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Truncation and its effect on standard error of correlation coefficients

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TRUNCATION AND ITS EFFECT ON STANDARD ERROR OF CORRELATION COEFFICIENTS

by

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ABSTRACT

A Monte Carlo study was conducted to investigate the effect of truncation of score distributions on systematic bias and random error of correlation coefficient distributions. The findings were twofold: Correlation decreases systematically due to increasing truncation; and the standard error of the correlation coefficient, which is a measure of random error, increases due to increasing truncation.

CHAPTER 1

INTRODUCTION

Correlation coefficients are often used to quantify the degree of relationship between pairs of scores in a sample drawn from a larger population of score pairs. If many samples are drawn from the population and correlated, the resulting average correlation should approximate the population correlation. Such a correlation can be used to estimate reliability, to make inferences about validity, or to infer the degree to which two measures are related in a population. The most popular estimate of the relationship between two sets of scores is the Pearson product-moment correlation coefficient. A recurring problem with using the Pearson product-moment correlation coefficient is that the sampling distribution of this statistic is derived under the assumption of normal bivariate distribution of the raw scores. Researchers in the social sciences often find that their scores are not normally distributed; that is, in many instances the distributions of scores in the sample used for correlation are skewed.

The skewness of score distributions of the samples raises a question: "How does one interpret the correlation coefficient when one of the assumptions that is required to interpret the magnitude of the statistic has been violated?" An examination of the literature revealed that this question has not been answered completely. Blommers and Forsyth (1977, p. 461) state that the "consequences of violating the bivariate normal assumption have not been extensively investigated." Nunnally (1978, p. 139) suggests that "unless these assumptions are seriously violated, no real problem in interpretation is involved." It is not expected that all readers would agree on the definition of "seriously violated".

Edwards (1984) describes the assumptions of the joint distribution of paired (X,Y) values which is called a bivariate normal distribution: 1) Both the X and Y variables are normally distributed in the population. 2) For each possible value of X there is a corresponding population of normally distributed Y values. 3) The variances of the Y distributions are equal for each value of X. 4) Points 2 and 3 above are also true for the X distributions at each possible value of Y. When all these assumptions are met, X and Y must be related linearly or not at all. When tests of significance of a Pearson product-moment correlation are conducted, the purpose is most often to infer whether the linear relationship in the bivariate population from which the score pairs were sampled differs from some predetermined value (usually zero). When any of the above assumptions are violated, the inference made regarding the relationship may be in error.

The assumption of normal distribution of scores is the violation of interest in this study because this assumption is violated frequently in the measurement of variables in the social sciences. Often, distributions are restricted in range due to sampling from a subset of a population which tends to be more homogeneous than the entire population, or are truncated due to restrictions imposed by the measurement instrument.

Restriction in range causes a decrease in the variance of scores due to homogeneity created within the sample. This homogeneity is accompanied by a decrease in correlation, and the decrease in correlation is more evident with increased restriction of range (Ferguson & Takane, 1989; Nunnally, 1978).

Truncation of score distributions, which is the focus of this study, differs from restriction of range. Truncation results from a ceiling or floor of the distribution of scores created by the measure used to assess individuals. For example, teacher-made achievement tests often are truncated because students usually score at the upper end of the distribution on these tests, since the purpose of the tests is to assess mastery. Truncation due to restriction at the upper end of the distribution results in J-shaped distributions, whereas restriction at the lower end results in L-shaped distributions.

Restriction of range occurs within the sample of individuals to be tested; the sample itself is more homogeneous than the population. Truncation refers to a ceiling or floor of a distribution created as a result of a measure. While restriction of range refers to a homogeneous sample of individuals selected before they are given the measure, truncation refers to a sample which is more heterogeneous in ability than the (restricted) scores indicate. This study assessed the effects of truncation on correlation coefficient distributions. The effect on correlation is the same whether the truncation is at the upper (ceiling) or lower (floor) end, and therefore only one type of truncation was studied.

There are two types of error associated with violation of the assumption of normally distributed scores, due to truncation of score distributions: systematic and random. Systematic error refers to the "bias" in the correlation resulting from the truncation, that is, coefficients computed from truncated distributions will "on the average" be lower than those computed from non-truncated distributions. Brown (1989) and Alexander, Carson, Alliger, & Carr (1987) address correction of correlation coefficients for systematic decrease in correlation due to truncated, or censored, variables. PRELIS, a computer software program developed by Joreskog and Sorbom (1988), has a routine to estimate the mean and standard deviation for the distribution of the latent trait underlying the censored variable, and also to estimate correlations between such traits and variables.

