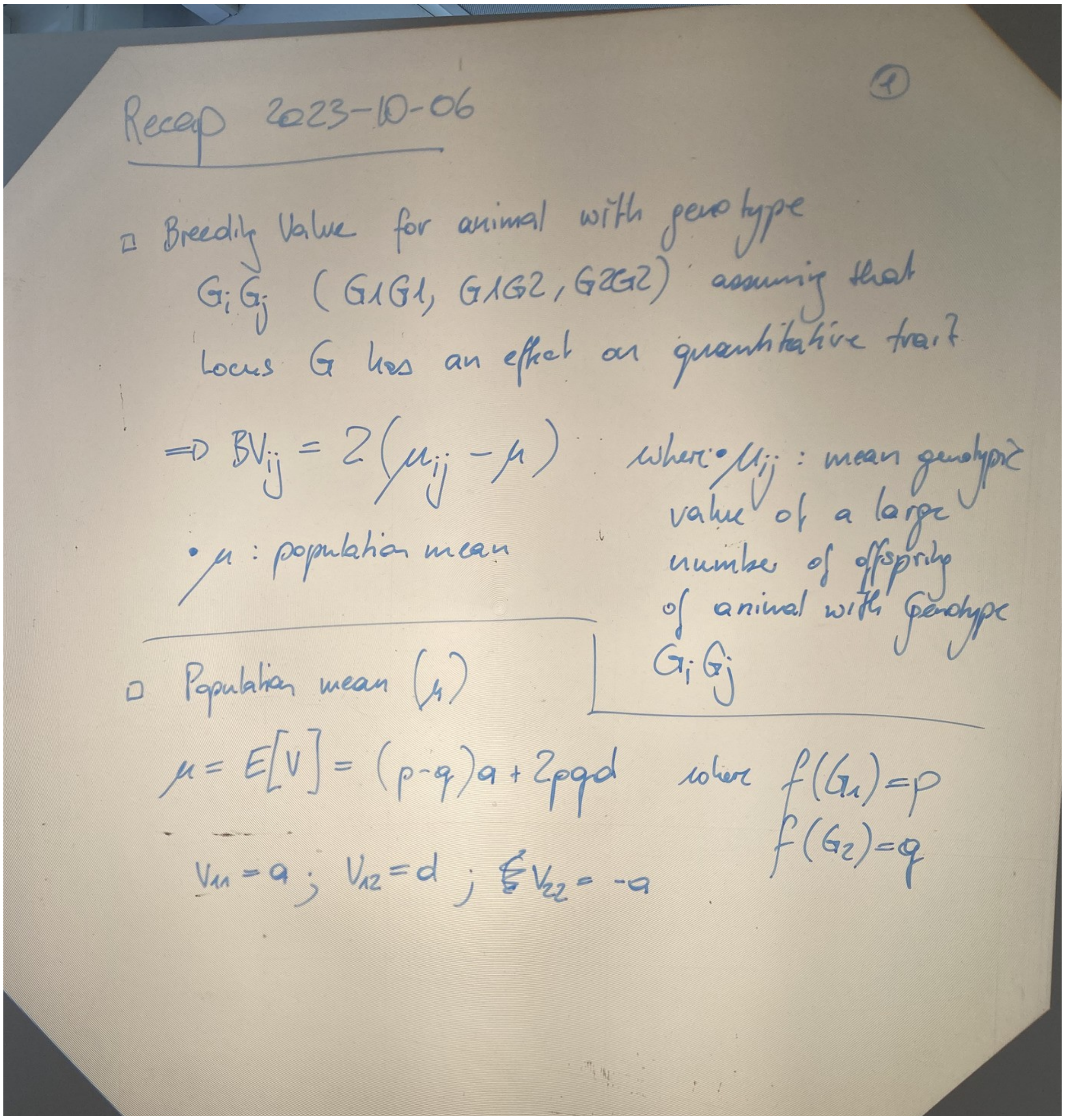
OHP Picture 1



Recap 2023-10-06

1

- Breeding Value for animal with genotype G_iG_j ($G1G1$, $G1G2$, $G2G2$) assuming that Locus G has an effect on quantitative trait

