PERITZ: A FORTRAN program for performing multiple comparisons of means using the Peritz Q method

SAMUEL A. MARTIN and LARRY E. TOOTHAKER
University of Oklahoma, Norman, Oklahoma

Several methods have been proposed for the comparison of means (see Miller, 1981; or Hochberg & Tamhane, 1987). Multiple comparison procedures for the completely randomized univariate design are available in commercial statistics packages such as SAS, SPSS^x, and BMDP. However, the analysis of mean differences in a design more sophisticated than the completely randomized univariate design requires extra programming in these packages—when it is at all possible. In two-way and higher order ANOVA designs, the most frequent approach to hypothesis testing is to test for overall significance by using the ANOVA followed by a comparison of cell means when there is a significant interaction, or by a comparison of marginal means when a main effect is significant. Cell mean comparisons are not handled in a straightforward manner in these packages. In addition, empirical research into the performance of multiple comparison procedures (Einot & Gabriel, 1975; Ramsey, 1978, 1981) indicates that most range procedures available in the statistics packages either are too liberal in attempting to control for Type I errors or are lacking in power. (See Jaccard, Becker, & Wood, 1984, for a review of Monte Carlo analysis of multiple comparison procedures.)

All statistics used in hypothesis testing similar to multiple comparison procedures seek to establish the following properties: First, the Type I error rate (probability of falsely rejecting at least one hypothesis of equality of means in an experiment) should not exceed the nominal alpha rate. Second, the multiple comparison procedure should detect as many true differences as possible (power), given that it meets the first criterion of controlling the Type I error rate. Fisher's *LSD*, Duncan's multiple range test, and the Newman-Keuls procedure violate the first requirement, while Scheffé's *S* procedure and Tukey's *HSD* protect against Type I errors at the expense of power. The RMP procedure proposed by Ryan (1960) and modified by Einot and Gabriel (1975) and Welsch (1977) (SAS's REGWQ procedure) changes the alpha rate of the Newman-Keuls procedure to protect against the type of configuration where the nominal alpha rate is exceeded (multiple equality of means in an experiment in which the full null condition is not true). Where Newman-Keuls uses the studentized range value at level α for each stretch in a stepdown fashion, Ryan's modified procedure allocates

α among k means for any stretch size p at $1 - (1 - \alpha)^{p/k}$ for all stretches of means from size $p = 2$ to size $k - 2$, and at α for $k - 1$ and k stretches. Peritz (Peritz, 1970; see also Begun & Gabriel, 1981) proposed a method to take advantage of the power of the Newman-Keuls while protecting against the type of mean configuration that provides a problem for this procedure. The Peritz logic involves a stepdown procedure that (1) accepts as non-significant any mean difference that Newman-Keuls fails to reject, (2) declares significant any mean difference that is significant at the RMP's alpha level and (3) declares any mean comparison not handled by (1) or (2) as contentious. Contentious sets of means are declared significant if all complementary sets of means are significant using the RMP's alpha level; otherwise, the set is stepdown accepted. Stepdown acceptance involves implicitly declaring as nonsignificant all comparisons of means contained within the stretch of a comparison that has been explicitly declared nonsignificant. Since α rates for stretch sizes k and $k - 1$ are equal for both the Newman-Keuls and the RMP procedures, all three procedures are equivalent for a comparison of three means.

The obtaining of critical values at the Ryan's alpha level and the performing of tests on complements of sets of means make the Peritz technique very difficult to compute by hand, and thus it is problematic as a useful method. The program discussed in this paper performs a Peritz pairwise comparison of means. Input to the program (see Appendix A for a sample run) includes the number of groups or cells, the mean square within (error) term, the degrees of freedom within (error), the alpha rate to use for the comparisons, a label for each group to provide group or cell information on the printout, the means to be compared, and the number of subjects per group or cell. By allowing the user to enter the error term and degrees of freedom, this program can be used for repeated measures designs, between-within designs, analysis of covariance designs, and randomized blocks designs. Designs involving unequal numbers of subjects per group or cell use the Tukey-Kramer adjustment procedure (Kramer, 1956; Tukey, 1953), since it has been demonstrated that using harmonic means (as done in SAS, SPSS^x, and BMDP) can result in a liberal (i.e., excessive Type I error rate) test (Keselman, Toothaker, & Shooter, 1975).

