ISAGREED

Quantitative traits and path way coefficients

Modul no. 1: Animal Breeding

Luboš Vostrý

Czech University of Life Sciences,

Fakulty of Agrobiology, Food and Natural Resources

Erasmus+ project 2021-1-SK01-KA220-HED-000032068

Co-funded by the European Union

Phenotype

- Phenotype is a set of observable characteristics (traits) exhibited by an organism and depends on genotype and environmental factors.

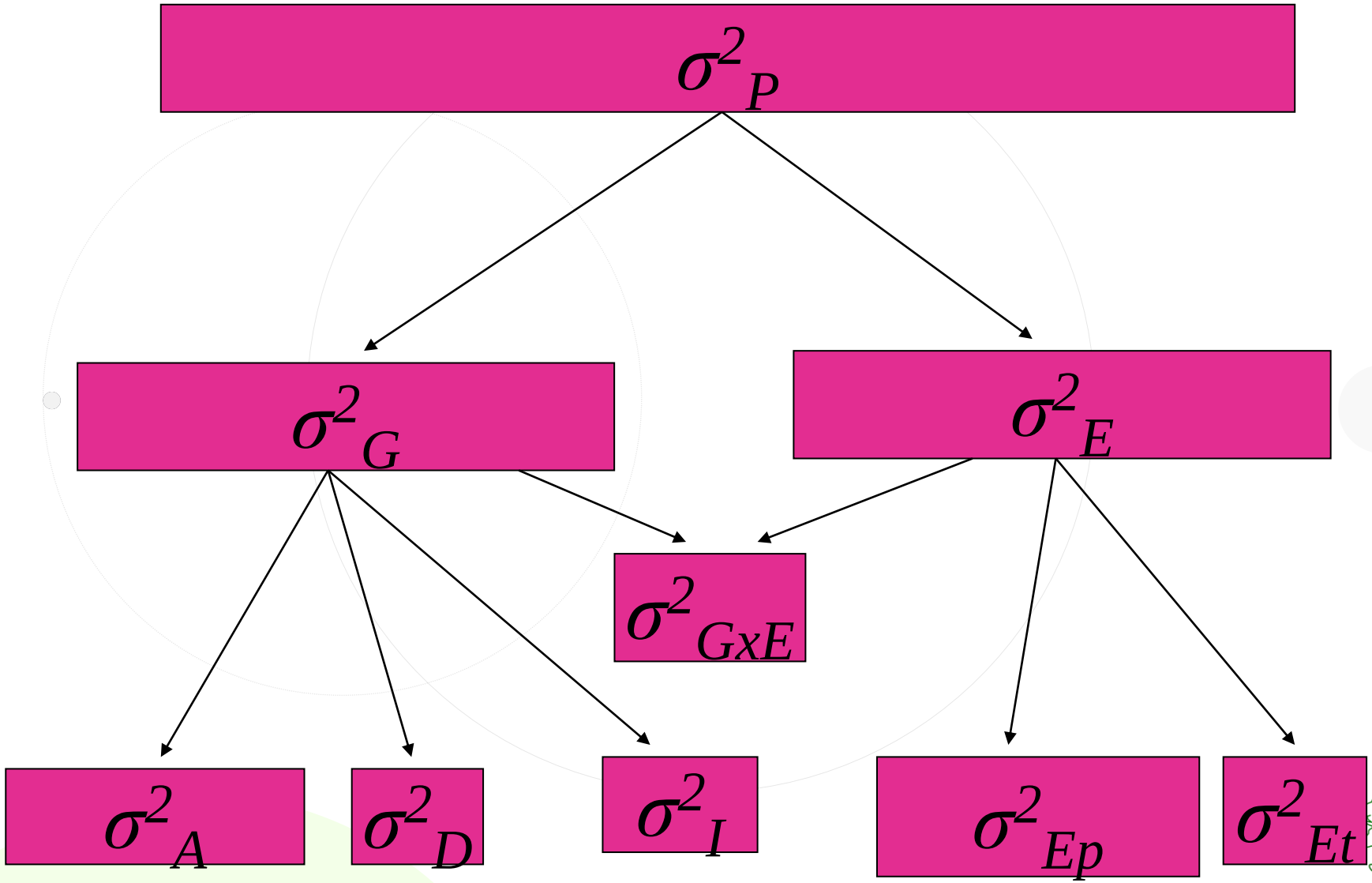
- Phenotypic traits have qualitative and/or quantitative character.

