New shorter routine available — see SER(a)

File # 3.06.01

Operation Simultaneous Equations (linear)

$$[y_i] = [A]^{-1} [x_i]$$

SER

Use Note; set BT and BH switches to 'NO' to start.

a) Calling Linkage

L : or {100 / 001} β / 1 [L+2] 3ff / [c12] [35f]

L + 1: n 5 (a_{11}) (A_{11}) (077) or (SER:1 + 076)

L + 2: expδ δ [x_1] (L+1) [β]

for symbols see overleaf.

b) Adaptation Link Word

L + 2: 0dc 1Wi[0dc β

c) Storage

j = 221 words plus matrices and solutions allocations.

k = 221 orders

\- constants

9 opstos: 357 to 35f

Requirements and Performance

a) Method of operation floating point, Crout reduction

b) Additional routines required none

c) Range and form of variable real and normalized

d) Accuracy as specified in calling sequence.
Recommended value 10^{-9} i.e. δexp, δ = 11d,8

e) Performance time

.0162 n^2 minutes, for first solutions, including test back substitution.

plus .00722 n^2 + .00288 n minutes, for each iteration. (four usually sufficient)

P.T.O.

NOTES

NOTATION

n = rank of equation matrix (in hexadecimal if greater than 9)

a_{11} = hexadecimal address of the first element of the equation matrix, stored sequentially by rows.

A_{11} = hexadecimal address of the first element of a 'derived matrix' developed during the solution, and of equal dimensions to the equation matrix.

x_1 = hexadecimal address for the first solution.(remaining solutions and determinant are inserted in successive locations)

β = return address on completion of subroutine.

The routine is completely general for any matrix up to 24 x 24, the limit being placed by memory capacity. Upon completion of each solution the routine is ready for a new matrix without requiring reinput.

Matrix Locations

(a) If the iterative convergence procedure is not desired, the specification $a_{11} = A_{11}$ in the calling sequence will conserve memory space at the expense of destroying the original equation matrix, and also cause the routine to transfer out as soon as the first solutions are obtained.

(b) If the iterative convergence procedure is desired, extra memory allocation is necessary for the derived matrix. In this case memory space may still be conserved by placing A_{11}= (SER:1+ 076)in the calling sequence, at the expense of destroying the subroutine for subsequent use.

Use of Breakpoint Switches

Normally the routine substitutes the solutions back into the original equations and continues iteration until this substitution satisfies all the equations to the degree of accuracy specified in the calling sequence (see below). With ill-conditioned matrices however, it is possible that the iterative procedure will converge on approximate solutions inferior to the specified accuracy, in which case the routine will continue to circulate. A manual control has therefore been provided in order to print and examine the approximate solutions, and should be used if the running time greatly exceeds the expectation. This control is obtained as follows;

Normally BH = BT = "NO"

If over-running, switch BT and BH to 'YES'. After the next iteration the routine will print the state of solutions to date in hexadecimal form and halt.

THEN, after examination,

set BT to 'NO' for continued iteration
or set BT to 'YES' for transfer out to β (and deconvert) } and press "RUN" button

Note on Accuracy.

In calling sequence,

δexp, δ = desired accurracy in the form $2^{-\gamma}$, expressed in hexadecimal form exactly as a normalized number except that the mantissa is restricted to one hexadecimal character in length, e.g. 11d,8 $= 2^{-30} \approx 10^{-9}$. With well conditioned matrices, accuracies of $2^{-39} = 10^{-12}$ are attainable on the first solution without any iteration, but for ill-conditioned matrices, accuracy may be limited.

DRS Oct 26th.

Simultaneous Equations Routine (Simplified) $\boxed{\text{SER (a)}}$

(a) Calling Linkage

L	100	8	(L+2)	3ff	35f
L+1	—	5	—	—	001
L+2	—	n	A_{11}	X_1	β

Where n = no. of equations (rank of matrix).

A_{11} = first element of matrix stored by rows with equation - right hand constants stored at the end of each row

X_1 = location of first solution (n solutions followed by determinant)

β = return location

(b) Adaptation Link Word

L+2 09a]Wi[09a β

(c) Storage

154 words plus matrix & solution allocations.

9 opstos 357 to 35f

Requirements & Performance

(a) Method floating point, Crout Reduction.

(b) No additional routines

(c) Real & Normalized Variables

(d) Accuracy Depends on matrix, - make sure the first term is largest and if necessary rearrange the order of the equations to make it so.

(e) Performance time = $.0162\, n^2$ minutes

(f) Further notes Note that original matrix is overwritten and that the n solutions are followed by the determinant.