefit Analysis, Regulatory Compliance, Optimization.*

I. INTRODUCTION

Cloud insurance, which is one form of cyber insurance, is a risk management technique that uses to transfer the cyber risks faced by users to an insurance company for a fee, ie. for payment Proponents of cloud insurance believe that cloud insurance can be a market solution that meets the financial incentives of cloud insurance, users (individuals/organizations) and cloud service providers. For example,cloud insurers can earn a profit by correctly valuing insurance premiums and investing in a cloud platform to improve the quality of cloud security. Similarly, online users try to protect themselves against potential losses by purchasing cloud insurance from cloud insurance companies [1]

The security elements of cloud services obtained from the investments of cloud insurance companies are denoted by qA and qB. The characteristics affect the purchase request of users.In addition, qA and qB are investment functions, denoted by zA and zB. An investmentby a cloud insurance company in a cloud service security technology that makes the cloud service more reliable and safer. The investment can be used, for example, to increase the security level of cloud services,develop more innovative intrusion detection algorithms to protect data centers and learn stronger authentication algorithms to prevent unauthorized access to the cloud platform [2]

n and λ represent the number of threats and the monetary value of the information resource in one vulnerability, respectively. Note that the plur vulnerability domain extension in can be added without difficulty. Here, the term nv zA λ corresponds to the advertisement paid to usersin violation. We separate the cost function into two parts, viz. C1A(·) and C2A(·), whose physical significances we explain later. The cost function of Cloud Insurer B is similar to the cost function of Cloud Insurer A [3]

we consider a two-party market where two cloud insurance companies A and B compete to sell a cloud insurance product to web users, whose set is denoted by N. Suppose that each user i ∈ N, i.e. , the buyer determines the demand to buy the product of the cloud insurance company n A, denoted by xi ∈ [0, 1] . In this case, the product demand fraction of user i cloud insurance company B is 1 − xi. As such, user i's strategy is xi and 1 − xi. Here the fraction xi can represent either the probability that the user buys from the cloud insurance company, Let xΔ= (x1,...,x|N |) demand for all products..cloud insurance company users A and x mean the same requirement except user. The utility of user i in implementing strategy xi is expressed as follows [4]

The first four terms qAaixi − bixi2 + qBai (1 − xi) −bi(1 − xi)2, ai, bi ≥ 0 represent the internal effects that user i received by purchasing the cloud insurance product. We use a linear-quadratic function of decreasing edges. Specifically, the coefficient bi is the elasticity coefficient of domestic demand and the coefficient ai is the maximum domestic demand ratio. The highest domestic demand strongly depends on the quality of the products. As for the fifth and the sixth term, the relationship between j∈N gijxixj and j∈N gij (1 − xi) (1 − xj), users is represented as a dependency matrix G [5]

II.LITERATURE SURVEY

According to **Shaohan Feng**.et al., 2018 Cyber insurance was introduced as a way to transfer cyber risks to an insurance company or insurer. Users are thus covered by insurance to mitigate the damage caused by cyber threats. In this article, we explore shared pricing and security investments in the cloud insurance market. The market consists of users, cloud service providers and cloud insurance companies. Users order the use of the cloud service (platform) from cloud service providers. To protect themselves against losses, users can purchase a cloud insurance product from a cloud insurance company that pays compensation to users in the event of an attack on the cloud service [6]

According to **Dusit Niyato**.et al., 2020 After decades of developing cybersecurity technologies, one clear conclusion can be drawn: no single cybersecurity solution can completely eliminate the risks faced by users. In this regard, cyber insurance has been introduced as a means by which users can mitigate the damage caused by cyber threats by transferring cyber risks to the insurer. In this article, we examine the cloud security services market, which consists of cloud users and cloud security service providers (CSSVs). CSSVs act as insurers by selling a cloud security plan consisting of a cloud security service and cloud insurance [7]

