This computer program, written in BASIC, performs three different calculations of test reliability: (1) the Kuder-Richardson method; (2) the "common split-half" method; and (3) the Rulon-Guttman split-half method. The program reads sequential access data files for microcomputers that have been set up by statistical packages such as STATPAC. The program is written in MS-DOS BASIC and is intended for use on IBM microcomputers and compatibles. Some of the program's statements may be changed for use on an Apple IIe microcomputer. The bulk of this document contains the main menu program; program flow charts and statements; and lists of variables, arrays, and notations. (GDC)
A BASIC Microcomputer Program for Estimating Test Reliability

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For sometime now social and behavioral science researchers have used SPSS (Nie, 1975) implemented on mainframe computers for their numerical analysis jobs. For most of these researchers the power of a mainframe far exceeds their needs, nevertheless the turnaround time on their "small" jobs is still significant due to the heavy demand on computer center facilities. With the advent of the micro-computer many of these researchers, particularly those in education have found a machine that is both more convenient and efficient for their numerical analysis needs. Almost immediately statistical packages designed for the micro-computer appeared on the market. Perhaps the best of these is "STATPAC" by Walonic Associates (1986). One difficulty with "STATPAC" and several other micro-computer statistical packages is that they do not do test reliability calculations. Of those that do most offer no choice of reliability type, only the Kuder-Richardson 20 formula is used.

There are in fact many ways of estimating reliability but the four most common are the test-retest method, the parallel-test method, split-half methods, and the Kuder-Richardson method. A discussion of these methods can be found in Magnusson (1967). The purpose of this paper is to present a BASIC program that does three reliability calculations: two split-half methods and the Kuder-Richardson method. The program reads sequential access data files that have been set up by statistical packages such as "STATPAC." The program is written in
MS-DOS BASIC intended for use on IBM-type micro-computers. The program has not been copyrighted and anyone who wishes to use it is free to do so.

**Two-Split-Half Methods**

The split-half methods of estimating reliability are actually forms of the parallel-test method. A single test is split in half to form two parallel tests that theoretically measure the same true scores. It is assumed that the two halves have roughly equivalent means and standard deviations. When splitting a test two factors must be considered, item difficulty and item content. It is assumed in splitting a test that the halves are parallel with regard to these factors. In the computer program that follows a test is split by odd and even items. This insures approximately parallel content but not difficulty. The program assumes that the test is homogeneous with respect to difficulty. If that is not the case then the reliability may be underestimated. In this situation the user may wish to reorder the test items according to difficulty so that the odd-even splitting of items results in more truly parallel tests. This will result in a higher reliability estimate. Lastly, the program also assumes that the test is a power test, i.e. there is no significant time limitation.

In the "common split-half" method a correlation coefficient between the two halves is calculated by the formula:

\[
    r_{oe} = \frac{\sum X X - \frac{(\sum X)(\sum X)}{R}}{\sqrt{\frac{2}{(\sum X)^2/R} - \frac{2}{(\sum X)^2/R}}} 
\]

\[
    = \frac{\sum X X - \frac{(\sum X)(\sum X)}{R}}{\sqrt{\frac{2}{(\sum X)^2/R} - \frac{2}{(\sum X)^2/R}}} 
\]
where $X_o$ is the sum of the odd items, $X_e$ is the sum of the even items, and $r$ is the number of items in one split-half test (Glass & Stanley, 1970, p. 114). The reliability estimation is then calculated with the Spearman-Brown formula (Magnusson, 1967, p. 73):

$$r = \frac{nr}{1 + (n - 1)r}$$

where $r_{oe}$ is the correlation coefficient between the two split-halves and $n$ is the number of times the test is increased in length. In the common split-half method the actual test is twice the size of the split-half, therefore $n$ is always 2.

The second split-half method is the Rulon-Guttman method. This method does not necessarily assume that the split-half tests have equal variances. The reliability estimate is based upon the error variance according to the following formula derived by P. J. Rulon:

$$r = 1 - \frac{S^2_d}{S^2_d + S^2_T}$$

where $S^2_d$ is the variance of the differences between odd and even scores (Magnusson, 1967, p. 111). In this program the actual equation used is a refinement of the Rulon equation derived by L. Guttman:

$$r = 4r \frac{S^2}{S^2_{oe} + S^2_{oe}}$$
where $S_0$ is the standard deviation of the odd split-half, $S_e$ is the standard deviation of the even split-half, $\rho_{oe}$ is the correlation between the two halves, and $S_T^2$ is the variance of the whole test (Magnusson, 1967, p. 111). When the variances of the two split-halves are equal then the reliability estimate will be the same as the common split-half estimate. When they are not equal then the common split-half method will systematically give a higher estimate. In this case the Rulon-Guttman method is preferable.

