Practicals 7: *t*- distribution and *t*-tests

1. Download the data "people" used in the first practicals. Plot a barplot displaying height means with 95% confidence intervals for each of the group of people defined by sex and eye color.
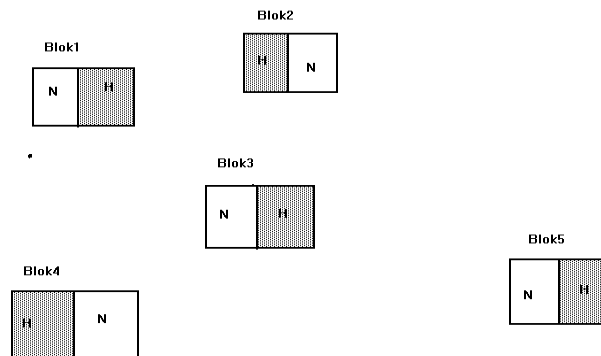
2. A student measured lengths of anthers of two species of *Ranunculus*, *R. auricomus* and *R. nemorosus*

The values, he obtained were as following (in mm):

Auri	Nemor
5	7
6	8
4	9
6	6
5	8
3	10

Does variability in anther length significantly differ between species? Does the mean anther length differ between species?

3. Five blocks were divided into two plots of which one was fertilized and the other not. The experiment looked like this in the field:

 Resulting plant biomass was as following

Block	1	2	3	4	5
Fertilized	23	25	36	19	22
Non-fertilized	20	24	33	18	21

Does fertilizer application affect biomass production?

A. Temperature of water in one pot was measured by different thermometers manufactured by two companies: Termom and Celsimet. Each of them provided 10 thermometers for the testing, The aim of the testing was to detect potential systematic bias (whether the thermometers of one company show in average different values from those made by the other) and whether there is a difference in accuracy. The data were as following:

Termom: 18, 19, 18, 17, 16, 19, 18, 17, 19, 18   Celsimet: 17, 15, 21, 20, 19, 22, 15, 16 ,18, 17

Test both differences in mean values and in the accuracy between the two manufacturers. Would you buy a thermometer produced by any of these companies?

B. 10 rats were fed by nutrition enriched in magnesium since their birth additional ten control rats were fed by the same nutrition except for that no extra Magnesium was added. The researchers expected that Mg should have a positive effect on the number of erythrocytes. The results of erythrocyte counting were following:

+Mg: 85, 89, 79, 80, 91, 95, 79, 88, 89, 90.

Control: 79, 80, 75, 79, 80, 71, 75, 80, 76, 80.

Does the assumption on positive effect of Mg on erythrocytes hold?

C. Heights of siblings (brother and sister) were measured at their adult age in eight families. The results (height in cm) are summarized in the table below.

family	brother	sister
1	198	165
2	164	162
3	173	158
4	180	177
5	188	178
6	169	170
7	181	165
8	174	159

Is there any significant difference in height between siblings of different sex?

D. Days with snow cover per year were monitored in Brno in 15 successive years. The resulting numbers were as following.

year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
days with snow cover	32	50	58	39	49	44	42	48	39	75	28	69	50	64	48

Is the mean number of days with snow cover significantly different from 58 days predicted for Brno on the basis of a global climatic model?

E. Wine was cultivated on 8 wine-yards in the Niederösterreich region. Red grape varieties Cabernet Sauvignon and Zweigeltrebe were cultivated on each of the wine-yards. Grapes were harvested on the same date, pressed and glucose content in the resulting juice was measured. The results are summarized in the table below:

Vineyard	Glucose (kg per hectolitre)	
	Cabernet Sauvignon	Zweigeltrebe
1	19.5	19.2
2	17.5	18.4
3	19.7	20.3
4	17.2	17.4
5	18	20.1
6	19.8	19.5
7	17.9	17.9
8	18.4	18.9

Do the two wine varieties significantly differ in mean glucose content?

F. Speed of swimming of two frog species was measured by a behavioral biologist. Following data were obtained.

Frog ID	Species	speed (cm s^{-1})
1	Bufo bufo	7.8
2	Bufo viridis	6.5
3	Bufo viridis	6.9
4	Bufo bufo	7.1
5	Bufo bufo	6.7
6	Bufo viridis	7.1
7	Bufo viridis	7.0
8	Bufo viridis	6.5
9	Bufo bufo	7.0
10	Bufo viridis	6.4
11	Bufo bufo	6.9
12	Bufo viridis	7.2
13	Bufo bufo	7.5
14	Bufo bufo	7.2

Do the two species significantly differ in speed of swimming?

G. A farmer tested yield difference between two varieties of rye. He cultivated each of them on six fields andweere obrained measured the grain yield (in tonnes per hectare). Following numbers were obtained

Field	Variety	yield (tonnes per hectare)
1	*Champion*	5.5
2	*Miracle*	6.1
3	*Champion*	5.7
4	*Champion*	6.0
5	*Miracle*	5.3
6	*Miracle*	5.8
7	*Champion*	6.4
8	*Miracle*	6.0
9	*Miracle*	5.5
10	*Champion*	6.4
11	*Miracle*	5.5
12	*Champion*	6.1