For the Following Correlational structure:

<table>
<thead>
<tr>
<th></th>
<th>Y</th>
<th>X1</th>
<th>X2</th>
<th>X3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>1.00</td>
<td>0.26</td>
<td>0.34</td>
<td>0.24</td>
</tr>
<tr>
<td>X1</td>
<td>1.00</td>
<td>0.10</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>X2</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

X1, - X3 are assumed to be equicorrelated at $R_{xx} = 0.10$

PROC IML CODE:
```
proc iml;
rx=.1;** Set the Correlation Among Predictors **;
rx3=(rx*(j(3,3,1)))+ ( (1-rx)*I(3));** 3x3 Correlation Matrix;
rx2=(rx*(j(2,2,1)))+ ( (1-rx)*I(2));** 2x2 Correlation Matrix (Rxx);
ryx3={.26, .34, .24};** Correlations of Y with Xs **;
ry12={.26, .34};ry13={.26, .24};ry23={.34, .24};
by3=inv(Rx3)*ryx3;** Standardized Regression Coefficents Full Model;
Rsqy3=by3`*ryx3;**** R-squared for the Full Model   ;
b12=inv(Rx2)*ry12;** Standardized Regression Coefficents Reduced Model;
Rsq12=b12`*ry12;**** R-squared for the Reduced Model without X3   ;
PRsq3=Rsqy3-Rsq12;** Part Squared Correlation for X3 ;

b13=inv(Rx2)*ry13;** Standardized Regression Coefficents Reduced Model;
Rsq13=b13`*ry13;**** R-squared for the Reduced Model without X2   ;
PRsq2=Rsqy3-Rsq13;** Part Squared Correlation for X2 ;

b23=inv(Rx2)*ry23;** Standardized Regression Coefficents Reduced Model;
Rsq23=b23`*ry23;**** R-squared for the Reduced Model without X1 ;
PRsq1=Rsqy3-Rsq23;** Part Squared Correlation for X1 ;

print 'Correlations of Y with X' (ryx3`);
print 'R-square for Reduced models 23 13 12'
print rsq23 rsq13 rsq12;
print 'Full Model R-square =' rsqy3;
print 'Semi-Partial R-square for X1 =' prsq1;
print 'Semi-Partial R-square for X2 =' prsq2;
print 'Semi-Partial R-square for X3 =' prsq3;
```

TAKE THESE RESULTS

<table>
<thead>
<tr>
<th>Correlations of Y with X</th>
<th>0.26</th>
<th>0.34</th>
<th>0.24</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-square for Reduced models 23 13 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RSQ23</td>
<td>Rsq13</td>
<td>Rsq12</td>
<td></td>
</tr>
<tr>
<td>0.1584646</td>
<td>0.1138586</td>
<td>0.1671919</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RSQY3</th>
<th>Full Model R-square = 0.2022222</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRSQ1</td>
<td>Semi-Partial R-square for X1 = 0.0437576</td>
</tr>
<tr>
<td>PRSQ2</td>
<td>Semi-Partial R-square for X2 = 0.0883636</td>
</tr>
<tr>
<td>PRSQ3</td>
<td>Semi-Partial R-square for X3 = 0.0350303</td>
</tr>
</tbody>
</table>
and ENTER into PROC POWER

**COMPUTING NECESSARY SAMPLE SIZE for FUTURE STUDY**

**FULL MODEL**

```
proc power;
   multreg
      model = fixed
      nfullpredictors = 3
      ntestpredictors = 3
      rsquarefull = 0.2022222
      rsquarediff = 0.2022222
      alpha = 0.05
      ntotal = .
      power = 0.80; run;
```

**INDIVIDUAL TEST for X1**

```
proc power;
   multreg
      model = fixed
      nfullpredictors = 3
      ntestpredictors = 1
      rsquarefull = 0.2022222
      rsquarediff = 0.2022222
      alpha = 0.05
      ntotal = .
      power = 0.80; run;
```