The focus of the research reported in the literature is on correcting for bias in the correlation coefficient from skewed or truncated distributions to make the coefficient more meaningful (cf., Guilford, 1965, Rosenthal, 1982, Silver & Dunlap, 1987, and Yu & Dunn, 1982). Overall, the literature indicates a systematic decrease in the correlation coefficient with increasing truncation.

Random error refers to the standard deviation of the sampling distribution of the correlation coefficient (this standard deviation is called the standard error of the correlation coefficient). Random error is also addressed in the form of sampling error caused by small sample size, which affects variance across correlation (Millsap, 1988). Nothing was found in an extensive literature search on the effect of increasing truncation of score distributions on the standard error of the correlation coefficient. For example, PRELIS has no routine to estimate the standard error of the correlation associated with the correction mentioned above.

As an example of another topic relating skewness to correlation, Blommers and Forsyth (1977) note that the correlation coefficient distribution becomes more skewed with increasing correlation between sets of scores. They propose that z-tests of hypotheses about [rho] are robust only if the correlation is close to zero. A transformation of the correlation coefficient to Fisher's z_r is recommended when [rho] is not equal to zero. The distribution of Fisher's z_r is approximately normal, and allows for inferences about significance of correlations for non-zero [rho] using parametric inferential statistical tests. This thesis was restricted to studying skewed distributions resulting from truncation of score distribution. Fisher's z_r is not related to truncation. However, the issue of how we average a correlation coefficient is relevant to this study. Hunter, Schmidt, and Jackson (1982) question use of the z_r statistic for averaging correlations because they perceive that its use leads to inflation of the resulting average, therefore, z_r was not used in this study.

This study was precipitated as the result of a discussion between three colleagues, Darrell Sabers, Patricia Jones, and Keith Meredith, over the correlation of two different highly truncated sets of scores. Sabers suspected spuriously high correlation for his set of scores, while Meredith suspected a spuriously low correlation for his data. Since the prediction from previous literature would be of a systematic decrease in the correlation coefficient with increasing truncation, it was hypothesized that the results observed in these data sets were due to an increase in random error because of truncation, resulting in spuriously high or low correlations in individual cases. This study was conducted to confirm the systematic decrease in the correlation coefficient, as would be predicted by the literature, and to investigate the effect of truncation on random error of the correlation coefficient distributions. In order to investigate random error, the standard error of the correlation coefficient is the relevant statistic to examine. This statistic provides a measure of random error across repeated samples from the same population. Two estimates of standard error were examined: the standard error of the correlation coefficient and the standard error of the average of correlation coefficients.

A Monte Carlo study was conducted to investigate the following research hypotheses: 1) The correlation coefficient decreases systematically due to truncation, as is predicted from the literature; and 2) The standard error of the correlation coefficient increases due to truncation, as would be predicted by the discrepancy between the correlations of Sabers's and Meredith's scores, mentioned earlier.

CHAPTER 2

METHODOLOGY

The Monte Carlo simulations were carried out using FORTRAN programming with IMSL (version 10.0) subroutines CHFAC and RNMVN. Raw scores were generated using the subroutine RNMVN, a random number generator. The scores generated were z-scores to five decimal places.

Pairs of scores were generated, correlated with each other either .3, .5, or .7. The correlations were created using IMSL subroutine CHFAC, which gives the Cholesky factorization of a matrix of intercorrelations for input sampling of the raw scores. More than one correlation between scores were examined to see the effect of truncation on standard error across a range of correlations. More than two correlations were used to determine if the hypothesized increase in the standard error was linear. Another advantage of using more than one correlation coefficient is to increase generalizability of the results to correlation coefficients not studied.

