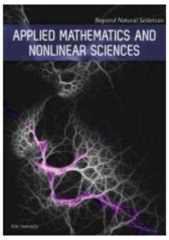
sciendo Applied Mathematics and Nonlinear Sciences, 9(1) (2024) 1-14



Applied Mathematics and Nonlinear Sciences

https://www.sciendo.com

Research on Early Warning Model of Wushu Event Broadcasting Right Operation Risk Based on Big Data XGBoost Algorithm

Xing Li[1, 2], Ying Ma[1], Zhiying Cui[2], Yongxia Cui[3,†]

1. School of Management, Wuhan University of Technology, Wuhan, Hubei, 430070, China.
2. School of Sports, Handan University, Handan, Hebei, 056605, China.
3. School of Sports and Health Engineering, HeBei University of Engineering, Handan, Hebei, 056038, China.

Submission Info

Communicated by Z. Sabir
Received January 10, 2024
Accepted January 15, 2024
Available online February 26, 2024

Abstract

Under the background of the development of new media technology, the attention of wushu events in the society is gradually increasing, which makes the competition in the event broadcasting market more and more intense. This paper focuses on the problem of predicting the operational risk of wushu event broadcasting rights, based on the GBRT algorithm, innovatively improves the traditional loss function, introduces the regular term, and proposes the application of XGBoost algorithm in the operational risk prediction of wushu event broadcasting rights. The improved algorithm divides the operational risk of broadcasting rights into two main levels, covering three primary and 10 secondary indicators. In this study, the XGBoost algorithm is applied in the early warning of informing proper operation risk, which is classified into two main levels, covering 3 primary and 10 secondary indicators. The article also conducts an in-depth experimental analysis of the risk of overpremium of the event rights and the risk of matching the audience's demand. In addition, according to the results of audience analysis, men have become the primary audience of wushu events, with a frequency of up to 401 times.Based on the XGBoost algorithm, the wushu event broadcasting right operation risk warning system can effectively predict and help the event broadcasting platform to avoid the potential operation risk, which provides valuable data support for the market decision-making.

Keywords: XGBoost; GBRT; Race Broadcasting; Risk Warning.
AMS 2010 codes: 68Q05

†Corresponding author.
Email address: cuiyongxia@hebeu.edu.cn

ISSN 2444-8656
https://doi.org/10.2478/amns-2024-0511

1 Introduction

In 2016, the construction of Chengdu World Events City kicked off, and various mega events landed in Chengdu, which brought great benefits to Chengdu's sports industry [1-3]. Wushu events, as an organic molecule of the sports industry, have a certain audience. Wushu, as an important part of the excellent traditional Chinese culture, is an indispensable and distinctive national characteristic of the cultural carrier in the construction of "cultural self-consciousness, cultural self-confidence." As an important part of Chinese excellent traditional culture, wushu is an indispensable cultural carrier with distinctive national characteristics in the construction of "cultural consciousness and cultural self-confidence," and the development research on wushu events is a means to promote the inheritance of Chinese traditional culture and a need for the development of Chengdu's wushu events [4-5].

As an important source of income in the sports industry, the broadcasting rights of sports events occupy a crucial position [6-8]. 2014, the State Council promulgated the "Opinions on Accelerating the Development of the Sports Industry and Promoting Sports Consumption," which puts forward the "innovation of the market operation mechanism, promote the rights to organize events, event broadcasting rights, athletes' transfer rights, intangible assets development and other resources with fair trading conditions, and promote the development of the sports industry. In 2018, the "Guiding Opinions on Accelerating the Development of the Sports Competition and Performance Industry" called for the promotion of "the separation of sports event production and broadcasting, and strong support for the development of new sports media platforms," which pushed the further development of the sports event broadcasting rights market [9-11]. Due to the rise of new media, between 2016 and 2020, the all-media broadcasting rights fee of the Chinese Super League surged to 8 billion yuan from millions of yuan in the past, creating a new milestone for China's sports event broadcasting rights [12-14]. However, behind the huge investment is also hidden a huge operational risk, such as "China's paid soccer pioneer" -Tiansheng Sports implemented the "China's paid soccer pioneer" -Tiansheng Sports implementing the "China's paid soccer pioneer" -Tiansheng Sports implemented the "China's paid soccer pioneer." However, behind the huge investment, there is also a huge operational risk, such as "China's pioneer of paid football" -Tiansheng Sports, which caused a large number of fans to lose due to the implementation of the pay-per-view model, and Leshi Sports, which invested in the broadcasting rights of the Chinese Super League at a high price and caused a huge loss, all of them are typical cases of the operational risk of the broadcasting rights of sports events, which caused a huge amount of property loss of the copyright owners and seriously affected the dissemination of sports events and the commercialization of the development of sports events, and they should be carried out in a timely and effective manner. Effective risk warnings should be carried out in a timely manner to maximize the control, resolution, and elimination of broadcasting right risks [15-16].

