

### Topic 3: Individual-Differences Variance and Residual Variance

1) The following questions ask you to compare individual-differences variances for pairs of experiments. In each case, it is possible to answer the question without having to calculate actual variance values. For individual-differences variance questions, think about the total score that each subject attained.

Study A			Study B		
	Level A <sub>1</sub>	Level A <sub>2</sub>		Level B <sub>1</sub>	Level B <sub>2</sub>
S <sub>1</sub>	1	1	S <sub>1</sub>	1	3
S <sub>2</sub>	2	2	S <sub>2</sub>	2	2
S <sub>3</sub>	3	3	S <sub>3</sub>	3	1

1a) Which experiment has the higher individual-differences variance?

Study A			Study B		
	Level A <sub>1</sub>	Level A <sub>2</sub>		Level B <sub>1</sub>	Level B <sub>2</sub>
S <sub>1</sub>	1	3	S <sub>1</sub>	0	2
S <sub>2</sub>	2	4	S <sub>2</sub>	2	4
S <sub>3</sub>	3	5	S <sub>3</sub>	4	6

1b) Which experiment has the higher individual-differences variance?

Study A			Study B		
	Level A <sub>1</sub>	Level A <sub>2</sub>		Level B <sub>1</sub>	Level B <sub>2</sub>
S <sub>1</sub>	1	3	S <sub>1</sub>	1	3
S <sub>2</sub>	3	1	S <sub>2</sub>	1	3
S <sub>3</sub>	1	3	S <sub>3</sub>	1	3

1c) Which experiment has the higher individual-differences variance?

Study A			Study B		
	Level A <sub>1</sub>	Level A <sub>2</sub>		Level B <sub>1</sub>	Level B <sub>2</sub>
S <sub>1</sub>	1	1	S <sub>1</sub>	1	3
S <sub>2</sub>	2	2	S <sub>2</sub>	2	4
S <sub>3</sub>	3	3	S <sub>3</sub>	3	5

1d) Which experiment has the higher individual-differences variance?

Study A			Study B		
	Level A <sub>1</sub>	Level A <sub>2</sub>		Level B <sub>1</sub>	Level B <sub>2</sub>
S <sub>1</sub>	1	1	S <sub>1</sub>	6	5
S <sub>2</sub>	3	3	S <sub>2</sub>	8	4
S <sub>3</sub>	5	5	S <sub>3</sub>	10	3

1e) Which experiment has the higher individual-differences variance?

Study A			Study B		
	Level A <sub>1</sub>	Level A <sub>2</sub>		Level B <sub>1</sub>	Level B <sub>2</sub>
S <sub>1</sub>	6	1	S <sub>1</sub>	3	4
S <sub>2</sub>	5	2	S <sub>2</sub>	4	4
S <sub>3</sub>	4	3	S <sub>3</sub>	3	4

1f) Which experiment has the higher individual-differences variance?

2) The following questions ask you to compare residual variances for pairs of experiments. In each case, it is possible to answer the question without having to calculate actual variance values. For residual variance questions, think about the direction of and size of the difference in the pair of scores for each subject.

Study A			Study B		
	Level A <sub>1</sub>	Level A <sub>2</sub>		Level B <sub>1</sub>	Level B <sub>2</sub>
S <sub>1</sub>	1	2	S <sub>1</sub>	1	3
S <sub>2</sub>	2	4	S <sub>2</sub>	2	4
S <sub>3</sub>	3	6	S <sub>3</sub>	3	5

2a) Which experiment has the higher *residual variance*?

Study A			Study B		
	Level A <sub>1</sub>	Level A <sub>2</sub>		Level B <sub>1</sub>	Level B <sub>2</sub>
S <sub>1</sub>	1	3	S <sub>1</sub>	0	2
S <sub>2</sub>	2	4	S <sub>2</sub>	4	6
S <sub>3</sub>	3	5	S <sub>3</sub>	8	10

2b) Which experiment has the higher *residual variance*?

Study A			Study B		
	Level A <sub>1</sub>	Level A <sub>2</sub>		Level B <sub>1</sub>	Level B <sub>2</sub>
S <sub>1</sub>	1	3	S <sub>1</sub>	1	3
S <sub>2</sub>	3	1	S <sub>2</sub>	1	3
S <sub>3</sub>	1	3	S <sub>3</sub>	1	3

2c) Which experiment has the higher *residual variance*?

