

## **Biometry practical 8**

### **Illustrated (imperfect) practical guide**

#### **Preparatory work**

1. Open in MS Excel the questionnaire data,
  2. insert new worksheet, rename new worksheet to 'Praks8' (or 'Practical 8') and
  3. make a copy of the data table (from worksheet 'Andmed'/'Data') and paste it into the upper left corner of the new worksheet 'Praks8'.
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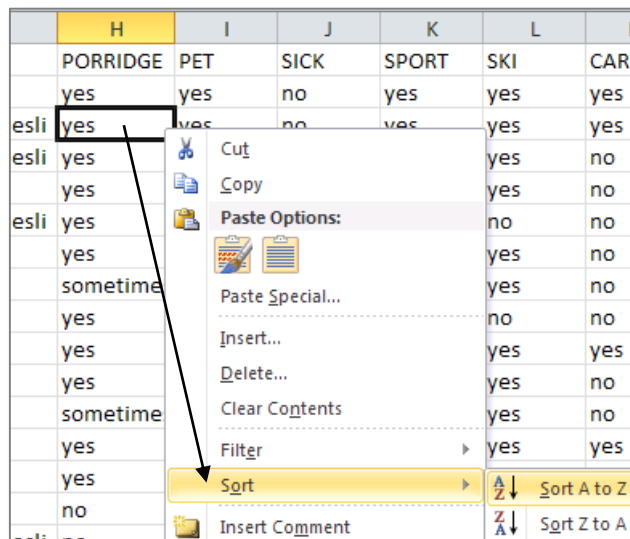
#### **Exercise.**

##### **Does the students' body weight depend on porridge eating?**

1. Sort the data table according to porridge eating and
2. make an additional table containing in different columns the body weights of students not eating, sometimes eating and eating the porridge.
3. Perform the analysis of variance:
  - write down the hypothesis pair,
  - perform the one-way analysis of variance using statistical procedure *ANOVA: Single Factor*,
  - describe the groups differences (or similarities) and
  - make a decision about statistical significance of porridge effect.
4. Illustrate the relationship between body weight and porridge eating with bar plot where the height of bar shows the average weight.  
Add to each bar the error lines showing the variability (standard deviation) of body weights.

## Guide

- Sort the data table according to porridge eating.
- Make an additional table containing in different columns the body weights of students not eating, sometimes eating and eating the porridge (for better understanding give to the columns short names).



