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More information on the Albillo Matrices

Message #1 Posted by ***Palmer O. Hanson, Jr.*** *on 4 July 2005, 11:34 p.m.*

In his April 26 submission "More Matrix Results on HP and TI Machines" Valentin Albillo proposed a seventh order matrix to be known as "Matrix No. 1" as a better test of computation capability than a seventh order Hilbert. In another April 26 submssion "There you are" Valentin proposed two more seventh order matrices, "Matrix No. 2" and "Matrix No. 3". In an April 27 submission "(LONG) Commented Results for HP-71B (and HP-15C)" he published the exact inverse for his No. 1 matrix. Exact inverses for matrices No. 2 and No. 3 have not been published to date. The exact inverses for those matrices as calculated using the exact mode on the HP-49 are:

```
Exact Inverse for Albillo's Matrix No. 2 :


 193969587   693099  -1665228   3111895  -14779418   67861431   -194191637
      7798       28       -67       125       -594       2728        -7807
    -64638     -231       555     -1037       4925     -22614        64712
    504013     1801     -4327      8086     -38403     176332      -504590
  -4282933   -15304     36769    -68712     326336   -1498410      4287836
  25738861    91971   -220968    412934   -1961160    9004896    -25768326
-193970402  -693102   1665235  -3111908   14779480  -67861716    194192453
```

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Exact Inverse for Albillo's Matrix No. 3:


 294228951   702720  -1942323   4764003  -21337482   76325631  -294398186
     12108       29       -80       196       -878       3141      -12115
    -90417     -216       597     -1464       6557     -23455       90469
    512920     1225     -3386      8305     -37197     133056     -513215
  -4325606   -10331     28555    -70038     313693   -1122101     4328094
  36887482    88100   -243509    597263   -2675080    9568944   -36908699
-294230620  -702724   1942334  -4764030   21337603  -76326064   294399856
```

I had previously noticed that the first and last elements for every row and every column of the inverse of Matrix No.1 were approximately equal and larger than any other element in the row or column. I was surprised to see the same characteristic in the inverses of Matrix No. 2 and Matrix No. 3. When I looked more closely at the inverses I saw patterns in the individual inverses and among the inverses. The following table shows the results when I divide each element of the seventh row of Matrix No. 1 by the corresponding element of the sixth row, and do the same for the seventh and sixth column.

Element	row 7 / row 6	col 7 / col 6
1	-7.32762314181	-3.19606552693
2	-7.32758186686	-3.19586894587
3	-7.32762522837	-3.19606732481
4	-7.32762448362	-3.19606423358
5	-7.32762198907	-3.19606453553
6	-7.32762262334	-3.19606533695
7	-7.32762303367	-3.19606551596

I found similar consistencies in every set of ratios that I tried. If I do the row 7 divided by row 6 calculations for the inverses of Matrices No. 2 and No. 3 I get ratios of -7.53609... and -7.97643... If I do the column 7 divided by column 6 calculations for the inverses of Matrices No. 2 and No. 3 I get ratios of -2.861... and -3.857... .

When I worked with problems like the one near the end of Kahan's "Mathematics Written in Sand" , namely an 8x8 modified Hilbert where A(i,j) = 360360/(i + j - 1) I recognized that the test matrix was symmetric and expected that the exact inverse would also be symmetric, which it was. I could also see evidence of approximate symmetry in the non-exact inverses as delivered from my HP-28S and TI-59. So, I was surprised to find that I could see patterns in the inverses of the Albillo matrices while I could not see patterns in the original matrices that Valentin had described as random. .

In the thread that introduced the Albillo matrices Werner asked twice for information on how the matrices were formed. I, too, would like to have more information on how these matrices were formed.

Re: More information on the Albillo Matrices

Message #2 Posted by ***Marcus von Cube, Germany*** *on 5 July 2005, 3:13 a.m.,*
in response to message #1 by Palmer O. Hanson, Jr.

> Quote:
>
> So, I was surprised to find that I could see patterns in the inverses of the Albillo matrices while I could not see patterns in the original matrices that Valentin had described as random.

I guess they just *look* random. I think Valentin has taylored the matrices in a way that computing the inverse yields to many differences of non integer numbers with very close values. In each such a subtraction a nonexact computer/calculator looses much of its accuracy.

Since the algorithms normally include pivoting (swapping rows or columns to avoid such situations) he must have done serious detective (or engineering) work!

Re: More information on the Albillo Matrices

*Message #3 Posted by **Valentin Albillo** on 27 July 2005, 6:01 a.m.,*
in response to message #1 by Palmer O. Hanson, Jr.

Hi, Palmer:

Sorry for not answering sooner but first I missed your post entirely, then was far too busy to be able to answer.

Thanks for your interest in my AM matrices, you can find a whole article on the subject in the very next August-September issue of Datafile, which not only discusses AM#1, #2, and #3 but introduces the yet unpublished AM#7, which is truly deadly as you'll see in the article.

So much so, indeed, that a **Mathematica(tm)** session is included as well to deal with it, because otherwise all you get is pure, meaningless *garbage* with the results having *no correct digits at all*. Instability problems are discussed and very graphically demonstrated for this AM#7 matrix. As the article discusses, *even using **Mathematica(tm)*** seems rather pointless in some particular AM#7 scenarios.

Hope you'll enjoy it.

Best regards from V.

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