The program uses a routine published by Dunlap, Powell, and Konnerth (1977) to provide for calculation of exact probabilities for studentized range values. This program supplements the POSTHOC program (Cooksey, 1979) by providing the Peritz procedure as well as removing the requirement that the user enter studentized range values.

The Peritz program was written for a VAX 8600 computer using the VAX/VMS operating system. The program is written in the VAX-FORTRAN implementation

Correspondence may be addressed to Samuel A. Martin, Department of Psychology, 455 West Lindsey, Room 705, Norman, Oklahoma 73019.

of the FORTRAN-77 language standard and should be fully compatible with any FORTRAN-77 level compiler. The listing for this program may be found in Appendix B.

REFERENCES

- BEGUN, J., & GABRIEL, K. R. (1981). Closure of the Newman-Keuls multiple comparisons procedure. *Journal of the American Statistical Association*, **76**, 241-245.
- COOKSEY, R. W. (1979). POSTHOC: A FORTRAN program for conducting post hoc multiple comparisons among means. *Behavior Research Methods & Instrumentation*, **11**, 601.
- DUNLAP, W. P., POWELL, R. S., & KONNERTH, T. K. (1977). A FORTRAN IV function for calculating probabilities associated with the studentized range statistic. *Behavior Research Methods & Instrumentation*, **9**, 373-375.
- EINOT, I., & GABRIEL, K. R. (1975). A study of the power of several methods in multiple comparisons. *Journal of the American Statistical Association*, **70**, 574-583.
- HOCHBERG, Y., & TAMHANE, A. C. (1987). *Multiple comparison procedures*. New York: Wiley.
- JACCARD, J., BECKER, M. A., & WOOD, G. (1984). Pairwise multiple comparison procedures: A review. *Psychological Bulletin*, **96**, 589-596.
- KESELMAN, H. J., TOOTHAKER, L. E., & SHOOTER, M. (1975). An evaluation of two unequal n_k forms of the Tukey multiple comparison statistic. *Journal of the American Statistical Association*, **70**, 584-587.
- KRAMER, C. Y. (1956). Extension of multiple range test to group means with unequal numbers of replications. *Biometrics*, **13**, 307-310.
- MILLER, R. G. (1981). *Simultaneous statistical inference* (2nd ed.). New York: McGraw-Hill.
- PERITZ, E. (1970). *A note on multiple comparisons*. Unpublished manuscript, Hebrew University, Jerusalem.
- RAMSEY, P. H. (1978). Power differences between pairwise multiple comparisons. *Journal of the American Statistical Association*, **73**, 479-485.
- RAMSEY, P. H. (1981). Power of univariate pairwise multiple comparison procedures. *Psychological Bulletin*, **90**, 352-366.
- RYAN, T. A. (1960). Significance tests for multiple comparisons, variances, and other statistics. *Psychological Bulletin*, **57**, 318-328.
- TUKEY, J. W. (1953). The problem of multiple comparisons. Unpublished manuscript, Princeton University, Princeton, NJ.
- WELSCH, R. E. (1977). Stepwise multiple comparison procedures. *Journal of the American Statistical Association*, **72**, 566-575.

APPENDIX A

Sample Run of Peritz Program

Please enter the following information:

Number of Groups: 5

Mean Square Within (Error): 7.669

Degrees of Freedom Within (Error): 20

Alpha Rate: .05

You will now be prompted for the 5 means and a label for each mean. If you don't want to enter a specific treatment label, enter <return> and a default label of "Mean nn" (nn = Group Number) will be provided.

NOTE: Labels can be up to 16 characters in length.

