Scientific Research

Several Relationships between Math and Life

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Abstract: This paper shows how to use math in our common life from the views of co residual, logic, set and integration.

Keywords: Co residual; logic; set; integration

College math is abstract and there are more and more concepts、theorem and verifications, so plenty of teachers and students are afraid of it. Math just like something that has not been proven to be useful, but it would be wasteful to discard it. This paper will discuss several relationships between math and life to increase our interests in studying math, deepen our understanding for math and then use math to deal with some practical problems in life.

In order to make it easy to understand, this paper avoids mathematical professional terms and reasoning process but provides some simple examples because the writer hopes we can study math easier in order to apply it in common life. In this way, math will be more interesting and we can learn it better.

1 Co residual

First of all, we can see the concept of co residual, that is two integers a and b to divide one integer n(a positive number or a negative number will be ok, generally we say n is a positive number)，its remainder will be the same, remarked as a=b(n),for example1=7(3). It is interesting that as equivalent relation it can classify the whole integer set. For a=a (n); if a=b (n), so b=a (n); if a=b(n) and b=c(n), so a=c(n). The relation that meeting the two integers need of reflexive, symmetric and transitive is called the equivalence relation. If n=3, so The entire integers set can be divided into three classes: the remainder is 0, the remainder is 1 and the remainder is 2, that is $[0]=\{\cdots,-3,0,3,,\cdots\}$、$[1]=\{\cdots,-2,1,4,,\cdots\}$、$[2]=\{\cdots-4,-1,2,5,8,\cdots\}$ .Similarly , if n=4, then the whole integer set can be divided into $[0]$、$[1]$、$[2]$、$[3]$. It seems nothing special, but when necessary it can be used for emergency. The author has such experience: let 82 students do 10 mathematics' topics in a specified time. In order to prevent unequal choices, generally we write 82 signs which are written numbers for 1 to 82 and each topic needs 8 Signs, then cutting paper, writing. It is waste of human and material resources. What is worse, the 82 students are waiting in line to draw lots. It will be very noisy and is waste of time. The author is to do so: let the students sit in accordance with their wishes. At the same time, make a student who is writing better, faster to write the 10 topics on the blackboard and number them, then he goes back to his seat. At the time of writing on the blackboard, the author ask each student to take their two last student numbers to divide by 10, then get the remainder to plus 1. And then the students take their resulting integers to find their own topics which need to complete. In this way, two or three minutes later, the students became quiet. The students who intend to cheat haven't thought the author would use this method, so they only can complete the topics on their own.

There is another example for co residual: you have only a par value of 3yuan and 5yuan (number is unknown)to go shopping, then you can pay anything more than 7 yuan, such as 8 yuan=3yuan +5yuan，9yuan=3yuan+3yuan+3yuan，10yuan=5yuan+5yuan. 8 divided by 3, the remainder is 2; 9 divided by 3, the remainder is 0; 10 divided by 3, the remainder is 1; 10 divided by 3, the remainder is 1. Now we have a positive integer more than 7, such as 123.Because123=41×3+0, 123 and 9 is co residual. In order to find out the regular pattern, 123 is written for $123-9=114=38\times3$. Because $350=116\times3+2$，350 and 8 is co residual, that is $350-8=342=114\times3$. Of course this is undeniable that $350=70\times5$,the same,$577-10=477=159\times3$.If an arbitrary integer divided by 3 the remainder is 1, we find out 10 which is co residual with the arbitrary integer. Then use this positive integer to minus 10, the rest is a multiple of 3, remarked by the equations is n=3q+10(q is a positive integer). Because 3q is a multiple of 3, we can use a par value of 3 yuan to pay and the remaining 10 yuan can be paid by two pars value of 5 yuan, the other two and so on. Another example, some villages and towns have a custom that three days is to be a fair day in cycle. On 1st,Nov. ,place A is a fair day , and on 2nd,Nov. , place B is a fair day, then on 3rd,Nov. ,place C is a fair day, then on 4th, Nov. ,the fair day will return to place A. So on 14th, Nov., the fair day will be in place B because 2=14(3). Co residual actually can bring us some convenience.