**The Kuder-Richardson Method**

The Kuder-Richardson method is based on the inter-item homogeneity of a test. It is generally used when a test is designed to measure only one trait. Therefore it is a "random parallel test" estimate of reliability as opposed to "parallel test" estimates derived from the split-half methods. In this program the formula used is:

$$r = \frac{S^2 - S}{n - 1} \frac{1}{S_T^2}$$

where $n$ is the number of test items, $S_T^2$ is the test variance, and $S$ stands for item variance (Magnusson, 1967, p. 116). This formula is commonly called the KR-20 estimate of reliability and should not be confused with the KR-21 formula. The KR-21 formula is a more simple calculation but requires the assumption of item variance homogeneity. When the calculations are done by computer the more simple calculation is of no advantage; and since the KR-20 formula is less restrictive it
is used in this program. In this method as the homogeneity of items increases, so does the reliability estimate.

**Program Structure**

The computer program actually consists of three programs. The first is a menu program that shows the user what reliability method options are available and asks for the user's choice. The second program is for the Kuder-Richardson method and the third program is for the two split-half methods. A flow chart showing program structure precedes the code listing for each program. The code listing itself contains explanatory comments. As stated previously the code is MS-DOS BASIC. For use on an Apple IIe the file commands, the LPRINT, PRINT USING, CLS and LOCATE statements, and the variable name lengths would need to be changed.

**The Main Menu**

```
Show Options on Screen
  ↓
Request Choice
  ↓
On Choice GOTO
  ↓
Load KR-20
Load Split-Half
Return to DOS
```
10 CLS    "RELIABILITY MAIN MENU PROGRAM"    FILE NAME = RELI
20 REM    "RELIABILITY MAIN MENU PROGRAM"
30 REM
40 PRINT   "RELIABILITY PROGRAMS"
50 PRINT   "********************"
60 PRINT
70 PRINT
80 PRINT   "1  ................. Kuder Richardson-20"
90 PRINT
100 PRINT   "2  ................. Spit-half Methods"
110 PRINT
120 PRINT   "3  ................. END PROGRAM"
130 PRINT
140 PRINT
150 PRINT
160 INPUT "Enter Number of Choice: ",X
170 REM
180 ON X GOTO 200, 220, 240
190 REM
200 LOAD "KR20",R
210 REM
220 LOAD "SHM",R
230 REM
240 CLS
250 SYSTEM
The KR-20 Method

**NOTATION:**

- \( X \) \text{ test item value where } i \text{ is the number of the item } \text{ of the item}
- \( X^2 \) \text{ square of test item value}
- \( T \) \text{ test score, i.e. the sum of } X, \text{ where } r \text{ is the case } \#
- \( T^2 \) \text{ square of test score}
- \( S \) \text{ variance of test item}
- \( S^2 \) \text{ test variance}

The sums of \( X \), \( X^2 \), and \( S^2 \) are held in arrays.
MAIN MODULE: Lines 10 - 530

Variable List

Enter Test Information from Keyboard

Read Data File

Close Data File

Does Input # of Cases = # in File?

Calculate Variances

Calculate KR-20

Output to Printer/Screen

Load Main Menu

GOSUB 1000

GOSUB 2000

GOSUB 3000

GOSUB 4000

GOSUB 5000
10 CLS
20 REM "Kuder-Richardson -- 20"
30 REM
40 REM
50 REM
60 REM
70 REM
80 REM
90 REM
100 REM
110 REM
120 REM
130 REM
140 REM
150 REM
160 REM
170 REM
180 REM
190 REM
200 REM
210 REM
220 REM
230 REM
240 REM
250 REM
260 REM
270 REM
280 REM
290 REM
300 REM
310 REM

VARIABLE LIST:

R RECORD COUNTER
C CASE COUNTER
RR RECORD COUNTER
NVAR # OF VARIABLES PER RECORD
SumIvar SUM OF ITEM VARIANCES
Tvar TEST VARIANCE
SumSsqSo SUM OF SCORES SQUARED
SumScore SUM OF SCORES
Filen$ DATA FILE NAME
Y$ CORRECT KEYBOARD INPUT
K20 RELIABILITY COEFFICIENT
W$ INKEY$ IN OUTPUT MODULE
P$ OUTPUT TO PRINTER
FrstItem 1ST TEST ITEM
LastItem LAST TEST ITEM
Z # OF ITEMS ON TEST
CC COUNTER FOR NON-TEST VARIABLES
Var$ DUMMY VAR FOR NON-TEST VARIABLES
VAR DUMMY VAR FOR TEST ITEMS

ARRAY LIST:

SUM(ITEMS) SUM OF INDIVIDUAL ITEMS
Score(Cases) SET OF SCORES
SumSqvar(ITEMS) SUM OF ITEM SQUARES
Ivar(ITEMS) ITEM VARIANCES
10 320 REM 330 REM 340 REM ************************************************************
350 REM MAIN MODULE
360 REM ************************************************************
370 REM
380 GOSUB 1000 'ENTER KEYBOARD INFO
390 REM
400 PRINT "READING DATA FROM FILE "';FILEN$
410 GOSUB 2000
420 CLOSE#1
430 IF R<> CASES THEN GOTO 6000 '# OF CASES ERROR
440 PRINT
450 PRINT "CALCULATING VARIANCES"
460 GOSUB 3000
470 PRINT
480 PRINT "CALCULATING KR - 20"
490 GOSUB 4000
500 PRINT
510 GOSUB 5000 'OUTPUT MODULE
520 REM
530 LOAD "RELI", R
GOSUB 1000: Enter Test Information from Keyboard

1. Clear Screen
2. Print Request for:
   - File Name
   - # of cases
   - # of variables
   - # of 1st test item
   - # of last test item
3. LOCATE Command to Position Cursor
4. INPUT Statements for above Info
5. Display User's Input Plus Calculated # of Test Items
6. Is Input Correct?
   - No: Repeat Input
   - Yes: Dimension Arrays
7. Return to Main Module
970 REM  
980 PRINT "ERROR"  
990 STOP  
1000 REM  
1010 REM ENTER KEYBOARD INFO  
1020 REM  
1030 REM  
1040 CLS  
1050 PRINT "KUDER-RICHARSON 20 RELIABILITY PROGRAM"  
1060 PRINT:PRINT:PRINT  
1070 PRINT "ENTER FILE NAME  "  
1080 PRINT  
1090 PRINT "ENTER NUMBER OF CASES  "  
1100 PRINT  
1110 PRINT "ENTER NUMBER OF VARIABLES PER CASE  "  
1120 PRINT  
1130 PRINT "ENTER NUMBER OF FIRST TEST ITEM  "  
1140 PRINT  
1150 PRINT "ENTER NUMBER OF LAST TEST ITEM  "  
1160 LOCATE 5,40:INPUT FILEN$  
1170 LOCATE 7,40:INPUT CASES  
1180 LOCATE 9,40:INPUT NVAR  
1190 LOCATE 11,40:INPUT FRSTITEM  
1200 LOCATE 13,40:INPUT LASTITEM  
1210 CLS  
1220 PRINT USING "FILE NAME =  \\
FILEN$  
1230 PRINT  
1240 PRINT USING "No. OF CASES =  
CASES  
1250 PRINT  
1260 PRINT USING "No. OF VAR'S =  
NVAR  
1270 PRINT  
1280 PRINT USING "No. OF FIRST TEST ITEM =  
FRSTITEM  
1290 PRINT  
1300 PRINT USING "No. OF LAST TEST ITEM =  
LASTITEM  
1310 PRINT  
1320 LET Z = LASTITEM - FRSTITEM + 1  
1330 PRINT USING "No. OF TEST ITEMS =  
Z  
1340 PRINT:PRINT  
1350 INPUT "/ .:E THESE CORRECT (Y/N)";Y$  
1360 IF Y$<> "Y" AND Y$ <> "y" THEN GOTO 1040  
1370 DIM SUM(Z): DIM SCORE(CASES): DIM SUMSQVAR(Z): DIM IVAR(Z)  
1380 RETURN
GOSUB 2000: Read Data File

Initialize Variables
R, SUMSQSC
SUMSCORE

Open Data File

Does 1st Var = 1st Test Item?
Yes

EOF?
Yes

Update Case Counter

"FOR...NEXT STRUCTURE"