In recent years, Chinese scholars have conducted systematic research on the monopoly of broadcasting rights of sports events, copyright development, and legal protection, and a few of them have discussed the risk of broadcasting rights income from the Winter Olympics and large-scale sports events and put forward corresponding risk avoidance measures, but there is a lack of quantitative index system and scientific early warning method, and the research on the risk of relevant broadcasting rights is still insufficient [17-19].

In this paper, we use the XGBoost algorithm to improve and extend the gradient boosting regression tree algorithm; in order to penalize the complexity of a single regression tree, we propose an extended gradient boosting algorithm, XGBoost, which follows the basic idea of regular learning, and incorporates the regular term into the loss function of the GBRT algorithm. We use the integration idea to determine the split nodes and select the optimal split point to operate on them through the XGBoost algorithm to construct the framework of operational risk assessment indicators. The

XGBoost algorithm selects the optimal split points to construct the framework of operational risk assessment indexes, and then preprocesses the data, collects and analyzes the sample data according to the identified risk index system, and modifies the data of the XGBoost algorithm test according to the requirements of the sample size allocation of the algorithm's training set and the test set, so as to subdivide into the secondary indexes of the risk assessment. In addition, in order to improve the early warning function of the algorithm on the risk of broadcasting rights operation, this paper conducted an experimental evaluation on the risk of premium price of the copyright of martial arts events and the risk of matching the demand of audience groups.

2 Operational risk prediction for broadcast rights based on XGBoost algorithm

2.1 XGBoost model structure

XGboost algorithm adopts the integration idea, which can be used to solve both classification and regression problems. The algorithm mainly applies the integration idea, solves the minimum loss function through the second-order Taylor expansion, determines the splitting nodes, and constructs the final model. The following briefly introduces the principle of the XGboost algorithm.

First of all, we define the XGboost model, which comes from the additive model in Boosting idea, i.e.:

$$\hat{y}_i = \sum_{k}^{K} f_k\left(x_i\right) \tag{1}$$

Where, considering f_k as a tree, the model has a total of K trees.

Define the objective function of the model:

$$L(\phi) = \sum_{i} l\left(y_i y_i\right) + \sum_{k} \Omega\left(f_k\right) \tag{2}$$

The first term is the loss function, y_i is the predicted value, y_i is the true value, and i is the number of samples. The second term is the regular term $\Omega\left(f_k\right) = \gamma T + \frac{1}{2}\lambda\|\omega\|^2$, also known as the penalty term, in which T denotes the number of leaf nodes, and ω is the value of the leaf nodes. The regular term is added in order to control the complexity of the model, that is to say, to take a balance between the complexity of the model and the model effect. The regular term is added to control the complexity of the model, that is to say, to strike a balance between the model complexity and the model effect.

According to the objective function, the forward step-by-step algorithm is applied to solve the decision tree in the current state f_t:

$$L^{(t)} = \sum_{i} l\left(y_i \hat{y}_i^{(t-1)} + f_t\left(x_i\right)\right) + \Omega\left(f_i\right) \tag{3}$$

In the current state, round t, since the result of round $t-1$ is known, the optimization of the above Equation can obtain f_t, where the regular term $\sum_{k=1}^{t-1}\Omega\left(f_k\right)$ of the previous round $t-1$ is a constant term, which has no effect on the optimization result, so it is removed.

To solve Eq. (3), the second-order Taylor expansion of $L^{(t)}$ is as follows:

$$\begin{aligned} L^t \cong \sum_i \Big[& l\left(y_i, \hat{y}_i^{(t-1)}\right) + \partial_{\overset{\wedge}{y_i}^{(t-1)}} l\left(y_i \hat{y}_i^{(t-1)}\right) f_t\left(x_i\right) \\ & + \frac{1}{2}\partial^2_{\hat{y}_i^{(t-1)}} l\left(y_i, \hat{y}_i^{(t-1)}\right) f_t^2\left(x_i\right)\Big] + \Omega\left(f_t\right) \end{aligned} \tag{4}$$

Let $g_i = \partial_{\overset{\wedge}{y_i}^{(t-1)}} l\left(y_i \hat{y}_i^{(t-1)}\right), h_i = \partial^2_{\hat{y}_i^{(t-1)}} l\left(y_i, \hat{y}_i^{(t-1)}\right)$ be the first and second order derivatives of the loss function with respect to $\hat{y}_i^{(t-1)}$, respectively.

Then:
$$L^{(t)} \cong \sum_i \left[l\left(y_i \hat{y}_i^{(t-1)}\right) + g_i f_t\left(x_i\right) + \frac{1}{2} h_i f_t^2\left(x_i\right)\right] + \Omega\left(f_t\right) \tag{5}$$

Since $l\left(y_i, \hat{y}_i^{(t-1)}\right)$ in Eq. (5) is a known term (constant term), its removal yields:

$$L^{(t)} \cong \sum_i \left[g_i f_t\left(x_i\right) + \frac{1}{2} h_i f_t^2\left(x_i\right)\right] + \Omega\left(f_t\right) \tag{6}$$

