The UNIVARIATE Procedure
Variable: fecund
line = NS

The summary statistics and normality checks here are the same as those in the output for fruitfly1.

Basic Statistical Measures			
Location		**Variability**	
Mean	33.37200	**Std Deviation**	8.94201
Median	34.40000	**Variance**	79.95960
Mode	.	**Range**	36.90000
		Interquartile Range	9.70000

Tests for Normality				
Test	**Statistic**		**p Value**	
Shapiro-Wilk	**W**	0.983892	**Pr < W**	0.9498
Kolmogorov-Smirnov	**D**	0.11463	**Pr > D**	>0.1500
Cramer-von Mises	**W-Sq**	0.037842	**Pr > W-Sq**	>0.2500
Anderson-Darling	**A-Sq**	0.21906	**Pr > A-Sq**	>0.2500

Quantiles (Definition 5)	
Level	**Quantile**
100% Max	51.8
99%	51.8
95%	47.4
90%	42.4
75% Q3	37.9
50% Median	34.4
25% Q1	28.2
10%	20.3
5%	19.3
1%	14.9
0% Min	14.9

Extreme Values			
Lowest		**Highest**	
Order	**Value**	**Order**	**Value**
1	14.9	21	41.7
2	19.3	22	41.8
3	20.3	23	42.4
4	22.6	24	47.4
5	23.4	25	51.8

The UNIVARIATE Procedure
Variable: fecund
line = RS

Basic Statistical Measures			
Location		**Variability**	
Mean	25.25600	**Std Deviation**	7.77239
Median	23.60000	**Variance**	60.41007
Mode	20.30000	**Range**	31.60000
		Interquartile Range	9.00000

Tests for Normality				
Test	**Statistic**		**p Value**	
Shapiro-Wilk	**W**	0.949559	**Pr < W**	0.2450
Kolmogorov-Smirnov	**D**	0.139336	**Pr > D**	>0.1500
Cramer-von Mises	**W-Sq**	0.076663	**Pr > W-Sq**	0.2253
Anderson-Darling	**A-Sq**	0.473402	**Pr > A-Sq**	0.2288

Quantiles (Definition 5)	
Level	**Quantile**
100% Max	44.4
99%	44.4
95%	38.7
90%	38.6
75% Q3	29.3
50% Median	23.6
25% Q1	20.3
10%	14.9
5%	14.8
1%	12.8
0% Min	12.8

Extreme Values					
Lowest			**Highest**		
Order	**Value**	**Freq**	**Order**	**Value**	**Freq**
1	12.8	1	20	29.6	1
2	14.8	1	21	34.6	1
3	14.9	1	22	38.6	1
4	16.4	1	23	38.7	1
5	19.7	1	24	44.4	1