---

**Necessary Sample Size (N*) to Detect Significant Effect at α=0.05 and 80% Power**

- Full Model R-square = 0.20222
  - N = 48
- Unique R-Square for X1 = 0.04376
  - N = 146
- Unique R-Square for X2 = 0.08836
  - N = 73
- Unique R-Square for X3 = 0.03503
  - N = 181

---

**COMPUTING PROSPECTIVE POWER FOR FIXED N = 100**

**FULL MODEL**

```
proc power;
   multreg
      model = fixed
      nfullpredictors = 3
      ntestpredictors = 3
      rsquarefull = 0.2022222
      rsquarediff = 0.2022222
      alpha = 0.05
      ntotal = 100
      power = .; run;
```

**INDIVIDUAL TEST for X3**

```
proc power;
   multreg
      model = fixed
      nfullpredictors = 3
      ntestpredictors = 1
      rsquarefull = 0.2022222
      rsquarediff = 0.0350303
      alpha = 0.05
      ntotal = 100
      power = .; run;
```

---

**Power to Detect Significant Effect at α=0.05 for N =100**

- Full Model R-square = 0.20222
  - Power = 0.992
- Unique R-Square for X1 = 0.04376
  - Power = 0.640
- Unique R-Square for X2 = 0.08836
  - Power = 0.909
- Unique R-Square for X3 = 0.03503
  - Power = 0.546
For the Following Correlational structure:

<table>
<thead>
<tr>
<th></th>
<th>Y</th>
<th>X1</th>
<th>X2</th>
<th>X3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>1.00</td>
<td>0.26</td>
<td>0.34</td>
<td>0.24</td>
</tr>
<tr>
<td>X1</td>
<td>1.00</td>
<td>0.20</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>X2</td>
<td>1.00</td>
<td>0.20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

X1 - X3 are assumed to be equicorrelated at $R_{xx} = 0.20$.

Necessary Sample Size ($N^*$) to Detect Significant Effect at $\alpha=0.05$ and 80% Power

- Full Model R-square = 0.175000.
- Unique R-Square for X1 = 0.028583
- Unique R-Square for X2 = 0.070583
- Unique R-Square for X3 = 0.021000

Necessary Sample Size ($N^*$) to Detect Significant Effect at $\alpha=0.05$ and 80% Power

<table>
<thead>
<tr>
<th></th>
<th>Y</th>
<th>X1</th>
<th>X2</th>
<th>X3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>1.00</td>
<td>0.26</td>
<td>0.34</td>
<td>0.24</td>
</tr>
<tr>
<td>X1</td>
<td>1.00</td>
<td>0.40</td>
<td>0.40</td>
<td></td>
</tr>
<tr>
<td>X2</td>
<td>1.00</td>
<td>0.40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

X1 - X3 are assumed to be equicorrelated at $R_{xx} = 0.40$.

Necessary Sample Size ($N^*$) to Detect Significant Effect at $\alpha=0.05$ and 80% Power

- Full Model R-square = 0.140000.
- Unique R-Square for X1 = 0.011524
- Unique R-Square for X2 = 0.050381
- Unique R-Square for X3 = 0.006095

**Note**: Holding the correlations of Y with the X variables ($r_{xy}$) constant, as the correlation among X variables ($R_{xx}$) increases, there is more overlap and the Full Model $R^2$ decreases, and therefore, Power will decrease and the Necessary Sample Size for any given level of Power will increase.

From the General Regression $F$-ratio,

$$F = \frac{[R_{FULL}^2 - R_{REDUC}^2][N - df_{FULL} - 1]}{[1 - R_{FULL}^2][df_{FULL} - df_{REDUC}]}$$

and Holding $N$ constant, Power for the Full-Model $F$-ratio ($R_{REDUC}^2 = 0$) is a function of the Explained Variance, $R_{FULL}^2$. Holding $N$ constant, Power for an individual test of a single predictor, $X_j$, is a function of the magnitude of the “unique” effect $[R_{FULL}^2 - R_{REDUC}^2] = r_{ij,12...k}$, and the Error Variance $[1 - R_{FULL}^2]$. In general, Models that Explain more Variance ($R_{FULL}^2$ is relatively Large, therefore, Error Variance $[1 - R_{FULL}^2]$ is relatively small) have more statistical power for the Full-Model and individual tests.
For the Following Correlational structure:

