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Academic Skills II – Lecture 5

Additional slides on testing for normal
distribution in SPSS

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How can I test for normal distribution in SPSS?

Testing normal distribution

Why?

- Certain statistical testing procedures require normal distribution of the data in your variable(s).
- In SPSS you can compute the Kolmogorov-Smirnov-Test (KS-Test) and the Shapiro-Wilk-Test.
- We recommend to generally use the Shapiro-Wilk-Test, as it is considered more powerful than the KS-Test.
- However, both tests are sensitive to large samples in the sense that they will quickly show a significant deviation from the normal distribution when the sample size is > 200 , even though the data does approximate a normal distribution. Therefore, look at the normality plots first, when you have a large data set and decide whether or not you need a normality test.

(see e.g. <https://www.nrc.gov/docs/ML1714/ML17143A100.pdf>)

Normal distribution test



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- Regardless of which normality test you choose, they basically function as follows:
 - They test a pair of hypotheses: the alternative hypothesis states that the data for a given variable significantly deviates from the normal distribution
 - The null hypothesis states that the data for a given variable does not significantly deviate from the normal distribution (and can therefore be considered normally distributed).
 - We want our scores of the two variables to be normally distributed, so we want a p-value for both variables which is above the threshold value of 5% (remember – a hypothesis test is about the null hypothesis, not about the alternative hypothesis)!!

Normal distribution test



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- Let's have a look at the normality test for our two dimensions Extraversion and Agreeableness (in this case I will rely on the p-values of the Shapiro-Wilk-Test)
- **The relevant SPSS command is: Analyze → Descriptive Statistics → Explore...**

Normal distribution test



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Dataset_bfi_2_s_1.sav [DataSet1] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

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Nonparametric Tests
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Multiple Response
Missing Value Analysis...
Multiple Imputation
Complex Samples
Simulation...
Quality Control
Spatial and Temporal Modeling...
Direct Marketing

Frequencies...
Descriptives...
Explore...
Crosstabs...
TURF Analysis
Ratio...
P-P Plots...
Q-Q Plots...

Name	Type	ng	Columns	Align	Measure	Role
1 BFI_2_S_1	Numeric	8		Right	Ordinal	Input
2 BFI_2_S_2	Numeric	8		Right	Ordinal	Input
3 BFI_2_S_3	Numeric	8		Right	Ordinal	Input
4 BFI_2_S_4	Numeric	8		Right	Ordinal	Input
5 BFI_2_S_5	Numeric	8		Right	Ordinal	Input
6 BFI_2_S_6	Numeric	8		Right	Ordinal	Input
7 BFI_2_S_7	Numeric	8		Right	Ordinal	Input
8 BFI_2_S_8	Numeric	8		Right	Ordinal	Input
9 BFI_2_S_9	Numeric	8		Right	Ordinal	Input
10 BFI_2_S_10	Numeric	8		Right	Ordinal	Input
11 BFI_2_S_11	Numeric	8		Right	Ordinal	Input
12 BFI_2_S_12	Numeric	8		Right	Ordinal	Input
13 BFI_2_S_13	Numeric	8		Right	Ordinal	Input
14 BFI_2_S_14	Numeric	8		Right	Ordinal	Input
15 BFI_2_S_15	Numeric	8		Right	Ordinal	Input
16 BFI_2_S_16	Numeric	8		Right	Ordinal	Input
17 BFI_2_S_17	Numeric	8		Right	Ordinal	Input
18 BFI_2_S_18	Numeric	8		Right	Ordinal	Input
19 BFI_2_S_19	Numeric	8		Right	Ordinal	Input
20 BFI_2_S_20	Numeric	8		Right	Ordinal	Input
21 BFI_2_S_21	Numeric	8		Right	Ordinal	Input
22 BFI_2_S_22	Numeric	8		Right	Ordinal	Input
23 BFI_2_S_23	Numeric	8		Right	Ordinal	Input
24 BFI_2_S_24	Numeric	8		Right	Ordinal	Input
25 BFI_2_S_25	Numeric	8		Right	Ordinal	Input
26 BFI_2_S_26	Numeric	8	0	Right	Ordinal	Input
27 BFI_2_S_27	Numeric	8	0	Right	Ordinal	Input
28 BFI_2_S_28	Numeric	8	0	Right	Ordinal	Input
29 BFI_2_S_29	Numeric	8	0	Right	Ordinal	Input
30 BFI_2_S_30	Numeric	8	0	Right	Ordinal	Input
31 BFI_2_S_1_R	Numeric	8	2	Right	Ordinal	Input
32 BFI_2_S_21...	Numeric	8	2	Right	Ordinal	Input
33 BFI_2_26_R	Numeric	8	2	Right	Ordinal	Input
34 Extraversion	Numeric	8	0	Right	Scale	Input
35 BFI_2_S_7_R	Numeric	8	2	Right	Ordinal	Input
36 BFI_2_S_17...	Numeric	8	2	Right	Ordinal	Input
37 BFI_2_S_27...	Numeric	8	2	Right	Ordinal	Input
38 Agreeablen...	Numeric	8	0	Right	Scale	Input