The UNIVARIATE Procedure
Variable: fecund
line = SS

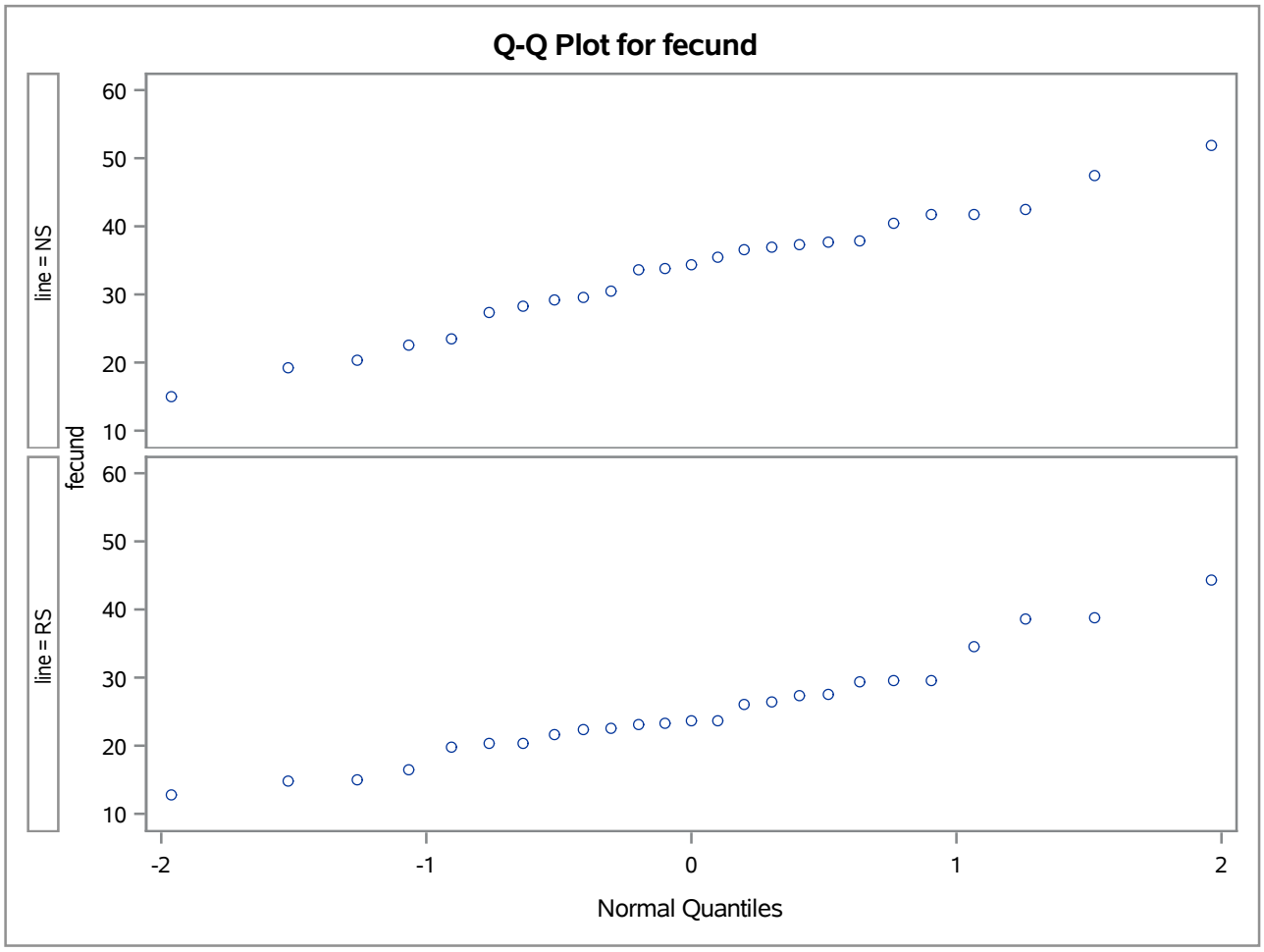
Basic Statistical Measures			
Location		**Variability**	
Mean	23.62800	**Std Deviation**	9.76847
Median	22.50000	**Variance**	95.42293
Mode	.	**Range**	37.70000
		Interquartile Range	14.20000

Tests for Normality				
Test	**Statistic**		**p Value**	
Shapiro-Wilk	**W**	0.939562	**Pr < W**	0.1446
Kolmogorov-Smirnov	**D**	0.153393	**Pr > D**	0.1312
Cramer-von Mises	**W-Sq**	0.070113	**Pr > W-Sq**	>0.2500
Anderson-Darling	**A-Sq**	0.457935	**Pr > A-Sq**	0.2463

