Test your knowledge

1. Define terms

Area -

Ecosystem -

Population –

2. Home task for groups

Questions -

Research Hypotheses –

Null hypotheses -

Alternate hypotheses-

Your topic -

ecology of water bodies

You are a scientist in the field of ecology and you were given the task to determine the population of squirrels in a pine forest. How do you do that?

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Data collection and analysis

- Methods of mathematical statistics

- The application of these methods makes it possible to get an objective view on a particular (определённая) population

Types of statistical test

T-test (Student's T-test)

Use to test the equality of the average values in two samples

(проверка равенства средних значений в двух выборках)

Chi- squared test (X^2).

Use if using categorical variables (if you are evaluating the differences between experimental data and expected or hypothetical data)… Example: expected distribution of organisms

(оценка различий между экспериментальными данными и ожидаемыми данными)

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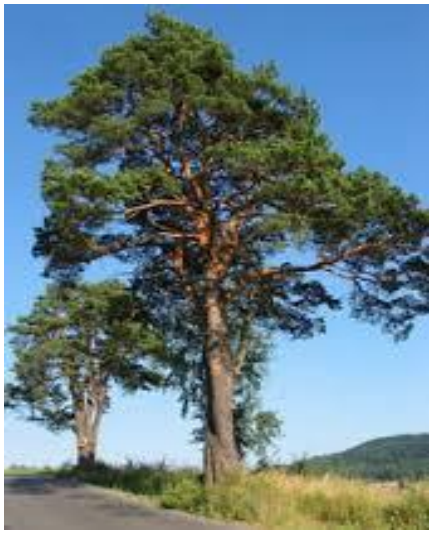
T-test

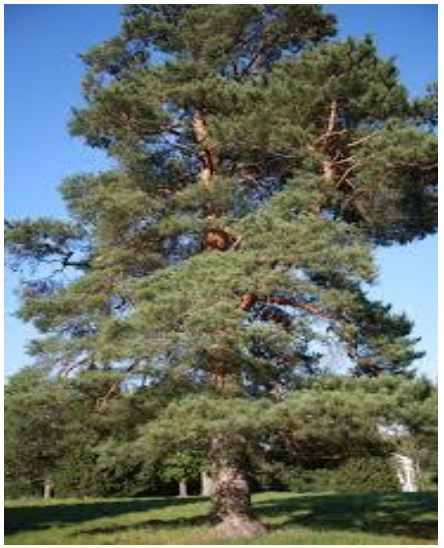
- 2 test groups
- Determining the differences between the two groups
- One or more samples per group are made

Example of research question

- Which species of pine (Scotch or Kulunda) are more common in Kazakhstan?



Scotch pine (сосна обыкновенная)



Kulunda pine (сосна Кулундинская)

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Examples of Hypotheses

Research Hypotheses

In Kazakhstan the Kulunda pine is more common

Statistical hypotheses

Null hypotheses (H_o)

H_o – there is no difference in the prevalence of Scots pine or Kulunda pine

Alternate hypotheses

H_a – there IS a difference in the predominance of Scots pine or Kulunda pine

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Methods of ecological research

- Laboratory method
- Experimental and experimental method
- Field method

The objects of field research can be living organisms, populations, species and their natural communities

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Objectives of field researches

Determine (определить)

- the distribution (распространение), abundance (численность) and quality of the species, population, biocenosis, ecosystem of lakes, rivers and other objects

- the influence of abiotic, biotic, anthropogenic factors on organisms

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Methods of field research

- Lay out and describe a sample area (закладка и описание пробных площадей (ключевых участков))
- The sizes of sample areas (squares) for groups of plants are 1, 10, 100 m^2, for forests - an area of 100 - 5000 m^2
- The main indicator of the research is the quantitative registration of organisms

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Example

Question: Which part of the school garden has more dandelions?

Research hypothesis:

Null hypothesis:

Alternate hypothesis:

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Method of research (squares method or key sites) метод квадратов или ключевых участков

1. Select the sample area.
2. Lay out a square grid of known size.
3. Count the dandelions in each grid.
4. Repeat this 5 times for both the locations.
5. Tabulate the data.
6. Analyze the data.

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Data collection

Number of dandelions on the school garden

Area	**Eastern part**	Western part
Square 1	5	7
Square 2	12	1
Square 3	7	17
Square 4	8	5
Square 5	8	10

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Step 1

- Calculate the mean value

Sample 1 (X_1)	$X_1 - \bar{X}_1$ **(deviation from the mean)**	$(X_1 - \bar{X}_1)^2$	**S_1^2= variance of sample1** дисперсия выборки1 $s^2 = \frac{\sum (X - \bar{X})^2}{N-1}$	**Sample 2** (X_2)	$X_2 - \bar{X}_2$ **(deviation from the mean)**	$(X_2 - \bar{X}_2)^2$	**S_2^2= variance of sample 2**
5				7			
12				1			
7				7			
8				5			
8				0			
Mean of $X_1 = 8$		*T-sum of all values*		***Mean of*** $X_1 = 6$		*T-sum of all values*	

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Step 2

Calculate the deviation from mean by subtracting the mean from the value of X for both the samples

Рассчитать отклонение от среднего значения путем вычитания среднего по величине X для обоих образцов.

