

About the Impact of Probability and Statistics on Modern Life

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Abstract. To study probability and statistics to see how they are used in modern life. In this paper, I use the method of examples and column data to discuss the application of probability and statistics in daily life, and research shows that it is of great help to modern life. Finally, we draw the conclusion that probability and statistics are important methods in modern times.

Keywords: Law of large numbers, Bayes' law, classical probability.

1. Introduction

Probability and statistics is a characteristic and active branch of mathematics and an important part of modern mathematics. There are many examples of statistics used in our everyday lives. The first is that probability and statistics are widely used in medicine such as disease risk assessment and drug efficacy analysis. By collecting large amounts of medical data and conducting statistical analysis, we can infer the risk of developing a certain disease and help doctors make the right diagnosis and treatment plan. At the same time, probability and statistics can also evaluate the efficacy of drugs and help doctors choose the most appropriate treatment. [1]

Then there is the application of probability statistics in finance, which plays an important role in the financial field, just like using probability and statistics to make investment decisions and market evaluations. We can conduct a probabilistic analysis of historical data, evaluate investment risks and returns, and formulate corresponding investment strategies. Moreover, it also has the ability to predict market trends and help investors make informed decisions. [2]

At the same time, probability and statistics can also be applied to engineering, which can do many things like reliability assessment, quality control, and risk analysis. Its method is a probabilistic analysis of the material strength of the product to evaluate the reliability and life of the product, providing a reference for product design and manufacturing. More importantly, probability and statistics can help engineers carry out quality control and ensure the stability and consistency of products. [3]

Finally, there is the application of probability and statistics to the social sciences, which can be used in public opinion polling and social economy analysis. It is applied to social science in the form of statistical analysis of large-scale social survey data, so as to understand people's opinions and attitudes on a certain issue and provide a basis for policy making. Through this method, the social and economic data can also be analyzed to understand the trend and laws of social and economic development. [4]

2. The application of the Law of large numbers in life

Probability and statistics involve a wide range of knowledge, if we observe carefully, we can find that many things in daily life are used in probability and statistics. One of them is the law of large numbers. The so-called law of large numbers refers to that when the observed data sample is large enough, the probability of the event will gradually stabilize with the gradual expansion of the sample size, and there will not be too much deviation. That is to say, the possibility of this event occurring can be determined through certain cases. If the law of large numbers is applied, then many events in modern life can be solved by the law of large numbers. For example, insurance premium valuation is calculated based on the law of large numbers, and relevant personnel summarize and analyze years of data to determine how much insurance premium can make the company profitable. By analyzing

data from previous years, it is possible to generally predict the probability of death from such accidents in the future. Then, by estimating the number of people who intend to enroll in insurance and estimating the cost to the company, the premiums for each participant can be assessed. In this whole process, it is a reasonable application of the law of large numbers.

For another example, when predicting a flood disaster and geological disaster in a place, it is necessary to conduct a large sample data search of the flood disaster and geological disaster in the past. With this data, through statistics and analysis, a prediction of the frequency and extent of future disasters in the area allows the authorities not to panic and be unprepared before a natural disaster strikes, but to take the necessary measures to avoid or minimize harm. And this predicted probability is determined by the law of large numbers, which is also the application of the law of large numbers in modern life. In some natural disasters, the application of this law of large numbers is very important to make timely predictions of disasters, so that people have enough time to take preventive measures or evacuate the disaster area, and protect people's life and property safety.

Some of the events that happen in daily life are irregular, but many are found to be regular after applying the law of large numbers. It can be seen that the law of large numbers has a very important application in life, and the law of large numbers plays an important role in probability theory and mathematical statistics, so we must master the law of large numbers, and will use it to solve practical problems in life, learning how to use the law of large numbers will help us in various ways. In future social development, the law of large numbers will play an irreplaceable role. The Law of large numbers will promote the development of human society and lead people to think about the laws behind some seemingly random events.