The population of correlation values of the non-truncated score pairs was held small by specifications imposed on the selection of scores. Only sets of pairs of scores correlated within a small range around the target correlation were selected. This restricts the sampling distribution of the r population distribution, causing sampling error to be smaller than if an unrestricted sample were selected from a normal bivariate population distribution. The selected value for the restricted range of correlations, or tolerance level, was .01, (for example, the samples selected for the .3 group had score pairs correlated between .29 and .31). Because of these restrictions, the sampling error in this study is much smaller than 'typical' standard errors as expressed by formulas in statistical texts. Although there is no precedent in the literature that applies directly to this study, the tolerance level of .01 seemed sufficiently precise for the purposes of this simulation. Following the above restrictions, 100 pairs of z scores were selected for each of the three correlations, .3, .5, and .7.

Each set of 100 pairs of scores was truncated three times. The set levels of truncation were at the 25th, 50th, and 75th percentile scores. For each set of pairs of scores, all scores below the assigned percentile score were changed to equal that score. For example, for truncation at the 25th percentile, all scores below the 25th percentile were changed to equal that score. A correlation coefficient (r) was then calculated from the truncated distribution of the pairs of z-scores. Both distrubutions were truncated identically, to allow the correlation coefficient to take on any value from -1 to +1. The distribution of z-scores that made up each correlation coefficient is denoted as Distribution A in Figure 1.

In all, for each 100 pairs of z-scores, four _r_s were calculated: On the original set of scores; on the set truncated at the 25th percentile; on the set truncated at the 50th percentile; and on the set truncated at the 75th percentile. As shown in Figure 1, this created 12 combinations of correlation (.3, .5, and .7) and truncation (0, 25, 50, and 75).

This process was reiterated 100 times for each combination of correlation and truncation to create a correlation coefficient distribution containing 100 correlations at each level of truncation (0, 25, 50, and 75) for each correlation (.3, .5, and .7). This distribution is shown as Distribution B in Figure 1. The mean and standard deviation of the correlation coefficient distributions were then calculated. The equation for the mean was: (Sum r)/n, where r stands for the correlation coefficients constituting the distribution and n equals 100 as it does in all formulas in this thesis. The standard deviation was calculated using the following equation: $[(\text{sum } (r-M)^2)/n]^{1/2}$, where r stands for the correlation coefficients constituting the distribution, and M stands for the mean of the correlation

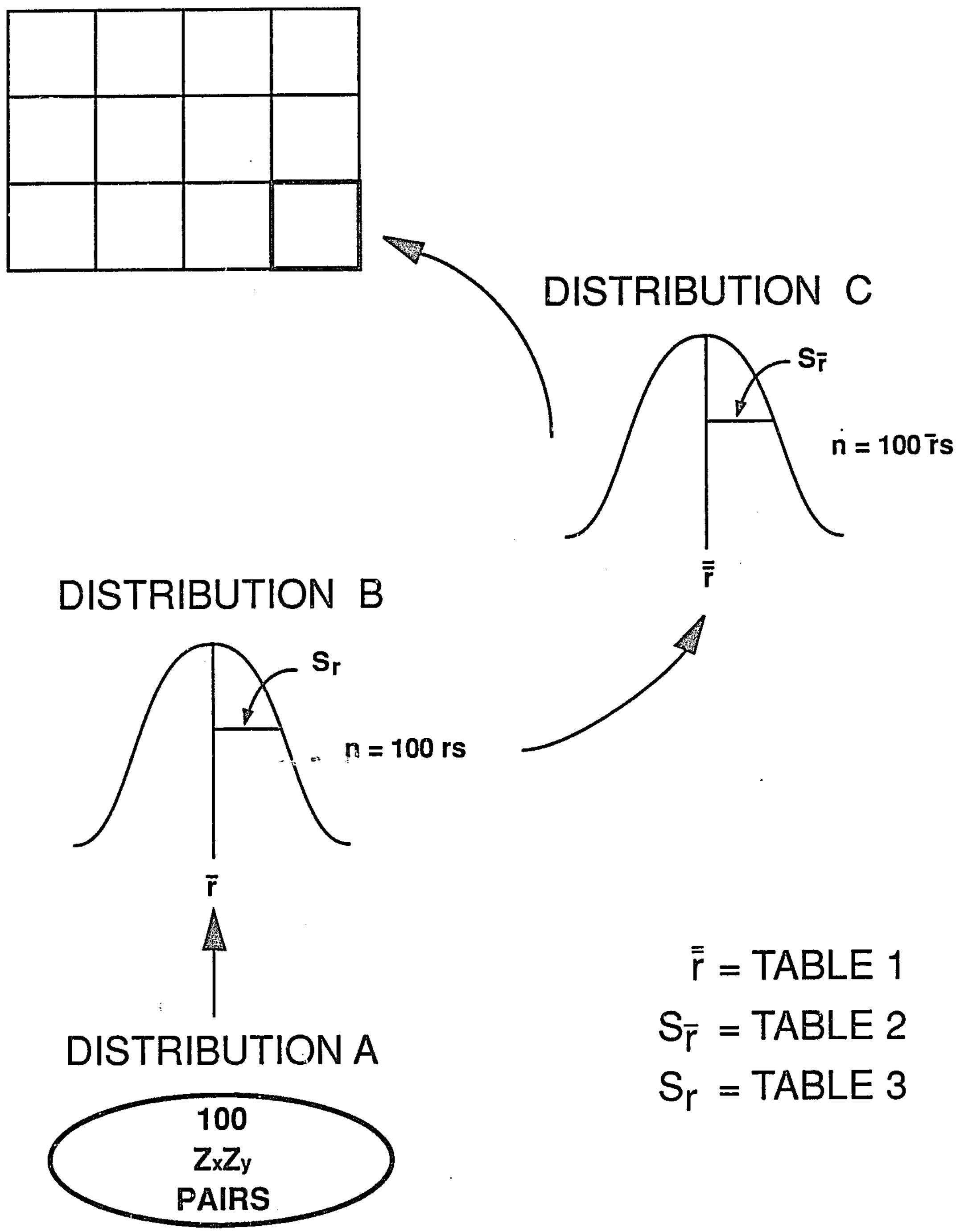
DISTRIBUTION C
$S_{\bar{r}}$
n = 100 $\bar{r}$s
$\bar{\bar{r}}$
DISTRIBUTION B
S_r
n = 100 rs
$\bar{r}$
DISTRIBUTION A
100
ZxZy
PAIRS
$\bar{\bar{r}}$ = TABLE 1
$S_{\bar{r}}$ = TABLE 2
S_r = TABLE 3