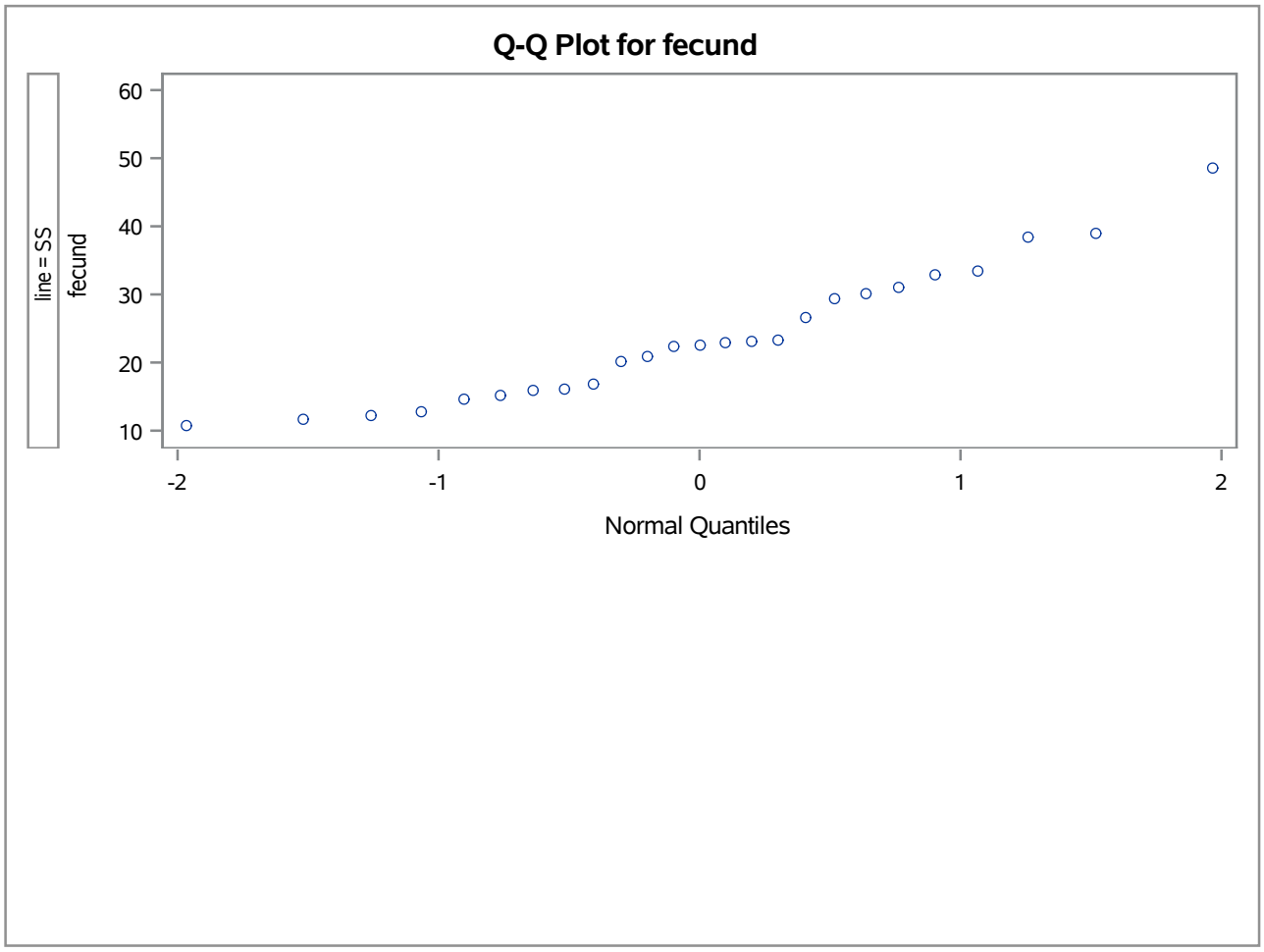
Quantiles (Definition 5)	
Level	**Quantile**
100% Max	48.5
99%	48.5
95%	39.0
90%	38.4
75% Q3	30.2
50% Median	22.5
25% Q1	16.0
10%	12.2
5%	11.6
1%	10.8
0% Min	10.8

Extreme Values			
Lowest		**Highest**	
Order	**Value**	**Order**	**Value**
1	10.8	21	32.9
2	11.6	22	33.4
3	12.2	23	38.4
4	12.8	24	39.0
5	14.6	25	48.5

The UNIVARIATE Procedure



The UNIVARIATE Procedure



The GLM Procedure

Class Level Information		
Class	**Levels**	**Values**
line	3	NS RS SS

Number of Observations Read	75
Number of Observations Used	75

ANOVA and model comparison approach to the fruitfly fecundity example.

We begin with the full model with 3 means -- one for each genetic line

We will consider the reduced model obtained by grouping the two selected lines (RS and SS) to give the reduced model with 2 means -- one for NS and one for selected.

