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**Modeling the effect of spending on cyber security by using surplus process.** (English)

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Summary: In this paper, we assume the security level of a system is a quantifiable metric and apply the insurance company ruin theory in assessing the defense failure frequencies. The current security level of an information system can be viewed as the initial insurer surplus; defense investment can be viewed as premium income resulting in an increase in the security level; cyberattack arrivals follow a Poisson process, and the impact of attacks is modeled as losses on the security level. The occurrence of cyber breach is modeled as a ruin event. We use this framework to determine optimal investment in cyber security that minimizes the total cyber costs. We show by numerical examples that there is an optimal allocation of total cyber security budget to (1) IT security maintenance/upkeep spending versus (2) external cyber risk transfer.

**MSC:**

94A62 Authentication, digital signatures and secret sharing

91G05 Actuarial mathematics

62P05 Applications of statistics to actuarial sciences and financial mathematics

60K10 Applications of renewal theory (reliability, demand theory, etc.)

**Full Text:** [DOI](#)

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