Last Test Item?
No

Read Test Item X
Update Array of $\sum X$
Add X to Score (T)
Update Array of $\sum X$

Yes

Update $\sum T$
and $\sum X$

Does Last Test Item = Last Var?
Yes

GOSUB 2300: Read Non-Test Var's into Dummy Var

No

Return to Main Module
1970 REM
1980 PRINT "ERROR!!!!"
1990 STOP
2000 REM ***************************************************************
2010 REM READ DATA
2020 REM ***************************************************************
2030 REM
2040 LET R = 0: LET SUMSQSCO = 0: LET SUMSCORE = 0
2050 OPEN "I", #1, FILE$1
2060 IF FRSTITEM = 1 THEN GOTO 2090
2070 LET 0 = 1: LET W = (FRSTITEM - 1)
2080 GOSUB 2300
2090 REM
2100 IF EOF(1) THEN RETURN
2110 LET R = R + 1: PRINT "R = ";R
2120 FOR C = FRSTITEM TO LASTITEM
2130 INPUT #1, VAR
2140 PRINT "VAR ";C:" = " ;VAR
2150 LET SUM(C) = SUM(C) + VAR
2160 LET SUMSQVAR(C) = SUMSQVAR(C) + VAR^2
2170 LET SCORE(R) = SCORE(R) + VAR
2180 NEXT C
2190 LET SUMSQSCO = SUMSQSCO + SCORE(R)^2
2200 LET SUMSCORE = SUMSCORE + SCORE(R)
2210 REM
2220 IF LASTITEM = NVAR THEN GOTO 2250
2230 LET Q = (LASTITEM + 1): LET W = NVAR
2240 GOSUB 2300
2250 REM
2260 GOTO 2100
2270 REM
2280 PRINT "ERROR!!!"
2290 STOP
2300 REM ***************************************************************
2310 REM RL:.D NON-TEST VARIABLES
2320 REM ***************************************************************
2330 REM
2340 FOR CC = Q TO W
2350 INPUT#1, VAR$
2360 NEXT CC
2370 RETURN

* From lines 2070 and 2230 values are sent to the FOR...NEXT loop at lines 2340 to 2360 so that any non-test variables in the data file in front of and/or behind the test items are skipped.
**GOSUB 3000: Calculate Variances**

Calculate $S^2$ and $S^2_1$

Calculate $S^2_t$

Return to Main Module

**GOSUB 4000: Calculate KR-20**

Calculate KR-20

Is Absolute Value of KR-20 $\leq 1$ ?

- No: Print Error ** Message: END
- Yes: Return to Main Module

** If the sum of the item variances is equal to or greater than twice the test variance then the KR-20 value will be less than -1.0. Therefore the test has zero reliability. **
2970 REM
2980 PRINT "ERROR!!!"
2990 STOP
3000 REM ************************************************************************
3010 REM CALCULATE VARIANCES
3020 REM ************************************************************************
3030 REM
3040 FOR C = FRSTITEM TO LASTITEM
3050 LET IVAR(C) = (SUMSQVAR(C) - ((SUM(C)^2)/R))/(R-1)
3060 LET SUMIVAR = SUMIVAR + IVAR(C)
3070 NEXT C
3080 REM
3090 FOR RR = 1 TO R
3100 LET TVAR = (SUMSOSCO - ((SUMSCORE^2)/R))/(R-1)
3110 NEXT RR
3120 REM
3130 RETURN
3140 REM
3150 REM ************************************************************************
3160 REM CALCULATING KR-20 COEFFICIENT
3170 REM ************************************************************************
3180 REM
3190 LET KR20 = (2/(2-1)) * (CTVAR - SUMIVAR)/TVAR)
3200 IF ABS(KR20) <= 1 THEN RETURN
3210 REM
3220 CLS : PRINT "SUM OF ITEM VARIANCES IS > 2 X TEST VARIANCE"
3230 END
GOSUB 5000: Output to Printer/Screen