The GLM Procedure

Coefficients for Estimate RS vs SS		Row 1
Intercept		0
line	NS	0
line	RS	1
line	SS	-1

contrast coefficients for the model comparison

mu_RS - mu_SS

The GLM Procedure

Dependent Variable: fecund

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	1362.211467	681.105733	8.67	0.0004
Error	72	5659.022400	78.597533		
Corrected Total	74	7021.233867			

R-Square	Coeff Var	Root MSE	fecund Mean
0.194013	32.33390	8.865525	27.41867

Source	DF	Type I SS	Mean Square	F Value	Pr > F
line	2	1362.211467	681.105733	8.67	0.0004

Source	DF	Type III SS	Mean Square	F Value	Pr > F
line	2	1362.211467	681.105733	8.67	0.0004

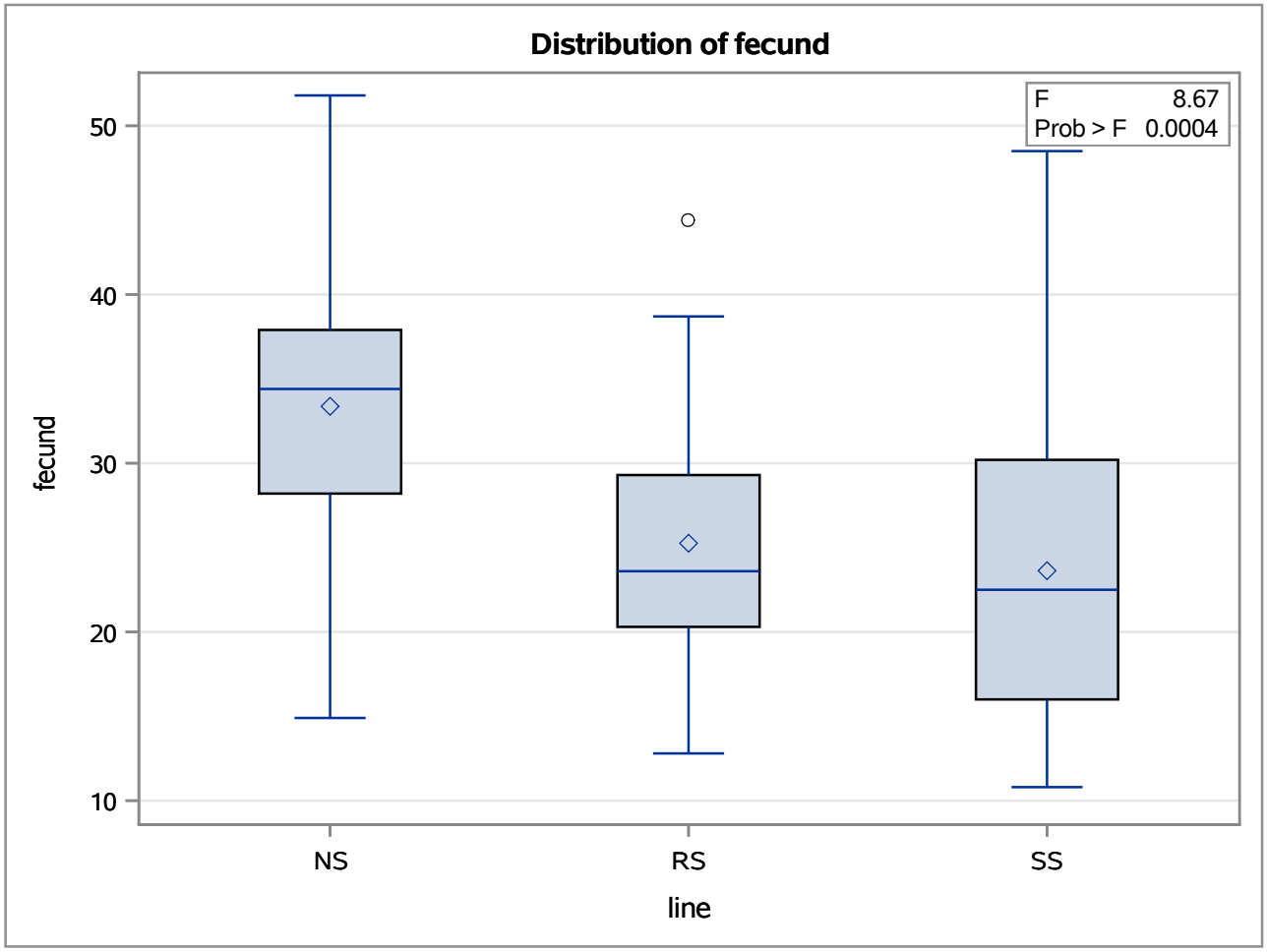
Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F
RS vs SS	1	33.12980000	33.12980000	0.42	0.5182

Parameter	Estimate	Standard Error	t Value	Pr > |t|	95% Confidence Limits	
RS vs SS	1.62800000	2.50754914	0.65	0.5182	-3.37070784	6.62670784

the large P-value .5182 indicates that we cannot reject the null hypothesis
H_0: mu_RS=mu_SS
Thus we do not need the full model with three means and the reduced model with 2 means mu_NS and mu_S will suffice.