ISAGREED

Erasmus+ project 2021-1-SK01-KA220-HED-000032068

ISAGREED
Co-funded by the European Union

Part of phenotypic variance



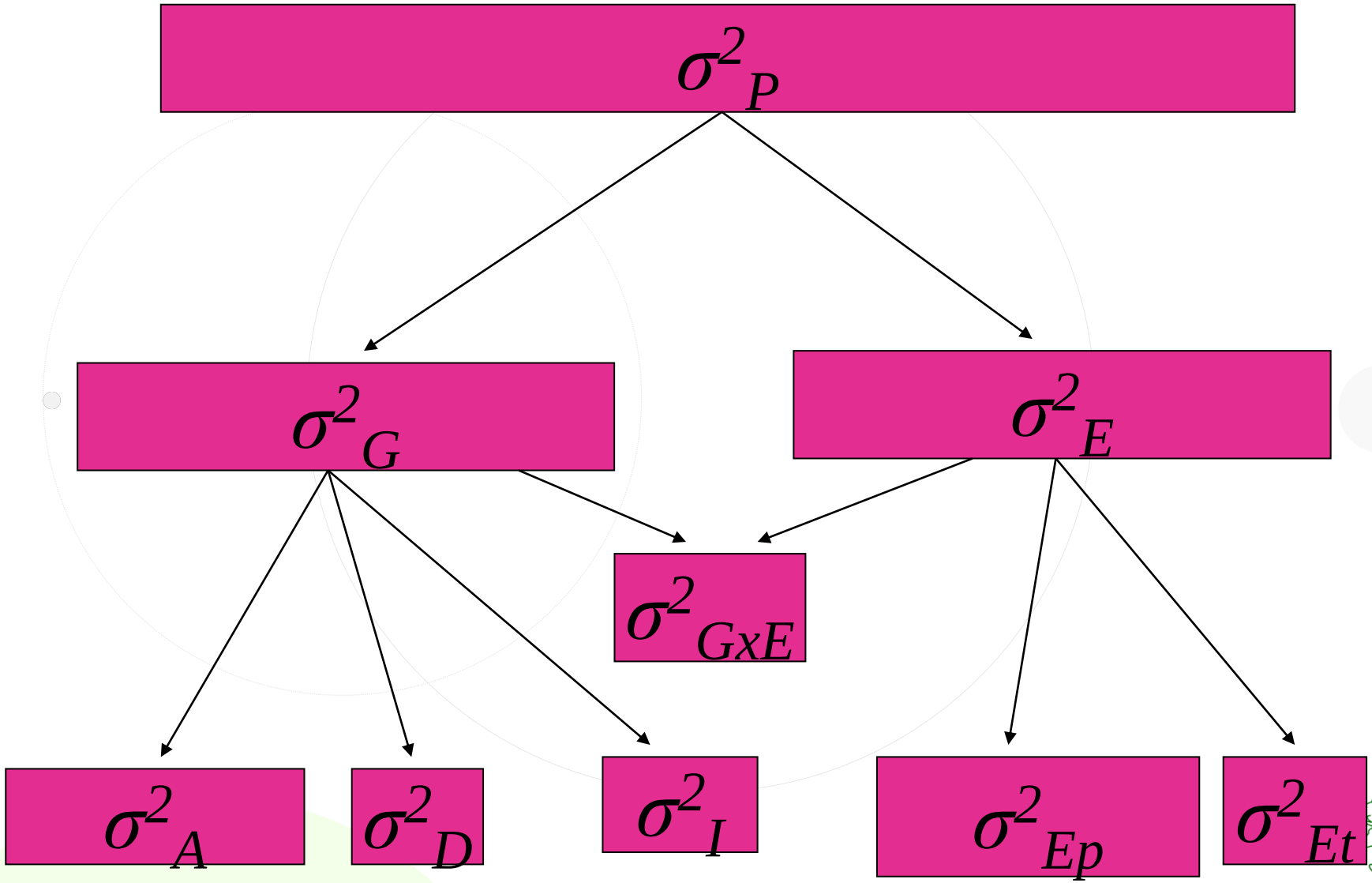
ISAGREED

Erasmus+ project 2021-1-SK01-KA220-HED-000032068

ISAGREED

Co-funded by the European Union

Part of phenotypic variance



ISAGREED

Erasmus+ project 2021-1-SK01-KA220-HED-000032068

ISAGREED

Co-funded by the European Union

Additive effect

Each gene has some effect, and it is generally assumed that the dominant allele exhibits a higher value of a given trait (e.g., 5 kg) than the recessive one (e.g., 2 kg).
The genetic value of a given genotype affected only by the additive effect (A) is:

A a B B c c D d E E f f
5+2+5+5+2+2+5+2+5+5+2+2 = <u>38 kg</u>.

Dominance

For example, if there is superdominance, this means that if the alleles at one locus are heterozygous, productivity is increased by 10 kg.
The genetic value of a given genotype affected only by the dominance effect (D) is:

Aa BB cc Dd EE ff
10 0 0 10 0 0 = <u>20 kg</u>.

Interaction

Interaction (epistasis) between two alleles of different loci (e.g., A and B – increases by 10 kg).
The genetic value of a given genotype affected only by the interaction effect (I) is **<u>20 kg</u>**.

The total genotype value (G) is then 78 kg (G = A + D + I = 38 + 20 + 20).

Erasmus+ project 2021-1-SK01-KA220-HED-000032068

ISAGREED
Co-funded by the European Union

Transmission of genetic effects to the next generation via gametes:

Genotype: A a B B c c D d E E f f

Type of gamet:

AbcDEf
ABCdEf
aBCDEF
abCdEF

ADITIVITIVE → YES
DOMINANCES → NO
INTERAKCTIONS → NO

The effect of dominance and interaction by the formation of gametes disappears because the gametes are haploid and therefore there can be no interactions at the locus level. In some gametes, the interaction effect also does not occur due to random segregation of alleles.

Only half of the additive genetic effect is transmitted through the gametes.

Erasmus+ project 2021-1-SK01-KA220-HED-000032068

Co-funded by the European Union

Transmission of the additive effect between related individuals:

- progeny – parents,
- sibs,

and the resulting genetic similarity between individuals can be studied using path way coefficients.

Erasmus+ project 2021-1-SK01-KA220-HED-000032068

Co-funded by the European Union

Path way coefficients (Wright, 1921)

They define a section (relationship, dependence) from something to something (between variables)

Two types of section coefficients

- one variable fully determined by another variable (regression).
- equal status of both variables (correlation).

ISAGREED

Erasmus+ project 2021-1-SK01-KA220-HED-000032068

Co-funded by the European Union

Rules for work with path way coefficients

1. If there is another variable (e) between the variables x and y, the path from x to y consists of sub-sections (x-e, e-y). The section coefficient from x to y is obtained as a ***product*** of partial sections