FIGURE 1

coefficients in the distribution. The above procedures constitute one run of the program.

The program was run 100 times, to create 100 correlation coefficient distributions at each level of truncation (0, 25, 50, and 75) for each correlation (.3, .5, and .7). This yielded 100 means and standard deviations of correlation coefficient distributions for each of the twelve cells diagrammed in Figure 1. The correlation coefficient mean distribution is depicted as Distribution C in Figure 1.

The data were then compiled for analysis. Average means and standard deviations were calculated at each level of truncation for each correlation. The average mean was calculated using the following formula:

mean = (sum M)/n , where M = correlation mean.

Examination of these means shows the systematic decrease in the correlation coefficient as truncation increases.

Two standard errors were examined: The standard deviations of the twelve correlation coefficient mean distributions (see Distribution C, Figure 1), and the average standard deviations of the 100 correlation coefficient distributions in each cell (see Distribution B, Figure 1), which are represented by the equation:

standard error = $[(\text{sum (standard deviations)}^2)/n]^{1/2}$.

It should be noted that the standard errors represented by Distributions B and C in Figure 1 do not accurately represent the sampling error encountered when sampling from a normal bivariate distribution, because these statistics were controlled by design for sampling error.

Another facet of random error relevant to this study concerns the shape of the distributions. Large skewness or kurtosis indices would indicate non-normal distributions, and the degree of non-normality might change due to increasing truncation. A distribution that varies from normal shape would render the standard error of that distribution uninterpretable.

The shape of the correlation mean distributions (Distribution C in Figure 1) were investigated to examine whether the sample size of 100 was sufficient for the central-limit theorem to hold true for these levels of truncation. An index of skewness indicates the symmetry of the distribution. Negative indices show negative (left) skew, where numbers tend to cluster at the top of the distribution. Positive indices show positive (right) skew, where numbers tend to cluster at the bottom of the distribution.

An index of kurtosis indicates the peakedness of the distribution, where an index different from zero indicates deviation from "normal" shape. Negative indices show platykurtic distributions, which are flatter than a normal distribution. Positive indices show leptokurtic distributions, which are more peaked than a normal distribution.

Both indices are calculated using the moments about the mean. Formulas for calculating the indices are as follows (Ferguson & Takane, 1989):

2nd moment = m2 = $(r-M)^2/n$

3rd moment = m3 = $(r-M)^3/n$

4th moment = m4 = $(r-M)^4/n$

where r = individual correlations, and

M = correlation mean.