The GLM Procedure

Dependent Variable: fecund



The GLM Procedure

Class Level Information		
Class	**Levels**	**Values**
line2	2	NS S

Number of Observations Read	75
Number of Observations Used	75

The GLM Procedure

Dependent Variable: fecund

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1329.081667	1329.081667	17.05	<.0001
Error	73	5692.152200	77.974688		
Corrected Total	74	7021.233867			

R-Square	Coeff Var	Root MSE	fecund Mean
0.189295	32.20553	8.830328	27.41867

Source	DF	Type I SS	Mean Square	F Value	Pr > F
line2	1	1329.081667	1329.081667	17.05	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
line2	1	1329.081667	1329.081667	17.05	<.0001

Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F
NS vs selected	1	1329.081667	1329.081667	17.05	<.0001

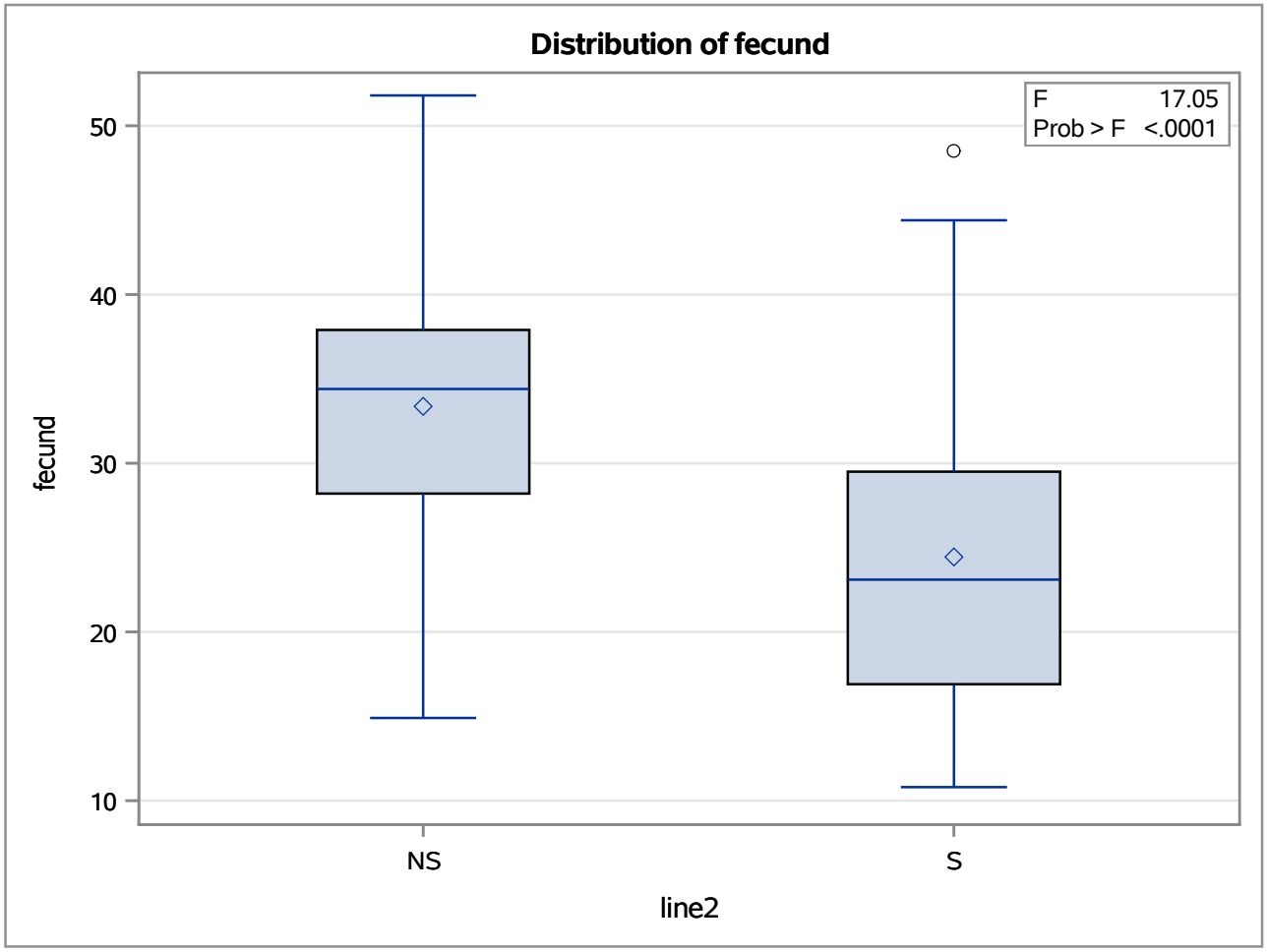
Parameter	Estimate	Standard Error	t Value	Pr > |t|
NS vs selected	8.93000000	2.16297972	4.13	<.0001