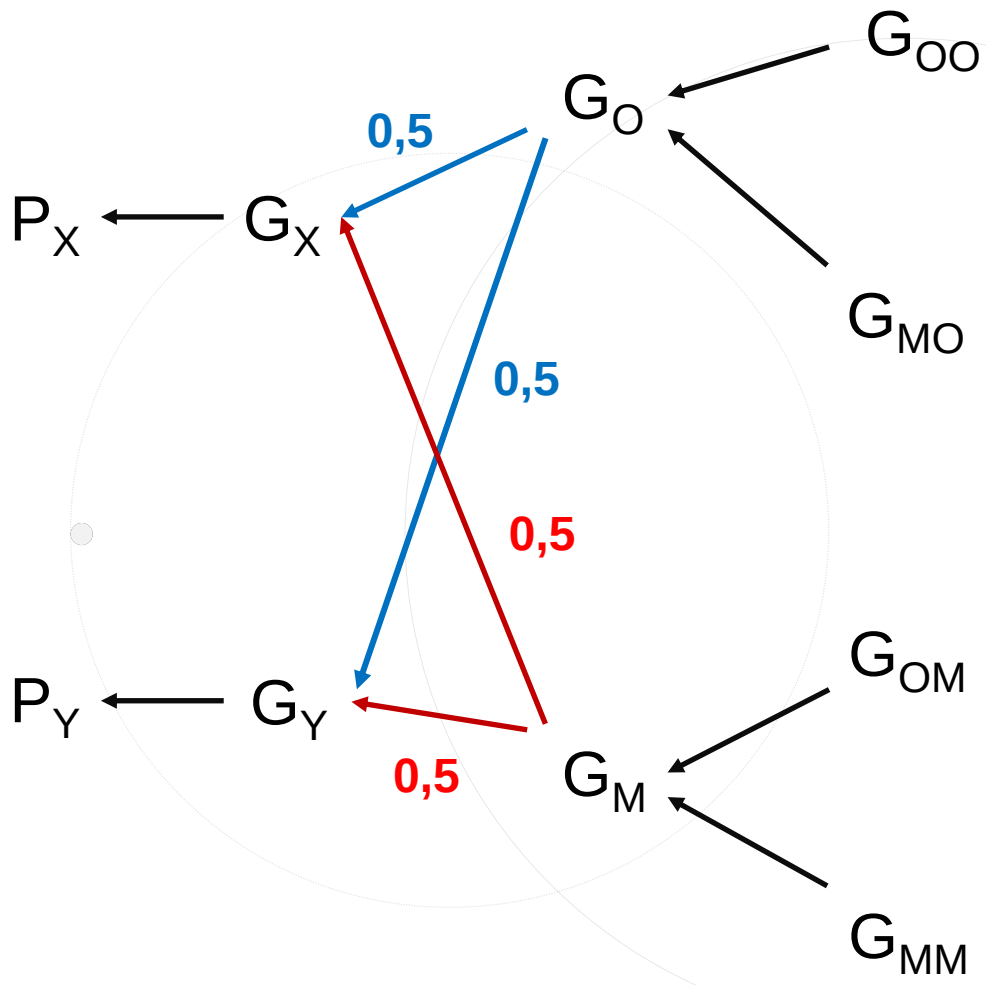
2. If a greater number of possible connections can be found between two Individuals, the total path - the total path way coefficient is equal to the ***sum*** of the individual possible connections.

Note: individual possible connections may consist of a product of partial sections.

