

Quantitative Methoden in der Molekularbiologie

7. Planning an experiment

Outline

Planning an experiment:

1. Sampling
2. Design
3. Simulation

Sampling

- Representatives from a population



- Avoid Biases!

Random Sampling

8	7	12	9	14	5	3	3	4	6
16	18	9	10	10	6	5	4	5	7
22	15	17	14	9	8	3	3	5	9
19	16	13	10	9	6	6	5	9	10
20	17	14	16	17	17	16	19	22	18
31	35	38	45	47	40	37	30	35	22
28	33	30	37	40	35	31	16	19	20
26	29	32	35	35	22	19	16	8	4
22	28	31	29	32	12	8	7	6	6
21	22	28	26	31	14	10	9	7	3

Random Sampling

8	7	12	9	14	5	3	3	4	6
16	18	9	10	10	6	5	4	5	7
22	15	17	14	9	8	3	3	5	9
19	16	13	10	9	6	6	5	9	10
20	17	14	16	17	17	16	19	22	18
31	35	38	45	47	40	37	30	35	22
28	33	30	37	40	35	31	16	19	20
26	29	32	35	35	22	19	16	8	4
22	28	31	29	32	12	8	7	6	6
21	22	28	26	31	14	10	9	7	3

Systematic Sampling

8	7	12	9	14	5	3	3	4	6
16	18	9	10	10	6	5	4	5	7
22	15	17	14	9	8	3	3	5	9
19	16	13	10	9	6	6	5	9	10
20	17	14	16	17	17	16	19	22	18
31	35	38	45	47	40	37	30	35	22
28	33	30	37	40	35	31	16	19	20
26	29	32	35	35	22	19	16	8	4
22	28	31	29	32	12	8	7	6	6
21	22	28	26	31	14	10	9	7	3

Systematic Sampling

8	7	12	9	14	5	3	3	4	6
16	18	9	10	10	6	5	4	5	7
22	15	17	14	9	8	3	3	5	9
19	16	13	10	9	6	6	5	9	10
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31	35	38	45	47	40	37	30	35	22
28	33	30	37	40	35	31	16	19	20
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Exam question

Under which conditions is systematic sampling allowed and useful?

Outline

Planning an experiment:

1. Sampling
2. Design
3. Simulation

Design of experiments

1. Objectives
2. Replication
3. Randomisation
4. Controls
5. Blocking

Replication

A	A	
	A	
	B	
	B	
	C	
	C	

Randomization

A	A	C	A
A	A	A	B
B	B	C	A
B	B	B	B
C	C	A	C
C	C	C	B

Controls

1. Negative Controls

2. Positive Controls

Need also replication and randomization!

Blocking

- Compensate for known biases
- Generate blocks covering biases
- All variables/treatments within each block
- Randomize within blocks

Blocking

Block 1	A	A	C
Block 2	B	C	B
Block 3	C	A	B
Block 4	B	C	A

Block 1	C	B	A
Block 2	B	A	C
Block 3	B	C	A
Block 4	A	B	C

Outline

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Simulation

1. Define distribution and biases
2. Calculate samples from probability density functions, according to biases
3. Sampling from calculated data
4. Evaluate data
5. Comparison results to known distribution and biases

Literature

McCleery, Watt, Hart: Introduction to Statistics
for Biology, pp 75-89

Exam question

4. What is “blocking” w.r.t designing experiments? Explain the term and illustrate it through a fictive example.

Exam question

5. You are investigating a diseased human tissue and want to study differences in the gene expression compared to healthy tissue. Consider these tasks:

- a. First you determine the genes that are differentially expressed in both tissues.
- b. For the 10 most differentially expressed genes (from a) you want to quantify the expression values in both tissues and want to check if their difference is statistically significant.

Plan this experiment. Give the names of the experimental and mathematical methods you'd use and describe as far as possible suitable parameters and the schedule of the experiment.