Enter the group 1 label (default: Mean 01): A1
Mean for group 1 (A1): 16.1
Number of subjects for group 1 (A1): 5

Enter the group 2 label (default: Mean 02): A2
Mean for group 2 (A2): 17
Number of subjects for group 2 (A2): 5

Enter the group 3 label (default: Mean 03): A3
Mean for group 3 (A3): 20.7
Number of subjects for group 3 (A3): 5

Enter the group 4 label (default: Mean 04): A4
Mean for group 4 (A4): 21.1
Number of subjects for group 4 (A4): 5

Enter the group 5 label (default: Mean 05): A5
Mean for group 5 (A5): 26.5
Number of subjects for group 5 (A5): 5

(Program Output)

Number of groups: 5 Degrees of Freedom Within: 20
Mean Square Within: 7.66900 Set Alpha: 0.050

Comparison	Mean	N	Q	Mean Difference
A1	16.10000	5	0.72670	0.90000
A2	17.00000	5	Non-significant	

APPENDIX A (Continued)

A1	16.10000	5	3.71427	4.60000
A3	20.70000	5	Significant	
A1	16.10000	5	4.03725	5.00000
A4	21.10000	5	Significant	
A1	16.10000	5	8.39748	10.40000
A5	26.50000	5	Significant	
A2	17.00000	5	2.98756	3.70000
A3	20.70000	5	Non-significant	
A2	17.00000	5	3.31054	4.10000
A4	21.10000	5	Non-significant	
A2	17.00000	5	7.67077	9.50000
A5	26.50000	5	Significant	
A3	20.70000	5	0.32298	0.40000
A4	21.10000	5	Non-significant	
A3	20.70000	5	4.68321	5.80000
A5	26.50000	5	Significant	
A4	21.10000	5	4.36023	5.40000
A5	26.50000	5	Significant	

APPENDIX B
Program Peritz

```

C
C Program to perform PERITZ MCP test
C
      IMPLICIT NONE
C
      INTEGER*2      MAX_GROUPS
      PARAMETER      (MAX_GROUPS = 50)
      INTEGER*2      GROUPS,N(MAX_GROUPS),DFW
      REAL*8         MEANS(MAX_GROUPS),MSW,ALPHA
      CHARACTER*16    LABELS(MAX_GROUPS)
      LOGICAL*1      PERITZ_TEST(MAX_GROUPS,MAX_GROUPS)
C
C get data from user
C
      CALL READ_PARAMS (GROUPS,DFW,N,MEANS,MSW,ALPHA,LABELS)
C
C sort data into ordered set of means
C
      CALL QUICK_SORT (GROUPS,MEANS,LABELS)
C
C perform Peritz MCP procedure
C
      CALL DO_PERITZ (GROUPS,DFW,N,MEANS,MSW,ALPHA,PERITZ_TEST)
C
C print output from analysis
C
      CALL PRINT_PERITZ (GROUPS,DFW,N,MEANS,MSW,ALPHA,LABELS,PERITZ_TEST)
C
      END

      SUBROUTINE READ_PARAMS (GROUPS,DFW,N,MEANS,MSW,ALPHA,LABELS)
C
C Subroutine to get parameters for pairwise mean comparisons
C
C      GROUPS: Number of Means (Minimum: 3, Maximum: 50)
C      N:      Number of Subjects per Group
C      MEANS:  Vector of Means
C      MSW:    Mean Square Within
C      ALPHA:  Set alpha for comparison
C      LABELS: Vector of Treatment Labels (Default: Mean ##)
C
      IMPLICIT NONE
C