$\Rightarrow BV_{ij} = 2(\mu_{ij} - \mu)$

where • μ_{ij} : mean genotypic value of a large number of offspring of animal with Genotype G_iG_j

• μ : population mean

- Population mean (μ)

$\mu = E[V] = (p-q)a + 2pqd$

where $f(G_1) = p$

$f(G_2) = q$

$V_{11} = a$; $V_{12} = d$; $V_{22} = -a$

OHP Picture 2

Parent S with genotype: G_1G_1 (2)

Mate of S (random sample of population $\Rightarrow f(G_1)=p$, $f(G_2)=q$)

Alleles of S	G_1 with $f(G_1)=p$	G_2 with $f(G_2)=q$
G_1 (with $f(G_1)=1$)	$f(G_1G_1)=1\cdot p = p$	$f(G_1G_2)=1\cdot q=q$
G_2 (with $f(G_2)=\emptyset$)	$\emptyset$	$\emptyset$

$$\mu_1 = f(G_1G_1)\cdot V_{11} + f(G_1G_2)\cdot V_{12}$$

$$\mu_1 = f(G_1G_1)\cdot a + f(G_1G_2)\cdot d$$

$$= p\cdot a + q\cdot d$$

$$BV_1 = 2(\mu_1 - \mu)$$

$$= 2(pa + qd - [(p-q)a + 2pqd])$$

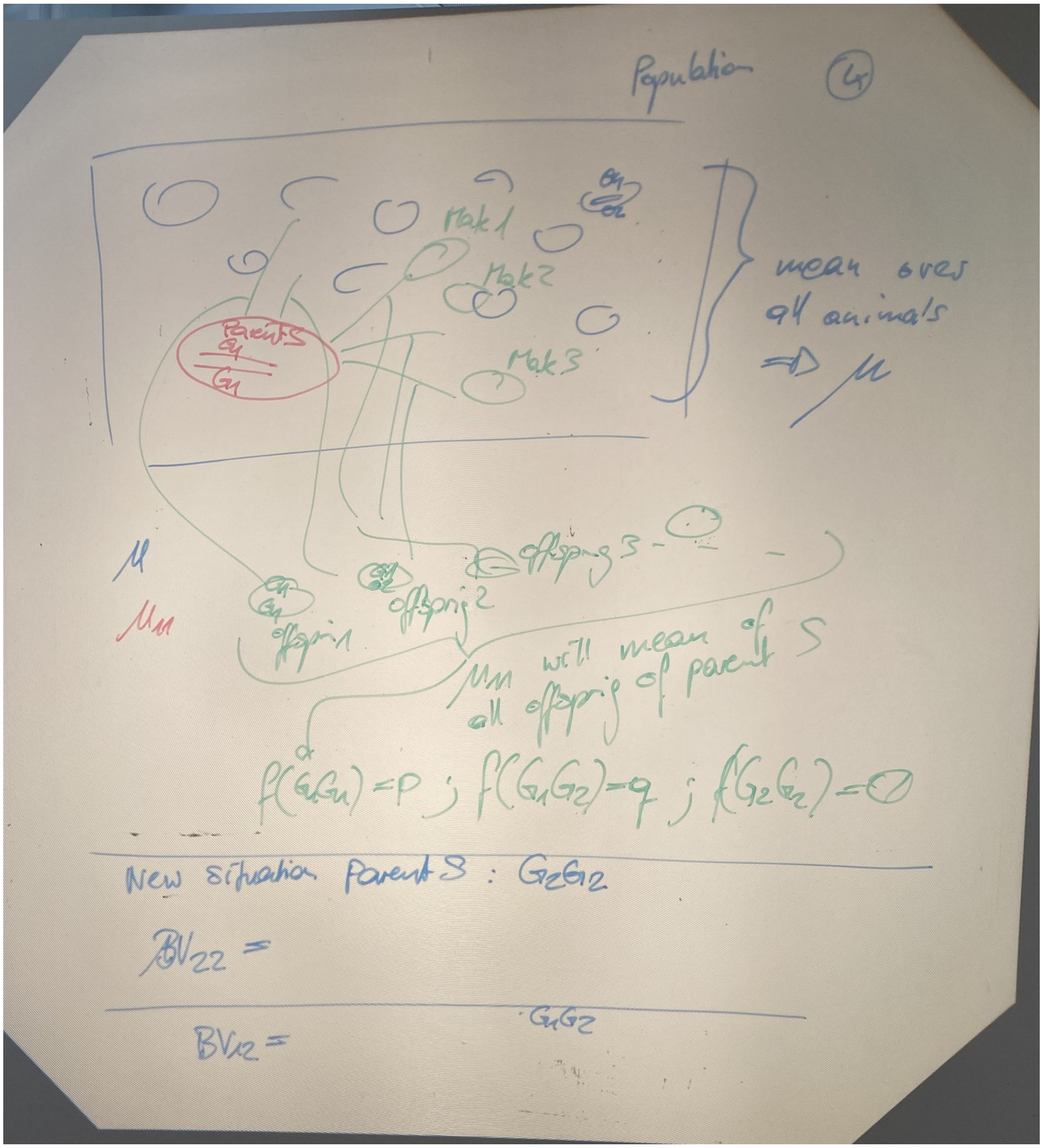
OHP Picture 3

3

Breeding value BV_{11} for parent S with genotype G_1G_1:

$$
\begin{aligned}
BV_{11} &= 2\left(p\cdot a + q\cdot d - \left[(p-q)a + 2pqd\right]\right)\\