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Finally we will see another example: There is a dancing team which needs to transform a rectangular array from 16 people to 23 people. For the two kinds of performances, one should have 4 people as the protagonist, and the other need 5 people. The question is at least how many people will be in the show? We can suppose x, like following : because $x \equiv 4(16), x \equiv 5(23)$, formula（1）. Then $(x,16) = (4,16) = 4$， so $x = 4y$, so $x \equiv 4(16)$, $x \equiv 5(23)$ transform into $y \equiv 1(4), 4y \equiv 5(23)$ ， formula（2）.Because $4 \times 6 \equiv 1(23)$, so formula (2) can be transformed into $y \equiv 1(4), y \equiv 30 \equiv 7(23)$. If $y = 1 + 4t$, so $4t \equiv 6(23)$， that is $t \equiv 36 \equiv 13(23)$， so $y = 1 + 4t = 1 + 4(13 + 23q)$, that is $x = 4y =$. $4 + 16 \times 13 + 16 \times 23q$. The result of formula (1) is $x \equiv 4 + 16 \times 13 \equiv 212(368)$. Thus at least 212 people will be in the show. This example is a bit difficult, so it is not used too much in daily life, but hobbyists of math should be interest in it.

2 Logic

We see some logical reasoning in discrete mathematics such as: $(p \to q) \wedge p \Rightarrow q$. It can be explained like this: if p has q, when we know there has p, then the conclusion will be q. Sometimes there are many problems to disturb our anglicizing in life, so we can use discrete logic reasoning to deal with problems. For example: The policemen is hearing a diamond necklace robbery for a jewelry store and the reconnaissance results are as follows: (1) the salesman A or B steals the diamond necklace; (2) if B is the crime, he（she） does not steal it in shop hours; (3) if A 's testimony is right, then the container would be unlocked; (4) if A's testimony is not correct, then the robbery occurred during shop hours; (5) The container is lock. The question is who will be the thief? It is a little difficult to know who will be the thief in a short time for there are so many Possibilities getting together. In order to make good use of logical reasoning and make our logical reasoning process clearer and more efficient, we should do like this: first of all we symbolize the statements that only including one result, such as p means A is the crime, q means B is the crime, r means the diamond is stolen in shop hours, s means A's testimony is right and t means the container is locked. So the findings can be symbolized as：$p \vee q$； $q \to \neg r$； $s \to \neg t$； $\neg s \to r$； t . Then we will firstly considerate t, that is the container is locked, but if A's testimony is right, then the container will not be unlocked, so we know that A's testimony is not correct, so as to know that the robbery occurred during shop hours. It is certain that the robbery occurred in the business hours, but we have known that if B is the crime, he would not steal in the business hours. So it is sure that A stole the diamond necklace, not B. In order to make it clearer, we can symbolize the logic reasoning like this: $t \wedge (s \to \neg t) \Rightarrow s$ (It is called modus tollendo ponens in discrete mathematics.), and $\neg s$ means A's testimony is not correct. Then $\neg s \wedge (\neg s \to r) \Rightarrow r$, so we know the result is the robbery occurred during business hours. Because $r \wedge (q \to \neg r) \Rightarrow \neg q$, so the conclusion is $\neg q$, that is the crime is A, not B.

3 Set

If the reader is not familiar with this reasoning, we can also use set to analyze. First of all, symbolizing the results like this set A: A is the crime; set B: B is crime; set R: the robbery occurred in business hours; set R: A's testimony is right; set T: the container is locked. So all the results could be written like $A \cup B$， $A \cup B, \overline{B} \cup \overline{R}$ ($\overline{B}$ means B is not the crime), $\overline{S} \cup \overline{T}$， $S \cup R$， T . Then $T \cap (\overline{S} \cup \overline{T}) = \overline{S}$ ， $\overline{S} \cap (S \cup R) = R$ ， $R \cap (\overline{B} \cup \overline{R}) = \overline{B}$, $\overline{B} \cap (A \cup B) = A$ ， so A is the crime.

The number of elements in a finite set can also be like this: there are 25 students in a class, of which 14 students can play basketball, 12 students can play volleyball, 6 students can play both basketball and volleyball, 5 students can play both basketball and tennis, and another 2 students can play the three kinds of ball, while the 6 students who can play tennis also can play another ball, the question is how many students who can play none of the three kinds of ball.