<table>
<thead>
<tr>
<th></th>
<th>Y</th>
<th>X1</th>
<th>X2</th>
<th>X3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>1.00</td>
<td>0.26</td>
<td>0.34</td>
<td>0.24</td>
</tr>
<tr>
<td>X1</td>
<td>1.00</td>
<td>0.06</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>X2</td>
<td>1.00</td>
<td></td>
<td></td>
<td>0.06</td>
</tr>
</tbody>
</table>

X1 - X3 are assumed to be equicorrelated at \( R_{xx} = 0.06 \).

**Necessary Sample Size (N*) to Detect Significant Effect at \( \alpha = 0.05 \) and 80% Power**

<table>
<thead>
<tr>
<th></th>
<th>Full Model R-square</th>
<th>N*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique R-Square for X1</td>
<td>0.0519591</td>
<td>121</td>
</tr>
<tr>
<td>Unique R-Square for X2</td>
<td>0.0978202</td>
<td>65</td>
</tr>
<tr>
<td>Unique R-Square for X3</td>
<td>0.0427419</td>
<td>146</td>
</tr>
</tbody>
</table>

**Power to Detect Significant Effect at \( \alpha = 0.05 \) for \( N = 44 \)**

<table>
<thead>
<tr>
<th></th>
<th>Full Model R-square</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique R-Square for X1</td>
<td>0.0519591</td>
<td>0.385</td>
</tr>
<tr>
<td>Unique R-Square for X2</td>
<td>0.0978202</td>
<td>0.628</td>
</tr>
<tr>
<td>Unique R-Square for X3</td>
<td>0.0427419</td>
<td>0.327</td>
</tr>
</tbody>
</table>

**Note**: If we set the Prospective Sample Size at \( N^* = 44 \), we will have 80% Power to reject the Null Hypothesis for the Full Model:

\[ H_0: \beta_1 = \beta_2 = \beta_3 = 0 \]

However, this sample size will only provide 62.8% Power for the Null Hypothesis for the “strongest” variable X2 \([H_0: \beta_2 = 0]\). The F-tests for the Full Model and the Individual Coefficients have different Power Functions.
Power is a function of the **Non-Central F-distribution**. The parameters for the Non-Central F-distribution are the degrees-of-freedom for the hypothesis (numerator) \((df_H)\), degrees-of-freedom for the error (denominator) \((df_E)\), and a Non-Centrality Parameter, \(\lambda\).

For the \(F\)-ratio testing the Full Model Null Hypothesis \([H_0: \beta_1 = \beta_2 = \beta_3 = 0]\) with a sample size of \(N = 44\), the number of predictors \((p)\) is the degrees-of-freedom for the hypothesis \((df_H = 3)\) and degrees-of-freedom for the error term \((df_E = N - p - 1 = 40)\). From any standard text, the \(\alpha = 0.05\) critical value from the **Central F-distribution** is \(F_{[(1-\alpha), df_H, df_E]} = F_{[0.95, 3, 40]} = 2.84\).

For the **Non-Central F-distribution**, we will use the same \(dfs\), but we must determine the Non-Centrality Parameter, \(\lambda\). From a Regression approach we can define the Non-Centrality Parameter for the Full Model \(F\)-ratio as:

\[
\lambda = N \frac{R^2_{FULL}}{1 - R^2_{FULL}}
\]

Thus in this case, \(\lambda = 44 \frac{0.2159574}{1 - 0.2159574} = 12.12\).

The Central \(F\)-distribution Critical Value, \(F_{[0.95, 3, 40]} = 2.84\) (Blue Line) is at the 20\(^{th}\) Percentile of the Non-Central \(F\)-distribution with a Non-Centrality Parameter of \(\lambda = 12.12\). Thus, \(80\%\) (\(1 - \beta =\) Power) of random values (\(F\)-tests) sampled from this Non-Central \(F\)-distribution (based on the Alternative Hypothesis) exceed the Central \(F\)-distribution Critical Value (based on the Null Hypothesis \([H_0: \beta_1 = \beta_2 = \beta_3 = 0]\)).

