1. THE SUDOKERSON MATRIX

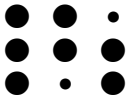
Sudoku, as you know, involves a 9 x 9 matrix of cells, which can be thought of either as (a) nine horizontal rows, (b) nine vertical columns, or (c) nine 3 x 3 boxes. Starting from a given handful of numbers, the object is to find numbers for the blank cells so that all of the nine rows, all of the nine columns, and all of the nine boxes, each contain a complete set of digits from 1 through 9. In a classical Sudoku puzzle, starting digits are positioned in a symmetrical manner around the center of the matrix, although two symmetry-related digits do not have to be the same. All of the puzzles in this book at least approximate this symmetry. Some more recent computer-generated examples abandon symmetry entirely and distribute digits at random across the matrix, but I frankly find these less interesting.

The trick in solving a Sudoku puzzle is to keep track of digits that cannot be allowed in each empty cell, and eventually to determine the sole digit that can occupy that cell. It is a process of elimination. Playing on the usual small published newspaper Sudoku layout makes it difficult to keep track of what can, and cannot, be allowed. To make life easier, I have designed the Sudoku matrix shown as Plate 1.1. (Make Xerox copies of Plate 1.1 for your own use.) For ease of reference, the nine rows are labeled 1 through 9, and the nine columns are labeled A through I. The central cell, for example, is cell E5, and the cell in the lower right corner is I9.

Double lines separate the nine 3 x 3 boxes, numbered 1–9 as at the foot of Plate 1.1. Hence for example, cell C9 occupies the lower right corner of box 7, and G1 sits at the upper left corner of box 3. Each of the 81 cells has nine dots, symbolizing the digits:

1 2 3
4 5 6
7 8 9

A crossed-out or otherwise marked dot within a cell indicates that this particular digit is not allowed because it clashes with the same digit found elsewhere in the row, column or box containing that cell. I have found that the quickest and simplest plan is to cancel dots by marking them with a fine-tipped red felt pen. If • indicates one of the original 3 x 3 dots and ● is a cancellation by marking pen or other means, then the following array tells you that the only possible digits remaining for that cell are 3 or 8:



When you figure out what a given cell must contain, you can then overwrite the correct digit in black.

Bill Chapin showed me how to display the Sudokerson matrix on a laptop computer using the *Excel* program. His version of Plate 1.1 is displayed in Plate 1.2, which shows how you can place numbers of any size and style wherever you want. In

row 1 are five different sizes of the same digit, and row 2 displays the open-outline format that I find convenient to identify the clashing digits in a failed trial. Row 3 demonstrates how two through six digits can fit into one cell. A matrix with the starting digits large and all undecided cells blank can be used exactly as the original matrix in Plate 1.1.

But there's yet another advantage to the Excel program that will become useful later. Rows 4, 5 and 6 of Plate 1.2 show a portion of a Sudoku in which the starting digits are in large type, and each cell that is initially unspecified has all nine possible digits. Instead of marking a 3x3 array of dots, on a laptop computer one can simply delete digits that clash with other known digits. To illustrate this, in rows 7, 8 and 9 below it, I have cancelled all the digits that clash with the starting set, as though this was some kind of mini-Sudoku. Every digit but 4 has been canceled in cell E7, so as a starting point make that digit full-size and then continue the search.