We use $|A|$ to mean the number of elements in set A, so A、B and C is respectively used to mean the set of students who play basketball, volleyball, and tennis . Thus $|A| = 14$， $|B| = 12$， $|C| = 6$， $|A \cap C| = 5$， $|A \cap B| = 6$, $|A \cap B \cap C| = 2$, $|(A \cup B) \cap C| = 6$, so $|A \cup B \cup C| = |A| + |B| + |C| - |A \cap B| - |A \cap C| - |B \cap C| + |A \cap B \cap C| = 23 - |B \cap C|$ .Because $|B \cap C| = |(A \cup B) \cap C| - |A \cap C| + 2 = 3$， the answer is there are three students who can play none of the three kinds of ball. Using the set theory to deal with preambles in life can not only make our thinking more clearly, but also increase our the interest in learning mathematics.

4 Integration

There are two integrals, named Riemann integral and Lebesgue integral, which perplex many students and teachers. In fact, the Riemann integral is mainly concerned for the continuous function. Generally speaking, there are four parts for it : split (split x axis or y axis), product, sum and take the limit, with which we can approximate a trapezoid with curved edge, a column with curved roof, curve arc length , and so on. However, the famous Dirichlet function in section $[0,1]$ is diffident. The real numbers are dense. When we divide $[0,1]$, no matter how small you divide the section, there will be both the rational numbers and irrational numbers in the smaller section, so we cannot confirm the function value is 0 or 1in this section. If we divide the y axis (only including two values: 0 and 1), and there are many x, of which function value is 0, in the section $[0,1]$, and it can be measured. Its measure (as length) m_1 =1, if the function value is 1, then measure m_2 =0, so the function $D(x)$ to the Lebesgue integral value is $m_1 \cdot 0 + m_2 \cdot 1 = 0$ .It seems very abstract and be difficult to understand.

We take counting coins for example. Now you are counting a pile of coins including a par value of 1 points, 2 points, 5 points and 1 yuan .Of course you can either count them one by one, or divide them into four piles according to their par value (as the function value), then count the coins number for each pile (as measure), multiple the numbers and the par value of each pile of coins and add them, then we know the total amount of money. This example can help us to distinguish the difference between two integrals (Riemann and Lebesgue), and understand the necessity of generalizing the Riemann integral to Lebesgue integral. Thus increase our interest in learning Math.

5 More Examples

There are such problems in our life. There are four cities, we have known there are buses in city 1; we can go to city 4 from city 1 by ship; from city 4 to city1we can take bus; from city 2 to city1 we can fly; we can go to city 4 from city 3 by car. There has a common ticket from city k to city j, the question is how many kinds of ticket can be used to show the above routes. We can use the symbols (i, j) to show the city i to j, so the above example can be symbolized like this: $R = \{ (1,1), (1,1), (1,4), (2,1), (3,4), (4,1)\}$. From city i to city j, there has a transfer station, which can be expressed like $R \circ R = \{(1,1),(1,4),(2,1),(2,4),(3,1),(4,1),(4,4)\}$ .If there has two transfer stations, we express like $R \circ R \circ R = \{(1,1),(1,4),(2,1),(2,4),(3,1),(3,4),(4,1),(4,4)\}$. There are four cities, so $R \circ R \circ R \circ R = R \circ R \circ R$ that is there are 8 kinds of tickets can be used to show the above routes for 4 cities. Although this example is interesting and simple, it is very practical, and can be used to do some simple traffic scheduling. There is another example: 200 students will go to the auditorium for meeting. The auditorium has 8 steps and these students should walk for 1 or 2 steps every time. The question is at least how many students will walk the same steps after finishing walking all steps? Symbolized like this: walking on a step written as 1, otherwise is 0. If a student takes 2 steps once time, written as: 01010101.So we express students' walking methods like m_n , then the data is recorded as $m_8 + m_7 + m_6 + m_5 + m_4 = 1 + 7 + 15 + 10 + 1 = 34$. For $\frac{200}{34} = 5 + \frac{30}{34}$, so the answer is there are at least six students will walk the same steps after finishing walking all steps.

6 Conclusion

There are more problems which could be dealt with by the mathematical concept, theorem and mathematical thought method. When learning mathematics, we can link it with our life, and then it could be a win-win result.

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