	A	B	C	D	E	F	G	H	R	S	T	U
1	GENDER	HEIGHT	WEIGHT	HEAD	SHOE_S	MATH	BREAKFAST	PORRIDGE		Weight("No")	Weight("Stimes")	Weight("Yes")
2	W	161	50	55	37	4	nothing	no		50	65	70
3	W	170	85	57	41	4	cereals or mu	no		85	66	47.5
4	M	189	82	43	4	4	cereals or mu	no		82	52	60
5	M	170	80	56	41	4	cereals or mu	no		80	52	50
6	W	170	60	53	39	5	other	no		60	73	68
7	W	166	68	56	39	3	other	no		68	53	56
8	W	165	58	56	37	5	sandwich	no		58	87	53
9	W	177	63	60	40	2	sandwich	no		63	61	75
10	W	162	70	55	40	5	sandwich	no		70	80	74
11	W	177	65	55	40	3	sandwich	sometimes			70	64
12	W	176	66	57	39	4	sandwich	sometimes			58	82
13	W	164	52	56	37	4	other	sometimes				58
14	W	165	52	50.5	37	4	sandwich	sometimes				90
15	M	175	73	54	43	4	other	sometimes				55
16	W	169	53	55	38	3	sandwich	sometimes				60
17	M	174	87	57	40	4	sandwich	sometimes				62
18	W	165	61	57	39	3	other	sometimes				66
19	W	185	80	60	41	4	cereals or mu	sometimes				60
20	W	160	70	57	39	4	sandwich	sometimes				50
21	W	172	58	62	39	4	other	sometimes				74
22	W	170	70	55.5	39	3	other	yes				63
23	W	158	47.5	55	36	3	cereals or mu	yes				62
24	W	170	60	53	38	5	cereals or mu	yes				74
25	W	170	50	55	37	4	sandwich	yes				60
26	W	179	68	58	41	5	cereals or mu	yes				54
27	W	163	56		37	4	sandwich	yes				63
28	W	162.5	53	55	38	3	porridge	yes				75
29	W	170	75	56	39	5	other	yes				77
30	M	175	74	57	42	3	sandwich	yes				55
31	M	175	64	56	42	4	other	yes				75
32	M	190	82	58	46	4	other	yes				60
33	W	176	58	52	39	5	cereals or mu	yes				80
34	W	172	90	58	41	4	porridge	yes				70
35	W	158	55	57	38	4	cereals or mu	yes				58
36	W	169	60	55.5	41	4	cereals or mu	yes				
37	W	172	62	56	39	4	sandwich	yes				
38	W	173	66	56	40	5	cereals or mu	yes				
39	W	169	60	55	39	3	other	yes				
40	W	162	50	50	38	3	porridge	yes				
41	M	176	74	56	42	5	porridge	yes				
42	W	171	63	57	39	5	cereals or mu	yes				
43	W	163	62	56	38	5	cereals or mu	yes				
44	M	181	74	55	44	4	sandwich	yes				
45	W	168	60	55	39	4	cereals or mu	yes				
46	W	174	54	55	40	5	cereals or mu	yes				
47	W	168	63	53	39	4	sandwich	yes				
48	W	171	75	55	41	4	sandwich	yes				
49	W	165	77	58	39	5	sandwich	yes				
50	W	161	55	57	38	3	porridge	yes				
51	M	183	75		43	3	porridge	yes				
52	W	175	60	57	42	5	cereals or mu	yes				
53	W	167	80	57.5	41	5	other	yes				
54	W	158	70	55	38	5	cereals or mu	yes				
55	W	164	58	57	39	3	sandwich	yes				

Copy -> Paste

3. Perform the analysis of variance.

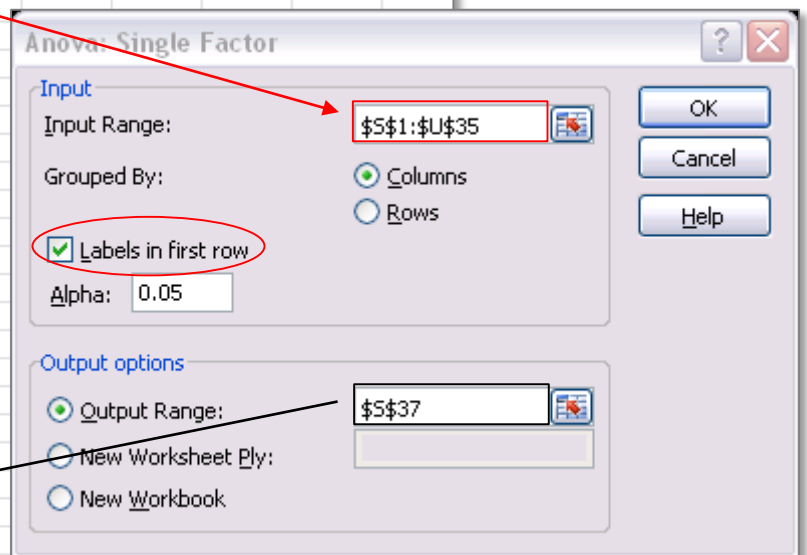
- Write down the hypothesis pair.
- Perform the one-way analysis of variance using statistical procedure ANOVA: Single Factor

(Data-tab → Data Analysis... → ANOVA: Single Factor)

Weight("No")	Weight("Stimes")	Weight("Yes")
50	65	70
85	66	47.5
82	52	60
80	52	50
60	73	68
68	53	56
58	87	53
63	61	75
70	80	74
	70	64
	58	82
		58
		90
		55
		60
		62
		66
		60
		50
		74
		63
		62
		74
		60
		54
		63
		75
		77
		55
		75
		60
		80
		70
		58

H<sub>0</sub>: Kehamass ja pudru söömine ei ole seotud  
H<sub>1</sub>: Kehamass ja pudru söömine on seotud

H<sub>0</sub>: the weight does not depend on porridge eating  
H<sub>1</sub>: the weight depends on porridge eating



Groups	Count	Sum	Average	Variance
Weight("No")	9	616	68.444	143.03
Weight("Stimes")	11	717	65.182	134.56
Weight("Yes")	34	2200.5	64.721	104.11

Source of Variatio	SS	df	MS	F	F-value	Fcrit
Between Group	99.56897405	2	49.784	0.4285	0.6538	3.1788
Within Groups	5925.454174	51	116.19			
Total	6025.023148	53				

- Describe the groups difference and make a decision about statistical significance of porridge effect (it must be uniquely understandable why you made this decision).

