# The Use of Probability Statistics to Address Practical Issues

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**Abstract:** The mathematical approach of probability statistics is used to discover the statistical rule governing the occurrence of random events in the natural world. Probability statistical knowledge has gained popularity as science and technology have advanced, and it is now widely used in industrial and agricultural production, the national economy, as well as day-to-day living. This paper examines the use of probability statistics to resolve real-world issues, focusing primarily on the relevant understanding of the Bernoulli scheme, common school, and mathematical expectation.

**Keywords:** Mathematics expectations, regular school, and the Bernoulli scheme

## INTRODUCTION

As one mathematical branch, the probability statistics has innumerous links with our life[1-6]. People master the nature of things by observing the random phenomena and researching its statistical law, and therefore applying the probability statistics thinking to the practice to guide our behaviors [6]. The following is the practical application of the probability statistics knowledge.

## The application of Bernoulli scheme to the insurance industry

We often contact the social insurance in real life. With people paying more and more attention to the properties, safety, retirement and others of themselves and their family members, the social insurance has received more and more attention.

Take an example: assuming that 2500 people at the same age and social class join the life insurance of some insurance company. On January 1, each of them pays 120 insurance expenses to the company, and the family members can receive 20 thousand insurance benefits from the company when the insured dies. Assuming that the death probability within one year is 0.002, the question is: the probability that "the insurance company losses money" is?

The analysis is: assuming that "whether the people will die or not within one year" is as one test, thus 2500 people take part in this test, then the question turns to be the 2500 Bernoulli scheme, assuming that the death probability of each person within one year is P=0.002,

and that the death record each year of the insured is X, thus

$$P(X = k) = C^k \quad 0.002^k (1-0.002)^{2500-k}$$
$$(0 \le k \le 2500)$$

And assuming that "the insurance company losses money" is the incident A, X is the number of the death toll, then the company shall pay 20000 by X (Yuan), thetotal income of the company shall be 2500 by 120 (Yuan). If the company pays more than its income, that is 20000 by X is greater than 2500 by 120, thus the company will lose money.

Solve the inequation 20000 by X is greater than 2500 by 120, to obtain X is greater than 15. And then $P(A) = P(X > 15) = C^k_{2500}\ 0.002^k (1-0.002)^{2500-k}$ $\approx 0.000069$,

Therefore the insurance company "benefits a lot" and basically will not lose money.

## The application of normal school to selecting the travel routes

The normal school has its extremely broad practical background, which prevails in mathematics, physics, medical science, engineering and other fields, therefore the probability distribution of so many random variables in the practical problems is subject to normal school. For example measuring the random error of the same object in physics; the red blood cell count and the mean corpuscular and others in the medical science; the students' intelligence level in educational statistics; under the certain production

conditions, the caliber, the length and other indexes of the products are all similarly in normal school. Thefollowing is one specific application of normal schoolto selecting the travel routes.

For example: one person takes a ride from some place in Beijing to the Beijing station, there are two routes to choose:

- To take the city bus. The advantage is: the route is relatively short; the disadvantage is: there is the traffic jam, the required time (the unit: minute) is subject to normal school $N(50,10^2)$.
- To take the subway. The advantage is: there is nearly no traffic jam; the disadvantage is: the route is relatively long, the required time is subject to normal school $N(60,4^2)$.

The question is that: if the time available is 68 minutes, which route to choose? If the time available is 62 minutes, which route to choose?

In order to arrive at the station in time, this person utilizes the normal school knowledge to make the following analysis in advance:

If the practical problem satisfies the given standard normal school $N(1,0)$, assuming that $P(\xi < x) = p$, and in accordance with the standard normal school table, the known $p$ can be used to obtain $x$, and also the known $x$ can be used to obtain $p$; and if the problem is not the standard normal school $N(\mu,\sigma^2)$ (as the above example), then in accordance with $\frac{\xi-\mu}{\sigma} \sim N(1,0)$, it can be turned into the standard normal school. Here the time for traveling along the first route is assumed as $\lambda$ minutes, and that for traveling along the second route is as $\eta$ minutes.

(1) Then the probability for traveling along the first route within 68 minutes is $P(\lambda \le 68) = \varphi(\frac{68-50}{10}) = \varphi(1.8) = 0.9641$; and that for traveling along the second route is

$P(\eta \le 68) = \varphi(\frac{68-60}{4}) = \varphi(2) = 0.9772$, and so the second route shall be taken.

(2) The probability for traveling along the first route within 62 minutes is $P(\lambda \le 62) = \varphi(\frac{62-50}{10}) = \varphi(1.2) = 0.8849$; and that for traveling along the second route is $P(\eta \le 62) = \varphi(\frac{62-60}{4}) = \varphi(0.5) = 0.6915$, and so the first route shall be taken.

Our life will virtually concern so many probability statistics knowledge, if we pay attention to the close mathematical knowledge, we will be surprised and find that mathematics plays a great role in the ordinary life.

**The Application of the mathematical expectation to solving the maximum profits**

The mathematical expectation is one numeral characteristic researching the average of the whole value of the random variable. In the practical problem especially the economic decision-making, the mathematical expectation provides the important theoretical basis for the decision-makers to gain the maximum profits. The following is the applying the mathematical expectation to the economic decision-making.

For example: one person invests one million Yuan for one year, and the investment plans to choose are two, the first is to buy the stocks; the second is to deposit with the bank to gain the interest. If buying the stocks, you can gain 400 thousand Yuan under the good economic situation, and 100 thousand Yuan under the moderate economic situation, and loss 200 thousand Yuan under the bad economic situation. If depositing with the bank, assuming that the interest rate is 7.6%, you can gain 76 thousand Yuan. Knowing that the probabilities under the good, moderate and bad economic situation are respectively 30%, 50% and 20%, we should like to ask that which investment plan can make the investors to maximize their income?

The analysis is: we can know from the known conditions of the problem that, when under the good and moderate economic situation, buying the stocks can make relatively great profits; while under the bad economic situation, then depositing with the bank can make relatively great profits. Because that we can by no means predict the economic situation, therefore comparing the expectations of the two investment plans to make profits is necessary.

The expectation of buying the stocks to make profits is calculated that $E_1 = 40\times0.3 + 10\times0.5 + (-20)\times0.2 = 13$ (ten thousand Yuan)

Then the expectation of deositing with the bankto make profits is calculated that $E_2 = 7.6$ (ten thousand Yuan)

Because that $E_1 > E_2$, the expected revenue from buying the stocks is greater than that from depositing with the bank, and the plan of buying the stocks shall be adopted.

We can see that, as for the random risk investment, correctly utilizing the whole characterisitc of the random variable of mathematical expectation to predict profits or make investment decisions is relatively objective.

## CONCLUSION

As a very important branch of mathematics, probability and mathematical statistics is playing its due role under the knowledge industrialization nowadays, and has obtained the breakthrough development in many fields. Such as utilizing the law of large numbers and center-limit theorem can obtain the very precise approximate probability; utilizing variance analysis, regression analysis and other contents can examine whether the averages of several whole values differ greatly, treating and analyzing the interrelation among factors, predicting and controlling the change in relevant factors and others. Therefore, applying the probability statistics knowledge to studying, working and the daily life can help us to obtain the reliable conclusion.

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