Output to Printer/Screen?
   P → Printer
   S → Screen

To Printer?
   Yes → Printer
   No → Main Module
4970 REM
4980 PRINT "ERROR!!!!"
4990 STOP
5000 REM ***********************************************************************
5010 REM OUTPUT
5020 REM ***********************************************************************
5030 PRINT:PRINT:PRINT
5040 PRINT "SEND OUTPUT TO SCREEN ONLY OR ALSO TO PRINTER?"
5050 PRINT
5060 INPUT "ENTER S/P "; PS
5070 IF P$<> "P" AND P$<> "p" AND P$<> "S" AND P$<> "s" THEN GOTO 5060
5080 REM
5090 IF PS = "S" OR PS = "s" THEN CLS : GOTO 5280
5100 CLS
5110 LPRINT "*******************************************************************"
5120 LPRINT "KUDER-RICHARDSON - 20 RELIABILITY COEFFICIENT"
5130 LPRINT "*******************************************************************"
5140 LPRINT
5150 LPRINT
5160 LPRINT USING "DATA FILE NAME \
      \”;FILENS
5170 LPRINT
5180 LPRINT USING "No. OF CASES READ ";";R
5190 LPRINT
5200 LPRINT USING "No. OF ITEMS ";";Z
5210 LPRINT
5220 LPRINT USING "TEST VARIANCE = ";";TVAR
5230 LPRINT
5240 LPRINT USING "SUM OF ITEM VARIANCES = ";";SUMIVAR
5250 LPRINT
5260 LPRINT USING "KR-20 = ";";KR20
5270 REM
5280 PRINT "***********************************************************************"
5290 PRINT "KUDER-RICHARDSON - 20 RELIABILITY COEFFICIENT"
5300 PRINT "***********************************************************************"
5310 PRINT
5320 PRINT
5330 PRINT USING "DATA FILE NAME \
      \”;FILENS
5340 PRINT
5350 PRINT USING "No. OF CASES READ ";";R
5360 PRINT
5370 PRINT USING "No. OF ITEMS ";";Z
5380 PRINT
5390 PRINT USING "TEST VARIANCE = ";";TVAR
5400 PRINT
5410 PRINT USING "SUM OF ITEM VARIANCES = ";";SUMIVAR
5420 PRINT
5430 PRINT USING "KR-20 = ";";KR20
5440 REM
5450 PRINT:PRINT:PRINT:PRINT
5460 INPUT "SEND OUTPUT TO PRINTER (Y/N)";Y$
5470 IF Y$ = "Y" OR Y$ = "y" THEN GOTO 5100
5480 REM
5490 RETURN
5970 REM
5980 PRINT "ERROR!!!!"
5990 STOP
6000 REM ****************************************
6010 REM "R <> CASES" ERROR
6020 REM ****************************************
6030 PRINT "R <> CASES ERROR!!!!"
6040 PRINT "R = "; R ; "AND CASES = "; CASES
6060 PRINT
6070 STOP
Split-Half Methods

Notation:

\( X \)  
odd test item, i.e. 1, 3, 5, 7 etc.

\( 2X \)  
square of odd test item

\( X \)  
even test item, i.e. 2, 4, 6 etc.

\( 2X \)  
square of even test item

\( XX \)  
product of even item and odd item

\( T \)  
score on test (odd items + even)

\( 2T \)  
square of test score

\( S \)  
odd half variance

\( 2S \)  
even half variance

\( R \)  
odd-even correlation coefficient

\( 2S \)  
test variance
\( R_{csh} \)  common split-half coefficient

\( R_{rg} \)  Ruilon-Guttman split-half coefficient

**Main Module: Lines 10 - 700**

1. **Variable List**
   - Enter Test Information from Keyboard \( \rightarrow \) GOSUB 1000
2. **Read Data File** \( \rightarrow \) GOSUB 2000
3. **Close Data File**
4. **Does Input # of Cases = # in File?**
   - No \( \rightarrow \) 
     - Error: END
   - Yes \( \rightarrow \)
   - **Calculate Variances** \( \rightarrow \) GOSUB 3000
   - **Calculate Split-Half R's** \( \rightarrow \) GOSUB 4000
   - **Output to Printer/Screen** \( \rightarrow \) GOSUB 5000
5. **Load Main Menu**
VARIABLE LIST:

R: RECORD COUNTER
C: CASE COUNTER
RR: RECORD COUNTER
NVAR: # OF VARIABLES PER RECORD
CASES: # OF CASES OR RECORDS
FRSTITEM: FIRST ITEM OF TEST
LASTITEM: LAST ITEM OF TEST
Z: # OF ITEMS ON TEST
Filen$: DATA FILE NAME
Y$: CORRECT KEYBOARD INPUT
CSH: COMMON S. H. RELIABILITY COEFFICIENT
RGSH: RULON-GUTTMAN S. H. REL. COEFFICIENT
W$: INKEY$ IN OUTPUT MODULE
P$: OUTPUT TO PRINTER
ITEMS: # OF ITEMS ON TEST
CC: COUNTER FOR NON-TEST VARIABLES
VAR$: DUMMY VAR FOR NON-TEST VARIABLES
SUMODD: SUM OF ODD ITEMS
SUMEVN: SUM OF EVEN ITEMS
SUMODEV: SUM OF ODD ITEM * EVEN ITEM
Q AND W: RECORD COUNTERS FOR NON-TEST VARIABLES
ODDITEM: SCORE OF ODD ITEM
EVENITEM: SCORE OF EVEN ITEM
SMSOODD: SUM OF SQUARE ODD ITEMS
SMSQEVN: SUM OF SQUARE EVEN ITEMS
TESTVARO: VARIANCE OF ODD ITEMS
TESTVARE: VARIANCE OF EVEN ITEMS
COVARAB: COVARIANCE OF ODD AND EVEN ITEMS
ROE: ODD ITEM-EVEN ITEM CORRELATION COEF.
TESTSQSC: SUM OF ALL SQUARED SCORES (ODD + EVEN)
TESTSUSC: SUM OF ALL SCORES (ODD + EVEN)
TVAR: TEST VARIANCE
VARE & VARO: STEP IN RAH CALCULATION
OC & EC: ODD AND EVEN ITEM COUNTERS

ARRAY LIST:

ODDSCOR(CASES): SET OF ODD ITEM SCORES
EVENSCOR(CASES): SET OF EVEN ITEM SCORES
REM ************************************************************************
REM MAIN MODULE
REM ************************************************************************
540 GOSUB 1000 'ENTER KEYBOARD INFO
560 PRINT "READING DATA FROM FILE "; FILEN$
590 IF R> CASES THEN GOTO 6030 '# OF CASES ERROR
640 PRINT "CALCULATING VARIANCES"
670 GOSUB 5000 'OUTPUT MODULE
690 REM
700 END
GOSUB 1000: Enter Test Information from Keyboard

Same as flow chart for KR-20; see page 11.

970 REM
980 PRINT "ERROR"
990 STOP
1000 REM ***********************************************************
1010 REM ENTER KEYBOARD INFO
1020 REM ***********************************************************
1030 REM
1040 CLS
1050 PRINT "***********************************************************
1060 PRINT "RELIABILITY: SPLIT-HALF METHODS"
1070 PRINT "***********************************************************
1080 PRINT;PRINT;PRINT
1090 INPUT "ENTER FILE NAME ",FILEN$
1100 PRINT
1110 INPUT "ENTER NUMBER OF CASES ",CASES
1120 PRINT
1130 INPUT "ENTER NUMBER OF VARIABLES PER CASE ",NVAR
1140 PRINT
1150 INPUT "ENTER NUMBER OF FIRST TEST ITEM ";FRSTITEM
1160 PRINT
1170 INPUT "ENTER NUMBER OF LAST TEST ITEM ";LASTITEM
1180 LET Z = LASTITEM - FRSTITEM + 1
1190 CLS
1200 PRINT USING "FILE NAME = \\ \\ \\
1210 PRINT
1220 PRINT USING "No. OF CASES = \\
1230 PRINT
1240 PRINT USING "No. OF VAR'S = \\
1250 PRINT
1260 PRINT USING "FIRST ITEM = \\
1270 PRINT
1280 PRINT USING "LAST ITEM = \\
1290 PRINT
1300 PRINT USING "No. OF ITEMS = \\
1310 PRINT;PRINT;PRINT
1320 INPUT "ARE THESE CORRECT (Y/N)";Y$
1330 IF Y$<> "Y" AND Y$ <> "y" THEN GOTO 1040
1340 DIM ODDSCOR(CASES); DIM EVNSCOR(CASES)
1350 CLS
1360 RETURN
1370 REM
1980 PRINT "ERROR!!!!"
GOSUB 2000: Read Data File

1. Initialize Variables
2. Open Data File
3. Is 1st Var = 1st Test Item?
   - Yes
   - ELF?
   - No
4. Update Case Counter
5. "For ... Next Structure"
6. Last Test Item?
   - Yes
   - Adjust for odd # of Items
   - # of odd = # of even?
   - No
   - Read X
   - Yes
   - Update Array ΣX and Counter
   - No
   - Update Array ΣX and Counter
   - Check if it's the last item
   - Read X

R, SMSQODD SMSQEVN
Read Non-Test Var's Into Dummy Var's
Return to Main Module
Update:

\[ \sum x^2 \quad \& \quad \sum X_o^2 \]
\[ \sum x^2_e \quad \& \quad \sum X_e^2 \]
\[ \sum x x_o \quad \& \quad \sum T^2 \]

Yes

Last Item = last Var?