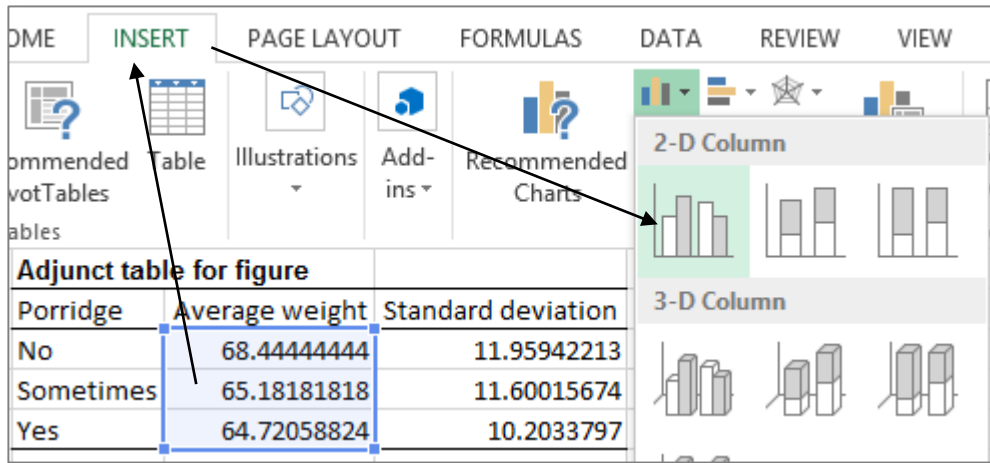
4. Illustrate the relationship between body weight and porridge eating with bar plot where the height of bar shows the average weight. Add to each bar the error lines showing the variability (standard deviation) of body weights.

- Make an additional table of average values and standard deviations necessary for bar plot (look at the following scheme).

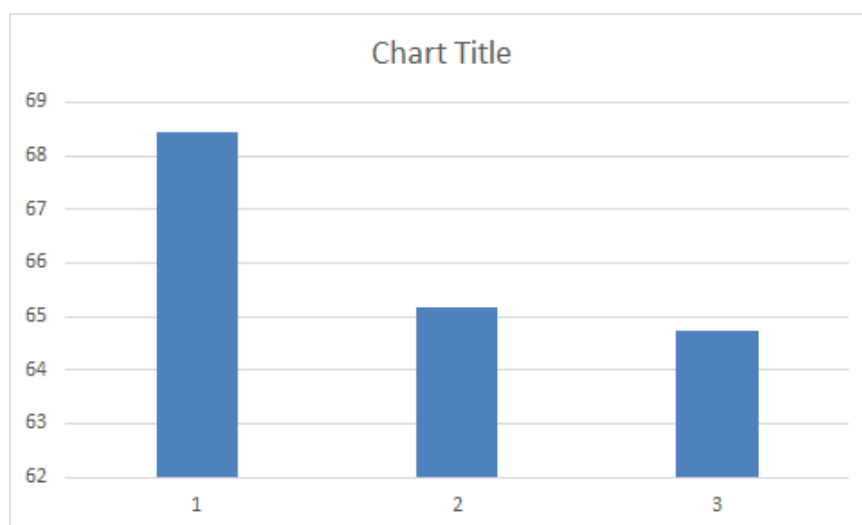
Standard deviations for bar plot error lines can be calculated from the output of analysis of variance (follow the scheme) or applying the function `STDEV.S` (in older Excel versions `STDEV`) to the corresponding cells in data table.