```

APPENDIX B (Continued)

```

INTEGER*2      MAX_GROUPS
PARAMETER      (MAX_GROUPS = 50)
INTEGER*2      GROUPS,DFW,N(MAX_GROUPS),I,LEN
REAL*8         MEANS(MAX_GROUPS),MSW,ALPHA
CHARACTER*16   LABELS(MAX_GROUPS),TEMP
CHARACTER*47   PROMPT

C
WRITE (6,1000)
GROUPS = 0
DO WHILE ((GROUPS .LT. 3) .OR. (GROUPS .GT. MAX_GROUPS))
    WRITE (6,1001) 'Number of Groups: '
    READ (5,*,ERR=10) GROUPS
10    IF ((GROUPS .LT. 3) .OR. (GROUPS .GT. MAX_GROUPS)) THEN
        WRITE (6,2001) 7,MAX_GROUPS
    END IF
END DO

C
MSW = 0.0
DO WHILE (MSW .LE. 0.0)
    WRITE (6,1001) 'Mean Square Within (Error): '
    READ (5,*,ERR=30) MSW
30    IF (MSW .LE. 0.0) THEN
        WRITE (6,2002) 7,0
    END IF
END DO

C
DFW = 0
DO WHILE (DFW .LT. 2*GROUPS)
    WRITE (6,1001) 'Degrees of Freedom Within (Error): '
    READ (5,*,ERR=20) DFW
20    IF (DFW .LT. 2*GROUPS) THEN
        WRITE (6,2002) 7,2*GROUPS
    END IF
END DO

C
ALPHA = 0.0
DO WHILE ((ALPHA .LT. 0.001) .OR. (ALPHA .GT. .25))
    WRITE (6,1001) 'Alpha Rate: '
    READ (5,*,ERR=35) ALPHA
35    IF ((ALPHA .LT. 0.001) .OR. (ALPHA .GT. .25)) THEN
        WRITE (6,4002) 7
    END IF
END DO

C
WRITE (6,3000) GROUPS
DO I=1,GROUPS
    WRITE (6,*)
    WRITE (LABELS(I),3001) I
    WRITE (PROMPT,3002) I,LABELS(I)
    CALL LIB$GET_INPUT(TEMP,PROMPT,LEN)
    IF (LEN .GT. 0) THEN
        LABELS(I)=TEMP
    ELSE
        LEN = 7
    END IF
40    WRITE (6,3003) I,LABELS(I) (1:LEN)
    READ (5,*,ERR=40) MEANS(I)
    N(I) = 0
50    DO WHILE (N(I) .LT. 2)
        WRITE (6,3004) I,LABELS(I) (1:LEN)
        READ (5,*,ERR=50) N(I)
        IF (N(I) .LT. 2) THEN
            WRITE (6,2002) 7,2
        END IF
    END DO
END DO

1000  FORMAT ('OPlease enter the following information:')
1001  FORMAT (//'+',A,$)
2001  FORMAT (1X,A1,'Please enter a number between 3 and',I3)
2002  FORMAT (1X,A1,'Please enter a number larger than',I4)
3000  FORMAT (//1X,'You will now be prompted for the',I3,' means'
1      ' and a label for each mean. If you/'
2      ' don''t want to enter a specific treatment label,'
3      ' enter <return> and a default/'
4      ' label of "Mean nn" (nn = Group Number) will be provided.'//
5      ' NOTE: Labels can be up to 16 characters in length.')
3001  FORMAT ('Mean ',I2.2)
3002  FORMAT ('Enter the group',I3,' label (default: ',A7,'): ')
3003  FORMAT (11X,'Mean for group',I3,' (' ,A,'): ',A,$)