No

GOSUB 2500

Read Non-Test Items Into Dummy Var's
'970 REM
'980 PRINT "ERROR!!!!"
'990 STOP
2000 REM ****************************
2010 REM READ DATA
2020 REM ****************************
2030 REM
2040 LET R = 0: LET SMSQODD = 0: LET SMSQEVN = 0
2050 LET SUMODD = 0: LET SUMEVN = 0
2060 LET SUMODEV = 0
2070 OPEN "I", #1, FILE$1
2080 IF FRSTITEM = 1 THEN GOTO 2110
2090 LET Q = 1: LET W = (FRSTITEM - 1)
2100 GOSUB 2500
2110 REM
2120 IF EOF(1) THEN RETURN
2130 LET R = R + 1: PRINT "R = "; R
2140 LET EC = 0: LET OC = 0
2150 FOR C = FRSTITEM TO LASTITEM
2160 INPUT$1, ODDITEM: PRINT ODDITEM
2170 IF C = LASTITEM THEN GOTO 2200
2180 INPUT$1, EVNITEM: PRINT EVNITEM
2190 LET EVNSCOR(R) = EVNSCOR(R) + EVNITEM: LET EC = EC + 1
2200 LET ODDSCOR(R) = ODDSCOR(R) + ODDITEM: LET OC = OC + 1
2210 LET C = C + 1
2220 NEXT C
2230 IF EC <> OC THEN GOSUB 2610
2240 LET SMSQODD = SMSQODD + ODDSCOR(R)^2
2250 LET SUMODD = SUMODD + ODDSCOR(R)
2260 LET SMSQEVN = SMSQEVN + EVNSCOR(R)^2
2270 LET SUMDEV = SUMDEV + (ODDSCOR(R) * EVNSCOR(R))
2280 LET TESTSQSC = TESTSQSC + (ODDSCOR(R) + EVNSCOR(R))^2
2290 REM
2300 IF LASTITEM = NVAR THEN GOTO 2340
2310 LET Q = (LASTITEM + 1): LET W = NVAR
2320 GOSUB 2500
2330 GOTO 2120
2340 REM
2350 GOTO 2120
2360 REM
2370 PRINT "ERROR!!!!"
2380 STOP
2390 REM ****************************
2400 REM READ NON-TEST VARIABLES
2410 REM ****************************
2420 REM
2430 FOR CC = Q TO W
2440 INPUT$1, VAR$1
2450 NEXT CC
2460 RETURN
2470 REM
2480 PRINT "ERROR!!!!"
2490 STOP
2500 REM ****************************
2510 REM ADJUSTING FOR ODD NUMBER OF ITEMS
2520 REM ****************************
2530 REM
2540 FOR CC = Q TO W
2550 INPUT$1, VAR$1
2560 NEXT CC
2570 RETURN
2580 REM
2590 PRINT "ERROR!!!!"
2600 STOP
2610 REM
2620 REM
2630 REM ****************************
2640 LET ODDSCOR(R) = ODDSCOR(R)/OC
2650 LET EVNSCOR(R) = EVNSCOR(R)/EC
2660 RETURN
GOSUB 3000: Calculate Variances

Calculate
\[
\begin{align*}
S^2 & S R \\
\sigma^2 & \sigma^2
\end{align*}
\]

Calculate
\[
\begin{align*}
S^2 & \sum T \\
\sigma^2 & \sum T
\end{align*}
\]

Return to Main Module

GOSUB 4000: Calculate Split-Half R's

Calculate
\[
R_{csh}
\]

Calculate 1st Step in
\[
R_{rg}
\]

Condition?