	R	S	T	U	V	W	X	Y
37		Anova: Single Factor						
38								
39		SUMMARY						
40		<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>		
41		Weight("No")	9	616	68.44444	143.0278		
42		Weight("Stimes")	11	717	65.18182	134.5636		
43		Weight("Yes")	34	2200.5	64.72059	104.109		
44								
45								
46		ANOVA						
47		<i>Source of Variator</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
48		Between Groups	99.56897405	2	49.78449	0.428492	0.653815	3.178799
49		Within Groups	5925.454174	51	116.1854			
50								
51		Total	6025.023148	53				
52								
53								
54		Adjunct table for figure						
55		Porridge	Average weight	Standard deviation				
56		No	68.44444444	=SQRT(W41)				
57		Sometimes	65.18181818	11.60015674				
58		Yes	64.72058824	10.2033797				

- Make a barplot with average values.

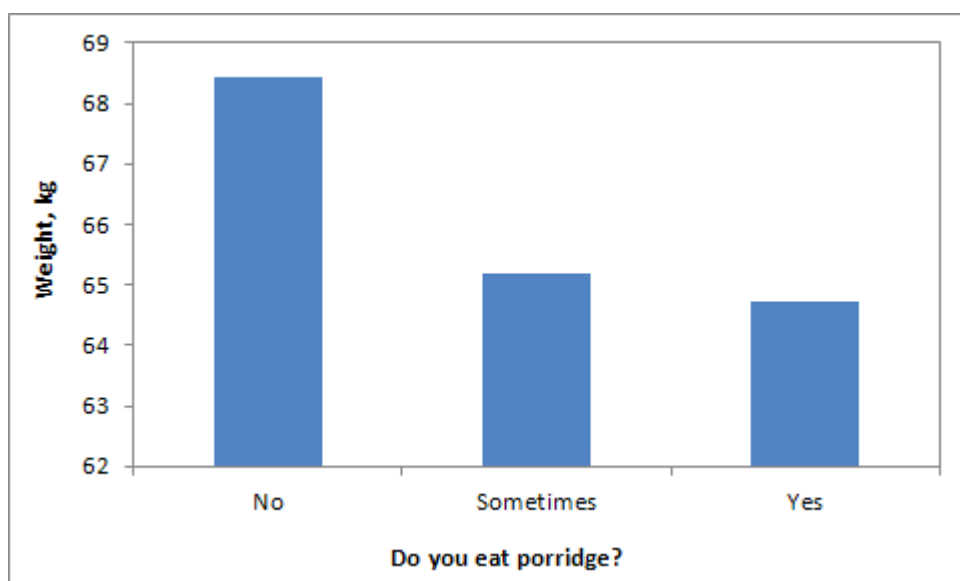


Result:

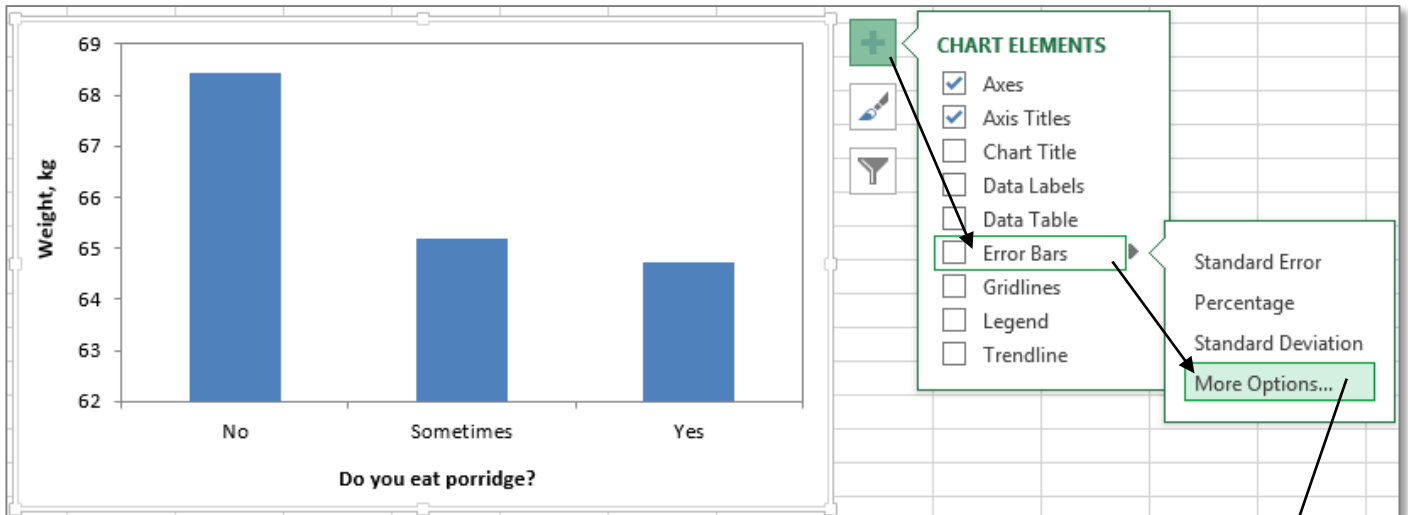


- Drop the title and gridlines; add axis, axis titles, borderline around the plot area and correct values to x-axis, present axis values and titles in black colour.

Expected result:



- Add to each bar the error lines showing the variability (standard deviation).



Abitabel joonise jaoks		
Puder	Keskmine mass	Standardhälve
Ei	68.44444444	11.95942213
Nii ja naa	65.18181818	11.60015674
Jah	64.72058824	10.2033797

**Format Error Bars**

Vertical Error Bars

Line Color  
Line Style  
Shadow  
Glow and Soft Edges

Vertical Error Bars

Display

Direction

Both

Minus

Plus

End Style

No Cap

Cap

Error Amount

Fixed value: 1.0

Percentage: 5.0 %

Standard deviation(s): 1.0

Standard error

Custom: **Specify Value**

Close

**Custom Error Bars**

Positive Error Value

=Praks 8!\$

Negative Error Value

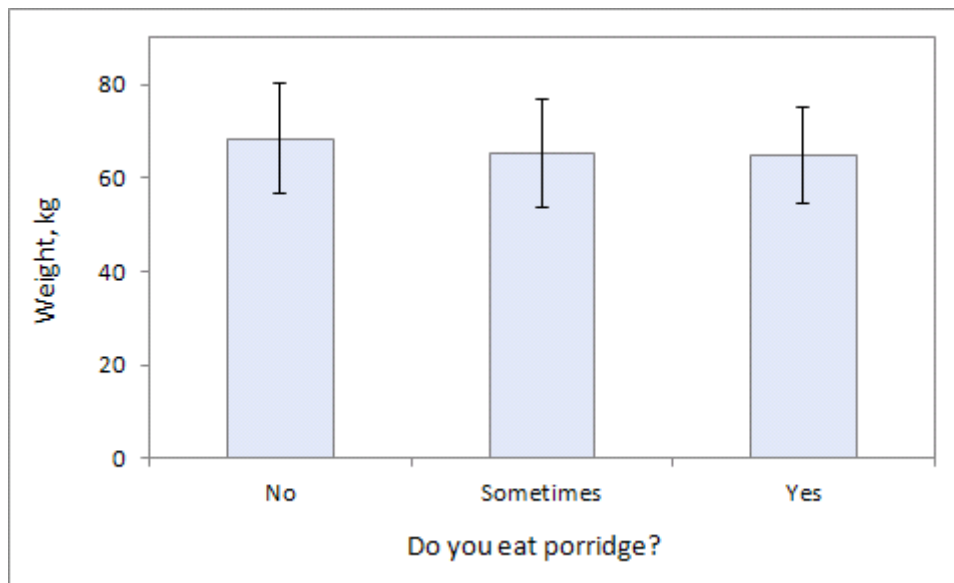
=Praks 8!\$

OK Cancel

To avoid potential error messages, the default values specified by Excel '= {1}' should be deleted.

- Result

(you can fill the bars with lighter colour to make error lines better visible):



- Final conclusion.

Although the body weight of students eating the porridge is 3.7 kg and body weight of students sometimes eating the porridge is 0.5 kg less than the body weight of students not eating the porridge, the variability of weights is too big and the data size is too small to prove this difference – according to the analysis of variance the weight does not depend on porridge eating ( $p = 0.654$ ). So, there is no scientific basis to talk about porridge diet.