```

APPENDIX B (Continued)

```

3004  FORMAT (11X,'Number of subjects for group',I3,' (',A,')': ', $)
4002  FORMAT (1X,A1,'Please enter a number between .001 and .25')
      END

      SUBROUTINE QUICK_SORT(GROUPS,MEANS,LABELS)
C
C Use Quicksort routine to sort means and labels into ascending order
C
      IMPLICIT NONE
      INTEGER*2 GROUPS
      REAL*8 MEANS(GROUPS),MIDDLE,TEMP1
      CHARACTER*16 LABELS(GROUPS),TEMP2
      INTEGER*2 LEFT_STACK(50),RIGHT_STACK(50),LEFT,RIGHT,I,J,POINTER
      POINTER=1
      LEFT_STACK(1)=1
      RIGHT_STACK(1)=GROUPS
      DO WHILE (POINTER .GT. 0)
          LEFT=LEFT_STACK(POINTER)
          RIGHT=RIGHT_STACK(POINTER)
          POINTER=POINTER-1
          DO WHILE (LEFT .LT. RIGHT)
              I=LEFT
              J=RIGHT
              MIDDLE=MEANS((LEFT+RIGHT)/2)
              DO WHILE (I .LE. J)
                  DO WHILE (MEANS(I).LT.MIDDLE)
                      I=I+1
                  END DO
                  DO WHILE (MIDDLE .LT. MEANS(J))
                      J=J-1
                  END DO
                  IF (I .LE. J) THEN
                      TEMP1=MEANS(I)
                      MEANS(I)=MEANS(J)
                      MEANS(J)=TEMP1
                      TEMP2=LABELS(I)
                      LABELS(I)=LABELS(J)
                      LABELS(J)=TEMP2
                      I=I+1
                      J=J-1
                  END IF
              END DO
              IF (I .LT. RIGHT) THEN
                  POINTER=POINTER+1
                  LEFT_STACK(POINTER)=I
                  RIGHT_STACK(POINTER)=RIGHT
              END IF
              RIGHT=J
          END DO
      END DO
      END

      SUBROUTINE DO_PERITZ (GROUPS,DFW,N,MEAN,MSW,ALPHA,TESTS)
C
C Peritz routine
C
C      MEAN:          sorted vector of group means
C      TESTS:         matrix to indicate peritz-reject for a comparison
C      GROUPS:        Number of means to be compared
C      N:             vector of subjects per group
C      MSW:           Error term - Mean Square Within
C      DFW:           Degrees of freedom for error term
C      ALPHA:         User-defined set alpha
C
      IMPLICIT NONE
C
C Parameters passed in the subroutine call
C
      INTEGER*2      GROUPS,N(50),DFW
      REAL*8         MEAN(GROUPS),MSW,ALPHA
      LOGICAL*1      TESTS(50,50)
C
C Local variables
C
      INTEGER*2      I,J,K,P,STRETCH,IQ,JQ
      REAL*8         Q,RYAN_ALPHA(49),PROB,Q_PROB,PROB_MTX(50,50)
      CHARACTER      STATUS(50,50),RYAN_REJECT(50,50)

```

APPENDIX B (Continued)

```

C
C Calculate Ryan's Alpha for each stretch size
C
      RYAN_ALPHA(GROUPS) = ALPHA
      RYAN_ALPHA(GROUPS-1) = ALPHA
      DO I=2,GROUPS-2
        RYAN_ALPHA(I)=1-(1-ALPHA)**(FLOAT(I)/FLOAT(GROUPS))
      END DO
C
C Set up test matrix to initially show that all comparisons are Peritz reject
C Set up status matrix to indicate that all comparisons are NK-reject
C Set up matrix to indicate if any pw-comparison is Ryan-significant
C
      DO I=1,GROUPS
        DO J=1,GROUPS
          TESTS(I,J)=.TRUE.
          STATUS(I,J)='C'
          RYAN_REJECT(I,J)='R'
        END DO
      END DO
C
C Do STP comparison of all means to test if Ryan critical
C
      DO I=1,GROUPS-1
        DO J=I+1,GROUPS
          STRETCH=J-I+1
          Q = ABS(MEAN(J)-MEAN(I))/SQRT((MSW/N(I)+MSW/N(J))/2.)
          PROB=Q * PROB(Q,STRETCH,DFW)
          PROB_MTX(I,J)=PROB
          IF (PROB .GT. RYAN_ALPHA(STRETCH)) RYAN_REJECT(I,J) = 'A'
        END DO
      END DO
C
C Perform the Newman-Keuls stepdown procedure
C Note: An NK accept is an automatic Peritz accept
C
      STRETCH = GROUPS
      DO WHILE (STRETCH .GE. 2)
        DO I=1,GROUPS-STRETCH+1
          P=I+STRETCH-1
          IF (TESTS(I,P)) THEN
C
C IF not NK-critical, stepdown accept
C
            IF (PROB_MTX(I,P).GT.ALPHA) THEN
              DO J=I,P-1
                DO K=J+1,P
                  TESTS(J,K)=.FALSE.
                  STATUS(J,K)='A'
                END DO
              END DO
            ELSE IF (RYAN_REJECT(I,P).EQ.'R') THEN
              STATUS(I,P)='R'
            ELSE
C Otherwise, perform the Peritz procedure
C
              ELSE
C Test the complements to the left
C
                IF (STATUS(I,P).EQ.'C') THEN
                  DO IQ=1,I-2
                    DO JQ=IQ+1,I-1
                      IF (RYAN_REJECT(IQ,JQ).EQ.'A') STATUS(I,P)='A'
                    END DO
                  END DO
                END IF
C Test the complements to the right
C
                IF (STATUS(I,P).EQ.'C') THEN
                  DO IQ=P+1,GROUPS-1
                    DO JQ=IQ+1,GROUPS
                      IF (RYAN_REJECT(IQ,JQ).EQ.'A') STATUS(I,P)='A'
                    END DO
                  END DO
                END IF
              END DO
            END IF
          END DO
        END DO
      END DO