Academically, the Law of large numbers reveals the relationship between probability and frequency of random events, so it is an important theoretical basis of probability theory. The Law of large numbers starts from the average value of a large number of measured values and discusses and reflects the stability of the arithmetic mean value and the frequency. It affirms the rationality of using arithmetic mean instead of mean and frequency instead of probability. The law of large numbers not only validates the rationality of some hypotheses in probability theory but also provides a theoretical basis for inferring population distributions with samples in mathematical statistics.

3. The application of Bayes' law in life

Bayes theorem is a mathematical tool to calculate conditional probability or to extract probabilities from a conditional relationship. In Bayes theorem, A and B will not be random, but rather dependent on each other. It allows us to use the knowledge of outcome A in order to infer something about the cause B.

$$P(B|A) = \frac{P(A|B)P(B)}{P(A)}$$

Mathematically Bayes Theorem is that the probability of B given A equal to the probability of A given B times probability B divided by the probability of A. To explain it, we assume that A is a certain symptom, and B is a disease and we want to know the probability that someone has a certain disease given that they have the symptoms. Bayes theorem tells me that the way I can calculate this, is by first knowing the probability that symptoms occur if you have that disease which is A given B $P(A|B)$ then we need to know the probability of having the disease in general population $P(B)$ and the probability of the symptoms in the general population $P(A)$. Finally we can know the probability of have a certain disease given that have the symptoms $P(B|A)=P(A|B)*P(B)/P(A)$. Similarly, Bayes theory can be used in many medical tests, provided that the necessary probabilities are known.

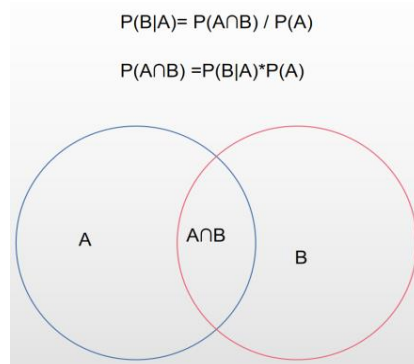


Figure 1. The probability of B occurring if A has already occurred

Bayes theorem can be used to some daily activities, for example, a primary school held an Open Day for parents. There is a student P, P's parents were welcome to join the activity. The probability of P's mother attending is 80%. If the mother participates, the probability of the father participating is 30%; If the mother does not participate, the probability of the father participating is 90%. Find:

- (1) The probability of both parents attending;
- (2) The probability of the father participating;
- (3) The probability of requesting the participation of the mother under the condition that the father is known to participate.

Assume that A is the probability of the mother attending, and B is the probability of the father attending. We can know that $P(A)=0.8$, $P(B|A)=0.3$, and $P(B|\bar{A})=0.9$.

$$P(AB)=P(B|A)*P(A)=0.24$$

By Bayes theorem

$$P(B|A)=P(A|B)*P(B)/P(A)=0.9 \quad P(B|\bar{A})=P(\bar{A}|B)*P(B)/P(\bar{A})$$

$$P(\bar{A})=0.2$$

$$\text{Since } P(A|B)+P(\bar{A}|B)=1$$

$$P(B)=P(B|A)*P(A)+P(B|\bar{A})*P(\bar{A})=0.42$$

$$P(A|B)=P(B|A)*P(A)/P(B)$$

After understanding Bayes theorem, we can predict the probability of unknown events from known information. This method applies not only to natural phenomena but also to the analysis and prediction of social phenomena and human behavior. It can help us make more accurate and reliable predictions and decisions. In conclusion, Bayes' theorem is an important mathematical tool that can be widely used in various fields to help us better understand and solve unknown problems.

4. The application of classical models of probability in life

If we talk about probability theory, we can't go around classical probability. As the oldest probability model in probability theory, classical probability plays an important role in the whole system of probability theory. At the same time, in life, there is also the shadow of classical concepts everywhere. The so-called classical probability is actually another name for equally possible events. In a probability calculated with classical probabilities, the probability of the outcome is finite, not infinite, and the probability of each possibility occurring is the same. It requires only one calculation and can produce accurate results, unlike other types of probability, which require a large number of repeated experiments. This type of probability is very common in life. For a question like a coin flip is equally likely to be heads and tails, and there are only two outcomes: heads and tails. Therefore, the probability of heads does not need to be obtained through repeated tests, but can be obtained through a calculation, the probability of heads is 50%. Romanovsky did an experiment with a coin flip where there were 80,640 flips, 39,699 heads, 40,941 tails [5], and as we continue to flip the coin we know that heads and tails tend to be the same number of times as the total number of flips, so the probability of flipping both sides of the coin is 50%. Another classical model is a six-sided die, and since the probability of flipping each side is equal, we can use the classical scheme to find the