Substituting the regular term $\Omega\left(f_k\right)$ into the specifics, we get:

$$L^{(t)} \cong \sum_i \left[g_i f_t\left(x_i\right) + \frac{1}{2} h_i f_t^2\left(x_i\right)\right] + \gamma T + \frac{1}{2}\lambda \sum_{j=1}^{T} \omega_j^2 \tag{7}$$

The ω_i in Eq.(7) is the value on the leaf node j, which is summed over all the sample points. Since each sample point will eventually fall on a leaf node, summing over all the sample points can be converted to summing over all the leaf nodes, which can be obtained in the following Equation:

$$L^{(t)} \cong \sum_{j=1}^{T}\left[\left(\sum_{i\in I_j} g_i\right)\omega_j + \frac{1}{2}\left(\sum_{i\in I_j} h_i + \lambda\right)\omega_j^2\right] + \gamma T \tag{8}$$

Eq. (8) I_j denotes all the sample points that fall to the leaf node j. For a certain decision tree structure, the only unknown quantity is ω_j, then (8) is viewed as a quadratic equation to find the maximum value of:

Let $\dfrac{\partial L^{(t)}}{\partial \omega_j} = 0$, we get:

$\omega_j^* = -\frac{\sum_{i=I_j} g_i}{\sum_{i=I_j} h_i + \lambda}$, substituting the value of ω_j^* into equation (8) yields:

$$L^{(t)}(q) \cong -\frac{1}{2}\sum_{j=1}^{T}\frac{\left(\sum_{i\in I_j} g_i\right)^2}{\left(\sum_{i\in I_j} h_i + \lambda\right)} + \gamma T \tag{9}$$

The smaller the value of Eq. (9), the better, and the score function for evaluating the tree structure is as follows:

$$score \cong \frac{1}{2}\sum_{j=1}^{T}\frac{\left(\sum_{i\in I} g_i\right)^2}{\left(\sum_{i=I_j} h_i + \lambda\right)} - \gamma T \tag{10}$$

The larger the value of Eq. (10), the better; according to this, the score function can be obtained to divide the nodes based on the node, that is, a node after the split of the score function minus the node before the split of the score function.

$$L_{splut} = \frac{1}{2}\left[\frac{\left(\sum_{i\in I_L} g_i\right)^2}{\sum_{i=I_L} h_i + \lambda} + \frac{\left(\sum_{i\in I_R} g_i\right)^2}{\sum_{i\in I_R} h_i + \lambda} - \frac{\left(\sum_{i\in I_j} g_i\right)^2}{\sum_{i=I_j} h_i + \lambda}\right] - \gamma \tag{11}$$

In Eq. (11) I_L denotes all the sample points falling to the left node after splitting of a node, and I_R denotes all the sample points falling to the right node, so the model is constructed by splitting at the node with the largest L_{split}. The XGboost algorithm can be used to select the optimal splitting point, and the enumeration can be performed in parallel.

2.2 XGBoost algorithm for gradient boosted regression tree improvement

The XGBoost model is an improvement and extension of the decision tree (GBRT) model. The serial iterative process of the GBRT model can be expressed as follows:

$$\begin{aligned}
&\hat{y}^{(0)}=0\\
&\hat{y}^{(1)}=vf_1\left(x;\Theta_1\right)=\hat{y}^{(0)}+vf_1\left(x;\Theta_1\right)\\
&\hat{y}^{(2)}=v\sum_{j=1}^{2}f_j\left(x;\Theta_j\right)=\hat{y}^{(1)}+vf_2\left(x;\Theta_2\right)\\
&\cdots\cdots\\
&\hat{y}^{(T)}=v\sum_{j=1}^{T}f_j\left(x;\Theta_j\right)=\hat{y}^{(T-1)}+vf_T\left(x;\Theta_T\right)
\end{aligned} \tag{12}$$

In Equation (12), T denotes the number of basic regression trees used for integrated modeling; Θ_j denotes the structure of the first j regression tree, and v denotes the scaling weight factor (also known as the learning rate of $0<v<1$, which is used to scale the contribution of a single regression tree to the final results of the integrated model). $\hat{y}^{(j)}$ denotes the prediction results using the j regression tree, and $f_j\left(x;\Theta_j\right)$ denotes the output results of the j regression tree without considering the scaling weight factor. The output of the regression Θ_j tree is calculated using the variable x and the approximate residual $y-\hat{y}^{(j-1)}$ of the regression tree OJ. The gradient enhancement process of the GBRT model is shown in Fig. 1. As the regression trees are superimposed, the residuals will decrease in a gradient, and the model effect will increase in a gradient.

