

## Topic 16 – Lab

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Course in Behavioral and Experimental  
Economics

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## Overview

- Excursion to the lab
- Practical issues such as programming languages (z-tree), recruiting etc.
- Statistics

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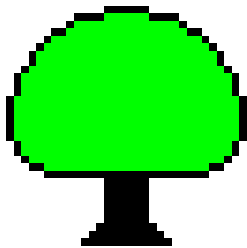
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# z-Tree

Zurich Toolbox for Ready-made Economic Experiments  
Slides © Urs Fischbacher  
For more information see: <http://www.iew.unizh.ch/ztree>  
See also: Fischbacher, 2007, in *Experimental Economics*  
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## Basic concepts

- There is a server program z-Tree and a client program z-Leaf.
- With z-Tree you can write treatment programs. It is also the server when running experiments.
- In z-Tree experiments are defined and experimental sessions are conducted.

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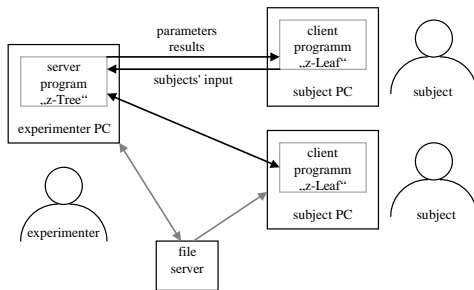
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## Realtime z-Tree



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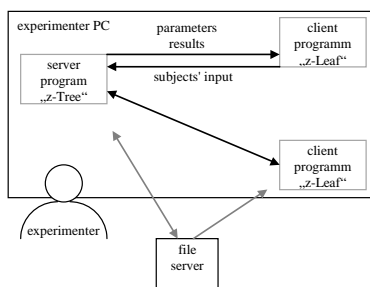
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## Testing z-Tree



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## How to build a test environment with several z-Leaves

- Put z-Tree and z-Leaf into one directory.
- Create shortcuts for z-Leaf with command line options

```
zleaf.exe /name 1 /language english /size 640x480
zleaf.exe /name 2 /language english /size 640x480 /position 10,10
zleaf.exe /name 3 /language english /size 640x480 /position 20,20
zleaf.exe /name 4 /language english /size 640x480 /position 30,30
```
- Start z-Tree
- Start as many z-Leaves as necessary

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## Concepts

- Subjects go through stages
- Screens are composed of boxes
- Data is stored in z-Tree
- Programs allow us to modify the data (payoff functions)
- Data is shown in z-Leaf (in items)
- Data can be read in in z-Leaf (in items)
- Data is automatically saved
- Earnings are automatically accumulated

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## Going Through a Stage



Can subject enter stage?



Programs are executed.



Active screen is displayed.



Waiting screen is displayed  
(if the next stage cannot be entered)

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## Tables and Programming

Period	NumPeriods	RepeatTreatment
1	1	0

Period	Subject	Group	Profit	TotalProfit	Participate
1	1	1	0	0	1
1	2	1	0	0	1
1	3	1	0	0	1

- The data is stored in tables.
- The tables can be viewed in a window in z-Tree (menu Treatment)
- Rows are called records.
- Columns are called variables.
- Variables have names.
- Programs are executed in a record (in a table).

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## Finishing a session – Questionnaires

- Payoff file can be written.
- Questions with no consequence on payoff.
- Different formats for the questions.
- Layout not screen oriented - indefinite end with scrollbar.
- Text entry possible.
- Some variables (FinalProfit,...) can be accessed.
- Importing questionnaires.

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## Typical Questionnaire

- address form (payment file)
- questionnaires
- profit display
- bye bye screen

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## A note on emergency handling. Crash of Subject PCs

- Subject PC can simply be restarted.
- If other computer is started: Move the z-Leaf name in the clients' window onto the crashed computer's name ...
- ... and continue.

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## Overview: Non-parametric statistics

- Applications of non-parametric statistics
- Some tests
  - U-test (Mann-Whitney; Wilcoxon-Whitney)
  - Kolmogorov-Smirnov-test
  - Wilcoxon test
  - Chi-squared-test

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## Applications of non-parametric statistics

- Small samples (in experiments often between  $n=6$  und  $n=30$ )
- No assumptions regarding the distribution of the population (in contrast to, e.g., the t-test: normal distribution)
- Easy application to ordinal and categorical variables.

Literature: Siegel, S., Castellan, N. J. Jr. (1988), Nonparametric Statistics for the Behavioral Sciences. McGrawHill, New York.

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### Mann-Whitney U-test

tests, whether data from two statistically independent samples (X and Y) come from the same population (regarding the **mean**).

H0: no difference (null hypotheses)

H1: difference :  $X \neq Y$  (two-sided test) (alternative hypotheses)  
(one-sided test would be  $X > Y$  or  $X < Y$ )

Reject H0, if  $p < \alpha$  (significance level)

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### Kolmogorov-Smirnov-test

tests, whether data from two statistically independent samples (X and Y) come from the same population (regarding the **distribution** of the observations).

H0: no difference

H1: difference (two-sided test)

Reject H0, if  $p < \alpha$  (significance level)

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### Wilcoxon-signed ranks test

tests, whether data from **two statistically dependent** samples (X1 and X2) come from the same population (regarding the **mean (= central tendency)**).

H0: no difference ( $X1 = X2$ )

H1: difference:  $X1 \neq X2$  (two-sided test)  
(one-sided test would be  $X1 > X2$  or  $X1 < X2$ .)

Reject H0, if  $p < \alpha$  (significance level)

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### Chi-squared-test ( $\chi^2$ -test)

tests for differences in distributions with two or more categories (average number of observations per cell: at least 5).

The test is between realized distributions or between a realized and an expected distribution.

Easiest application: 2x2-tables.

A	B
C	D

Test statistic (with continuity correction):

$$\chi^2 = N\{|AD - BC| - N/2\}^2 / \{(A+B)(C+D)(A+C)(B+D)\}$$

Reject, if  $\chi^2 > 3.84$  ( $p < 0.05$ ).

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### Binomial-test

**Two events** [ $X=1$  or  $X=0$ ] (e.g., Head or Tail with a coin)

Probability for  $X=1$ : **p**

Probability for  $X=0$ : **q** = 1 - p

$H_0: p = p_0$

tests, whether the distribution of event can come from a population with  $p =$

$p_0$ .

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### Binomial-test: Example I

Throw of a coin: A coin is thrown 10 times

Wurf	1	2	3	4	5	6	7	8	9	10
Ergebnis	K	Z	K	K	K	K	Z	K	K	K
X	0	1	0	0	0	0	1	0	0	0

Probabilities:  $p = q = 0.5$

$Y = \sum X = 2$

Probability that Y takes on a certain value:

$$P[Y = k] = \binom{N}{k} p^k q^{N-k}$$

with

$$\binom{N}{k} = \frac{N!}{k!(N-k)!}$$

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## Binomial-test: Example II

Probability for  $Y=2$

$$P[Y = 2] = \binom{10}{2} p^2 q^8 = \frac{10!}{2!8!} 0.5^2 0.5^8 = \frac{9 \cdot 10}{2} 0.5^{10} = 0.043$$

We are interested in the cumulative probability that  $Y \leq r$  or  $Y \geq s$

$$P[Y \leq k] = \sum_{i=0}^k \binom{N}{i} p^i q^{N-i}$$

$$P[Y \leq 2] = P[Y = 0] + P[Y = 1] + P[Y = 2] =$$

$$= \sum_{i=0}^2 \binom{N}{i} p^i q^{N-i} = 0.055$$

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