Study A			Study B		
	Level A <sub>1</sub>	Level A <sub>2</sub>		Level B <sub>1</sub>	Level B <sub>2</sub>
S <sub>1</sub>	1	1	S <sub>1</sub>	0	2
S <sub>2</sub>	1	3	S <sub>2</sub>	1	5
S <sub>3</sub>	1	5	S <sub>3</sub>	2	8

2d) Which experiment has the higher *residual variance*?

Study A			Study B		
	Level A <sub>1</sub>	Level A <sub>2</sub>		Level B <sub>1</sub>	Level B <sub>2</sub>
S <sub>1</sub>	1	1	S <sub>1</sub>	1	3
S <sub>2</sub>	2	2	S <sub>2</sub>	2	4
S <sub>3</sub>	3	3	S <sub>3</sub>	3	5

2e) Which experiment has the higher *residual variance*?

Study A			Study B		
	Level A <sub>1</sub>	Level A <sub>2</sub>		Level B <sub>1</sub>	Level B <sub>2</sub>
S <sub>1</sub>	3	1	S <sub>1</sub>	3	4
S <sub>2</sub>	5	3	S <sub>2</sub>	5	4
S <sub>3</sub>	7	5	S <sub>3</sub>	7	8

2f) Which experiment has the higher *residual variance*?

### Topic 3: Within-Subjects ANOVA

1) In the following within-subjects design experiment with two levels, some scores are missing. However, for the original full set of scores the *individual-differences variance came to zero*. It is therefore possible to reconstruct the missing data. **This is Data Set 1**

1a) Fill in the missing scores so that the individual-differences variance is zero.

	Level A <sub>1</sub>	Level A <sub>2</sub>
S <sub>1</sub>	2	8
S <sub>2</sub>	3	
S <sub>3</sub>	4	
S <sub>4</sub>	4	
S <sub>5</sub>	5	
S <sub>6</sub>	6	

1b) What is the mean and standard deviation for each level?

2) In the following within-subjects design experiment with two levels, some scores are missing. However, for the original full set of scores the *residual variance came to zero*. This means that it is possible to reconstruct the missing data. **This is Data Set 2**

2a) Fill in the missing scores so that the residual variance is zero.

	Level A <sub>1</sub>	Level A <sub>2</sub>
S <sub>1</sub>	2	4
S <sub>2</sub>	3	
S <sub>3</sub>	4	
S <sub>4</sub>	4	
S <sub>5</sub>	5	
S <sub>6</sub>	6	

2b) What is the mean and standard deviation for each level?

**3) Compare Data Sets 1 and 2 [Do not perform further calculations to answer these]**

**a) Which will have the higher between-group variance?**

Data Set 1 will be higher	Data Set 2 will be higher	Data Sets will be Identical
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**b) Which will have the higher within-group variance?**

Data Set 1 will be higher	Data Set 2 will be higher	Data Sets will be Identical
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**c) Which will have the higher individual-differences variance?**

Data Set 1 will be higher	Data Set 2 will be higher	Data Sets will be Identical
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**d) Which will have the higher residual variance?**

Data Set 1 will be higher	Data Set 2 will be higher	Data Sets will be Identical
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**e) Predict the results of an ANOVA conducted on Data Set 1**

Definitely non-significant	Possibly non-significant	Cannot make a decision	Possibly significant	Definitely significant
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**f) Predict the results of an ANOVA conducted on Data Set 2**

Definitely non-significant	Possibly non-significant	Cannot make a decision	Possibly significant	Definitely significant
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4a) Perform an Analysis of Variance on Data Set 1 to determine whether or not there is a significant difference in means between the two levels. Fill in the details on the table.

Source	Sum of Squares	Degrees of Freedom	Variance (Mean Square)	F-value	p-value (sig. level)
<b>A</b> BETWEEN-GROUP					
<b>S</b> INDIVIDUAL-DIFFS.					
<b>AxS</b> RESIDUAL					
<b>TOTAL</b>					

4b) What is the value of the error term?

4c) What are the Degrees of Freedom of the *F* value

4d) What is the critical value for these Degrees of Freedom ( $p < .01$  and  $p < .05$ )

4e) Is *F* significant? At what level [Circle]?     $p > .05$      $p < .05$      $p < .01$

4f) What is the value of the within-group variance?