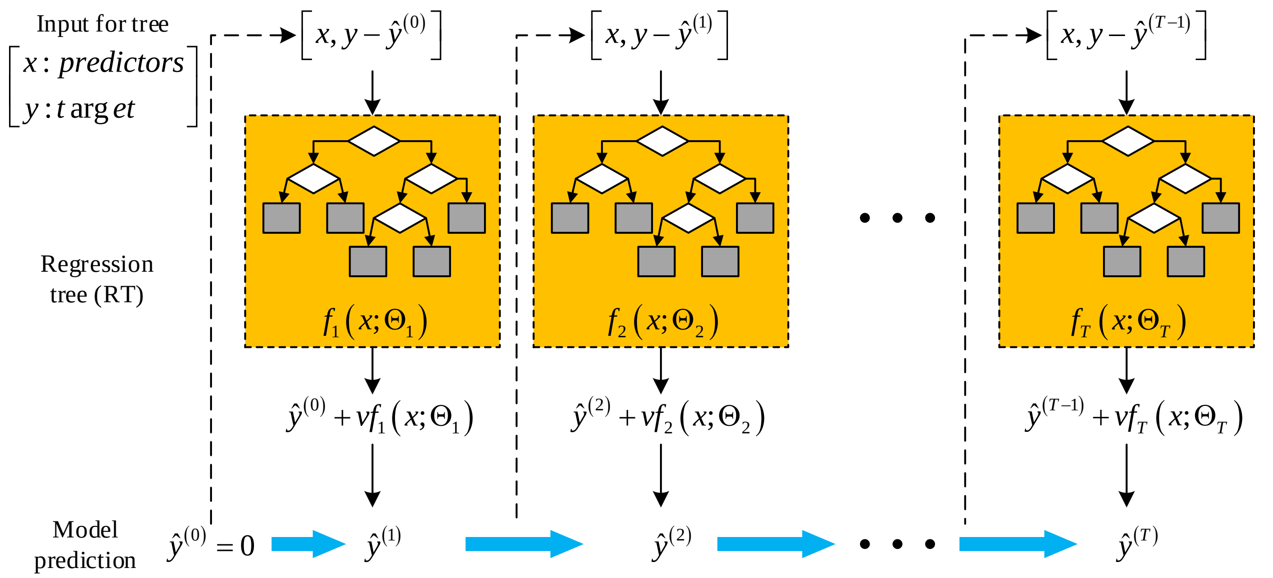


Figure 1. Principles of GBRT model

In order to penalize the complexity of a single regression tree, an extended gradient boosting algorithm, XGBoost, is proposed. It follows the basic idea of regular learning and integrates the regular term into the traditional loss function of the GBRT algorithm. The meta-model of the commonly used XGBoost model is based on the form of a tree model, which approximates the negative gradient of the model through the second-order Taylor expansion of the loss function and takes it as the residual of the previous model. A model of the residuals for learning, the last round of regression tree training accuracy of lower samples given higher learning weights to improve the model accuracy, so as to achieve serial iteration of multiple models, so that the deviation is gradually corrected until the loss to meet the conditions for convergence. Therefore, in the gradient boosting tree model of the core task is to find the optimal single regression tree Θ_j for each and by minimizing the objective function to establish a decision function in the first step of the j step, the objective function formula is as follows $f_j\left(x;\Theta_j\right)$, whose objective function is formulated as follows:

$$\begin{aligned}\hat{\Theta}_1 &= \arg\min_{\Theta_j}\left\{\sum_{i=1}^{N} L\left[y_i, \hat{y}_i^{(j-1)} + vf_j\left(x_i;\Theta_j\right)\right] + \Omega\left(\Theta_j\right)\right\} \\ &= \arg\min_{\Theta_j}\left\{\sum_{i=1}^{N}\left[\hat{y}_j^{(j-1)} - y_i + vf_j\left(x_i;\Theta_j\right)\right]^2 + \Omega\left(\Theta_j\right)\right\}\end{aligned} \tag{13}$$

In Eq. (13), N denotes the sample size; $L(y,\hat{y}) = (\hat{y}-y)^2$ is usually expressed as the square of the loss function. $\Omega\left(\Theta_j\right)$ denotes the canonical term of the j th regression tree, which works as follows:

$$\Omega\left(\Theta_j\right) = \gamma M_j + \frac{1}{2}\lambda\left\|w_k\right\| = \gamma M_j + \frac{1}{2}\lambda\sum_{k=1}^{M_j}\left(w_k^{(j)}\right)^2 \tag{14}$$

In Equation (14), $w_k^{(j)}$ denotes the leaf score of the k th leaf node of the j th regression tree. M_j denotes the number of leaf nodes of the j th regression tree, γ denotes the minimum loss for each additional branch of the leaf node, $\lambda = L2$ denotes the regular term of the leaf score of the regression tree.

