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Research on Teaching Reform of Probability Theory and Mathematical Statistics in Artificial Intelligence Major

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Abstract: *Probability Theory and Mathematical Statistics is a discipline focused both on theory and practice. For students majoring in Artificial Intelligence, it is a basic discipline they must master. Whether they have a good grasp of this course would affect their understanding and learning of other professional courses in the future, so it is greatly important to improve their learning enthusiasm for enhancing their ability to integrate theory with practice. The measures such as teaching with case and inspiration, changing assessment methods, increasing practical teaching, drawing mind map, etc. can cultivate students' ability to solve practical problems by applying Probability Theory and Mathematical Statistics. The teaching methods is reformed by using the mixed mode teaching based on online and offline. In this way, the teaching quality could be improved.*

Keywords**:** *Practical teaching, Case teaching;Heuristic teaching, Mind map, Curriculum Ideological and Political Education, Mixed Mode Teaching Based On Online and Offline*

1. Introduction

Now we have entered the era of Artificial Intelligence that has been integrated into all aspects of our life. Accordingly, more and more intelligent speech recognition software and applications has become a part our life, such typical examples as Apple's Siri and IFLYTEK's speech input method. Also, the face recognition can be seen everywhere due to its full application in daily life. As the mainstream algorithm of Artificial Intelligence, "machine learning", one of its very essential mathematical foundations is Probability Theory and Mathematical Statistics that permeates all aspects in machine learning.

It is such an important and basic course for students majoring in Artificial Intelligence that they could lay a sound foundation for future machine learning, data mining and visualization. By this way, students could get ready for future work in data analysis and Artificial Intelligence. However, the current Probability Theory and Mathematical Statistics Course fails to meet the requirements of students in terms of teaching contents and methods. Therefore, it is necessary to reform these two aspects.

2. The Reform of Teaching Contents

2.1 Compiling typical teaching case sets with ones related to Artificial Intelligence and integrating them into routine teaching.

Obviously, the traditional indoctrination is inconsistent with the current teaching. Choosing vivid cases to enhance its practicability and interest and creating an active classroom atmosphere to improve students' interest are the key to actively guide students to learn Probability Theory and Mathematical Statistics.

It is required that collecting cases of knowledge points related to Probability Theory and Mathematical Statistics, especially in Artificial Intelligence. Instead of explaining the contents of Probability Theory and Mathematical Statistics that students may feel boring, the teacher could introduce teaching cases to improve students’ interest. In a course, cases are used to explain the knowledge points closely related to Artificial Intelligence, which can mobilize students' learning enthusiasm, so students will no longer take this course as a simple mathematics one. In the meantime,

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they will attempt to learn the basis from other professional courses. The important applications of machine learning are classification and prediction. When explaining the 0-1 Distribution, i.e. Bernoulli Distribution, through the guidance of teachers, students will have opportunity to be asked whether their face can be correctly recognized, whether there is a cat in the picture, whether the user will buy a certain commodity and whether these are 0-1 Distribution. It is concluded that the solution of these problems is 0-1 Distribution. Then students can be inspired to think about what problems in daily life belong to 0-1 Distribution. Through similar contents, students can understand the application of distributions of Probability. For Binomial Distribution, Poisson Distribution, Geometric Distribution, Negative Binomial Distribution, Exponential Distribution and Gamma Distribution, through specific examples, such as traffic lights at the crossing, students can string several discrete and continuous distributions together to fully understand these distributions and the relationship among them with the observation of the color of cars in the other direction. For another example, when a vehicle passes through several traffic intersections with signal lights, students can observe whether it is a red light and the number of times it encounters a red light. After the analysis, students could be required to discuss in groups what other practical examples can have similar effects.

In the study of Mathematical Statistics, the hunting problem and the black and white ball problem in the box are used to introduce the Maximum Likelihood Estimation. Galton's law used to research the height of parents and children is introduced into the Regression Analysis. Different rice varieties led by different yield per mu is introduced into the Analysis of Variance [1].

