A risk evaluation model and its application in online retailing trustfulness

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Abstract. Building a general model for risks evaluation in advance could improve the convenience, normality and comparability of the results of repeating risks evaluation in the case that the repeating risks evaluating are in the same area and for a similar purpose. One of the most convenient and common risks evaluation models is an index system including of several index, according weights and crediting method. One method to build a risk evaluation index system that guarantees the proportional relationship between the resulting credit and the expected risk loss is proposed and an application example is provided in online retailing in this article.

1. Introduction
Risk evaluation is common in many areas, such as enterprise management planning, credit rating and information security. In many cases, the evaluation result is only a numeric score, it’s important to guarantee the comparability of the result, and the reasonable way is to build an evaluation model in advance.

2. Model

2.1. Risk Evaluation
The expected loss, the product of the probability that the risk happens and the loss once it happens is used usually to measure the severity of risk:

\[ S = P(R) \cdot L(R) \]

The methodology to assess the risk by the expected loss is not new. Early in 1947, Learned Hand put forward a famous "B > PL" rule [1] concerning civil liability, which later became the foundation of the study of "law and economics".

\( P(R) \) refers to the probability that the risk \( R \) happens, and \( L(R) \) the loss caused by the risk \( R \). In information security, \( P(R) \) is the product of the probability of being attacked and that of the system being breached under attacking, and the latter is the indicator of the vulnerability of the system [2]. \( L(R) \) can be the amount of economic loss, or the utility changes if the type of the risk appetite is considered.

Usually multi-point risks exist in one system, and the total expected loss of all risks can be used to measure the severity of the risks, and the summation of expected losses of all risk points is:

\[ \sum_{R_i} P(R_i) L(R_i) \]

(1)
2.2. Model of Risks Evaluation

For the convenience and comparability of repeating the risks evaluation, an index system is built in advance adaptable to a special area. Usually, the loss in money or the economic utility of the loss caused by a given risk happening do not change widely for a special risk bearer. For example, the loss caused by 10-day delay of materials delivery is almost the same whoever the seller is. Therefore theoretically, the loss can be evaluated in advance for all kinds of risk points once happening, and then the probabilities according to different sellers evaluated in order to make a better choice.

Assume that n risk points are treated as indexes with n credits C(R_i) are used to evaluate them, and the according probabilities are P(R_i) respectively.

To obtain a comprehensive score, it’s required to appoint n weights W(R_i) respectively, and the sum of them is 100 in centesimal scale without loss of generality:

\[ \sum_{R_i} W(R_i) = 100 \]

According to Eq. 1, the expected loss caused by total risks is:

\[ \sum_{R_i} P(R_i) L(R_i) = \sum_{R_i} \{1 - [1 - P(R_i)]\} \cdot L(R_i) \]

\[ = \frac{\sum_{R_i} L(R_i)/100 \cdot \sum_{R_i} [1 - P(R_i)]}{\sum_{R_i} L(R_i)} \]

Since \( \sum_{R_i} L(R_i)/100 \) is constant, if let the weights and the credits as following:

\[ W(R_i) = \frac{100 \cdot L(R_i)}{\sum_{R_i} L(R_i)} \]

\[ C(R_i) = [1 - P(R_i)] \]

Then the expected loss is:

\[ K \cdot \sum_{R_i} [1 - C(R_i)] \cdot W(R_i) \]

\[ = K \cdot \sum_{R_i} W(R_i) - K \cdot \sum_{R_i} C(R_i) \cdot W(R_i) \]

\[ = 100 \cdot K - K \cdot \sum_{R_i} C(R_i) \cdot W(R_i) \]

Therefore, if let every credit be the probability that the according risk does not happen, and the ratio of the loss caused if it happens to the total loss if all risks happen, the comprehensive score obtained is a multiple of the expected loss caused by all risks, and there are many advantages of such method to determine the weights and credits:

- The credit of single index is linear to the probability of the according risk happening, and the higher the probability is, the lower the score, and vice versa.
- The weight of an index is proportional to the according loss caused if happening. Then the weight will be small if the loss of the according risk is negligible though it can happen often.
- The comprehensive score is linear to the expected loss caused by all risks, and then the higher the score is, the lower the risk is. If the comprehensive score is close to 100, the expected loss is close to 0 or negligible, and if the score is close to 0, the expected loss is high and all risks have a high probability to happen. So the comprehensive score includes the total information of the expected loss caused by all
risks. In other word, the lost score is proportional to the severity level of the total risk under this ideal 
evaluation model.

