Calendar Dice

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Figure 1: Sample desktop perpetual calendar. The 2 six-sided die are used to show the current date.

1 Introduction

We will be exploring how 2 six-sided die can be used to show the date in a perpetual calendar. We will develop a C++ program that will locate all valid dice configurations out of a potential 10^{12} combinations in less that 1 minute.

2 Analysis

Desktop perpetual calendars often use a pair of 6-sided die to show the date (see Figure 1). These calendars are offered on-line for relatively low prices[1]. The intriguing question is, how many possible combinations of the digits 0 through 9, spread across the 2 6-sided die are there to represent the dates 1 through 31?

2.1 Constraints

The constraints of the problem are:

1. There are 2 die.

2. Each die has 6 sides.

3. The range of digits necessary are 0 through 9 inclusive.

4. The one die represents 10s.

5. The other die represents 1s.

6. The range of values for the first and second die is a minimum of 1 through 31 inclusive.

2.2 Detailed analysis

Every reasonable effort must be made to reduce the number of possible die combinations to be evaluated.

- Because each die has 6 sides, the number of decimal values that could be encoded on a die is 10^6 (or 1,000,000).

- Because the numbers on a die can be viewed as a set where the die numbers $\{1\ 2\ 3\ 4\ 5\ 6\}$ and $\{2\ 1\ 3\ 4\ 5\ 6\}$ are equivalent. The number of unique sets is 5,005.

- Because each die digit combination could be paired with any other die combination, the total number of pairings is 25,050,025.

- Because each dice combination has to have all digits 0 through 9 (where 6 and 9 are the same, just inverted[2]), we can eliminate 12,460,000 dice pairings.

2.3 Execution

Evaluating the remaining pairing combinations, there are 20 possible solutions (see Table 1).

Evaluating the possible pairing solutions, and recognizing that 6 and 9 are the same (one is the inverse of the other), there are 12 truly unique pairing combinations (see Table 2).

Program execution time to arrive at the unique gross combinations was less than 1 minute on a 3.1GHz computer. The Unix based C++ program to replicate these results in the Files section (see Section A).

Table 1: Gross possible die values. The values represent the digits on the 6 faces. By taking one die as representing the 10s, and the other die the 1s, all dates between 1 and 31 are possible. Other non-dates are possible as well. Cells of the same color have the same values when the die values of 6 and 9 are considered the same.

Die #1	Die #2	Die #1	Die #2
012345	012678	012345	012789
012346	012578	012349	012578
012347	012589	012347	012568
012348	012579	012348	012567
012356	012478	012359	012478
012357	012489	012357	012468
012358	012479	012358	012467
012367	012458	012368	012457
012378	012456	012378	012459
012379	012458	012389	012457

Table 2: Reduced possible die values. The values represent the digits on the 6 faces. By taking one die as representing the 10s, and the other die the 1s, all dates between 1 and 31 are possible. Other non-dates are possible as well. The colored cells are possible dice combinations that match the background image on the title page (see Figure 1).

Die #1	Die #2
012345	012678
012346	012578
012347	012589
012348	012579
012349	012578
012356	012478
012357	012489
012358	012479
012367	012458
012368	012457
012378	012459
012389	012457

3   Conclusion

We examined all possible combinations of the digits 0 through 9 inclusive on 2 six-sided dice to be used as part of a perpetual date calendar. We found the 12 unique die numberings that can be used to represent the dates 01 through 31 inclusive using a C++ program that took less than 1 minute to execute.

A   Miscellaneous files

A collection of files used in the creation of this report.

- A C++ program used to create and analyze die values 📎

The embedded files can be extracted using an Adobe reader tool. The files may not be extractable using a web browser.

References

[1] Amazon Staff, *Small wooden desk blocks calendar - perpetual block month date display home office decoration*, `https://www.amazon.com/Small-Wooden-Desk-Blocks-Calendar/dp/B07L9XR8L1`, 2021.

[2] GeeksforGeeks Staff, *Puzzle 23 — (days of month using 2 dice)*, `https://www.geeksforgeeks.org/puzzle-23-days-of-month-using-2-dice/`, 2021.