Analyzing teaching cases can also improve students' moral quality. For example, the Bayesian Formula can be used to analyze the story of "*the Wolf is Coming*" in *Aesop's Fables* [2], so that students could consider whether there are similar examples, such as the *War Drama Leud.* What's more, it can warn students to be honest and trustworthy. Since they signed the commitment for integrity examination before the examination, they must do what they promise others, and abide by the examination discipline. Bayesian Formula can also solve other practical problems. The Independence is applied to explain why there were the white-haired champion in ancient times. Furthermore, they will turn into the education materials to explain that perseverance means victory.

In order to give full play to students' subjective initiative, teachers could openly collect cases related to Probability Theory and Mathematical Statistics among students with rewards in each lecture, and students who actively do above mentioned will be given certain bonus points for their usual grades and be praised in class. In addition, teachers will give comments at the beginning of the next class for reviewing the contents of the last class.

2.2 Highlighting the practical characteristics by constructing the experimental course of Probability Theory and Mathematical Statistics, and compiling the experimental textbooks.

The materials for the experiment can origin from certain place where Probability Theory is widely used in Artificial Intelligence and other aspects of daily life. Through the experiment, students could understand the generation of some theories or discover the hidden laws in random events. For instance, Monte Carlo Method is extremely important for simulation. Teachers could share the geometric concept with the introduction of Monte Carlo Method. And students could be encouraged to calculate the PI and integral through the simulation of Buffon's needle problem by means of experiments. Finally, through experiments, students can master the Monte Carlo Method. When giving explanations for Binomial Distribution, Geometric Distribution, Hyper-geometric Distribution and Normal Distribution, teachers shall design experiments to guide students to use Python program to realize the distribution law or density function of these distributions for promoting their understanding of the relationship among various distributions, which can not only exercise students' hands-on programming ability, but also deepen their understanding of these contents. For the Mathematical Statistics, students shall be encouraged to use the formulas in the textbook to write their own programs for hypothesis test, regression analysis, analysis of variance, cluster analysis and so on, so as to fully comprehend the theory.

For the experiment of Probability Theory and Mathematical Statistics, on the one hand, when explaining the knowledge points in class, teachers can randomly simulate specific problems or directly use software to calculate, such as in mathematical expectation, probability calculation, Mathematical Statistical calculation, etc. On the other hand, teachers shall pay attention to the students' learning about Python to construct Probability Theory and Mathematical Statistics experimental courses by means of voluntary registration as group.

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2.3 Compiling textbooks suitable for Artificial Intelligence Major.

The textbooks for current Probability Theory and Mathematical Statistics fail to integrate the contents required for the research of machine learning with the previous. For example, information entropy, which belongs to the Information Theory related to Theory, but it is a little unrealistic to set up Information Theory Course separately for this part. Therefore, when compiling textbooks for Probability Theory and Mathematical Statistics, we can consider adding the Information Entropy. In addition, the past topics from postgraduate entrance examination, as exercises, can be integrated into the textbooks to lay a foundation for those who will participate in this examination. In routine teaching, teachers can also point out the key contents of exams over the years, so that students could be exposed to the real exams in advance when learning Probability Theory and Mathematical Statistics, which is helpful for the review of their future postgraduate entrance examination.

Students can be invited to collect after-school exercises. For example, teachers can assign some exercises, such as blank filling and choice questions, while some students are responsible for collecting calculation questions. The students who collect the questions must give the answers to the questions, and then teachers could check whether the questions are appropriate. And other students who do not participate in the collection of questions will take these questions as homework. If it is difficult for them, the collectors could be invited to explain it in class.

2.4 Focusing on ideological and political work.

Teachers shall expound the course contents with the ideological and political education to achieve the teaching goal for educating people.

2.4.1 Combining the teaching contents to make students comprehend various policies formulated by the nation in real life.

In combination with various policies designated by the nation during the pandemic period, teachers can try to explain the conclusions that can be deduced or proved by Probability Theory and Mathematical Statistics. In this process, students will have opportunity to comprehend the scientificity of national policies and the application of Probability Theory and Mathematical Statistics during the pandemic period. For example, before explaining the Histogram, Stem-and-Leaf display and other contents, teachers could make an introduction to students about "*battle is the best mathematics course*" produced by our School of Mathematics and Statistics, focusing on "*drawing the pandemic change curve with data statistics*". Because various graphs in statistics are tools to reflect the change of data, we can use statistics to fit specific discrete data into curves, so as to find out the change of data.