&= 2\left(pa + qd - (p-q)a - 2pqd\right)\\
&= 2\left(\cancel{pa} + qd - \cancel{pa} + qa - 2pqd\right)\\
&= 2\left(qd + qa - 2pqd\right)\\
&= 2\left(qa + qd - 2pqd\right)\\
&= 2q\left(a + d - 2pd\right)\\
&= 2q\left(a + (1-2p)d\right) \quad ; \quad 1 = p+q\\
&= 2q\left(a + (p+q-2p)d\right)\\
&= 2q\underbrace{\left(a + (q-p)d\right)}_{=\alpha} = 2q\cdot\alpha
\end{aligned}
$$

OHP Picture 4



OHP Picture 5

6

Breeding Value for parent S with genotype G_2G_2 :

$$BV_{22} = 2(\mu_{22} - \mu)$$

$$\mu_{22} = \overbrace{pd}^{G_1G_2} - \overbrace{qa}^{G_2G_2}$$

$$BV_{22} = 2\left(pd - qa - [(p-q)a + 2pqd] \right)$$

$$\cancel{= \dots}$$

$$\cancel{= 2(-pa + p(}$$

$$= 2(pd - qa - (p-q)a - 2pqd)$$

$$= 2(pd \cancel{-qa} - pa \cancel{+qa} - 2pqd)$$

$$= 2(pd - pa - 2pqd)$$

$$= 2(-pa + pd - 2pqd)$$

$$= 2(-pa + (p - 2pq)d)$$

$$= 2(-pa + p(1-2q)d)$$

$$= 2p(-a + (1-2q)d)$$

$$= -2p(a - (1-2q)d)$$

$$= -2p(a + (q-p)d) = -2p\alpha$$

$$p + q - 2q = p - q$$

OHP Picture 6

(6)