Yes

Ratio Error: END

No

Calculate
\[
R_{rg}
\]

Return to Main Module
2970 REM
2980 PRINT "ERROR!!!!"
2990 STOP
3000 REM ***********************************************************************
3010 REM
3020 REM CALCULATE VARIANCES
3030 REM
3040 REM
3050 LET VARO = SMSQODD - ((SUMODD^2)/R)
3060 LET TESTVARO = VARO/(R-1)
3070 LET VARE = SMSQEVN - ((SUMEVN^2)/R)
3080 LET TESTVARE = VARE/(R-1)
3090 LET COVARAB = SUMODEV - (SUMODD * SUMEVN)/R
3100 LET ROE = COVARAB/ (SQR(VARO) * SQR(VARE))
3110 REM
3120 LET TESTSUSC = SUMODD + SUMEVN
3130 LET TESTVAR = (TESTSQSC - ((TESTSUSC^2)/R))/((R - 1)
3140 RETURN
3150 REM
3160 PRINT "ERROR!!!!"
3170 STOP
3180 REM ***********************************************************************
3190 REM CALCULATING SPLIT-HALF RELIABILITIES
3200 REM ***********************************************************************
3210 REM
3220 COMMON SPLIT-HALF METHOD
3230 LET CSH = (2 * ROE)/(1 + ROE)
3240 RULON-GUTTMAN SPLIT-HALF METHOD
3250 LET RG = ROE * SQR(TESTVARO) * SQR(TESTVARE)/TESTVAR
3260 IF ABS(RG) => .25 THEN GOTO 6500
3270 LET RGSH = 4 * RG
3280 RETURN
GOSUB 5000: Output to Printer/Screen

Same as flow chart for KR-20; see page 17.

4970 REM
4980 PRINT "ERROR!!!!"
4990 STOP
5000 REM ################################################################################
5010 REM OUTPUT
5020 REM ################################################################################
5030 PRINT:PRINT:PRINT
5040 PRINT "SEND OUTPUT TO SCREEN ONLY OR ALSO TO PRINTER?"
5050 PRINT
5060 INPUT "ENTER S/P "; P$
5070 IF P$<> "P" AND P$<> "p" AND P$<> "S" AND P$<> "s" THEN GOTO 5060
5080 REM
5090 IF P$ = "S" OR P$ = "s" THEN CLS : GOTO 5340
5100 CLS
5110 LPRINT "*******************************************************************
5120 LPRINT "SPLIT-HALF RELIABILITY COEFFICIENTS"
5130 LPRINT "*******************************************************************
5140 LPRINT
5150 LPRINT
5160 LPRINT USING "DATA FILE NAME \
5170 LPRINT
5180 LPRINT USING "No. OF CASES READ \\
5190 LPRINT
5200 LPRINT USING "No. OF ITEMS \\
5210 LPRINT
5220 LPRINT USING "S-ODD = \\
5230 LPRINT
5240 LPRINT USING "S-EVEN = \\
5250 LPRINT
5260 LPRINT USING "MEAN-ODD = \\
5270 LPRINT
5280 LPRINT USING "MEAN-EVEN = \\
5290 LPRINT
5300 LPRINT USING "COMMON SPLIT-HALF METHOD \\
5310 LPRINT
5320 LPRINT USING "RULON-GUTTMAN SPLIT-HALF METHOD \\
5330 REM
31

5340 PRINT "********************************************************************************
5350 PRINT "SPLIT-HALF RELIABILITY COEFFICIENTS"
5360 PRINT "********************************************************************************
5370 PRINT
5380 PRINT
5390 PRINT USING "DATA FILE NAME \ ";FILEN$
5400 PRINT
5410 PRINT USING "No. OF CASES READ  "; R
5420 PRINT
5430 PRINT USING "No. OF ITEMS    "; Z
5440 PRINT
5450 PRINT USING "S-ODD  =         ";SQR(VARO)
5460 PRINT
5470 PRINT USING "S-EVEN =         ";SQR(VARE)
5480 PRINT
5490 PRINT USING "MEAN-ODD =       ";SUMODD/R
5500 PRINT
5510 PRINT USING "MEAN-EVEN =      ";SUMEVN/R
5520 PRINT
5530 PRINT USING "COMMON SPLIT-HALF METHOD r = ";CSH
5540 PRINT
5550 PRINT USING "RULON-GUTTMAN SPLIT-HALF METHOD r = ";RGSH
5560 REM
5570 LOCATE 12,45 : PRINT "ENTER RETURN TO CONTINUE"
5580 LOCATE 12,69 : LET W$ = INKEY$: IF W$ = "" THEN GOTO 5580
5590 REM
5600 RETURN
**The ratio in line 6650 is the value referred to in line 6550. If this happens the program is aborted because the resulting r value would be greater than the absolute value of 1.**
References