2.4.2 Giving publicity to experts and scholars who have made great contributions to the Probability Theory and Mathematical Statistics.

Because of Bernoulli's contribution to 0-1 Distribution, it is also called Bernoulli distribution. Similarly, in order to commemorate Gauss's contribution to Normal Distribution, Normal Distribution is also known as the Gaussian Distribution. And the 10 Mark of German is painted with the image of Gauss and the density function curve of the Normal Distribution. Famous statisticians such as Fisher, Bayers and Pearson have also made very important contributions to the development of Probability Theory and Mathematical Statistics. The learning of relevant contents can help students to understand their research achievements. Xu Baolu is a famous mathematician in China. He has created the teaching and research in Probability Theory and Mathematical Statistics, and his major outstanding achievements presented in the mathematical fields such as Parameter Estimation, Neyman-Pearson Lemma, Multivariate Statistics Analysis and Limit Theory. It can be introduced emphatically to stimulate students' patriotism[3].

2.5 Using mind map to summarize each chapter.

Mind map is recommended to introduce into the teaching of Probability Theory and Mathematical Statistics. It is easier for students to master and summarize knowledge points of each chapter. In each chapter students are invited to summarize the knowledge points of the chapter by using the mind map and teachers can give comments as summary. What’s more, it is a good way to show nice ones in the course group.

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3. The Reform of Teaching Methods -- Mixed Mode Teaching Based on Online and Offline

Online and offline teaching is designated for the daily teaching. At present, the lecture videos has been recorded and put on the online platform. Students can make a preview by studying some basic contents from the videos and writing down a summary failed to be understood. During the formal lecture, firstly, teachers should make a comment on the students' cases and homework collected in the last class, and invite them to share their views on the stage if necessary. Secondly, teachers can share the deeds of mathematicians with students to cultivate their "mathematical cultural quality". Thirdly, teachers could explain the summary, key points and difficulties, and then post relevant cases of this course for students to discuss problems in groups. Fourthly, assignments after class should help students strengthen what they have learned in this course. Accordingly, homework can be divided into online (choice questions) and offline form (blank filling, calculation and application questions). Choice questions can be automatically corrected by the online platform. Blank filling and calculation questions need to be manually corrected by teachers. In this way, teachers only need to check the accuracy of choice questions. In addition, the questions collected by students can be reviewed by themselves and finally summarized to teachers. These measures greatly reduce the workload of teachers', because teachers only need to focus on the contents with more errors for the next class.

In teaching process, instead of insisting on complex proof and calculation, teachers might as well try to use short videos to explain their typically simple exercises, so as to appropriately reduce the theoretical property and difficulty of Probability Theory and Mathematical Statistics. For example, the demonstration of Probability Distribution, Central Limit Theorem and Law of Large Numbers are recommended to add. Also, chat software such as QQ voice is used to answer students' doubts in class and homework. In this way, the combination of online platform, traditional blackboard writing and PPT can cover full teaching contents and achieve significant teaching effect, so as to meet the needs of comprehensively cultivating application-oriented talents.

Course comprehensive score is divided into eight parts. They are attendance (10%) , homework (10%) , chapter test (10%) , e-learning (10%) , final exam (50%) , learning interaction and effect (5%) and chapter summary (mind map) (5%). The method for compute score can change the situation that one final exam determines the scores of students in the course.

4. Conclusion

Psychologically, students will feel that Probability Theory and Mathematical Statistics are easy to learn, which will help to stimulate their interest in this course. Students actively participate in the collection and sorting process of teaching cases, exercises and test questions, which can greatly give play to their subjective initiative, so that they can really take part in the whole teaching, rather than just get credits in the exam. These improvements can not only train students' ability to collect data and solve problems, and lay a foundation for their future scientific research, but also create an atmosphere for them to be busy in learning happily. In this way, they will embrace the chance for learning Probability Theory and Mathematical Statistics, which lays a solid foundation for their subsequent courses and postgraduate entrance examination.

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