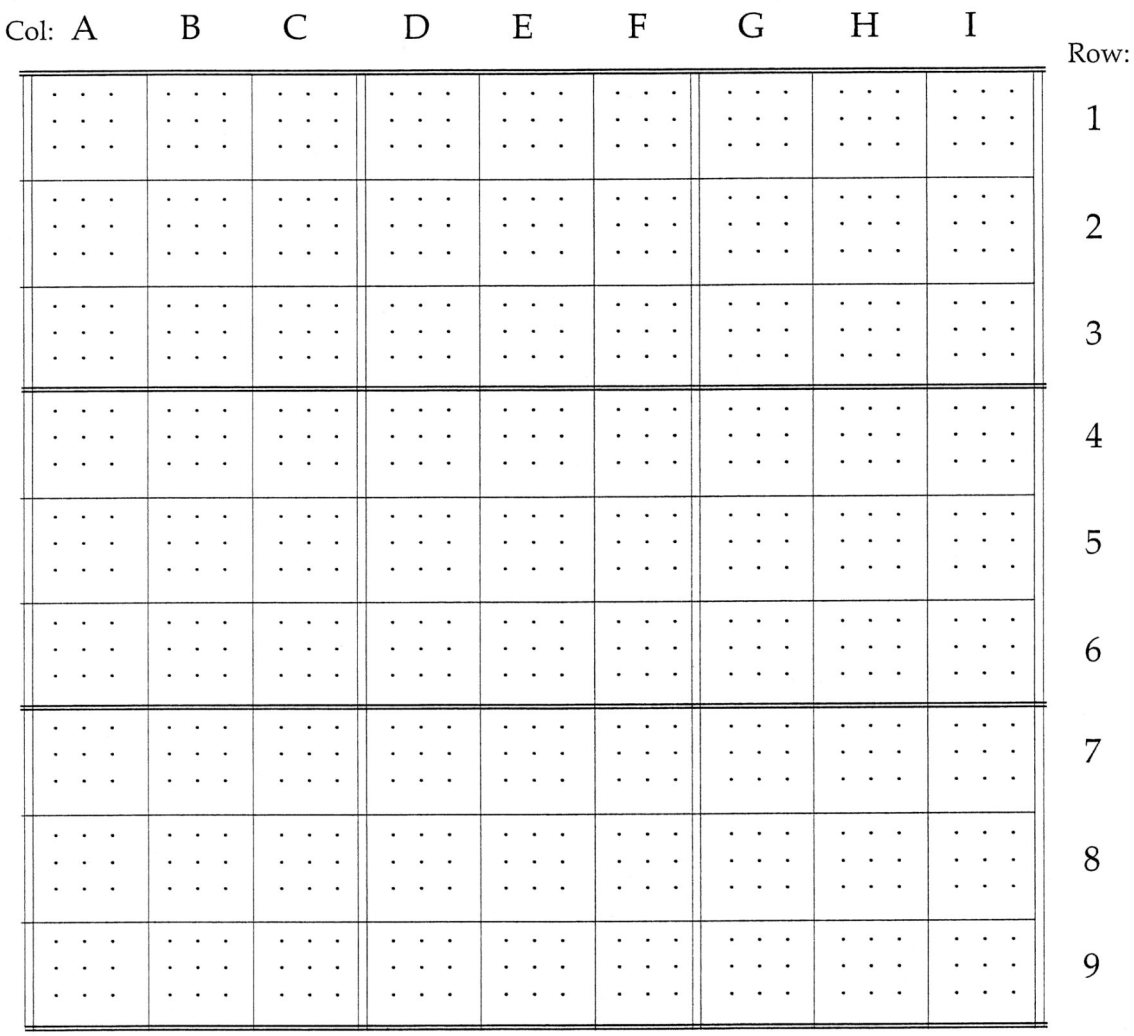
The *Excel* matrix is particularly useful in the later stages of solving a Sudoku puzzle, after more than half the digit possibilities have been eliminated. In the initial stages, running a felt tipped marking pen down a hard copy of Plate 1.1 is faster and easier than manipulating the matrix on the computer. But there comes a time when the choices remaining are few but confusing, and it helps to change from Plate 1.1, which shows you which digits cannot be used, to Plate 1.2, which can keep track of which digits are still possible.

The next four chapters describe strategies for solving Sudokus that are rated Easy, Medium, Hard and Diabolical. For the Easy chapter we will use only the hand-drawn matrix of Plate 1.1. For the Medium and Hard chapters we will place the starting digit set in an Excel matrix, but then cross out forbidden digits as before. For later chapters we will go over completely to the computer deletion of forbidden digits as in the middle and bottom thirds of Plate 1.2.

Bill Chapin's *Excel* computer display is an enormous asset when solving the most difficult levels of Sudoku puzzles. Make no mistake; it is not a puzzle-solving program *per se*, since you still have to do all the thinking for yourself. But its ability to add and remove digits quickly, to enlarge or shrink them, or display them in special formats, is an immense help in rapidly recording what you are thinking. Because it helps terminate a Sudoku solution in record time, I call it the Chapinator, after our illustrious California governor. The advantage of the Chapinator over hand-drawn hard copy solutions is analogous to the advantage of the printing press over hand illuminated books. You don't have to use *Excel* to solve Sudokus by the methods used in this booklet, but it helps.

THE SUDOKERSON MATRIX

Plate 1.1: Original version of the Sudokerson matrix for handwritten solutions



Boxes:

1	2	3
4	5	6
7	8	9

Plate 1.2: The Excel Matrix

Col: / Row:	A	B	C	D	E	F	G	H	I
1	5	5	5	5	5		1	2	3
2	5	5	5	5	5		4	5	6
3	4 5	4 5 6	4 5 6 7	4 5 6 7 8	4 5 6 7 8 9		7	8	9
4	7	1 2 3 4 5 6 7 8 9	1	9	1 2 3 4 5 6 7 8 9	2	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	5
5	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	6	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9
6	4	1 2 3 4 5 6 7 8 9	1 2 3 4 5 6 7 8 9	8	1 2 3 4 5 6 7 8 9	3	1	1 2 3 4 5 6 7 8 9	9
7	7	3 6 8	1	9	4	2	3 4 6 8	3 4 6 8	5
8	2 3 5 8 9	2 3 5 8 9	2 3 5 8 9	1 4 5 7	6	1 4 5 7	2 3 4 7 8	2 3 4 7 8	2 3 4 7 8
9	4	2 5 6	2 5 6	8	5 7	3	1	2 6 7	9