```

APPENDIX B (Continued)

```

C
C Test the complements surrounding
C
      IF (STATUS(I,P).EQ.'C') THEN
        DO IQ=1,I-1
          DO JQ=P+1,GROUPS
            IF (RYAN_REJECT(IQ,JQ).EQ.'A') STATUS(I,P)='A'
          END DO
        END DO
      END IF
C
C If STATUS has not been set to 'A' on the complements, do a PERITZ reject
C Otherwise, stepdown accept
C
      IF (STATUS(I,P).EQ.'A') THEN
        DO J=I,P-1
          DO K=J+1,P
            TESTS(J,K)=.FALSE.
          END DO
        END DO
      END IF
    END IF
  END IF
END DO
STRETCH = STRETCH-1
END DO
END
REAL*8 FUNCTION Q_PROB(R,S,DF)
C
C Calculate probability for Studentized Range Statistic
C Adapted from: Dunlap, Powell, & Konnerth, 1977
C
C   R:    For a stretch, (largest mean-smallest mean)/(MSW/n)
C   S:    Number of groups in the stretch
C   DF:    Degrees of Freedom Within
C
  IMPLICIT NONE
C
  REAL*8      R,ZP(2),COEFF(33),EMAX/89./,XDF,DG,G,XI,C,DT,DMAX,BI,
1            RI,UI,SI,SRA,BR,SR,RA,XJ,X,Z,BZ,T,P,RH,H,PR,D,SRH,Q,XS
  INTEGER*2   S,DF,I,IDG,J,K
C
  DATA COEFF /1.,4.,2.,4.,2.,4.,2.,4.,2.,4.,2.,4.,2.,4.,2.,
1          4.,2.,4.,2.,4.,2.,4.,2.,4.,2.,4.,2.,4.,2.,1./
C
  IF (R .LE. 0) THEN
    Q_PROB=1.0
    RETURN
  END IF
  XDF=DF
  DG=XDF/2.-1.
  IDG=DG
  XS=S
  G=0.0
  IF (DG .LT. 0.) THEN
    G=.572364943
  ELSE IF (DG .EQ. 5.) THEN
    G=G-.120782238
  ELSE IF (DG .GT. 0.) THEN
    DO I=1,IDG
      XI=I
      G=G+LOG(DG-XI+1.)
    END DO
    IF (MOD(DF,2).NE.0) G=G-.120782238
  END IF
  C=EXP(.693147181+LOG(.196349541*XDF)*XDF/2.-G)
C
  DT=LOG(R+1.)*100.
  DMAX=MAX(DT,XDF)
  RI=5.2+R*.5-LOG(DMAX)-1./SQRT(R)
  IF (RI.LT.0.15) RI=.15
  BI=R-RI
  IF (BI.LT.0.0) BI=0.
  UI=R+RI
  SI=(UI-BI)/32.
C
  SRA=0.0
  DO I=2,33
    XI=I-1
    BR=BI+SI*XI
    SR=(-.918938533-BR*BR/(R*R*2.))+LOG(4.*BR/R))*XDF