The advantages of the XGBoost algorithm over GBRT are that the second-order Taylor expansion of the loss function makes it more efficient to solve the optimal solution; the rule terms included in the objective function penalize the complexity of each regression tree, and the model is better protected against overfitting. With the introduction of the second-order Taylor expansion of the loss function, the objective function can be approximated as follows:

$$\Theta_j \approx \arg\min_{\Theta_j}\left\{\begin{array}{c}\sum_{i=1}^{N}\left[L\left(y_i,\hat{y}_j^{(j-1)}\right) + vg_i^{(j)} f_j\left(x_i;\Theta_j\right) + \frac{1}{2}v^2 h_i^{(j)} f_j^2\left(x_i;\Theta_j\right)\right] \\ +\gamma M_j + \frac{1}{2}\lambda\sum_{k=1}^{M_j}\left(w_k^{(j)}\right)^2\end{array}\right\} \tag{15}$$

In Equation 15, $g_i^{(j)}$ and $h_i^{(j)}$ are expressed as Equation (16) and Equation (17), respectively:

$$g_i^{(j)} = \frac{\partial L\left(y_i,\hat{y}_j^{(j-1)}\right)}{\partial \hat{y}_j^{(j-1)}} = 2\left(\hat{y}_j^{(j-1)} - y_i\right) \tag{16}$$

$$h_i^{(j)} = \frac{\partial^2 L\left(y_i,\hat{y}_j^{(j-1)}\right)}{\left(\partial \hat{y}_j^{(j-1)}\right)^2} = 2 \tag{17}$$

Obviously, the larger the number of leaves M_j is, the larger the penalty term γ is, and the larger the γ is, the more we want to get a tree with a simple structure, and the larger the λ is, the more we want to get a tree with simple structure, too. Since y_i is the given sample, and $\hat{y}^{(j-1)}$ has already been determined in the $j-1$ step, $L\left(y_i,\hat{y}_j^{(j-1)}\right)$ can be regarded as a constant term to offset from the Eq. (15).After finding the optimal uni-regression tree $\Theta_j\left(j=1,2,\ldots,T\right)$ of every single regression tree, the XGBoost model completes the training, and it can be used to make the final prediction.

The kernel of the XGBoost algorithm is the boosted tree method, which has been developed into a scalable open-source machine learning system. xGBoost can be used for both regression and classification problems and applied to a wide range of scenarios. in addition to the advantage of accuracy, another advantage of xGBoost is that the training speed is very fast, and it can be run more than ten times faster than the existing popular solutions on a single machine. The excellent performance can be attributed to several important system design optimizations and algorithmic optimizations, such as the inclusion of regular terms and automatic pruning processing and the inclusion of features in parallel processing. The excellent performance of XGBoost can be attributed to several important system design and algorithmic optimizations, such as the inclusion of regular terms, feature parallel processing, automatic pruning, built-in cross-validation, and other improvements.

3 Risk Analysis of Wushu Event Broadcasting Rights Operation

With the continuous development of new media technology, sports events are getting more and more attention in society, and wushu, as a category of sports, has been noticed by more and more groups, so the competition in the wushu broadcasting market is getting more and more intense, and the operation risk is also increasing, based on which, the above chapter proposes an XGBoost algorithm model to predict the risks that the operation of wushu broadcasting rights may face, and put forward a corresponding avoidance scheme. This chapter analyzes the first two levels based on the XGBoost algorithm.

3.1 Analysis of Risk Indicators for Wushu Event Broadcasting Rights Operations

The operation risk of wushu event broadcasting right is a kind of complex event with comprehensive uncertainty; in order to construct a reasonable operation risk early warning model of wushu event broadcasting right, the XGBoost algorithm proposed in this paper is used to select the operation risk indexes reasonably and calculate the mean, standard deviation, coefficient of variation and filtering results of each index, the indexes are constructed, and the related calculations are shown in Table 1, the indexes are divided into two levels through the XGBoost algorithm, which includes three first-level indexes, namely the production factor risk, the market environment risk and the social environment risk, and ten second-level indexes. XGBoost algorithm, the evaluation indexes of the operation risk of wushu event broadcasting right are divided into two levels, which include three first-level indexes, namely, the production factor risk, the market environment risk, and the social environment risk, and ten second-level indexes. From the data in the table, it can be seen that the mean value of the three reasonable degrees of first-level indexes is in the range of 4.6-4.65, and the compilation coefficient is in the range of 0.11-0.13<0.15, which indicates that, through the XGBoost algorithm, the indexes are selected reasonably, and the standard deviation of each index is calculated, and the screening results are shown in Table 1. It shows that the indicators screened by the algorithm meet the standard and can be used as indicators for evaluating the operation risk. Regarding the screening of the secondary indicators, the average value of the 10 reasonable degrees of the secondary indicators is 4.15-4.45>3.00, and the coefficient of variation is 0.12-0.14<0.15, so it meets the standard of the screening.

It can be seen that the XGBoost algorithm proposed in this paper can reasonably screen the indicators for evaluating the risk of broadcasting the right operation of wushu events, provide a practicable evaluation index system, and effectively predict the risk of broadcasting the right operation.

