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Testing Stefan's Matrix Multi-Tool Program for the HP-35s

*Message #1 Posted by **Palmer O. Hanson, Jr.** on 17 Jan 2008, 10:30 p.m.*

In a thread starting on of November 2, 2007 Stefan Vorkoetter announced that a Matrix Multi-Tool program for the HP-35s was available at his site http://www.stefanv.com/calculators/hp35s_matrix_multitool.html . The only test results reported in the thread were for the determinant of a 6x6 Hilbert matrix and a modified 6x6 Hilbert where each term has been multiplied by 27720. This submission presents additional determinant calculations with both Stefan's program and with other machines. The exact determinants are provided followed by the calculated determinants and the relative errors of the calculated values. For each test case the results are listed in the order of decreasing relative error. The results show that Stefan's HP-35s program yields determinants which are always very close to those obtained with another 12 digit machine such as the HP-28S and are only bettered with machines which use more digits.

Modified 6x6 Hilbert where the multiplier is 27720:

```
Exact        2,435,091,120
HP-35s       2,435,091,262.15        5.84E-8
HP-28S       2,435,091,046.63        3.01E-8
TI-85        2,435,091,108.7971      4.60E-9
HP-48G       2,435,091,119.56        1.81E-10
```

Modified 7x7 Hilbert where the multiplier is 360360:

```
Exact       381,614,277,072,600
HP-28S      381,615,844,742,xxx      7.06E-5
HP-35s      381,613,558,746,xxx      1.88E-6
TI-85       381,614,296,892,56x      5.19E-8
```

Modified 8x8 Hilbert where the multiplier is 360360:

```
Exact          778,350,798,225
HP-35s         777,765,489,858          7.52E-4
HP-28S         777,765,489,858          2.78E-4
TI-85          778,356,750,393.68       7.65E-6
```

Modified 9x9 Hilbert where the multipler is 12,252,240 where the twelve digit "exact' value listed in the table is actually a rounded value from the exact determinant 6,048,061,401,328,975,508,480:

```
Exact      6.04806140133E21
HP-35s     6.05382043333E21          9.52E-4
TI-85      6.05196898219E21          6.46E-4
HP-28S     6.04575974478E21          3.81E-4
```

where I admit that I was surprised to find that the exact value for the 8x8 case was shorter than the exact value for the 7x7 case.

In early 2005 there was a series of threads comparing the calculated results from various machines for various tests. At one point Valentin Albillo expressed his dissatisfaction with tests using matrices made up of Hilberts, sub-Hilberts and modifications since they involve matrices which have "... both very large elements and very small ones at the same time, i.e., very unbalanced, which is not a fair test ...". He proposed use of the following 7x7 matrix which has a determinant of exactly 1 and was designated as Albillo 1 :

```
58  71  67  36  35  19  60
50  71  71  56  45  20  52
64  40  84  50  51  43  69
31  28  41  54  31  18  33
45  23  46  38  50  43  50
41  10  28  17  33  41  46
66  72  71  38  40  27  69
```

Valentin commented that "... If you're aware that the matrix is difficult to begin with (like those nasty-looking Hilbert matrices), you may be forewarned to extensively check the accuracy of the results you get. But if you happen to inadvertently stumble uponj such an 'innocent' looking matrix as this one, blindly trusting your results can result in cataatrophic failure. ..."

```
HP-15C          1.080204421          8.02E-2
HP-71B          0.97095056196        2.91E-2
HP-28S          0.970960198039       2.91E-2
HP-35s          1.00282960115        2.83E-3
CC-40:          1.0028267103..       2.83E-3
TI-95           1.0006767082..       6.77E-4
TI-85           0.999646804338       3.52E-4
HP-48G          0.999945522778       5.45E-5
```

In a subsequent submission I will present comparative results for matrix inversions and linear equations. You willl see that the Hp-35s results are comparable to those obtained with the HP-28S, but only if iterative refinement is not used with the HP-28S. In the meantime if you want to see more of the April 2005 results you can go to directly to http://www.hpmuseum.org/cgi-sys/cgiwrap/hpmuseum/archv015.cgi?read=72366

Re: Testing Stefan's Matrix Multi-Tool Program for the HP-35s

*Message #2 Posted by **Walter B** on 18 Jan 2008, 7:37 a.m.,*

in response to message #1 by Palmer O. Hanson, Jr.

> Quote:
>
> ```
> HP-28S           0.970960198039
> ```

FWIW, I get exactly the same result on my **HP-42S** for AlbilloMatrix1 (hence called AM1).

Edited to include more results of the 42S:

```
det(AM1) = 0.970960198039      det(AM1^-1) = 0.999174878211
det(AM2) = 1.04724620039       det(AM2^-1) = 0.957596502668
det(AM3) = 0.914586459198      det(AM3^-1) = 1.22237326795
```

Pretty terrific.

And now the good news: **Free42Decimal** calculates all these determinants = 1 exactly and delivers integers for all elements of the inverted matrices in microseconds :)

Kudos to Thomas Okken!

Edited: 20 Jan 2008, 6:37 p.m. after one or more responses were posted

Re: Testing Stefan's Matrix Multi-Tool Program for the HP-35s

*Message #3 Posted by **George Bailey (Bedford Falls)** on 18 Jan 2008, 8:20 a.m.,*
in response to message #1 by Palmer O. Hanson, Jr.

The determinant of 'Albillo 1' on the 49G+ is exactly 1, on the 50G the same ;-)

On the TI-89 Titanium I get .99971836

Casio's Algeba FX 2.0 yields 1.000000097

Edited: 18 Jan 2008, 8:43 a.m. after one or more responses were posted

Re: Testing Stefan's Matrix Multi-Tool Program for the HP-35s

*Message #4 Posted by **Walter B** on 18 Jan 2008, 8:41 a.m.,*
in response to message #3 by George Bailey (Bedford Falls)

George, did you switch "exact mode" OFF? Please see the old thread mentioned above ;)

Re: Testing Stefan's Matrix Multi-Tool Program for the HP-35s

*Message #5 Posted by **George Bailey (Bedford Falls)** on 18 Jan 2008, 8:46 a.m.,*
in response to message #4 by Walter B

> Quote:
>
> George, did you switch "exact mode" OFF? Please see the old thread mentioned above ;)

;-)

In R= the result is 1

In R~ the result is 1.

(And yes, I multiplied it with 1.)

Edited: 18 Jan 2008, 8:56 a.m.

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