ISAGREED

Erasmus+ project 2021-1-SK01-KA220-HED-000032068

Co-funded by the European Union



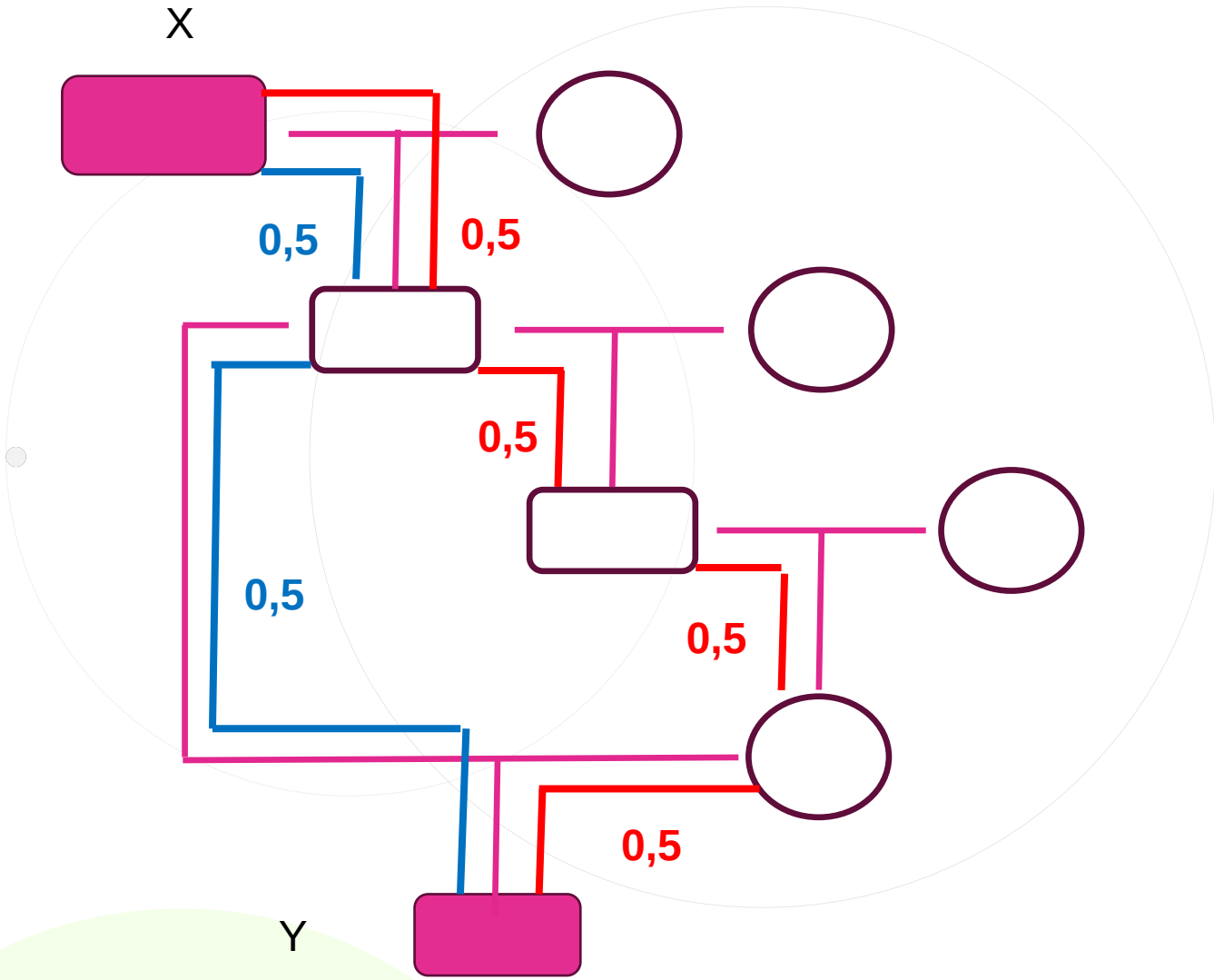
Full sibs

(0,5 x 0,5) + (0,5 x 0,5)

= **0,5**

Erasmus+ project 2021-1-SK01-KA220-HED-000032068

Co-funded by the European Union



Another pedigree

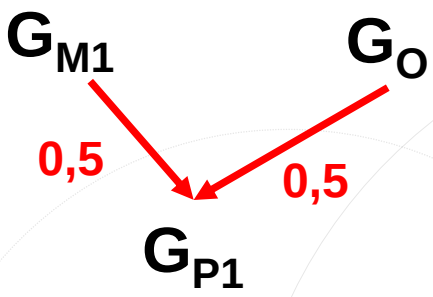
(0,5 x 0,5 x 0,5 x 0,5) + (0,5 x 0,5)

= $0,5^4$ + $0,5^2$

= 0,3125

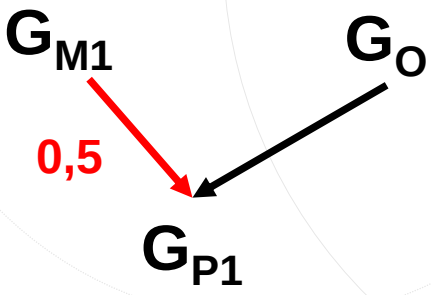
Erasmus+ project 2021-1-SK01-KA220-HED-000032068