Skewness and kurtosis indices are calculated in the following manner, using the above moments:

skewness = $m3/m2(m2)^{1/2}$

kurtosis = $[m4/(m2)^2] - 3$

These indices were calculated at each level of truncation for each correlation, and the results are shown in Table 4 in the appendix.

CHAPTER 3

RESULTS AND DISCUSSION

Correlation means and standard deviations of the distributions are examined for systematic and random error. For bias, a systematic decrease in the correlation coefficient was shown with increasing truncation, as depicted in Table 1. The results in Table 1, showing systematic error, agree with the literature, as listed in the introductory section. The average correlation coefficient mean was calculated using the 100 mean correlations that made up Distribution C of Figure 1.

The standard deviation of the correlation coefficient mean distribution describes the precision with which the bias resulting from truncation was measured. This measure of random error of the correlation means is presented in Table 2.

Table 2 shows the standard error of the _average_ correlation coefficient. This statistic was calculated using the standard deviations of the correlation coefficient mean distributions, as depicted in Distribution C of Figure 1. The standard error was very small for each of the cells, indicating that the simulation did in fact precisely measure the bias that resulted from truncation, partially due to the

TABLE 1. AVERAGE CORRELATION MEANS

CORRELATIONS	LEVELS OF TRUNCATION 0	25	50	75
.3	.30006	.27585	.23767	.17702
.5	.50006	.46973	.42424	.34655
.7	.70004	.67215	.63093	.55649

TABLE 2. STANDARD DEVIATION OF THE CORRELATION COEFFICIENT MEAN DISTRIBUTION

CORRELATIONS	LEVELS OF TRUNCATION 0	25	50	75
.3	.00062	.00493	.00852	.01370
.5	.00069	.00461	.00774	.01187
.7	.00060	.00272	.00518	.01219

restrictions imposed on sampling that were mentioned in the Methodology section.

Each row in Table 2 indicates that, for a given correlation, the standard error of the correlation coefficient increases with increasing truncation. The standard error of the correlation coefficient mean shows a large increase with increasing truncation. However, the increase in this standard error is not as large as the systematic decrease of the correlation coefficient. Using the standard error of the correlation means, the differences among all pairs of means in any row of Table 1 are statistically significant at the .001 level.

Table 3 shows the increase in the standard error for individual cases of correlation with increasing truncation. The standard error depicted in Table 3 describes the effect of truncation on random error of the individual correlation coefficient distributions. This statistic was calculated from Distribution B of Figure 1. The standard error of the correlation coefficient is roughly ten times the size of the standard error of the correlation mean. This result is to be expected, since the standard error of the correlation means is actually an approximation of the standard error of the mean, given by the equation: $sd/(n)^{1}/2$ (Guilford, 1965). The amount of increase in the standard error represents the square root of the increase in sample size

TABLE 3. INCREASE IN AVERAGE STANDARD DEVIATION OF CORRELATION COEFFICIENT DISTRIBUTIONS ACROSS TRUNCATION

CORRELATIONS	LEVELS OF TRUNCATION 0	25	50	75
.3	.00576	.04582 (.00576 x <u>7.95</u>)	.07761 (.00576 x <u>13.47</u>)	.11839 (.00576 x <u>20.55</u>)
.5	.00572	.04202 (.00572 x <u>7.35</u>)	.07395 (.00572 x <u>12.93</u>)	.12873 (.00572 x <u>22.50</u>)
.7	.00574	.03164 (.00574 x <u>5.51</u>)	.05832 (.00574 x <u>10.16</u>)	.11373 (.00574 x <u>19.81</u>)

needed to approximate a coefficient calculated from a normal distribution. For example, across the second row in Table 3, which represents increasing truncation at .5 correlation, the sample size needed for truncation at the 25th percentile would be 54.0225 times the sample size needed for the nontruncated distribution. The sample size needed for truncation at the 50th percentile would be 167.1849 times the sample size needed for the nontruncated distribution, and the sample size needed for truncation at the 75th percentile would be 506.25 times the sample size needed for the nontruncated distribution.