G_1G_2: offspring: $f(G_1G_2) = \frac{1}{2}p + \frac{1}{2}q$

$= \frac{1}{2}(\underbrace{p+q}_{=1}) = \frac{1}{2}$

Parents	Males: G_1 $f(G_1)=p$	G_2 with $f(G_2)=q$
G_1 with $f(G_1)=\cancel{p}\,0.5$	$f(G_1G_1)=\frac{1}{2}p$	$f(G_1G_2)=\frac{1}{2}q$
G_2 " $f(G_2)=\cancel{q}\,0.5$	$f(G_1G_2)=\frac{1}{2}p$	$f(G_2G_2)=\frac{1}{2}q$

$f(G_1G_1) = 0.5p$

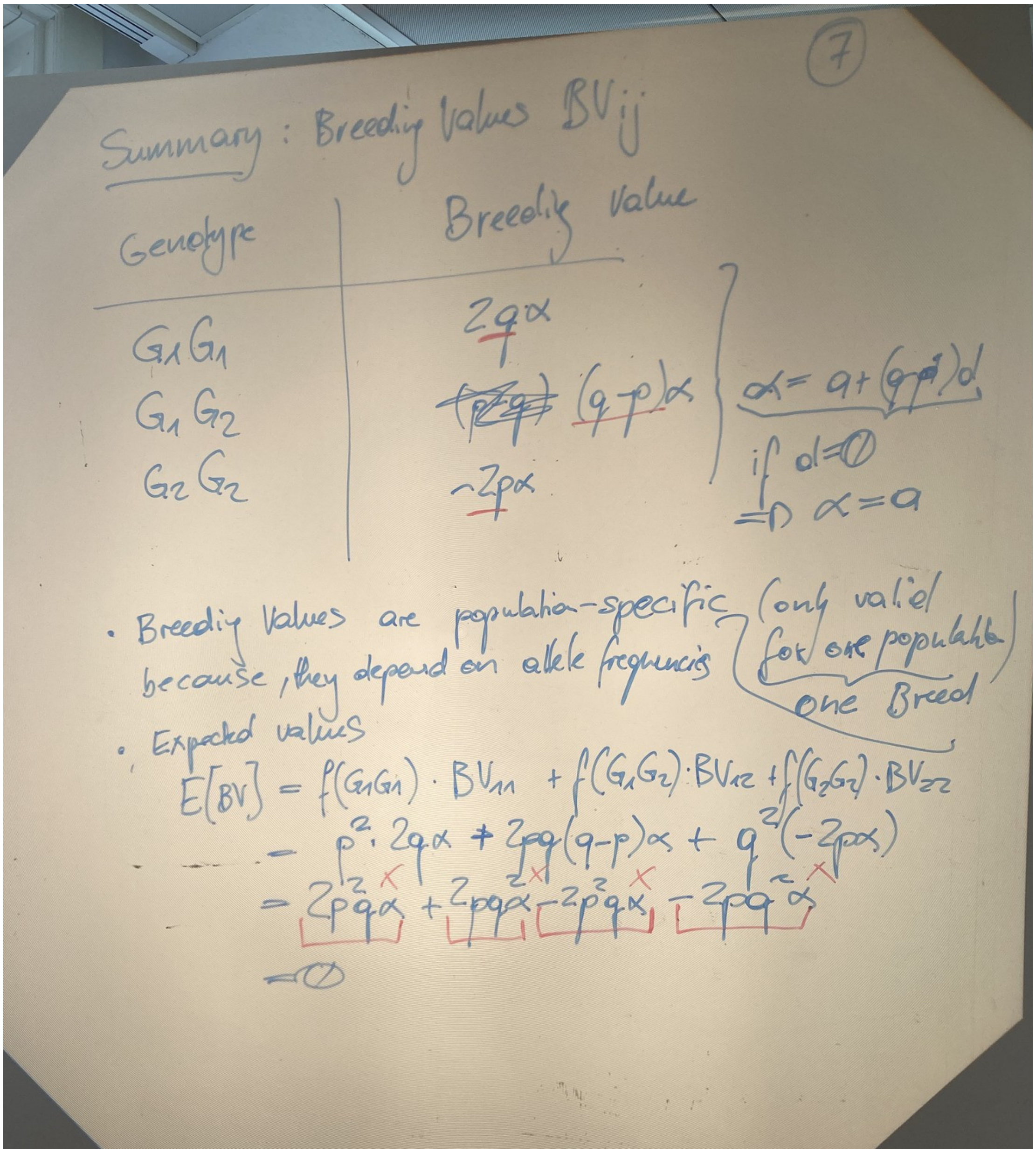
$f(G_1G_2) = \frac{1}{2}(p+q) = \frac{1}{2}$

