

Dicey Operations: Our Shared Solution

At first Dicey Operations looks like it is just luck because the die chooses the digits. After we played more rounds, we noticed that it is not just luck. The big idea is place value. The hundreds or thousands column changes the answer the most, the tens column changes it a bit, and the ones column is the last little adjustment.

So our first method is: choose the biggest-value columns first, then use the smaller columns to fix the answer and get it closer to the target.

The main things we noticed

- In addition, it does not matter which row the digit goes in if it is in the same column, because it is worth the same amount. So we sort the digits into the columns first.
- In subtraction, it does matter if the digit is on the top or the bottom. A digit on the top makes the answer bigger. A digit on the bottom takes more away.
- For the default target, do not just make the biggest or smallest answer. Try to make the main column close to the target, then use the tens and ones to get closer.
- For lowest and highest, the method is more direct. Put the important digits in the biggest columns because they are worth the most.

Addition

Add 1 - Default

We tried to make the tens column nearly make 10 tens. If the target is 100, then 90 is already close and the ones column can add the extra bit.

Example/proof: With 7, 2, 1 and 4, we can put 7 and 2 in the tens column and 1 and 4 in the ones column. That gives $71 + 24 = 95$. You could swap digits in the same columns and it would still be 95.

Add 1 - Lowest

To get the lowest answer, put the two lowest digits in the tens column and the two highest digits in the ones column. This works because tens are worth more than ones.

Example/proof: With 7, 8, 7 and 9, the lowest is $78 + 79 = 157$.

Add 1 - Highest

For the highest answer, do the opposite. Put the two highest digits in the tens column, in no particular order, and put the smaller digits in the ones column.

Example/proof: With 9, 8, 6 and 7, we did $97 + 86 = 183$. This is the highest you can get.

Add 2 - Default

In this situation, we need to think about the hundreds column first. If there are smaller numbers, try to make 900 in the hundreds column. If there are bigger numbers, you might need to make 800 and then make the tens column high, like 70, 80 or 90. The ones column is the final adjustment.

Example/proof: $174 + 025 + 801 = 1000$. The hundreds make 900, the tens make 90, and the ones make 10, so the answer is exactly 1000.

Add 2 - Lowest

For the lowest Add 2 answer, put the three lowest digits in the hundreds column. Then put the next three lowest digits in the tens column. The three highest digits can go in the ones column. It does not matter which row they go in inside the same column, because they still have the same value.

Add 2 - Highest

Add 2 highest is the same idea as Add 1 highest, but with hundreds as well. Put the three highest digits in the hundreds column, the next three in the tens column, and the three lowest in the ones column. That gives the biggest total because the biggest digits are worth hundreds, not ones.

Subtraction

Sub 1 - Default

For Sub 1, we were trying to get as close to 10 as possible. We put the highest digit in the tens column on the top row, and the second biggest digit in the tens column on the second row. Then we used the ones column to adjust it.

Example/proof: With 6, 3, 5 and 4, $64 - 53 = 11$. That would work, and $63 - 54 = 9$ would also work. Sometimes it does not land on the exact number, but that does not matter as long as it is the closest.

Sub 1 - Lowest

For the lowest answer, we make the top number as small as possible and the bottom number as big as possible. Put the lowest digit in the top tens column if you can. If you have a 0, put that in the top tens column because that makes the top number much smaller. Then put the biggest digits on the bottom row, especially in the tens column.

Example/proof: $56 - 77 = -21$, which was the lowest for those digits.

Sub 1 - Highest

For Sub 1 highest, put the biggest digit in the top tens column and the next biggest digit in the top ones column. Then put the smallest digits on the bottom row.

Example/proof: $98 - 13 = 85$. We found the highest digit possible and subtracted the smallest number we could make.

Sub 2 - Default

At the start, we found this tricky, but after we found the method it was easy peasy. We started by making the hundreds column close to 100. That means the top hundreds digit should usually be one more than the bottom hundreds digit. Then we try to make the tens and ones cancel out.

Example/proof: $610 - 510 = 100$ exactly.

Sub 2 - Another example

This one gets harder because the nearest-looking answer is not always the best answer.

Example/proof: $131 - 010 = 121$, but $113 - 010 = 103$. 103 is closer to 100 than 121, so 113 - 010 is better.

Sub 2 - Lowest

For the lowest Sub 2 answer, put the lowest digits in the top number and the highest digits in the bottom number. The most important place is the hundreds column, then the tens, then the ones. The reason is that a big digit on the bottom takes away a lot more, so the answer goes lower.

Sub 2 - Highest

For the highest Sub 2 answer, do the opposite. Put the highest digits in the top number and the lowest digits in the bottom number. Make the top hundreds digit as big as possible and the bottom hundreds digit as small as possible.

Sub 3 - Default

Sub 3 is the same method again, but with thousands. We try to make the thousands column close to 1000 first. Usually that means putting a top thousands digit that is one more than the bottom thousands digit. After that, the hundreds, tens and ones should cancel out as much as possible, or adjust the answer so it gets closer to 1000.

Sub 3 - Lowest

For Sub 3 lowest, put the lowest digits in the first four-digit number, starting with the thousands column. Then put the highest digits in the second four-digit number, starting with the thousands column. It is like doing the same thing but in the opposite order.

Example/proof: $0122 - 9733 = -9611$, which is very low.

Sub 3 - Highest

For Sub 3 highest, do the opposite of lowest. Put the highest digits in the top four-digit number and the lowest digits in the bottom four-digit number. The biggest digit should go in the top thousands column and the smallest digit should go in the bottom thousands column.

Our final answer

Our final strategy is not to guess. First, sort the digits and think about place value. For addition, choose which column each digit should go in. For subtraction, also choose whether each digit should go on the top or the bottom. The bigger columns decide most of the answer, and the smaller columns help us finish it off.

That is why Dicey Operations is not just a dice game. It is a place value and strategy game.