Table 1. Operational risk assessment indicators

Primary index	Mean value	Standard deviation	Variable coefficient	Secondary index	Mean value	Standard deviation	Variable coefficient	Evaluation result
Factor risk	4.6	0.60	0.13	Enterprise assets	4.2	0.62	0.14	High-risk
				Enterprise competitiveness	4.25	0.55	0.13	Medium risk
				Enterprise innovation	4.4	0.60	0.14	Low risk
				Corporate broadcast quality	4.45	0.61	0.13	High-risk
Market environment risk	4.6	0.51	0.11	Market mechanisms	4.3	0.57	0.13	Medium risk
				Market concentration	4.4	0.59	0.14	High-risk
				Market management mechanism	4.45	0.60	0.14	Low risk
Social environmental risk	4.65	0.49	0.11	Policy factor	4.35	0.59	0.13	Medium risk
				Technical factor	4.15	0.49	0.12	High-risk
				Humanity factor	4.6	0.60	0.13	Low risk

3.2 Analysis of the Risk of Excessive Premium for Broadcasting Rights of Wushu Events

Wushu event platform broadcasting rights are the link between the wushu sports industry and the media industry, but also the economic lifeblood of the current professional wushu sports. Broadcasting rights can become a precious commodity, determined by the relationship between supply and demand, but also the wushu sports organizations and communication agencies to help each other, the results of the game. In recent years, China's wushu sports industry in the government's support for the continuous growth of the scale of the related media industry has also continued to grow. This section of the large-scale wushu sports broadcast platform is the object of the research on the scale of investment in recent years to the growth of the situation and the situation of the Analysis of the revenues so as to deduce the whole of the wushu sports broadcasting industry's premium situation.

3.2.1 Analysis of the scale of investment in broadcasting platforms

The investment scale of a large martial arts sports broadcasting platform in recent years is shown in Figure 2. The investment scale of this martial arts event broadcasting platform has been on an upward trend overall. The investment scale of this platform's martial arts sports broadcasting platform has increased rapidly from 13.59 billion in 2013 to 194.87 billion in 2022, with a growth rate of more than 51.4% per annum, and after the prediction of the XGBoost algorithm, by the end of 2023, the investment scale of this platform will exceed 2.1 billion for the operation of martial arts event broadcasting rights. By the end of 2023, the investment scale of the platform in the operation of the broadcasting rights of martial arts events will exceed 2.1 billion, which shows that the operation cost of the martial arts broadcasting platform is increasing, and based on this, the fees charged to users of the broadcasting of martial arts events will be higher.

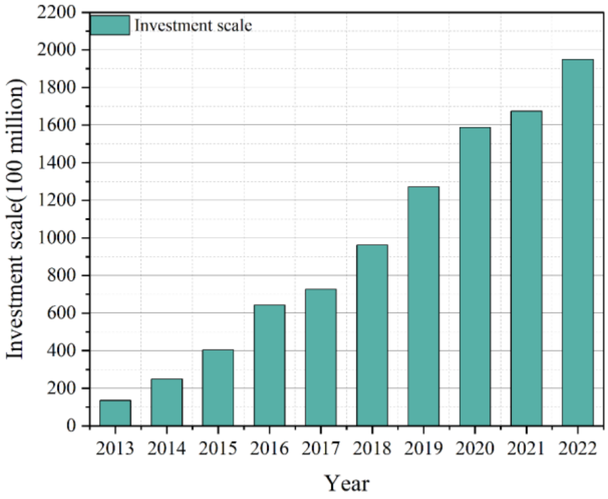


Figure 2. Investment scale growth

If a new media sports broadcasting platform holds the exclusive broadcasting rights of high-level popular sports events, it can effectively attract audiences and increase the influence of its platform, but the pursuit of high-quality sports event rights by major broadcasting platforms is very fierce, and the prices of these event rights are also soaring. In 2018-2020, the platform took the rights to martial arts events in the region at a cost of $100 million per year, but in 2021, the cost of the rights increased to $300 million, which is twice as much as before, but the revenues did not increase exponentially. This shows that the premium for the rights to the events is too high, but the revenues are not able to follow it, which may cause the broadcasting rights to be operated at a higher price than before. This may lead to the risk of a break in the broadcasting rights operating capital chain, affecting the normal operation of the platform broadcasting.

Table 2. 2018-2020 competition copyright revenue and expenditure

	Royalty payments ($100 million)	Membership income	Advertising revenue	Other revenue
2018	1	0.435	1.219	0.391
2019	1	0.398	1.088	0.287
2020	1	0.451	1.262	0.433
2021	3	0.513	1.274	0.514

3.2.2 Analysis of Wushu Tournament Rights Revenue

Wushu sports event copyright is the core competitiveness of the new media sports event broadcasting platform; with the event copyright, a lot of exciting content can attract a large number of consumers; these consumers in the process of watching wushu events will produce payment behavior, at the same time, the event copyright in the process of broadcasting can also attract a large number of commercial ads to obtain revenue, in addition, the audience in the process of watching wushu events will also be for the copyright holder to obtain a large number of traffic, this traffic is also a valuable resource. Therefore, the maintenance of the event copyright is the most important part of the operation of the broadcasting rights of wushu events. This experiment still takes the large broadcasting platform mentioned above as the research object, studies the specific way of obtaining benefits from the event copyright, and explores the specific measures of maintaining the event copyright in order to avoid the copyright risk of the operation of the broadcasting right. The revenue of the event copyright is shown in Fig. 3. The revenue of the broadcasting platform mainly consists of advertising, copyright distribution, pay-per-view, and e-commerce, but in recent years, there have been changes in the revenue structure of various aspects of the development of the platform. Advertising revenue has been the core revenue of the platform, from 72.1% of the total revenue of the broadcasting rights in 2013 to 46.3% in 2020; advertising revenue in the overall revenue structure accounted for a significant decline, while pay-per-view and e-commerce revenue has increased year by year, the platform's revenue has decreased significantly, and the revenue of the platform has increased year by year, and the revenue of the platform has increased. The revenue is increasing year by year, and the platform revenue structure is taking a diversified development path.