$f(G_2G_2) = \frac{1}{2}q$

$$\mu_{12} = 0.5p\cdot a + 0.5d - 0.5q\cdot a$$
$$= \frac{1}{2}(pa + d - qa)$$
$$= \frac{1}{2}([p-q]a + d)$$

$$BV_{12} = 2\left(0.5([p-q]a + d) - [(p-q)a + 2pqd]\right)$$
$$= (q-p)[a + (q-p)d] = (q-p)\alpha$$

OHP Picture 7



OHP Picture 8

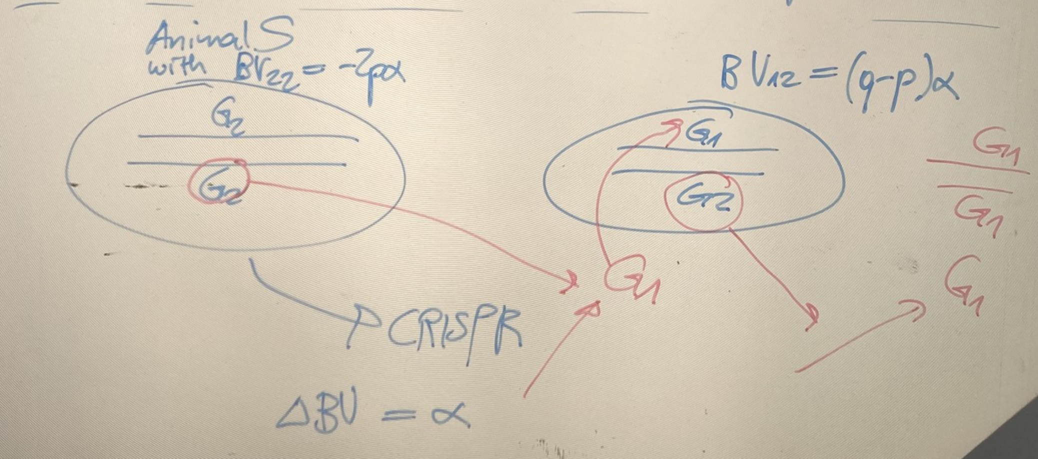
(8)