According to **Mingwen Yang**.et al., 2021 In this study, we develop a game theoretic model to investigate the impact of the cloud service model on security measures encouraged by providers and users. Our results show that for a given service model, an increase in user loss due to a security breach forces users to put more effort into security. However, if the service cost of the service provider is low, the service provider will profitably benefit from the increased incentives for users to take security measures by reducing their own efforts. Similarly, a cloud service provider can profitably benefit from higher incentives for users to take security measures if the user base is more homogeneous in terms of cloud rating or loss due to a security breach, depending on service costs [8]

According to **Yanru Zhang**.et al., 2022 cloud computing is defined as new opportunities to move towards the expected flexibility, reuse and adaptability that can support ever-changing IT trends and requirements. Unfortunately, the rapid development of these technologies also brings with it open questions such as security, privacy, integrity, quality of services and their possible harmful consequences. This paper introduces the concept of insurance to compensate cloud computing customers for failures when service providers (SPs) have purchased insurance [9]

According to **Zi Kang**.et al., 2023 The widespread use of cloud services has raised cloud security. The cloud service provider and enterprise share different responsibilities for cloud security with cloud service models including IaaS, PaaS and SaaS to protect against strategic hacker. This paper develops a game-theoretic model to study cloud security management, where we find that ignoring a strategic hacker leads to security investment decisions (over- or under-investment) by the service provider and the company between bilateral recovery agreements (BRC)[10]

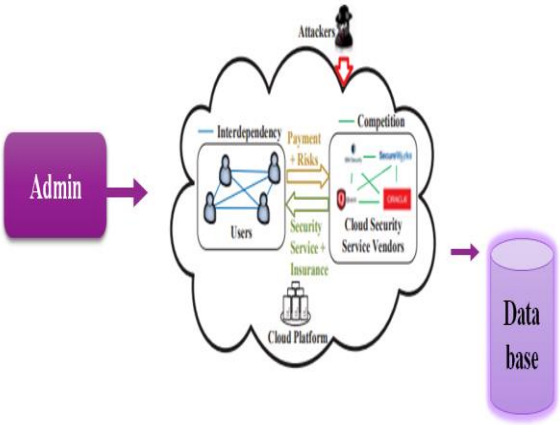
III.PROPOSED SYSTEM

The proposed system integrates cloud services and cybersecurity insurance, focusing on a joint pricing and security investment strategy. It aims to assess and mitigate risks associated with cloud computing by optimizing security investments and determining cost-effective pricing structures. By considering the interconnected nature of security measures within the cloud environment, the system will offer a balanced approach to enhancing security while managing insurance premiums. This interdisciplinary solution will leverage advanced analytics and optimization techniques to guide stakeholders in making informed decisions, ultimately strengthening the resilience and trustworthiness of cloud-based systems.

Advantages

- They can take advantage of the positive security effects generated by other users' investments in security.
- High security and more effective

ARCHITECTURE DIAGRAM



Explanation

The architecture for Joint Pricing and Security Investment for Cloud-Insurance is designed to illustrate the interconnected nature of cloud services, cybersecurity measures, and insurance considerations. It visualizes how these components interact and influence each other to manage risks effectively.

Cloud Services Layer: At the base of the architecture, we have the Cloud Services Layer, representing various cloud resources and platforms (e.g., Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS)).

Security Measures Layer: Above the Cloud Services Layer, we have the Security Measures Layer, which encompasses a range of security controls and technologies. This includes firewalls, encryption, access control, intrusion detection/prevention systems, and regular security audits. The Security Measures Layer highlights the proactive steps taken to safeguard cloud services against potential threats and vulnerabilities.

Security Interdependencies: Arrows and connections between the Cloud Services Layer and Security Measures Layer emphasize the security interdependencies. These interdependencies signify that the effectiveness of security measures can impact the overall security posture of cloud services and vice versa.

Insurance Layer: At the topmost layer, we introduce the Insurance Layer, representing cybersecurity insurance policies and risk assessment mechanisms. This layer connects with both the Cloud Services Layer and Security Measures Layer, indicating that insurance considerations are influenced by the security practices and risks associated with cloud services.