Therefore, in order to avoid the risk of broadcasting the right operation, the platform should take the diversified development path to create revenue for the event rights from various aspects. Therefore, in order to avoid the risk of broadcasting the right operation, platforms should take a diversified development path to create revenue for the event rights from various aspects.

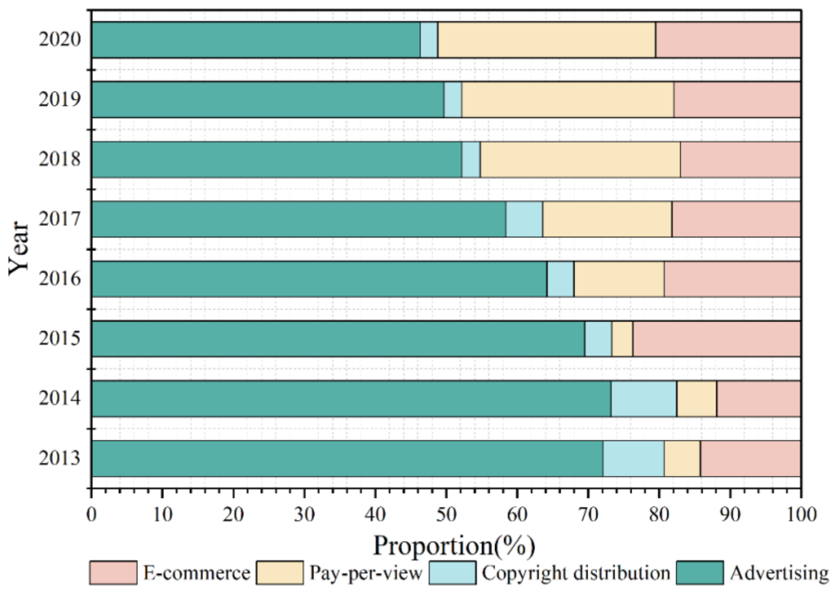


Figure 3. Copyright revenue from 2013 to 2022

3.3 Risk analysis of the match between tournament content and audience needs

According to the above experiments, today's soaring tournament copyright prices make it impossible for major broadcasting platforms to purchase a large amount of resources for high-end martial arts tournaments; although it means high income, at the same time, high cost and operational risk are also increased. In the actual operation process, meeting the needs of the audience is the ultimate operational goal and is also one of the ways to achieve income. However, the current major broadcast platform for the audience demand implementation is not in place and is still relying on the martial arts event brand with its own viscosity to maintain the audience, which is unscientific. In the many platforms under competition, it is very easy to produce user diversion and non-core user loss, and thus, it cannot bring the benefits of scale. In addition, many of the broadcast platforms of the wushu tournament content and the lack of interaction with the user resulted in reduced user viscosity. Its high copyright fees caused by the tournament broadcasting rights to the operation of the pressure of the platform will always be part of the user traffic in the long term. In the long run, the platform will be part of the user traffic at any time.

Based on this, this section utilizes the XGBoost algorithm to calculate and predict the user characteristics of a large broadcasting platform, and the specific calculation results are shown in Table 3. From the calculation data, the proportion of male audience groups of wushu events is much higher than that of females, and in the age distribution, the main force is the group of people over 30 years old, and from the distribution of the industry, the audience groups of wushu events have a wider distribution. From the distribution of the industry, it can be seen that the proposed algorithm can accurately calculate and classify the types of user groups, which helps the broadcasting platform grasp the different characteristics of the audience groups. The proposed algorithm can accurately calculate and categorize the types of user groups, which can help broadcasting platforms grasp the different characteristics of audience groups and, to a certain extent, avoid the operational risks of user stickiness reduction and user traffic loss.

Table 3. Audience type calculation

Category	Entry	Frequency	Percentage (%)
Gender	Male	401	78.8
	Female	108	21.2
Age situation	Under 18 years old	80	15.7
	19-25 years old	108	21.2
	26-30 years old	123	24.2
	Over 30 years old	198	38.9
Education background	High school and below	56	11.0
	Junior college	112	22.0
	Undergraduate	298	58.5
	Master degree or above	43	8.5
Job department distribution	Student	46	9.0
	White-collar worker	71	13.9
	Service staff	67	13.2
	Martial arts industry professionals	53	10.4
	Freelancer	41	8.1
	Worker	48	9.4
	Institutional person	43	8.4
	Merchant	37	7.3
	Agricultural practitioner	20	3.9
	Wait for employment	54	10.6
	Else	29	5.7

4 Conclusion

In this paper, the risk and prediction model of wushu event broadcasting right operation is studied, and the XGBoost algorithm is used to effectively predict the risk of event broadcasting right operation, and the XGBoost algorithm constructed by the study improves and extends the gradient boosting regression tree algorithm, and graded evaluates the risk indicators of various aspects of the broadcasting right operation, and experimentally analyzes the risk of the event right premium and the risk of matching the audience demand of the broadcast platform. At the same time, the risk of the premium price of broadcasting platforms and the risk of matching audience demand are analyzed.