Pairwise -Differences of BV

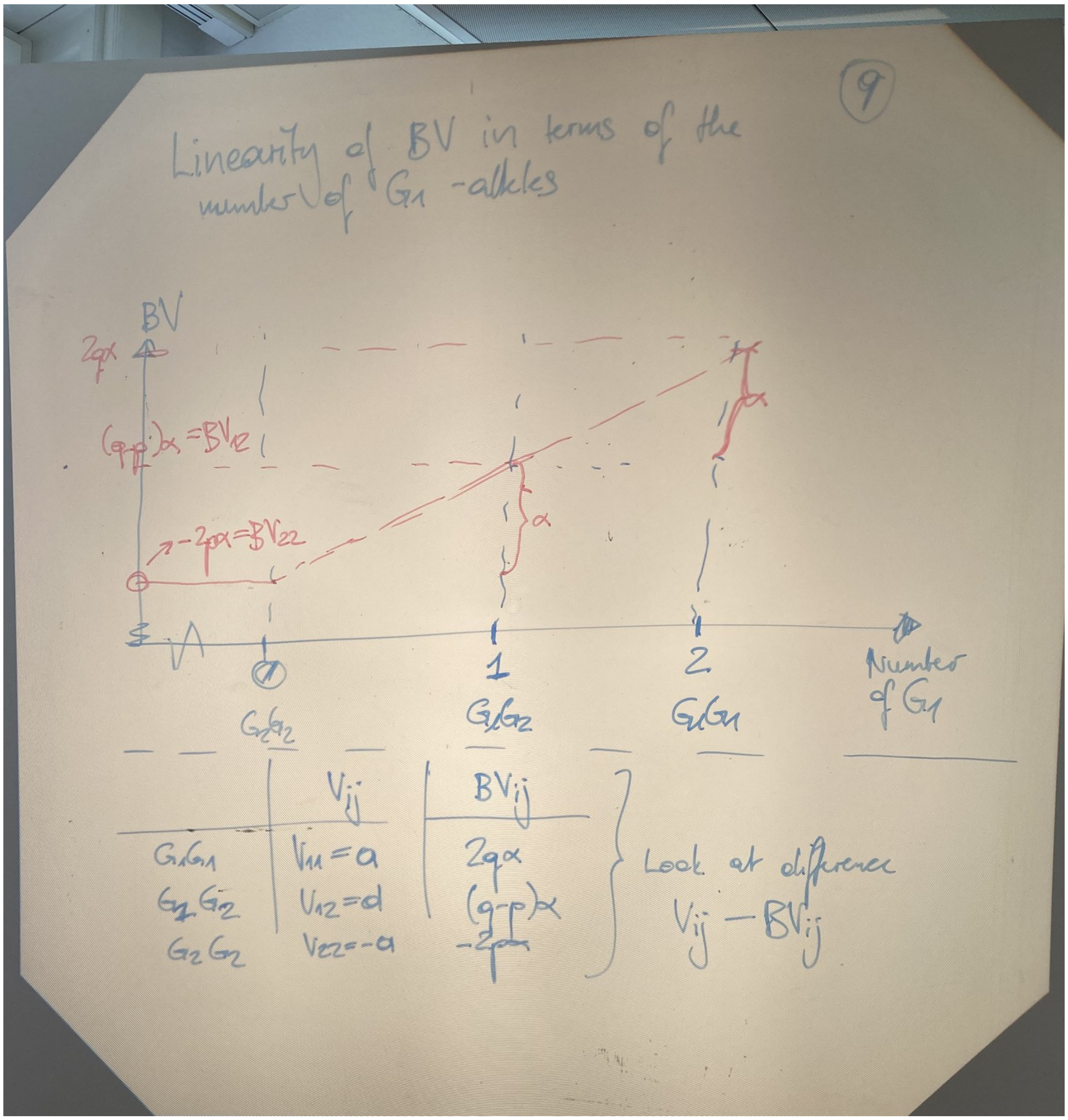
$$BV_{11} - BV_{12} = 2q\alpha - (q-p)\alpha$$
$$= 2q\alpha - q\alpha + p\alpha$$
$$= q\alpha + p\alpha = (p+q)\alpha = \alpha$$

$$BV_{12} - BV_{22} = (q-p)\alpha - (-2p\alpha)$$
$$= q\alpha - p\alpha + 2p\alpha$$
$$= q\alpha + p\alpha = \alpha$$

