

the part we have omitted deals with negative and zero values.

```

    DECLARE A(8) REAL DECIMAL FIXED(6,2) INITIAL(20.,10.,5.,1.,.25,
    .1,.05,.01), (AMT_PD,DIFF,COST) REAL DECIMAL FIXED(8,2),
    (I,J,NT) REAL DECIMAL FIXED(3);
    ...

    CHANGE:DO I=1 TO 8;
        NT=0;
        CASH:DO J=1 TO 50;

/* IN THIS LOOP WE DETERMINE THE MAXIMUM NUMBERS OF TIMES THE
   DIFFERENCE IS DIVISIBLE BY THE I(TH) DENOMINATION */
        IF DIFF/(J*A(I))<1 THEN GO TO OUT;
        NT=J;
    END CASH;
/* WE THEN DECREASE THE DIFFERENCE BY THE APPROPRIATE AMOUNT
   AND PRINT THE APPROPRIATE STATEMENT */
    OUT:IF NT>0 THEN DO;
        DIFF=DIFF-NT*A(I);
        IF I=1 THEN
            PUT SKIP(2) LIST(NT,'TWENTY DOLLAR BILLS');
        IF I=2 THEN
            PUT SKIP(2) LIST(NT,'TEN DOLLAR BILLS');
        IF I=3 THEN
            PUT SKIP(2) LIST(NT,'FIVE DOLLAR BILLS');
        IF I=4 THEN
            PUT SKIP(2) LIST(NT,'ONE DOLLAR BILLS');
        IF I=5 THEN
            PUT SKIP(2) LIST(NT,'QUARTERS');
        IF I=6 THEN
            PUT SKIP(2) LIST(NT,'DIMES');
        IF I=7 THEN
            PUT SKIP(2) LIST(NT,'NICKELS');
        IF I=8 THEN
            PUT SKIP(2) LIST(NT,'PENNIES');
    END CHANGE;

```

Consider the variable NT. It always has the value J-1 whenever it is referenced; it is not needed. Worse, its presence helps obscure an important point — the algorithm is wrong.

The inner DO loop (at label CASH) is clearly designed to exit via the IF before the loop completes. But 50 times \$20 is only \$1000, not \$10,000, so an exit can occur from the bottom of the loop. The program will make change poorly at or over \$1020, and incorrectly over \$1820.50.

Whenever a DO loop is designed “never” to exit from the bottom, one should ask:

- (1) Are there any circumstances when an exit from the bottom might take place?
- (2) What happens if such an exit does occur?

The first question points to the typo that made the upper limit of the CASH loop 50 instead of 500; the second question reveals that the program charges straight on after an error. (A judiciously placed error message, plus a comprehensive set of test