Co-funded by the European Union



Both parents - progeny

0,5 + 0,5 = 1

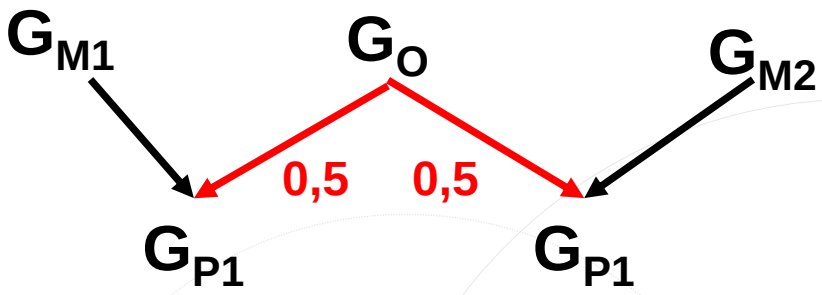


One from parents - progeny

= 0,5

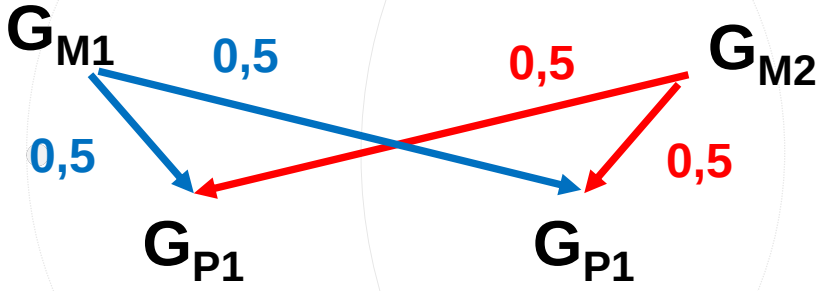
Erasmus+ project 2021-1-SK01-KA220-HED-000032068

Co-funded by the European Union



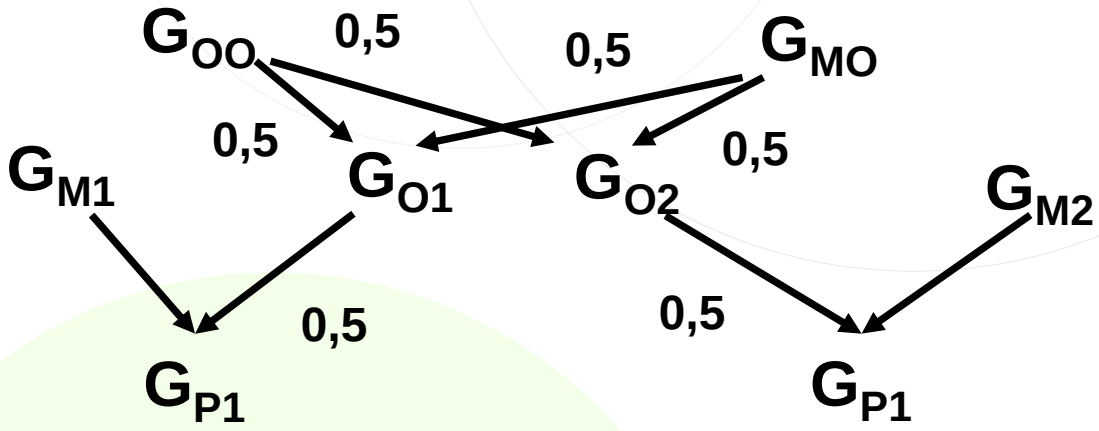
Half sibs

0,5 x 0,5 = 0,25



Full sibs

(0,5 x 0,5) + (0,5 x 0,5) = 0,5



Cousins

(0.5 x 0.5 x 0.5 x 0.5)

+

(0.5 x 0.5 x 0.5 x 0.5) = 0.125

ISAGREED

Erasmus+ project 2021-1-SK01-KA220-HED-000032068

Co-funded by the European Union

ISAGREED

- A group of related animals have similar genotypes (how similar depends on the degree of relatedness). Therefore, differences within groups of related animals are primarily conditioned by the environment.

- Different groups of related animals (different families) have different genotypes. Therefore, differences in their productivity are mainly caused by differences in the additive genetic part of their gene pool.

Erasmus+ project 2021-1-SK01-KA220-HED-000032068

Co-funded by the European Union

ISAGREED

Partners:

Thank you for your attentions

This presentation has been supported by the Erasmus+ KA2 Cooperation Partnerships grant no. ***2021-1-SK01-KA220-HED-000032068 "Innovation of the structure and content of study programs in the field of animal genetic and food resources management with the use of digitalisation - Inovácia obsahu a štruktúry študijných programov v oblasti manažmentu živočíšnych genetických a potravinových zdrojov s využitím digitalizácie"****. The European Commission support for the production of this presentation does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.*

Luboš Vostrý

vostry@af.czu.cz

Co-funded by the European Union