Demonstration of the Johnson-Neyman Procedure

Group	Ach	Anx
1.0	26.0	6.0
1.0	18.0	7.0
1.0	15.0	15.0
1.0	23.0	8.0
1.0	13.0	16.0
1.0	9.0	17.0
1.0	12.0	13.0
1.0	17.0	10.0
1.0	7.0	20.0
1.0	25.0	5.0
1.0	5.0	21.0
1.0	17.0	12.0
1.0	20.0	10.0
1.0	10.0	19.0
1.0	7.0	15.0
.0	24.0	18.0
.0	20.0	18.0
.0	17.0	15.0
.0	9.0	7.0
.0	7.0	6.0
.0	12.0	13.0
.0	17.0	17.0
.0	21.0	19.0
.0	26.0	23.0
.0	23.0	20.0
.0	19.0	15.0
.0	21.0	20.0
.0	15.0	16.0
.0	9.0	9.0
.0	11.0	9.0

Analyze
  General Linear Model - Univariate
    Dependent ach
    Fixed Factors gp
    Covariate anx
    Model Custom
      Model anx
        gp
        anx*gp

Univariate Analysis of Variance

Between-Subjects Factors

		N
gp	.0	15
	1.0	15

Tests of Between-Subjects Effects

Dependent Variable: ach

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1022.834[a]	3	340.945	66.485	.000
Intercept	792.154	1	792.154	154.471	.000
gp	778.841	1	778.841	151.875	.000
anx	1.635	1	1.635	.319	.577
gp * anx	996.797	1	996.797	194.377	.000
Error	133.333	26	5.128		
Total	8677.000	30			
Corrected Total	1156.167	29			

a. R Squared = .885 (Adjusted R Squared = .871)

Data
    Split file
        Organize output by groups
            Groups based on gp

Analyze
    Regression
        Linear
            Dependent ach
            independent anx
            Statistics
                Descriptive

```
Selected output shown below:
```

Regression

gp = .0

Descriptive Statistics[a]

	Mean	Std. Deviation	N
ach	16.733	5.9936	15
anx	15.000	5.1686	15

a. gp = .0

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.129	1.515		.085	.933
	anx	1.107	.096	.955	11.550	.000

a. Dependent Variable: ach

b. gp = .0

gp = 1.0

Descriptive Statistics[a]

	Mean	Std. Deviation	N
ach	14.933	6.7025	15
anx	12.933	5.1750	15

a. gp = 1.0

Coefficients[a,b]

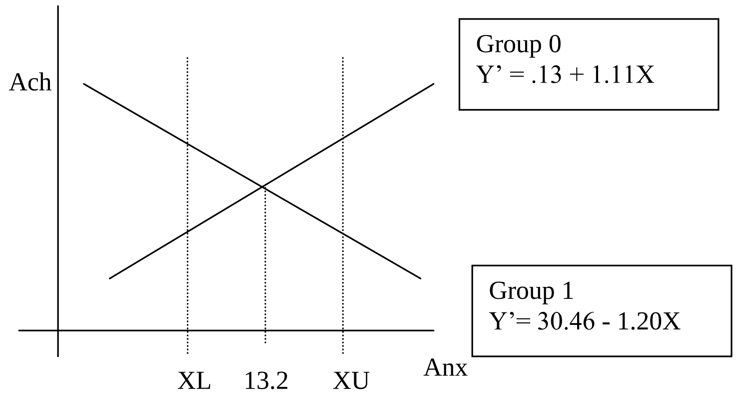
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	30.458	1.870		16.285	.000
	anx	-1.200	.135	-.927	-8.899	.000

a. Dependent Variable: ach

b. gp = 1.0

Intersect at

.129 + 1.1X = 30.46 + 1.2X
(1.1 +1.2)X = 30.46 -.129
X = 13.2



The Johnson-Neyman Procedure

$$X = \frac{-B \pm \sqrt{B^2 - AC}}{A}$$

Critical Points X's (XL and XU)

where

$$A = -\frac{2F_\alpha}{N-4}(SSres)[\frac{1}{\Sigma(X-\overline{X}_1)^2} + \frac{1}{\Sigma(X-\overline{X}_0)^2}] + (b_{11} - b_{10})^2$$

$$B = \frac{2F_\alpha}{N-4}(SSres)[\frac{\overline{X}_1}{\Sigma(X-\overline{X}_1)^2} + \frac{\overline{X}_0}{\Sigma(X-\overline{X}_2)^2}] + (b_{01} - b_{00})(b_{11} - b_{10})$$

$$C = -\frac{2F_\alpha}{N-4}(SSres)[\frac{N}{n_1 \bullet n_0} + \frac{\overline{X}_1^{\,2}}{\Sigma(X-\overline{X}_1)^2} + \frac{\overline{X}_0^{\,2}}{\Sigma(X-\overline{X}_0)^2}] + (b_{01} - b_{00})^2$$

F_α = F ratio from the F table, that is $F_{\alpha,}$ ~~1~~2, $_{N-4}$

N = Total sample size
n_1, n_0 = Number of subjects in groups Z = 1 and Z = 0 respectively
SS_{res} = Residual sum of squares for interaction model

$\Sigma(X-\overline{X}_1)^2 = S_{X1}^2 \cdot (n_1 - 1)$

$\Sigma(X-\overline{X}_0)^2 = S_{X0}^2 \cdot (n_0 - 1)$

Comment [tco1]: Note "2" was added to the numerator for A, B, and C.

