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Lab 3 Report

1. For an n by n Magic Square, how many distinct numbers will you have?  
     
   For an n by n Magic Square, the amount of distinct numbers will be equal to **n2**. The area of any square can be calculated by the product of its length and width, or, in other terms, by multiplying one of the sides by itself since the length and width are both the same. This is the same with a Magic Square. If a Magic Square has a length of 3 cells and a width of 3 cells, the number of cells comprising the total area of the square will be 3x3, or 32, which is 9. The number of distinct numbers the Magic Square will have is also equal to this number, one specific number for each cell. Following this rule, a 4x4 square will have 16 cells and 16 distinct numbers, a 5x5 square will have 25 cells and 25 distinct numbers, etc.
2. How many ways can the distinct numbers be arranged in an n by n square (when the row/column/diagonal sums are not the magic sums)?

A formula can be used to discover how many ways the distinct numbers can be arranged in an n by n square. This formula would be (**n2)!**. (Derived from **n! / [(n-r)!]**, except in our case **n** will always equal **r**, thus leaving a 1 in the denominator). This is the formula for a permutation where the order of the numbers does matter (ie. 1 2 3 differs from 1 3 2) and there are no repetitions allowed (ie. 1 1 1 or 1 1 2). First the number of distinct numbers in the square is found by way of the area, and then its factorial is calculated. A factorial is the product of all the whole numbers between **1** and **n**. Finding the factorial of the amount of the distinct numbers will give us the number of ways they can be arranged. The number of combinations will be covered since we are multiplying by each of the distinct numbers. Here is a simple example of this idea being used: Suppose we are given the letters “abc” and are told to rearrange them and write them in all of their possible combinations. We can easily find out that there are six possible combinations by taking the factorial of the amount of letters, 3! (3 x 2 x 1). These six combinations would be *abc, bac, bca, cba, cab, and acb.*

1. Is more than 1 “magic sum” possible for an n by n magic square? How many magic sums are possible for an n by n magic square?

No, more than 1 “magic sum” is not possible for an n by n magic square. Only 1 “magic sum” is possible. In order to find the “magic sum” for a Magic Square, you can use the formula **[n ( n2 + 1)] / 2** (<http://en.wikipedia.org/wiki/Magic_square>) where “n” is the number of cells that make up the length/width of the square. There is only one possible answer. When thinking about it, this makes sense. It would be almost impossible to have more than 1 “magic sum”. You would have to have an infinite amount of distinct numbers at your disposal in order to even be close to having that possibility.

1. How many of the arrangements in question 2 are correct Magic Squares – i.e. the row/column/diagonal sums are the magic sums?

There is no specific formula you can use to find the number of Magic Square arrangements out of the total amount of arrangements. However, you can find some of them individually. Of the 36880 arrangements offered by a 3x3 square, only 8 of them are correct magic squares. This is because you can reduce 15 in a sum of three numbers eight times. They are all rotations or reflections of one truly unique magic square.