3. Application Sample of Online Retailing

Online retailing is one kind of ecommerce, serving large number of consumers with large number of 
small orders. There are tens of thousands of online retailing website in China, and even millions of 
sellers on 3rd-part (such as taobao.com, jd.com) retailing platforms. Facing so many retailing sellers, a 
consumer may be confused, since he/she can’t know their trustfulness and the according risk. In such 
situation, some independent organizations like BBB online provide the trustfulness evaluation service 
for the online retailers, and which help consumers to distinguish the retailers with lower according risk 
[3, 4].

Using Eq.3 and Eq.4, the risk evaluation index system for online retailing trustfulness is built as 
following 3 steps:

1) Sort out main online shopping risk

Consumers may face many kinds of risk when shopping online, among which only 4 usual risks are 
chosen to be analyzed here for illustration purpose:
- quality flaw
- discrepancies between the physical goods and descriptions
- delay on delivery
- bad after service

2) Evaluate the loss if the according risk happen and determine the weights

For simplicity, the monetary loss caused by risks is considered when the online shopping amount is 
100 dollars. To calculate the loss according to a specific risk, several consumers can be inquired, 
and the average value can be used.

The data in table 1 are estimated according to some sampling survey:

| risk points          | frequency     | Average loss (ratio to the goods price) | weight |
|----------------------|---------------|----------------------------------------|--------|
| quality flaw         | often         | 23%                                    | 28 a   |
| discrepancies        | often         | 36%                                    | 43     |
| delay on delivery    | often         | 5%                                     | 7      |
| bad after service    | relatively often | 18%                                   | 22     |

a Notice, the weights are calculated using Eq. 2, for example the first weight of the quality 
flaw is obtained by 23% / (23%+36%+5%+18%) * 100 =28

3) Determine the standard of rating

According to Eq. 3, the score of every index is 1 minus the probability that the risk happens, in other 
word the probability that it doesn’t happen. In reality, the frequency that a risk happens in a past period 
can be used to substitute the probability. Though the loss caused by a specific risk is almost the same to 
the consumer, the frequency is different from seller to seller, and so different seller can obtain different 
evaluation score of trustfulness.

4. Discussion and Conclusion

Theoretically, this index system with the loss caused by every risk point once happening as weight and 
the probability that the risk point doesn’t happen as the rating standard is suitable to the risk evaluation 
case that many similar object is to be evaluated with the same risk points. The advantage and validity is 
that the comprehensive score is linear to the expected loss caused by all risks and the evaluation process 
is simple and convenient.

It’s usual that some risks are correlated, and this doesn’t affect the calculation of the expected of the 
total loss.

But problem comes since the $Ls$ are assumed as constants in the Eq.2 if the danger $L$ caused by a 
specific kind of risk changes widely, i.e. $L$ cannot be looked as a constant for a specific risk, and for
example a quality flaw can cause a big loss at this time or be trivial in another. There are two measures can be taken to solve this problem: the first is to split this risk into multiple risk point according to their danger once it happens, and the $L$s become constant for different risk point after splitting; and the second is to use the average loss to calculate the weight and consider the loss besides the probability when rating the according indicator.

Yet if the normal probabilities $P$s for every risk vary widely, it can become improper to deduce weights only from the according dangers when the risks happen. Some risks may cause serious danger but very seldom happen, for example, while deadly contaminated food and online economic crime can cause serious danger and loss, they are exceedingly rare on the familiar online retailing websites, and therefore if the weights are allocated too high, the discrimination of the whole index system will be reduced. Therefore, the probability of risk happening should be considered also to deduce a reasonable weight if the average probabilities are not comparable between different risks.

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6. References
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