SAS Code to Generate these Values And make a similar Plot.

```sas
data ss;
dfm=3; dfe=40; alpha=0.05; beta=.20;
Fcv=FINV((1-alpha), dfm, dfe, 0);
ncp=12.12;
power= 1 - probf(Fcv, dfm, dfe, ncp);
Fbeta=FINV (beta, dfm, dfe, ncp);
proc print;run;

data ss;set ss;
do x = 0 to 12 by 0.25;
Fc=PDF('F',x,dfm,dfe,0);
Fnc=PDF('F',x,dfm,dfe,ncp);
output;end;run;

proc plot data=ss;
    plot Fc*x='*'
        Fnc*x='o'
        Fnc*Fcv='I' / overlay box;
run;
```
For the $F$-ratio testing the Unique Effect of $X_2$, while statistically controlling for $X_1$ and $X_3$, $[H_0: \beta_2 = 0]$ with a sample size of $N = 44$, the degrees-of-freedom for the hypothesis ($df_H = 1$) and degrees-of-freedom for the error term stays the same ($df_E = N - p - 1 = 40$). From any standard text, the $\alpha = 0.05$ critical value from the Central $F$-distribution is $F_{[(1-\alpha), df_H, df_E]} = F_{[0.95, 1, 40]} = 4.08$.

For the Non-Central $F$-distribution, we will use the same $dfs$, but we must determine the Non-Centrality Parameter, $\lambda$. From a Regression approach we can define the Non-Centrality Parameter for the Full Model $F$-ratio as:

$$\lambda = N \frac{R_{FULL}^2 - R_{REDUCED}^2}{1 - R_{FULL}^2}$$

Thus in this case, $\lambda = \frac{44 \times (0.0978202 - 0.2159574)}{1 - 0.2159574} = 5.49$

The Central $F$-distribution Critical Value, $F_{[0.95, 1, 40]} = 4.08$ (Blue Line) is at the 37th Percentile of this Non-Central $F$-distribution with a Non-Centrality Parameter of $\lambda = 5.49$. Thus, 63% ($1 - \beta =$ Power) of random values ($F$-tests) sampled from this Non-Central $F$-distribution (based on the Alternative Hypothesis) exceed the Central $F$-distribution Critical Value (based on the Null Hypothesis $[H_0: \beta_2 = 0]$).