```

APPENDIX B (Continued)

```

C
      RA=0.0
      DO J=1,33
        XJ=J-1
        BZ=XJ*.34375-7.
        Z=BR+BZ
        DO K=1,2
          IF (K.EQ.2) Z=BZ
          X=ABS(Z)
          Q=.39894228*EXP(-X*X/2.)
          IF (X .GT. 3.7) THEN
            ZP(K)=Q*(SQRT(4.+X*X)-X)/2.
          ELSE
            T=1./(1+.2316419*X)
            P=.31938153*T
            P=P-.356563782*T**2
            P=P+1.78147937*T**3
            P=P-1.821255978*T**4
            P=P+1.330274429*T**5
            ZP(K)=Q*P
          END IF
          IF (Z .GT. 0.) ZP(K)=1.-ZP(K)
        END DO
        RH=0.
        D=ZP(1)-ZP(2)
        IF (D .GT. 0) THEN
          H=LOG(D)
          PR=-.918938533-BZ*BZ/2.+H*(XS-1.)+LOG(XS)
          IF (PR+EMAX.GT.0) RH=EXP(PR)
        END IF
        RA=RA+COEFF(J)*RH
      END DO
      RA=.34375*RA/3.
      SRH=0.
      D=(1.-RA)/BR
      IF (D .GT. 0.) THEN
        SR=SR+LOG(D)
        IF (SR+EMAX.GT.0) SRH=EXP(SR)
      END IF
      SRA=SRA+COEFF(I)*SRH
    END DO
    Q PROB=SI*SRA/3.*C
  END

  SUBROUTINE PRINT_PERITZ(GROUPS,DFW,N,MEANS,MSW,ALPHA,LABELS,PERITZ_TEST)
C
C Subroutine to print results from PERITZ MCP analysis
C
C      IMPLICIT NONE
C
C      INTEGER*2      MAX_GROUPS
C      PARAMETER      (MAX_GROUPS = 50)
C      INTEGER*2      GROUPS,DFW,N(MAX_GROUPS),I,J
C      REAL*8         MEANS(MAX_GROUPS),MSW,ALPHA,Q
C      CHARACTER*16   LABELS(MAX_GROUPS),SIGNIFICANCE
C      LOGICAL*1      PERITZ_TEST(MAX_GROUPS,MAX_GROUPS)
C      WRITE (6,1000) GROUPS,DFW,MSW,ALPHA
C      WRITE (6,1002)
C      DO I=1,GROUPS-1
C        DO J=I+1,GROUPS
C          IF (PERITZ_TEST(I,J)) THEN
C            SIGNIFICANCE='Significant'
C          ELSE
C            SIGNIFICANCE='Non-significant'
C          END IF
C          Q = ABS(MEANS(I)-MEANS(J))/SQRT((MSW/N(I)+MSW/N(J))/2.)
C          WRITE (6,1001) LABELS(I),MEANS(I),N(I),Q,
C            1             MEANS(J)-MEANS(I),LABELS(J),MEANS(J),
C            2             N(J),SIGNIFICANCE
C        END DO
C      END DO
1000  FORMAT (/5X,'Number of groups:',I3,21X,'Degrees of Freedom Within:',I4//
1      5X,'Mean Square Within:',F15.5,21X,'Set Alpha:',F6.3/)
1001  FORMAT (1X,A,F16.5,I6,8X,2F16.5/1X,A,F16.5,I6,9X,A/)
1002  FORMAT (75X,'Mean'/
1      1X,'Comparison',16X,'Mean',7X,'N',18X,'Q',11X,'Difference'/)
      END

```