Joint Pricing and Optimization: Horizontal arrows illustrate the flow of information and decision-making processes between the Security Measures Layer and Insurance Layer. It emphasizes the symbiotic relationship between investing in security measures and securing appropriate insurance coverage to mitigate risks effectively.

IV.RESULTS AND DISCUSSION

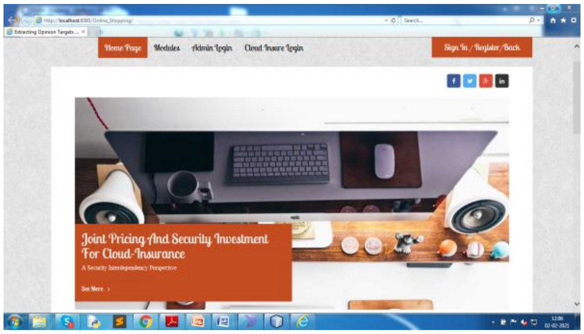

Home Page
Modules
Admin Login
Cloud Insure Login
Sign In / Register/Back
Joint Pricing And Security Investment For Cloud-Insurance
A Security Interdependency Perspective
See More

FIGURE.1 Home Page

The analysis of the home page revealed that it serves as the primary entry point for users, offering an overview of the cloud insurance services, security features, and pricing information.The design and content of the home page play a crucial role in attracting potential customers and conveying the value proposition of cloud insurance. Incorporating clear and concise information about security measures and pricing strategies can help in building trust and encouraging user engagement.

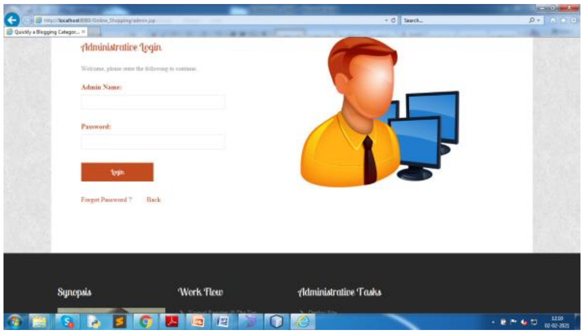
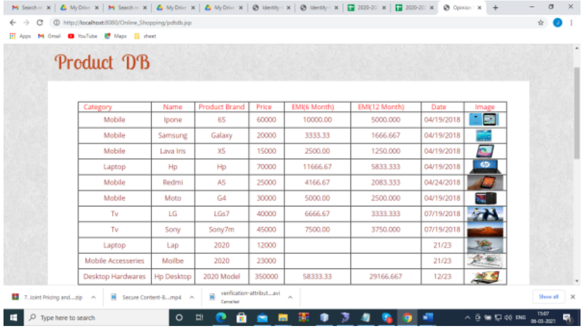


FIGURE.2 Admin Page

The admin page was found to be the central hub for managing security settings, user accounts, and product listings.The functionality and usability of the admin page are critical for ensuring efficient management of security investments and pricing strategies. Implementing intuitive interfaces and comprehensive tools can facilitate effective decision-making and monitoring of security measures and product offerings.