Data View Variable View



Explore...	IBM SPSS Statistics Processor is ready	Unicode.ON			
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Normal distribution test



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Quality Control
Spatial and Temporal Modeling...
Direct Marketing

Explore

Dependent List:
Factor List:
Label Cases by:

Display:
☒ Both ☐ Statistics ☐ Plots

OK Paste Reset Cancel Help

Name	Type
BFI_2_S_1	Numeric
BFI_2_S_2	Numeric
BFI_2_S_3	Numeric
BFI_2_S_4	Numeric
BFI_2_S_5	Numeric
BFI_2_S_6	Numeric
BFI_2_S_7	Numeric
BFI_2_S_8	Numeric
BFI_2_S_9	Numeric
BFI_2_S_10	Numeric
BFI_2_S_11	Numeric
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BFI_2_S_26	Numeric
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BFI_2_S_27...	Numeric
Agreeablen...	Numeric

Normal distribution test



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Frequency...
Descriptive...
Explore...
Crosstabs...
TURF Analy...
Ratio...
P-P Plots...
Q-Q Plots...

ng Columns Align Measure Role

Explore

Dependent List:
Extraversion
Agreeableness

Factor List:

Label Cases by:

Display
☒ Both ☐ Statistics ☐ Plots

OK Paste Reset Cancel Help

Name	Type
BFI_2_S_1	Numeric
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BFI_2_S_3	Numeric
BFI_2_S_4	Numeric
BFI_2_S_5	Numeric
BFI_2_S_6	Numeric
BFI_2_S_7	Numeric
BFI_2_S_8	Numeric
BFI_2_S_9	Numeric
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BFI_2_S_27_...	Numeric
Agreeablen...	Numeric

Name	Type	Measure	Scale	Role
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BFI_2_S_3	Numeric	8	2	None
BFI_2_S_4	Numeric	8	2	None
BFI_2_S_5	Numeric	8	2	None
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BFI_2_S_14	Numeric	8	2	None
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BFI_2_S_16	Numeric	8	2	None
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BFI_2_S_18	Numeric	8	2	None
BFI_2_S_19	Numeric	8	2	None
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BFI_2_S_24	Numeric	8	2	None
BFI_2_S_25	Numeric	8	2	None
BFI_2_S_26	Numeric	8	2	None
BFI_2_S_27	Numeric	8	2	None
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BFI_2_S_7_R	Numeric	8	2	None
BFI_2_S_17_...	Numeric	8	2	None
BFI_2_S_27_...	Numeric	8	2	None
Agreeablen...	Numeric	8	0	None

Data View Variable View

Explore...

IBM SPSS Statistics Processor is ready

Unicode: ON

Normal distribution test



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Q-Q Plots...

Explore

Dependent List:
Extraversion
Agreeableness

Factor List:

Label Cases by:

Display
☒ Both ☐ Statistics ☐ Plots

OK Paste Reset Cancel Help

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BFI_2_S_13	Numeric
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BFI_2_S_27...	Numeric
Agreeablen...	Numeric

Data View Variable View

Normal distribution test



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Explore: Plots

Boxplots
☒ Factor levels together
☐ Dependents together
☒ None

Descriptive
☐ Stem-and-leaf
☒ Histogram

☒ Normality plots with tests

Spread vs Level with Levene Test
☐ None
☐ Power estimation
☐ Transformed Power: Natural log
☒ Untransformed

Continue Cancel Help

Name	Type
BFI_2_S_1	Numeric
BFI_2_S_2	Numeric
BFI_2_S_3	Numeric
BFI_2_S_4	Numeric
BFI_2_S_5	Numeric
BFI_2_S_6	Numeric
BFI_2_S_7	Numeric
BFI_2_S_8	Numeric
BFI_2_S_9	Numeric
BFI_2_S_10	Numeric
BFI_2_S_11	Numeric
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BFI_2_S_15	Numeric
BFI_2_S_16	Numeric
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BFI_2_S_18	Numeric
BFI_2_S_19	Numeric
BFI_2_S_20	Numeric
BFI_2_S_21	Numeric
BFI_2_S_22	Numeric
BFI_2_S_23	Numeric
BFI_2_S_24	Numeric
BFI_2_S_25	Numeric
BFI_2_S_26	Numeric
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BFI_2_S_27...	Numeric
Agreeablen...	Numeric

Data View Variable View

Explore...