After the calculation of the XGBoost algorithm, the mean values of three reasonable degrees of primary indicators are 4.6-4.65, with compilation coefficients of 0.11-0.13<0.15, and the mean values of ten reasonable degrees of secondary indicators are 4.15-4.45>3.00, with coefficients of variation of 0.12-0.14<0.15. The annual growth rate of investment in broadcast platforms is more than 51.4%, and the investment in martial arts platforms in 2021 will increase by more than 51.4%, and the annual growth rate of investment in martial arts platforms in 2021 will be more than 51.4%. Moreover, the price of wushu event rights in 2021 will rise to 300 million US dollars, which is twice as much as before, indicating that the current premium of wushu event rights is too high, which puts pressure on the operation of broadcasting platforms. In addition, from the calculation results of the type of audience group, men are the main audience group of wushu events, with a frequency as high as 401%.

References

[1] Zhang, Y., Kim, E., & Xing, Z. (2020). Image congruence between sports event and host city and its impact on attitude and behavior intention. International Journal of Sports Marketing and Sponsorship, ahead-of-print(ahead-of-print).

[2] Lyu, Ok, S., Han, & Hyoung, J. (2017). Assessing preferences for mega sports event travel products: a choice experimental approach. Current issues in tourism.

[3] Kirkup, N., & Sutherland, M. (2017). Exploring the relationships between motivation, attachment and loyalty within sport event tourism. Current issues in tourism, 20(1-4), 7-14.

[4] Zhang, S. (2017). Research on the framework of the application mode of commercial events in wushu sanda competition. Boletin Tecnico/Technical Bulletin, 55(19), 227-232.

[5] Zhao, C., & Li, B. (2021). Artificial intelligence auxiliary algorithm for wushu routine competition decision based on feature fusion. Journal of Healthcare Engineering.

[6] Bergantios, G., & Moreno-Ternero, J. D. (2021). Compromising to share the revenues from broadcasting sports leagues. Journal of Economic Behavior & Organization, 183, 57-74.

[7] Bergantios, G., & Moreno-Ternero, J. D. (2022). Separable rules to share the revenues from broadcasting sports leagues. Economics Letters, 211.

[8] Lupien, & Philippe-Antoine. (2017). Sport and public service in canada: the roots of the inherent bonds between the canadian broadcasting corporation/radio-canada and the olympic games. International Communication Gazette, 79(2), 120-134.

[9] Smith, & Paul. (2017). Playing under pressure: sport, public service broadcasting and the bbc. International Communication Gazette, 79(2), 203-216.

[10] Bergantios, G., & Moreno-Ternero, J. D. (2019). Sharing the revenues from broadcasting sport events. Management Science.

[11] Artero, I., & Eduardo Bandrés. (2017). The broadcasting demand for the spanish national soccer team. Journal of Sports Economics, 19(7), 152700251769078.

[12] Vicente Prado-Gascó, Moreno, F. C., Vicente Aó Sanz, Juan Núez-Pomar, & Josep Crespo Hervás. (2017). To post or not to post: social media sharing and sporting event performance. Psychology & Marketing, 34(11).

[13] Wakefield, L. T., & Bennett, G. (2017). Sports fan experience: electronic word-of-mouth in ephemeral social media. Sport Management Review, S144135231730044X.

[14] Quayle, M., Wurm, A., Barnes, H., Barr, T., Beal, E., & Fallon, M., et al. (2017). Stereotyping by omission and commission: creating distinctive gendered spectacles in the televised coverage of the 2015 australian open men's and women's tennis singles semi-finals and finals. International Review for the Sociology of Sport, 101269021770188.

[15] Robert, B., & Patrick, M. (2018). Has competition in the market for subscription sports broadcasting benefitted consumers? the case of the english premier league. Journal of Sports Economics, 152700251878412-.

[16] Secular, S. (2021). The numbers game: the nba v. motorola, real-time statistics, and the rise of online fantasy sport. International Journal of the History of Sport, 38(1), 1-14.

[17] A, R. I. P., A, N. C., A, A. M., A, M. S., & B, F. D. (2020). Examining the frequency and nature of gambling marketing in televised broadcasts of professional sporting events in the united kingdom - sciencedirect. Public Health, 184, 71-78.

[18] Sun, Y., & Zhang, H. (2021). What motivates people to pay for online sports streaming? an empirical evaluation of the revised technology acceptance model. Frontiers in Psychology.

[19] Tickell, S., & Evens, T. (2021). Owned streaming platforms and television broadcast deals: the case of the world rally championship (wrc). European Journal of International Management, 15(2/3), 266.