The small P-value < .0001 shows strong evidence that mu_NS is not equal to mu_(selected)
The F and t tests are equivalent with
F = 17.05 = (4.13)^2 = t^2

On average the mean fecundity for the nonselected (NS) population is 8.93 units larger than the mean fecundity for the combined (selected) population.

The GLM Procedure

Dependent Variable: fecund



The GLM Procedure

Class Level Information		
Class	Levels	Values
line	3	NS RS SS

Number of Observations Read	75
Number of Observations Used	75

In this part of the program we use stick with the full model with 3 means and use linear combinations to explore relationships among the lines.

The GLM Procedure

Dependent Variable: fecund

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	1362.211467	681.105733	8.67	0.0004
Error	72	5659.022400	78.597533		
Corrected Total	74	7021.233867			

ANOVA for the full model with three means

R-Square	Coeff Var	Root MSE	fecund Mean
0.194013	32.33390	8.865525	27.41867

Source	DF	Type I SS	Mean Square	F Value	Pr > F
line	2	1362.211467	681.105733	8.67	0.0004

Source	DF	Type III SS	Mean Square	F Value	Pr > F
line	2	1362.211467	681.105733	8.67	0.0004

Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F
RS vs SS	1	33.129800	33.129800	0.42	0.5182
RS vs NS	1	823.368200	823.368200	10.48	0.0018
SS vs NS	1	1186.819200	1186.819200	15.10	0.0002
NS vs others	1	1329.081667	1329.081667	16.91	0.0001

Parameter	Estimate	Standard Error	t Value	Pr > |t|	95% Confidence Limits	
RS vs SS	1.62800000	2.50754914	0.65	0.5182	-3.37070784	6.62670784
RS vs NS	-8.11600000	2.50754914	-3.24	0.0018	-13.11470784	-3.11729216
SS vs NS	-9.74400000	2.50754914	-3.89	0.0002	-14.74270784	-4.74529216
NS vs others	8.93000000	2.17160125	4.11	0.0001	4.60099202	13.25900798