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For our data set:

Comment [tco2]: Note the new formula was used.

$$A = \frac{-2 * 3.37}{30 - 4}(133.33)[\frac{1}{374.92875} + \frac{1}{374.059854}] + (-1.200391 - 1.106952)^2$$

= ~~5.208~~5.14

$$B = \frac{2 * 3.37}{30 - 4}(133.33)[\frac{12.933}{374.92875} + \frac{15.000}{374.059854}]$$

= -67.39

$$C = \frac{-2 * 3.37}{30 - 4}(133.33)[\frac{30}{15 \bullet 15} + \frac{12.933^2}{374.92875} + \frac{15.000^2}{374.059854}] + (30.458393 - .129055)^2$$
$$+ (30.458393 - .129055)(-1.200391 - 1.106952)$$

~~= -68.366~~

= ~~894.31~~879.04

Finally,

$$XL = \frac{-(-67.39) - \sqrt{(-67.39)^2 - (5.14)(879.04)}}{5.14}$$

= ~~12.35~~12.14

$$XU = \frac{-(-67.39) + \sqrt{(-67.39)^2 - (5.14)(879.04)}}{5.14}$$

= ~~13.90~~14.10

Conclusions:

For individuals having anxiety below ~~12.35~~12.14 the intervention is effective but for individuals above ~~13.91~~14.10 the intervention appears to have been harmful. For individuals having anxiety between ~~12.65~~12.14 and ~~13.91~~14.10, there is insufficient evidence to conclude that the intervention was either helpful or harmful.

Using the computer to calculate the Johnson-Neyman procedure

The Johnson-Neyman procedure can be calculated by a hand calculator as shown in the previous page. However, the calculation is quite tedious and prone to errors (human errors and rounding errors).

Option 1: Use Excel

I made the Excel sheet called "QJN.xlsx" (Available on my Web page) for calculating JN. You need to run SPSS first to get relevant information.

Option 2: Use Syntax in SPSS

Use this syntax from http://www-01.ibm.com/support/docview.wss?uid=swg21476680. The syntax is also available on my Web page.

~~If you are used to SAS, you may want to use the SAS program shown below. However, the easiest way for anyone is to use a Windows-based program "The Quick Johnson-Neyman Procedure Calculator" (Oshima, 1996).~~

```
/*  This is a SAS propgram for the Johnson-Neyman procedure.
    It is assumed that you have already run SPSS or SAS to
    obtain necessary ingredients to calculate the JN procedure.
    You need 12 pieces of ingredients (5 for stats on Group 1,
    5 for stats on Group 0, 2 for F-value which you obtain from
    the F-table and SSres from the interaction model). Enter
    those values below.                                     */
data one;
/* Enter stats on Group 1 */
n1=15;
meanx1=12.933;
sdx1=5.175;
slope1=-1.200391;
int1=30.458393;

/*Enter stats on Group 0 */
n0=15;
meanx0=15.000;
sdx0=5.169;
slope0=1.106952;
int0=.129055;

/*Enter other necessary stats */
```

```
f = 4.22;
ssres=133.33;

/*************JN procedure ***************************/
n=n1+n0;
ssx1=sdx1*sdx1*(n1-1);
ssx0=sdx0*sdx0*(n0-1);

a=(-f/(n-4))*ssres*(1/ssx1+1/ssx0)+(slope1-slope0)**2;
b=(f/(n-4))*ssres*(meanx1/ssx1+meanx0/ssx0)+(slope1-slope0)*(int1-int0);
c=(-f/(n-4))*ssres*(n/(n1*n0)+meanx1*meanx1/ssx1+meanx0*meanx0/ssx0)
+(int1-int0)**2;
xlower=(-b-sqrt(b*b-a*c))/a;
xupper=(-b+sqrt(b*b-a*c))/a;

proc print; var a b c xlower xupper;
run;


         OBS        A           B           C          XLOWER      XUPPER

           1     5.20826    -68.3659    894.312     12.3563     13.8966
```

The Quick Johnson-Neyman Procedure Calculator (QJN)

In QJN, it is assumed that you have already run SPSS or SAS to obtain necessary ingredients to calculate the Johnson-Neyman procedure. You need to provide the 12 ingredients as QJN asks you to do so.

Ingredients:

The sample size for Group 1
Mean of X for Group 1
SD of X for Group 1
Slope for Group 1
Intercept for Group 1

The sample size for Group 0
Mean of X for Group 0
SD of X for Group 0
Slope for Group 0
Intercept for Group 0

F-value from the F-table, $F_{\alpha, 1, N-4}$
SSres for the interaction model

Results:

~~Lower and upper critical values for the Johnson-Neyman procedure~~

~~The QJN program is available in my web page. Simply download it and put it in your Desktop. Double click the icon to start.~~