IBM SPSS Statistics Processor is ready

Unicode/ON

Normal distribution test



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IBM SPSS Statistics Viewer

File Edit View Data Transform Insert Format Analyze Graphs Utilities Extensions Window Help

Output Log Explore

Explore

[DataSet1] \\lara\angestellte\smaurer\Desktop\AcSII_spss\Dataset_bfi_2_s_1.sav

Case Processing Summary

	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
Extraversion	50	100,0%	0	0,0%	50	100,0%
Agreeableness	50	100,0%	0	0,0%	50	100,0%

Descriptives

		Statistic	Std. Error
Extraversion	Mean	17,84	,522
	95% Confidence Interval for Mean	Lower Bound 16,79	
		Upper Bound 18,89	
	5% Trimmed Mean	17,90	
	Median	18,00	
	Variance	13,607	
	Std. Deviation	3,689	
	Minimum	10	
	Maximum	25	
	Range	15	
	Interquartile Range	5	
	Skewness	-,269	,337
	Kurtosis	-,344	,662
	Agreeableness	Mean	18,52
95% Confidence Interval for Mean		Lower Bound 17,52	
		Upper Bound 19,52	
5% Trimmed Mean		18,50	
Median		18,00	
Variance		12,336	
Std. Deviation		3,512	
Minimum		9	
Maximum		27	
Range		18	
Interquartile Range		5	
Skewness		,109	,337
Kurtosis		,336	,662

IBM SPSS Statistics Processor is ready Unicode: ON



Normal distribution test

IBM SPSS Statistics Viewer

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Output Log Explore

Explore

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Case Processing Summary

	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
Extraversion	50	100,0%	0	0,0%	50	100,0%
Agreeableness	50					

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Extraversion	,090	50	,200*	,974	50	,323
Agreeableness	,159	50	,003	,978	50	,461

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

	Mean	Std. Deviation	Minimum	Maximum	Range	Interquartile Range	Skewness	Kurtosis
Extraversion	18,00	12,336	9	27	18	5	,109	,337
Agreeableness	18,00	12,336	9	27	18	5	,336	,662

In our example, I chose the Shapiro-Wilk-Test, and it shows that both dimension scores are normally distributed, → each p-value > 0.05)



Normal distribution test

IBM SPSS Statistics Processor is ready | Unicode: ON

*Output1 [Document1] - IBM SPSS Statistics Viewer

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Output Log Explore

Explore

[DataSet1] \\lara\angestellte\smaurer\Desktop\AcSII_spss\Dataset_bfi_2_s_1.sav

Case Processing Summary

	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
Extraversion	50	100,0%	0	0,0%	50	100,0%
Agreeableness	50					

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk	
	Statistic	df	Sig.	Statistic	df
Extraversion	,090	50	,200*	,974	
Agreeableness	,159	50	,003	,978	50

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Extraversion

Mean	95% Confidence Interval for Mean	5% Trimmed Mean	Median	Variance	Std. Deviation	Minimum	Maximum	Range	Interquartile Range	Skewness	Kurtosis
18,00				12,336	3,512	9	27	18	5	,109	,337

Agreeableness

Mean	95% Confidence Interval for Mean	5% Trimmed Mean	Median	Variance	Std. Deviation	Minimum	Maximum	Range	Interquartile Range	Skewness	Kurtosis
18,00				12,336	3,512	9	27	18	5	,109	,337

If I had chosen the Kolmogorov-Smirnov-Test, it would show that the scores of the dimension agreeableness are not normally distributed → $p < 0.05$)

Normal distribution test



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- According to the Shapiro-Wilk-Test, I conclude that the data does not significantly deviate from the normal distribution. I consider the data normally distributed.
- However, if I had chosen the Kolmogorov-Smirnov-Test, the scores of the dimension agreeableness would not be considered normally distributed.