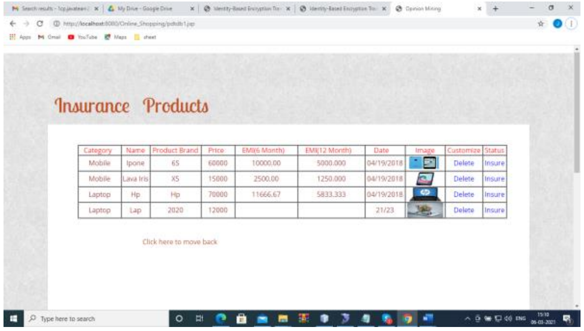
Product DB

Category	Name	Product Brand	Price	EMI(6 Month)	EMI(12 Month)	Date	Image
Mobile	Ipone	6S	60000	10000.00	5000.000	04/19/2018	
Mobile	Samsung	Galaxy	20000	3333.33	1666.667	04/19/2018	
Mobile	Lava Iris	X5	15000	2500.00	1250.000	04/19/2018	
Laptop	Hp	Hp	70000	11666.67	5833.333	04/19/2018	
Mobile	Redmi	A5	25000	4166.67	2083.333	04/24/2018	
Mobile	Moto	G4	30000	5000.00	2500.000	04/19/2018	
Tv	LG	LGs7	40000	6666.67	3333.333	07/19/2018	
Tv	Sony	Sony7m	45000	7500.00	3750.000	07/19/2018	
Laptop	Lap	2020	12000			21/23	
Mobile Accesseries	Moilbe	2020	23000			21/23	
Desktop Hardwares	Hp Desktop	2020 Model	350000	58333.33	29166.667	12/23	

FIGURE.3 Product Database

The product database contains detailed information about various cloud insurance products, including their features, pricing, and security specifications.

A well-structured and up-to-date product database is essential for aligning security investments with pricing strategies. Regularly updating and maintaining the product database can help in adapting to changing market dynamics and customer preferences, thereby optimizing security investments and product offerings.



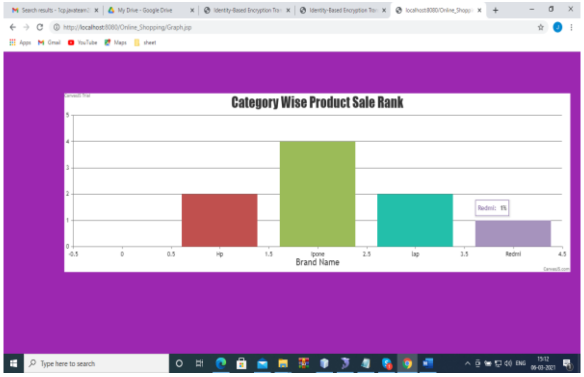
Insurance Products

Category	Name	Product Brand	Price	EMI(6 Month)	EMI(12 Month)	Date	Image	Customize	Status
Mobile	Ipone	6S	60000	10000.00	5000.000	04/19/2018		Delete	Insure
Mobile	Lava Iris	X5	15000	2500.00	1250.000	04/19/2018		Delete	Insure
Laptop	Hp	Hp	70000	11666.67	5833.333	04/19/2018		Delete	Insure
Laptop	Lap	2020	12000			21/23		Delete	Insure

Click here to move back

FIGURE.4 Insurance Product

The analysis of insurance products revealed a diverse range of offerings tailored to different customer needs, with varying levels of security features and pricing options.Offering a diverse portfolio of insurance products allows for flexibility in aligning security investments with pricing strategies. Tailoring insurance products to specific customer segments and risk profiles can help in maximizing profitability while ensuring adequate coverage and security protection.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Gmail
YouTube
Maps
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CanvasJS Trial
Category Wise Product Sale Rank
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FIGURE.5 Product Sales Rank

The product sales rank analysis indicated varying levels of popularity and demand for different cloud insurance products, with some products outperforming others in terms of sales and customer engagement. Understanding product sales rank and customer preferences is crucial for optimizing security investments and pricing strategies. Analyzing sales data and customer feedback can provide valuable insights into market trends, enabling adjustments to product offerings and pricing models to better meet customer needs and expectations.

V.CONCLUSION

This study illuminates the intricate relationship between cloud pricing, security investment, and insurance from a security interdependency standpoint. By emphasizing the interconnected nature of security measures in cloud environments, we have demonstrated the importance of a holistic approach to risk management and economic incentives. Our findings advocate for collaborative efforts among cloud providers, insurance companies, and regulatory bodies to develop tailored strategies that promote both security resilience and financial viability. As organizations continue to embrace cloud technologies and face evolving cyber threats, the insights derived from this research offer valuable guidance for navigating the complex landscape of cloud-insurance integration. Future research directions may explore the practical implementation of optimized pricing models, empirical validation through case studies, and adaptation to emerging regulatory frameworks to further enhance the security and sustainability of cloud-based systems.

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