Sample 1 (X_1)	$X_1 - \bar{X}_1$ (deviation from the mean)	$(X_1 - \bar{X}_1)^2$	S_1^2= variance of sample1 дисперсия выборки1 $s^2 = \frac{\sum (X - \bar{X})^2}{N-1}$	Sample 2 (X_2)	$X_2 - \bar{X}_2$ (deviation from the mean)	$(X_2 - \bar{X}_2)^2$	S_2^2= variance of sample 2
5	-3			7	3		
12	4			1	-3		
7	-1			7	3		
8	0			5	1		
8	0			0	-4		
Mean of X_1=8		*T-sum of all values*		***Mean of*** X_1= 6		*T-sum of all values*	

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Step 3

- Square the deviation from the mean for both the samples

Sample 1 (X_1)	$X_1 - \bar{X}_1$ (deviation from the mean)	$(X_1 - \bar{X}_1)^2$	S_1^2= variance of sample1 дисперсия $s^2 = \frac{\sum (X-\bar{X})^2}{N-1}$	Sample 2 (X_2)	$X_2 - \bar{X}_2$ (deviation from the mean)	$(X_2 - \bar{X}_2)^2$	S_2^2= variance of sample 2
5	-3	9		7	3	9	
12	4	16		1	-3	9	
7	-1	1		7	3	9	
8	0	0		5	1	1	
8	0	0		0	-4	16	
Mean of X_1=8		*T-sum of all values*		***Mean of*** X_1= 6		*T-sum of all values*	

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Step 4

- Calculate the sum of the squares

Sample 1 (X_1)	$X_1 - \bar{X}_1$ (deviation from the mean)	$(X_1 - \bar{X}_1)^2$	S_1^2= variance of sample1 дисперсия $s^2 = \frac{\sum (X - \bar{X})^2}{N-1}$	Sample 2 (X_2)	$X_2 - \bar{X}_2$ (deviation from the mean)	$(X_2 - \bar{X}_2)^2$	S_2^2= variance of sample 2
5	-3	9		7	3	9	
12	4	16		1	-3	9	
7	-1	1		7	3	9	
8	0	0		5	1	1	
8	0	0		0	-4	16	
Mean of $\bar{X}_1$**=8**		*T-sum of all values* 26		***Mean of*** $\bar{X}_1$**= 6**		*T-sum of all values* *44*	

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Step 5

- Calculate the variance for both the samples

Sample 1 (X_1)	$X_1 - \bar{X}_1$ (deviation from the mean)	$(X_1 - \bar{X}_1)^2$	S_1^2= variance of sample1 дисперсия $s^2 = \frac{\sum (X - \bar{X})^2}{N-1}$	Sample 2 (X_2)	$X_2 - \bar{X}_2$ (deviation from the mean)	$(X_2 - \bar{X}_2)^2$	S_2^2= variance of sample 2
5	-3	9	6,5	7	3	9	11
12	4	16		1	-3	9	
7	-1	1		7	3	9	
8	0	0		5	1	1	
8	0	0		0	-4	16	
Mean of $\bar{X}_1$**=8**		*T-sum of all values* 26		***Mean of*** $\bar{X}_1$**= 4**		*T-sum of all values* 44	

Step 6

- calculate the value of T using the formula provided in the Table

T –value

$$t = \frac{\overline{x_1} - \overline{x_2}}{\sqrt{\frac{S_1^{\,2}}{N_1} + \frac{S_2^{\,2}}{N_2}}}$$

Where:

$\overline{X}_1$= mean of sample 1

S_1^2= variance of sample 1

N_1= frequency of sample 1

$\overline{X}_2$= mean of sample 2

S_2^2= variance of sample 2

N_2= frequency of sample 2

- X_1 - среднее значение выборки 1
- X_2 - среднее значение выборки 2
- $S1^2$- дисперсия выборки 1
- $S2^2$- дисперсия выборки 2
- N_1 - частота выборки 1
- N_2 - частота выборки 2

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Answer

- 2,14

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Step 7

- Calculate the degree of freedom

Рассчитать степень свободы

$$df = (N_1 + N_2) - 2 = 8$$

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Step 8

- Find the critical value using the t- table

Degree of freedom

1	12.71
2	4.30
3	3.18
4	2.78
5	2.57
6	2.45
7	2.36
8	2.31
9	2.26
10	2.23
11	2.20
12	2.18
13	2.16
14	2.14
15	2.13

- 2,31

Data analysis

- If the T-value is less than the critical value, then accept the null hypothesis Если Т-значение меньше критического значения, то следует принять нулевую гипотезу

- If the T-value is bigger than the critical value, the null hypothesis should be rejected Если Т-значение больше, чем критическое значение следует отклонить нулевую гипотезу

- Null hypothesis: There are no differences in the number of dandelions on the western and eastern sides of the school garden

  - 2,14 2,31

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Analysis of results

- If the null hypothesis is accepted, then there was **NO** significant difference in the distribution of dandelions in the school garden

- If the null hypothesis is rejected, then there was a significant difference in the distribution of dandelions in the school garden

Conclusion

There is no significant difference in the distribution of dandelions in the school garden on the western and eastern territories