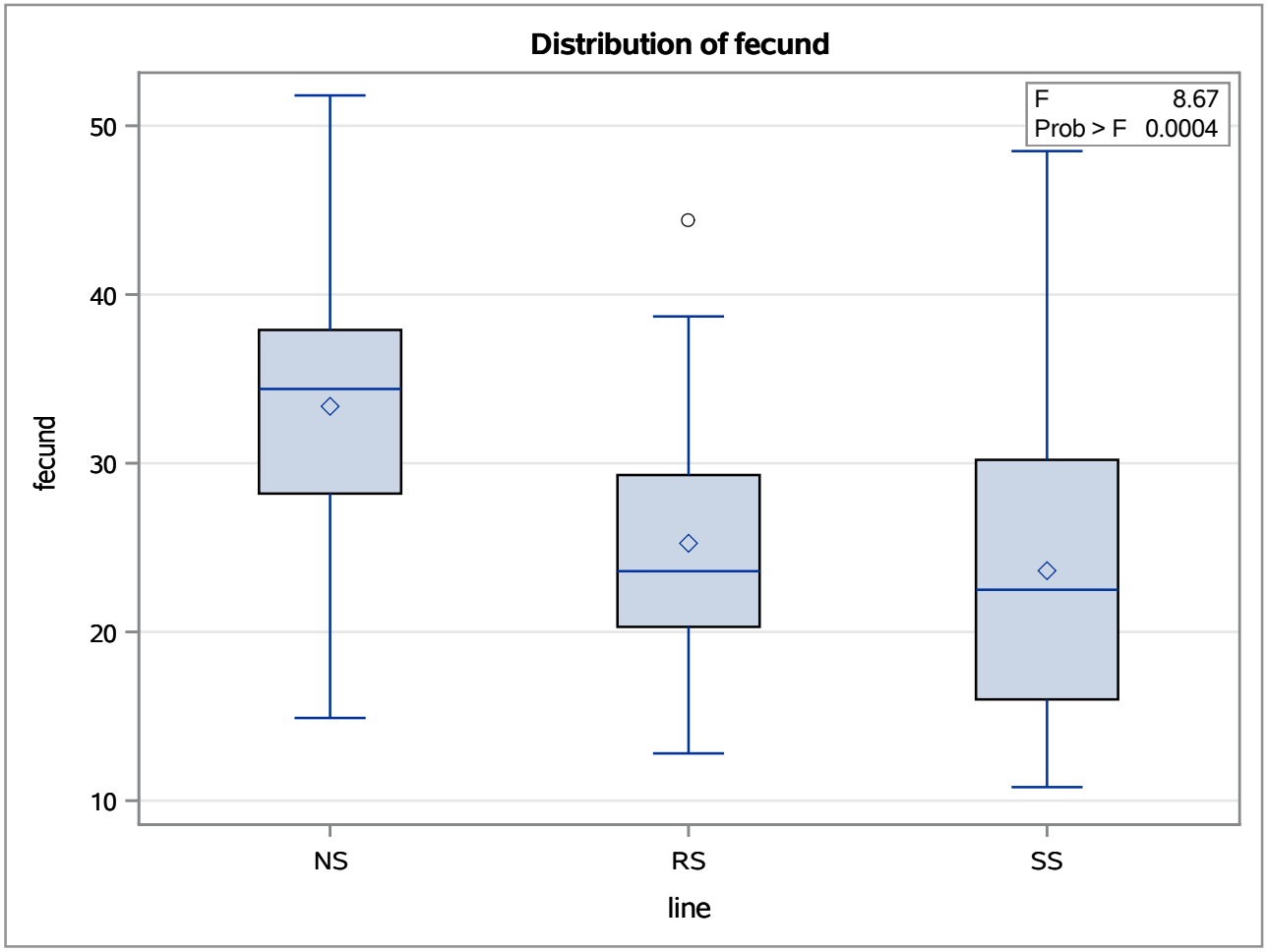
Thes F and t tests are for the null hypotheses that the contrast (indicated below) are equal to zero.