SPSS Syntax

```spss
COMPUTE Fcent = NPDF.F(x,1,40,0) .
COMPUTE Fncp = NPDF.F(x,1,40,5.49) .
EXECUTE .
GRAPH
    /SCATTERPLOT(OVERLAY)=x x WITH
    Fcent Fncp (PAIR)
    /MISSING=LISTWISE .
```
Before PROC POWER was a module, this type of SAS CODE was used to calculate power.

```sas
** Determine Sample Size for Omnibus Test *****;proc iml;
** Define Parameters for Power;
alpha=0.05;beta=0.20;power=1-beta;
dfm=3;****** df for Full Model = Number of Predictors ***;
r2=0.2159574;* R-square for Full Model ******************;
** Find sample size;
n=(dfm+3);powerj=0;
do until (powerj >= (1-beta));
n=n+1;dfm=n-dfm-1;******** Error df *****;
Fcv=finv((1-alpha),dfm,dfe,0);** F critical Value **;
f2=r2/(1-r2);ncp=f2*n;******** Noncentrality Parameter **;
powerj = 1 - probf(Fcv, dfm, dfe, ncp); powerj=ROUND(powerj, .00001);
** Power is the Percentile Rank of the critical value ******;
** in the Non-Central F with given Non-Centrality Parameter **;
end;
print 'For Power ='(1-beta)'at alpha =' alpha ;
print 'with R-square =' r2 ' in a' dfm 'predictor model';
print 'Necessary Sample Size for Omnibus Test is N=' n;
print 'Exact Power =' powerj;
print dfm r2 f2 ncp alpha beta n powerj;

*******************************************************************************;
*** Show exact Power for Omnibus Test for Specified N and R-square **;
proc iml;** Define Parameters for Power;
alpha=0.05;N=44;** N = Sample Size ***;
dfm=3;****** df for Full Model = Number of Predictors ***;
r2=0.2159574;* R-square for Full Model ******************;
f2=r2/(1-r2);ncp=f2*n;******** Noncentrality Parameter **;
dfe=n-dfm-1;******** Error df *****;
Fcv=finv((1-alpha),dfm,dfe,0);** Critical value for F-test **;
power = 1 - probf(Fcv, dfm, dfe, ncp);
** Power is the Percentile Rank of the critical value ******;
** in the Non-Central F with given Non-Centrality Parameter **;
print 'At alpha =' alpha 'with R-square =r2 'and N= ' N;;
print 'Power for Omnibus Test =' power;
print Fcv power N r2;

*** Find R-Square for Omnibus Test necessary with Fixed Sample Size;
proc iml;alpha=0.05;beta=0.20;
N=44;** N = Sample Size ***;
dfm=3;****** df for Full Model = Number of Predictors ***;
dfe=n-dfm-1;******** Error df *****;
** Find R-square for Omnibus Test ;
r2=0;powerj=0;
do until (powerj >= (1-beta));
r2=r2+.001;f2=r2/(1-r2);ncp=f2*n;****** Noncentrality Parameter **;
Fcv=finv((1-alpha),dfm,dfe,0);** Critical value for F-test **;
powerj = 1 - probf(Fcv, dfm, dfe, ncp); powerj=ROUND(powerj, .00001);
** Power is the Percentile Rank of the critical value ******;
** in the Non-Central F with given Non-Centrality Parameter **;
end;
print 'For Power ='(1-beta)'at alpha =' alpha 'with N = ' N;;
print 'Necessary R-Square for Omnibus Test' r2;
print 'Exact Power =' powerj;
print dfm r2 f2 ncp alpha beta n powerj;
```
** Determine Sample Size for Individual test ****; proc iml;
** Define Parameters for Power;
alpha=0.05; beta=0.20;
dfm=3; ******** df for Full Model = Number of Predictors **;
r2f=0.2159574; ***** R-square for Full Model ***************;
r2diff=0.0978202; * Change in R-square ***********************;
** Find sample size; n=(dfm+3); powerj=0;
do until (powerj >= (1-beta));
  n=n+1; dfe=n-dfm-1; *************** Error df *****;
f2=r2diff/(1-r2f); ncp=f2*n; ** Noncentrality Parameter **;
Fcv=finv((1-alpha),1,dfe,0); ** Critical value for F-test **;
powerj = 1 - probf(Fcv, 1, dfe, ncp); powerj=ROUND(powerj,.00001);
** Power is the Percentile Rank of the critical value ******;
** in the Non-Central F with given Non-Centrality Parameter **;
end;
print 'For Power =' (1-beta)'at alpha =' alpha ;
print 'with Full R-square ='r2 'and R-square Change =' r2diff;
print 'Necessary Sample Size for Individual Test is N =' n;
print 'Exact Power =' powerj;

*** Show exact Power for Individual Test for Specified N and R-square **;
** Define Parameters for Power;proc iml;
alpha=0.05; N= 44; ** N = Sample Size ***;
dfm=3; ******** df for Full Model = Number of Predictors **;
r2f=0.2159574; ***** R-square for Full Model ***************;
r2diff=0.0978202; * Change in R-square ***********************;
f2=r2diff/(1-r2f); ncp=f2*n; ** Noncentrality Parameter **;
dfe=n-dfm-1; ********** Error df *****************;
Fcv=finv((1-alpha),1,dfe,0); ** Critical value for F-test **;
power= 1 - probf(Fcv, 1, dfe, ncp);
** Power is the Percentile Rank of the critical value ******;
** in the Non-Central F with given Non-Centrality Parameter **;
print 'At alpha =' alpha  'and N=' N;;
print 'with Full R-square ='r2f 'and Change in R-square ='r2diff;
print 'Power for Individual Test=' power;