The average standard error of the correlation coefficient would be used for significance testing of correlation coefficients for individual sets of data. The standard deviation of the correlation coefficient distributions measures the precision with which each correlation was estimated. This standard deviation of the distribution of correlation coefficients from a bivariate population was used to estimate the standard error that would be used to make inferences about the significance of an obtained correlation. It would be used to calculate confidence intervals for a set of scores. Reading across rows in Table 3, this standard error increases to a large value with increasing truncation. The systematic decrease in correlation with increasing truncation would not be significant using this standard error. This large standard error addresses the problem of seemingly spuriously high and spuriously low correlation given two sets of highly truncated data, presented in the introductory section.

Besides the z-scores that were used in this simulation, smaller samples with a mean of 100 and a standard deviation of 15, were used in alternate runs to ensure generalizability from z-scores to common scores used in many measurement contexts. The only differences observed, which were in the thousandths for non-truncated scores and in the hundredths for truncated scores, were in standard errors.

To examine effect of random error on the correlation coefficient distribution shape, indices of skewness and kurtosis were calculated at each level of truncation for each correlation. The table of these values (Table 4) can be found in the appendix. These values were calculated from Distribution C in Figure 1.

Overall, the skewness and kurtosis indices are quite small, with the exception of the set of indices at truncation at the 75th percentile for .5 correlation. This pair of values was spuriously large due to an outlier that was more than four standard deviations above the mean. When this one outlier was eliminated from the analysis, the resultant skewness and kurtosis indices were similar to the other small values shown in the table.

The conclusion that can be reached from the small indices in Table 4 is that the shape of the correlation coefficient distributions were essentially normal, and therefore did not detract from the interpretation of the standard error. The correlation coefficient distributions conform to expectations from the central-limit theorem. Because the shape of the distributions is essentially normal, the significance testing of the means reported above seems appropriate.

CHAPTER 4

CONCLUSIONS

A Monte Carlo study was conducted to investigate the effect of truncation of score distributions on systematic bias and random error of correlation coefficient distributions. The findings were twofold: Correlation decreases systematically due to increasing truncation; and the standard error of the correlation coefficient, which is a measure of random error, increases due to increasing truncation.

The decrease in correlation indicating significant bias as a result of truncation was as expected from the literature review on this subject. The amount of decrease in correlation appeared to be the same for correlations of .3, .5, and .7, indicating that the decreases expected from these levels of truncation could be roughly equal for all correlations near these values.

The large increase in standard error of the 100 correlation coefficient distributions in each cell of Figure 1 would explain the disparate results of Sabers's and Meredith's correlations of test scores. Since the standard error increases more than the correlation decreases for those individual distributions, highly truncated distributions could yield extremely variable correlations. Any particular correlation of highly truncated scores could be a very unreliable estimate of the underlying relationship between the variables of interest.

