fiddling the system. In effect the program only allows one source of funds (the bank account). The upshot of all this is that if you use this package, you will not be able to reconcile the accounts produced by the program back to your bank statement, or your Access statement, or any other statement.

Another point to bear in mind generally when you are looking at this kind of very detailed system is that you will need lots of self control to log everything you spend. But if you don't do this it will make a nonsense of the whole system.

It is a pity this program has such basic flaws because it is very well presented and works very fast (much faster than many business programs I've seen). It also has the ability to do some analysis on your expenditure which, had it been executed correctly, has the potential to be very useful. Another potentially useful feature is that the program has been designed to work with both a ZX printer and any Centronics compatible printer using the Kempston interface.

Conclusions

So what is the upshot of all this? I think more and more people are looking for something useful to do with their home computers. However, at the moment, I think, this smacks of 'I've got a home computer so I might as well buy the package to give it something useful to do'. This is the reverse of what should happen. You ought to be saying 'I have a problem. Can a computer help?'.

Home accounts is certainly an area in which a home computer could be useful. However in all honesty I can't recommend either of the programs I have tested here. The OCP Finance Manager is full of good ideas but is let down by its execution. The Diamondsoft Home Accounts works, but it operates at such a simple level that I doubt its usefulness. An ideal system would allow analysis of expenditure and some budgeting but would remain easy and quick to use.

If you feel you would benefit from having your home accounts done by your home computer it may be that your best bet is to buy a simple spreadsheet such as Vu-File, and use that.

END

FRACTIONAL APPROXIMATION TO PRIME NUMBERS

New readers start here. The topics dealt with in this column attempt to reach the frontiers of knowledge in number theory with the minimal background information. The problems posed therefore have no complete solution known to the author, and readers are encouraged to submit their attempts at solution, however incomplete they may seem.

A Prime Number is defined to be a positive integer, greater than unity, which is divisible only by itself and unity. Thus the sequence of prime numbers commences 2,3,5,7,11,13,17,19,23,29 . . .

The Modulus of a number, x, written $|x|$, is identical with the Basic function ABS (x) and is defined to be the argument, x, made positive. $|x|=x$, if $x\geq 0$, else $|x|=-x$.

Readers will be familiar with ideas of (i) approximating a real number by a rational number (or fraction), and (ii) approximating a rational number in turn by an integer (or whole number); this latter being the process of rounding off to zero decimal places.

For example:
(i) π is approximately 22/7, $\sqrt{2}$ is approximately 141/100; and
(ii) 22/7 is approximately 3, while 397/400 is approximately 1.

We now ask how good an approximation to a prime number can be obtained using fractions of a restricted kind.

Case (i). If a_1,a_2,b_1 and b_2 are integers less than a given prime number, p, the minimum of

$$d_2=\left|\frac{a_1.a_2}{b_1.b_2}-p\right|$$ is known to be obtained

when $a_1=a_2=p-1$, $b_1=1$, and $b_2=p-2$. Elementary algebra shows this minimum value to be $1/(p-2)$; which may be used to verify the accuracy of any general program written in response to subsequent cases. Thus (12)(12)/((1)(11)) is the best approximation to 13 by fractions of the given type, and differs from it by 1/11.

Case (ii). If a_1,a_2,a_3,b_1,b_2, and b_3 are integers less than a given prime number, p, we wish to minimise

$$d_3=\left|\frac{a_1.a_2.a_3}{b_1.b_2.b_3}-p\right|$$

For example, if $p=13$ then $a_1=a_2=a_3=10$, $b_1=1, b_2=7, b_3=11$, yields the minimum d_3 value of 1/77.

Note. This result should also be used as a test case for any computer program generated in response to the more general problem posed below. There is a conjecture that the minimum of d_3 approaches $1/p^2$ as p tends to infinity: (becomes larger and larger). This case was investigated at Los Alamos c1960 for all prime numbers less than 100,000 — the evidence is consistent with the conjecture.

Problem

Case (n). $n>2$. Here we ask the question how good an approximation is $(a_1a_2a_3 \ldots a_{n+1})/(b_1b_2b_3 \ldots b_{n+1})$ to the prime p, where the a_i and b_i are all restricted to be less than p.

Section (a). Investigate this for a range of n and small values of the prime p, such as the first ten given in the introduction.

Section (b). Select a particular n, chosen with reference to the above results and extend the range of p, attempting to conjecture the limiting behaviour of d_{n+1} as p tends to infinity.

Readers are invited to submit a program, or suite of programs, to investigate this intriguing approximation problem.

All submissions should include program listings, hardware descriptions, run times and output. They will be judged for accuracy, originality and efficiency (not necessarily in that order). A prize of £10 will be awarded to the 'best' entry received. Entries, to arrive by 1 March 1984, to Mr M R Mudge, Room 560/A, Department of Mathematics, University of Aston in Birmingham, Gosta Green, Birmingham B4 7ET.

Harshad Numbers August

Several enquiries showed an interest in this problem. However, no real progress can be reported. Did holidays interfere with computing, since subsequent problems have been very well supported?

I would ask any interested reader who has neither access to *PCW* August 1983, page 108, nor *Repunits and Repetends* by Samuel Yates, 1982, pages 111-112, or who would simply like further discussion to contact me directly, home telephone (0902-892141). Those who have now got results should please submit them by 1 March, 1984, when a deferred prize award will be made.

Note. Submissions can only be returned if a suitable stamped addressed envelope is provided.