probability of getting each point after rolling multiple dice, that is, each side has a $1/6$ chance of being flipped. Similarly, classical probability can be used to solve the problem of genetic probability in medicine. For example, parents each carry the genes that control whether the eyelids are double eyelids, and the genes are Aa, that is, the memories given to parents by grandparents and grandparents are the superposition of dominant genes and recessive genes. When you want to calculate the probability that a child is not born with double eyelids, you need to use the classical probability calculation method, enumerating all the possibilities one by one, there are four, the child inherited from both parents are dominant genes, then the child must be double eyelids, are recessive genes, not double eyelids, inherited the father's recessive genes, the mother's dominant genes, The result is double eyelids, but carrying the recessive gene for single eyelids, inheriting the recessive gene from the mother, the dominant gene from the father, and the result is double eyelids, but carrying the recessive gene for single eyelids. From this inference, it can be seen that the probability of the child having a single eyelid is 25%. This is also the use of classical models of probability in life.

From this figure, we can learn that the double eyelid is the dominant gene A and the single eyelid is the recessive gene a. For recessive gene, only when receive from both parents does the recessive gene show its characteristics, that is, only when the gene combination is aa does the single eyelid characteristic appear. Both parents' genes are Aa combined to form double eyelids, so the children they give birth to have four possibilities: AA, Aa, Aa, and aa. According to the classical model, we know that the total number of events is 4, and the number of single eyelids, which is the number of times that the child's gene is aa, is 1 and the probability that two parents with double Aa eyelids will give birth to a child with single eyelids is $P=1/4$.

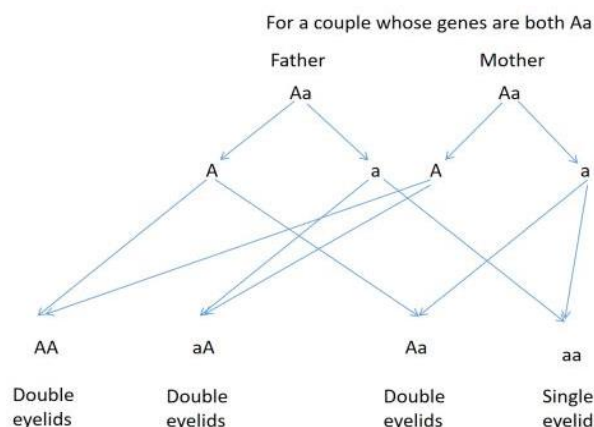


Figure 2. Genetic Formula for Dominant and Recessive Genes

In general, the probability $P(A)$ of the classical model = the number of occurrences of event A/the total number of basic events.

Although classical probability seems to be a very simple theory, it plays an important role in probability theory. Its significance is that it is helpful to understand the concept of probability. When studying such a scheme, the stability of the frequency can be easily verified, and thus the consistency between the stable value of the probability and the theoretically calculated probability value can be easily verified. The existence of probability values is easy for students to understand. Second, it is beneficial to calculate the probability of the event, study the problem in the range of classical probability, and avoid repeated experiments. Finally, this kind of model is widely used in practice, and the classical scheme is everywhere in life. Learning this kind of generalization is helpful to be able to apply the knowledge of statistical phenomena to solve some practical problems.

5. Conclusion

This paper examines the role of probability and statistics in modern life. Probability and statistics play an important role in many areas, and most notable is the Law of large Numbers, Bayes' Law, and classical probability with regards to applications to modern life. Overall, probability statistics, is

an important part of mathematical knowledge, has great application value in real life, which can help people make the best decisions and choices in various economic activities and protect people's fundamental interests. The public should fully realize the importance of probability statistics, strengthen the study of probability statistics, and use the knowledge of probability statistics to provide scientific cognition for themselves.

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