APPENDIX A

MONTE CARLO SIMULATION PROGRAM

```
      integer i,irank,iseed,j,k,ldr,ldrsig,nout,nr,incd(1,1)
      real cov(2,2),r(500,2),rsig(2,2)
      real rxy(1000,4)
      real mean,mean1,mean2
      real thresh(3),rmean(4),rsd(4)
      integer tval(3)
      character*40 file1,file2
      character*60 command
      data thesh/-.6745,0.0000,6745/
      data tval/25,50,75/
900   format (a40)
      write (*,*) 'Enter name of output file for summ stats'
      read (*,900) file2
      command = 'rm '//file2
      newvar=system(command)
      open(22,file=file2,status='new')
      write (*,*) 'Enter number of observs in each data set'
      read (*,*) nr
      write (*,*) 'Enter number of reps for experiment'
      read (*,*) nrep
      ldr=500
      k=2
      ldrsig=2
      write (*,*) 'Enter correlation of observations'
      read (*,*) corr
      cov(1,1)=1.00
      cov(1,2)=corr
      cov(2,1)=corr
      cov(2,2)=1.00
      write (*,*) 'Enter tolerance level'
      read (*,*) tol
      call chfac(k,cov,2,.00001,irank,rsig,ldrsig)
      write (*,*) 'Enter seed value'
      read (*,*) iseed
      call rnset(iseed)
      write (*,*) 'Enter number of vector pairs'
      read (*,*) npairs
      write (22,'(1h,7hseed = ,i7)') iseed
      write (*,*) 'Convert to discrete scores?'
      write (*,*) '1 = yes, 2 = no'
      read (*,*) iconv
      write (*,*) 'Convert scale mean and sd?'
      write (*,*) '1 = yes, 2 = no'
      read (*,*) mconv
      if (mconv .eq. 1) then
        write (*,*) 'Enter mean and sd'
        read (*,*) scalem, scalesd
        do i=1,3
                thresh(i)=scalem + thresh(i)*scalesd
                if (iconv .eq. 1) thresh(i)=aint(thresh(i))
```

```
          end do
        end if
        do itr=1,nrep
        icount=0
        write (21,1005) scalem, scalesd
1005    format (1h ,'scale mean = ',f8.2,2x,'scale sd =',f8.2)
        write (21,1006) nr, nrep
1006    format(1h ,'number of observations/r ',i6,
     & 5x, 'number of replications ',i6)
5       call rnmvn(nr,k,rsig,ldrsig,r,ldr)
        if (mconv .eq. 1) then
        do j=1,nr
          r(j,1)=scalem + r(j,1)*scalesd
          r(j,2)=scalem + r(j,2)*scalesd
          if (iconv .eq. 1) then
            r(j,1)=aint(r(j,1))
            r(j,2)=aint(r(j,2))
          end if
        end do
        end if
        call correl(r(1,1),r(1,2),nr,mean1,mean2,sd1,sd2,r12)
        delta=abs(r12-corr)
         if (delta .ge. tol) goto 5
        icount=icount+1
        if (icount .gt. 1000) stop
        rxy(icount,1)=r12
        write (21,1000) icount,mean1,sd1,mean2,sd2,r12
1000    format (1h ,i3,5x,5f10.5)
        do j=1,3
        do i=1,nr
          if (r(i,1) .lt. thresh(j)) r(i,1)=thresh(j)
          if (r(i,2) .lt. thresh(j)) r(i,2)=thresh(j)
        end do
        call correl(r(1,1),r(1,2),nr,mean1,mean2,sd1,sd2,r12)
        rxy(icount,j+1)=r12
        write (21,1001) tval (j),mean1,sd1,mean2,sd2,r12
1001    format (1h ,4x,i2,2x,5f10.5)
        end do
        if (icount .lt. npairs) goto 5
        do i=1,4
          call stat(rxy(1,i),npairs,mean,sd)
          rmean(i)=sd
          rsd(i)=sd
        end do
        write (22,1003) itr,(rmean(i),i=1,4)
        write (22,1004) (rsd(i),i=1,4)
1003    format (//,20x,'Means and Standard Deviations',/
     &         14x,'Correlation Coeffs - Iteration #',i4//
     &         2x,'Truncation Percentile',15x,'00',7x,'25',
     &         7x,'50',7x,'75'/2x,'Mean',27x,4f9.5)
```

```
1004  format (2x,'SD',29x,4f9.5)
      end do
      stop
      end
      subroutine stat(x,n,mean,sd)
      real x(1),mean,sd
      sumx=0.
      sumxx=0.
      do i=1,n
      sumx=sumx+x(i)
      sumxx=sumxx+x(i)*x(i)
      end do
      mean=sumx/n
      sd=sqrt(sumxx/n - mean*mean)
      return
      end
      subroutine correl(y,z,n,mean1,mean2,sd1,sd2,r)
      real num,y(500),z(500)
      real mean1,mean2
      sumyz=0.
      do i=1,n
      sumyz=sumyz+y(i)*z(i)
      end do
      call stat(y,n,mean1,sd1)
      call stat(z,n,mean2,sd2)
      num=sumyz/n - mean1*mean2
      r=num/(sd1*sd2)
      return
      end
```

APPENDIX B

TABLE 4, SKEWNESS AND KURTOSIS INDICES

TABLE 4. SKEWNESS AND KURTOSIS INDICES FOR CORRELATION COEFFICIENT MEAN DISTRIBUTIONS

CORRELATIONS		LEVELS OF TRUNCATION 0	25	50	75
.3	S	.00927	-.33951	-.29580	-.06830
	K	.10780	.59260	-.08257	-.12869
.5	S	-.05460	-.07350	-.05670	.60590
	K	-.57340	-.54350	-.44620	1.09060
.7	S	.04050	.38000	-.06960	.04360
	K	.34420	-.44430	-.35190	-.11510

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