[This can be calculated directly from the ANOVA table above.]

5a) Perform an Analysis of Variance on Data Set 2 to determine whether or not there is a significant difference in means between the two levels. Fill in the details on the table.

Source	Sum of Squares	Degrees of Freedom	Variance (Mean Square)	F-value	p-value (sig. level)
<b>A</b> BETWEEN-GROUP					
<b>S</b> INDIVIDUAL-DIFFS.					
<b>AxS</b> RESIDUAL					
<b>TOTAL</b>					

5b) What is the value of the error term?

5c) What are the Degrees of Freedom of the *F* value

5d) What is the critical value for these Degrees of Freedom ( $p < .01$  and  $p < .05$ )

5e) Is *F* significant? At what level [Circle]?     $p > .05$      $p < .05$      $p < .01$

5f) What is the value of the within-group variance?

*[This can be calculated directly from the ANOVA table above.]*

6) Which is worse for obtaining a significant effect in a within-subjects design? Two tied scores, or one reverse-direction outlier? **Data Set 3** and **Data Set 4** compare the two possibilities.

Data Set 3			Data Set 4		
	Level A <sub>1</sub>	Level A <sub>2</sub>		Level A <sub>1</sub>	Level A <sub>2</sub>
S <sub>1</sub>	2	3	S <sub>1</sub>	2	3
S <sub>2</sub>	3	5	S <sub>2</sub>	3	5
S <sub>3</sub>	4	5	S <sub>3</sub>	4	5
S <sub>4</sub>	4	6	S <sub>4</sub>	4	6
S <sub>5</sub>	5	5	S <sub>5</sub>	5	6
S <sub>6</sub>	6	6	S <sub>6</sub>	6	5

6a) On the tables above, circle the two pairs of scores that are tied in their data set, and also the one pair of scores that is a reverse-direction outlier in its data set.

6b) What is the mean and standard deviation for each level?

7) Compare Data Sets 3 and 4 *[Do not perform further calculations to answer these]*

a) Which will have the higher between-group variance?

Data Set 3 will be higher	Data Set 4 will be higher	Data Sets will be Identical
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b) Which will have the higher within-group variance?

Data Set 3 will be higher	Data Set 4 will be higher	Data Sets will be Identical
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c) Which will have the higher individual-differences variance?

Data Set 3 will be higher	Data Set 4 will be higher	Data Sets will be Identical
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d) Which will have the higher residual variance?

Data Set 3 will be higher	Data Set 4 will be higher	Data Sets will be Identical
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e) Which is more likely to give a significant difference between the means?

Data Set 3 more likely	Data Set 4 more likely	Data Sets will be Identical
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8a) Perform an Analysis of Variance on Data Set 3 to determine whether or not there is a significant difference in means between the two levels. Fill in the details on the table.

Source	Sum of Squares	Degrees of Freedom	Variance (Mean Square)	F-value	p-value (sig. level)
<b>A</b> BETWEEN-GROUP					
<b>S</b> INDIVIDUAL-DIFFS.					
<b>AxS</b> RESIDUAL					
<b>TOTAL</b>					

8b) What is the value of the error term?

8c) What are the Degrees of Freedom of the *F* value

8d) What is the critical value for these Degrees of Freedom ( $p < .01$  and  $p < .05$ )

8e) Is *F* significant? At what level [Circle]?     $p > .05$      $p < .05$      $p < .01$



9a) Perform an Analysis of Variance on Data Set 4 to determine whether or not there is a significant difference in means between the two levels. Fill in the details on the table.

Source	Sum of Squares	Degrees of Freedom	Variance (Mean Square)	F-value	p-value (sig. level)
<b>A</b> BETWEEN-GROUP					
<b>S</b> INDIVIDUAL-DIFFS.					
<b>AxS</b> RESIDUAL					
<b>TOTAL</b>					

9b) What is the value of the error term?

9c) What are the Degrees of freedom of the  $F$  value

9d) What is the critical value for these Degrees of Freedom ( $p < .01$  and  $p < .05$ )

9e) Is  $F$  significant? At what level [Circle]?  $p > .05$        $p < .05$        $p < .01$