muRS-muSS
mu_RS-mu_NS
muu_SS-mu_NS
and
mu_NS-(mu_RS+mu_SS)/2

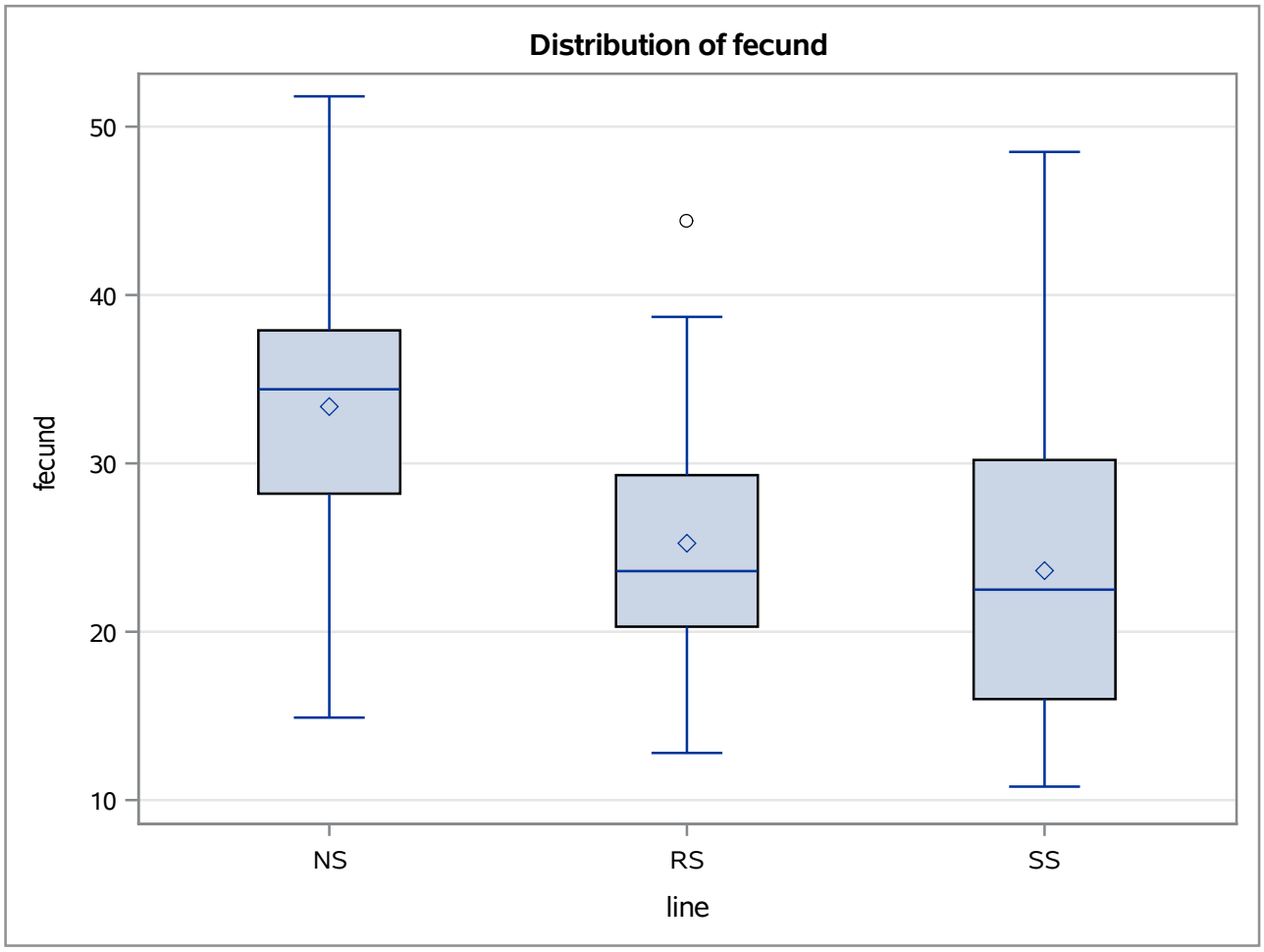
95% confidence intervals for:
muRS-muSS
mu_RS-mu_NS
mu_SS-mu_NS
and
mu_NS-(mu_RS+mu_SS)/2

The GLM Procedure

Dependent Variable: fecund



The GLM Procedure



The GLM Procedure

Scheffe's Test for fecund

Note: This test controls the Type I experimentwise error rate, but it generally has a higher Type II error rate than Tukey's for all pairwise comparisons.

The pairwise comparisons considered earlier are reconsidered here making adjustments for multiple comparisons.

Alpha	0.05
Error Degrees of Freedom	72
Error Mean Square	78.59753
Critical Value of F	3.12391
Minimum Significant Difference	6.2678

We can be 95% confident that all of these intervals apply simultaneously!

Comparisons significant at the 0.05 level are indicated by *.**

line Comparison	Difference Between Means	Simultaneous 95% Confidence Limits		
NS - RS	8.116	1.848	14.384	***
NS - SS	9.744	3.476	16.012	***
RS - NS	-8.116	-14.384	-1.848	***
RS - SS	1.628	-4.640	7.896	
SS - NS	-9.744	-16.012	-3.476	***
SS - RS	-1.628	-7.896	4.640	

Obs	F	multi
1	3.12391	2.49956

This is the multiplier used to form the simultaneous confidence intervals.

simultaneous Scheffe type intervals

Obs	differ	estimate	stderr	lowerCL	upperCL
1	RS_SS	1.628	2.50755	-4.6398	7.8958
2	RS_NS	-8.116	2.50755	-14.3838	-1.8482
3	SS_NS	-9.744	2.50755	-16.0118	-3.4762
4	NS_other	8.930	2.17160	3.5019	14.3581

The first three intervals here are the same simultaneous intervals for the pairwise differences as above. The last interval is for the contrast mu_NS-(mu_RS+mu_SS)/2.

The 95% confidence level is for all 4 intervals simultaneously.