*** Determine Increment in R-Square for Individual Test **;
** Necessary with Fixed Sample Size and Full Model R-Square;proc iml;
alpha=0.05; beta=0.20; N= 44; ** N = Sample Size ***;
dfm=3; ******** df for Full Model = Number of Predictors **;
r2f=0.2159574; ***** R-square for Full Model ***************;
dfe=n-dfm-1; ***** df for Error Term *************;
** Find R-square for Individual Test *****;
r2=0; powerj=0;
do until (powerj >= (1-beta)) ;
  if r2 < r2f then do;
    r2=r2+.001; f2=r2/(1-r2f); ncp=f2*n; ** Noncentrality Parameter **;
    Fcv=finv((1-alpha),1,dfe,0); ** Critical value for F-test **;
    powerj = 1 - probf(Fcv, 1, dfe, ncp); powerj=ROUND(powerj,.00001);
    ** Power is the Percentile Rank of the critical value ******;
    ** in the Non-Central F with given Non-Centrality Parameter **;
  end;
end;
print 'For Power =' (1-beta)'at alpha =' alpha ;
print 'with N = ' N 'Full Model R-sq=' r2f;;
print 'Necessary R-Square for Individual Test' r2;
print 'Exact Power =' powerj;
SPPS Syntax for Multiple Regression Power Analyses

For the omnibus Full Model F-test

```spss
COMPUTE alpha = 0.05.
COMPUTE beta = 0.20.
COMPUTE R2 = 0.2159.
COMPUTE N = 44.
COMPUTE NCP = N*R2/(1-R2).
COMPUTE dfm = 3.
COMPUTE dfe = N - dfm -1.
COMPUTE Fcv = IDF.F((1-alpha),dfm,dfe).
COMPUTE power = 1-NCDF.F(Fcv,dfm,dfe,NCP).
EXECUTE.
```

For the Individual Test

```spss
COMPUTE alpha = 0.05.
COMPUTE beta = 0.20.
COMPUTE R2 = 0.2159.
COMPUTE U2 = 0.0978202.
COMPUTE N = 44.
COMPUTE NCP = N*U2/(1-R2).
COMPUTE dfm = 3.
COMPUTE dfe = N - dfm -1.
COMPUTE Fcv = IDF.F((1-alpha),1,dfe).
COMPUTE power = 1-NCDF.F(Fcv,1,dfe,NCP).
EXECUTE.
```

```spss
proc power;
   multreg
      model = random
      nfullpredictors = 2
      ntestpredictors = 2
      rsquarefull = 0.25
      rsquarediff = 0.25
      alpha = 0.05
      ntotal = 8
      power = .;  run;
   multreg
      model = random
      nfullpredictors = 2
      ntestpredictors = 1
      rsquarefull = 0.25
      rsquarediff = 0.21
      alpha = 0.05
      ntotal = 8
      power = .;  run;
```

data reg;
proc iml;
seed=1321;
n=8;* Sample Size ***;
ri2=0.4;** Correlation between X1 and X2;
b1=0;** b1 is null ***;
b2=0.5;** b2 is non-null **;
Rxx=(1||ri2)//(ri2||1);*** Correlation Matrix of X1 X2 ***;
print n rxx;
b=b1//b2;
ryx=Rxx*b;
print 'Zero-order Correlation of Y with X1 an X2' ryx;
rsq=b`*ryx;print 'R-Square =' rsq;
srq1=rsq-(ryx[2,1]##2);srsq2=rsq-(ryx[1,1]##2);
print 'Semi-Partial R-Square for X1 and X2' srq1 srq2;
ncp=n#(rsq)/(1-rsq);print 'Non-Centrality parameter =' ncp;
reject1=0;reject2=0;rejectf=0;
reps=10000;
do i = 1 to reps;** Generate Data an Perform Regressions ****;
  ey=rannor(j(n,1,seed));
  e1=rannor(j(n,1,0));
  x2=rannor(j(n,1,0));
  X1 = (ri2#x2) + (((1-(ri2##2))##.5)#e1);
  y = (b1#x1) + (b2#x2) + (((1-rsq)##.5)#ey);
  Xm=(j(n,1,1))||x1||x2;
  beta=(inv(Xm`*Xm))*Xm`*y;
  yhat=xm*beta;
  resid=y-yhat;
  sse=ssq(resid);
  dfe=nrow(y)-ncol(xm);
  mse=sse/dfe;
  cssy=ssq(y-sum(y)/n);
  rsquare=(cssy-sse)/cssy;
  stdb=sqrt(vecdiag(inv(Xm`*Xm))*mse);
  t=beta/stdb;
  F=t##2;
  prob=1-probf(F,1,dfe);
  if prob[2,1] < .05 then reject1=reject1+1;
  if prob[3,1] < .05 then reject2=reject2+1;
  Fomni=(rsquare#dfe)/(1-rsq#(ncol(xm)-1));
  probf=1-probf(Fomni,(ncol(xm)-1),dfe);
  if probf < .05 then rejectf=rejectf+1;
  dat=y||x1||x2;
  vec=(beta[2,1])||(beta[3,1])||(t[2,1])||(t[3,1])||(F[2,1])||(F[3,1])||Fomni||(prob[2,1])||(prob[3,1])||probf;
  if i = 1 then vecout=vec;else vecout=vecout//vec;
  if i = 1 then datout=dat;else datout=datout//dat;
end;
  reject1=reject1/reps;reject2=reject2/reps;rejectf=rejectf/reps;
print reject1 reject2 rejectf;
vard={'y' 'x1' 'x2'};
create dats from datout [colname=vard];
append from datout;
varb={'b1' 'b2' 't1' 't2' 'f1' 'f2' 'Fomni' 'p1' 'p2' 'pf'};
create stats from vecout [colname=varb];
append from vecout;
proc corr data=dats;var y x1 x2;run;
proc corr data=stats;run;
N       RXX
8        1  0.4
0.4      1

Zero-order Correlation of Y with X1 an X2

R-Square = 0.25

Semi-Partial R-Square for X1 and X2

Non-Centrality parameter = 2.6666667

REJECT1   REJECT2   REJECTF
0.0508    0.1852   0.1641

The POWER Procedure
Type III F Test in Multiple Regression
Fixed Scenario Elements
Method                                       Exact    Exact
Model                                     Random X Random X
Number of Predictors in Full Model               2        2
Number of Test Predictors                        1        2
Alpha                                         0.05     0.05
R-square of Full Model                        0.25     0.25
Difference in R-square                        0.21     0.25
Total Sample Size                                8        8

Computed Power    Computed Power
0.202    0.162

The CORR Procedure
3 Variables:    y        x1       x2

Simple Statistics
Variable     N       Mean       Std Dev
y              80000    -0.0007400       0.99970
x1             80000       0.00391       1.00128
x2             80000       0.00451       0.99809

Pearson Correlation Coefficients, N = 80000
Prob > |r| under H0: Rho=0

y        x1        x2
y        1.00000  0.19968     0.50329
      <.0001      <.0001
x1      0.19968  1.00000     0.39731
      <.0001      <.0001
x2      0.50329  0.39731     1.00000
      <.0001      <.0001
### Variable: b1

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The UNIVARIATE Procedure
Variable: t1
Moments
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Mean                                               0.00472681    Sum Observations    47.2680623
Std Deviation                                         1.28894309    Variance            1.66137429
Skewness                                              0.05641281    Kurtosis            3.30299067
Uncorrected SS                                        16612.305    Corrected SS        16612.0815
Coeff Variation                                      27268.7948    Std Error Mean      0.01288943

The UNIVARIATE Procedure
Variable: t2
Moments
N                                      10000    Sum Weights              10000
Mean                                               1.48171282    Sum Observations    14817.1282
Std Deviation                                         1.50752363    Variance             2.2726275
Skewness                                              1.33138231    Kurtosis            6.08298762
Uncorrected SS                                        44678.7312    Corrected SS        22724.0023
Coeff Variation                                      101.741957    Std Error Mean      0.01507524
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