$\Rightarrow$ α is called Allele-Substitution effect



OHP Picture 9



OHP Picture 10

10

Difference: $V_{ij} - BV_{ij}$

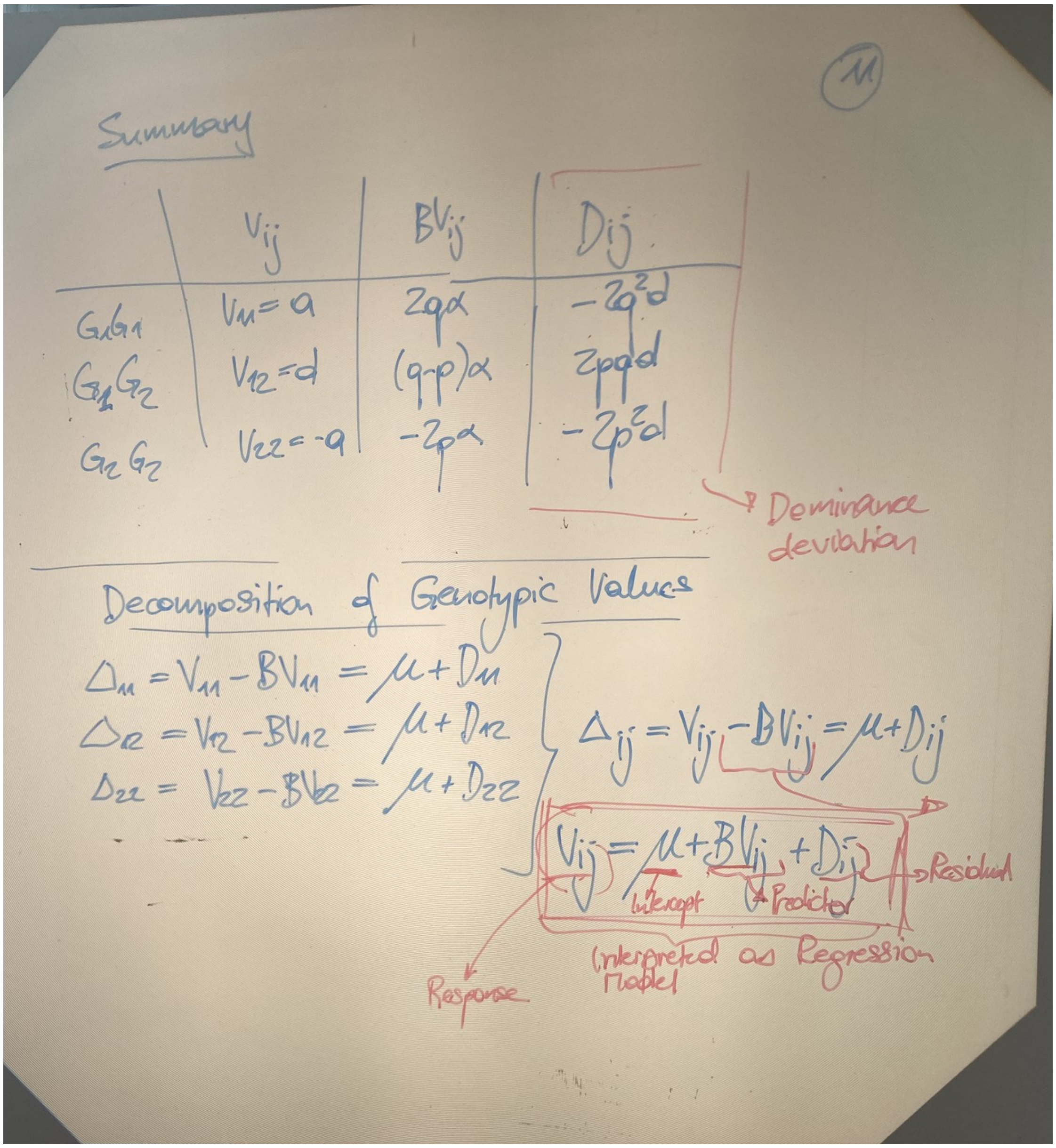
$\Delta_{ij} = V_{ij} - BV_{ij}$: G_1G_1

$$\Delta_{11} = V_{11} - BV_{11} = a - 2q\alpha$$
$$= a - 2q(a + (q-p)d)$$
$$= a - 2qa \cancel{+} - 2q(q-p)d$$
$$= a - 2qa - 2q^2d + 2pdq$$
$$= a(1-2q) - 2q^2d + 2pqd$$
$$= \underbrace{[(p-q)a + 2pqd]}_{\mu} \underbrace{- 2q^2d}_{D_{11}}$$
$$= \mu + D_{11} \text{ ; where } D_{11} = -2q^2d$$

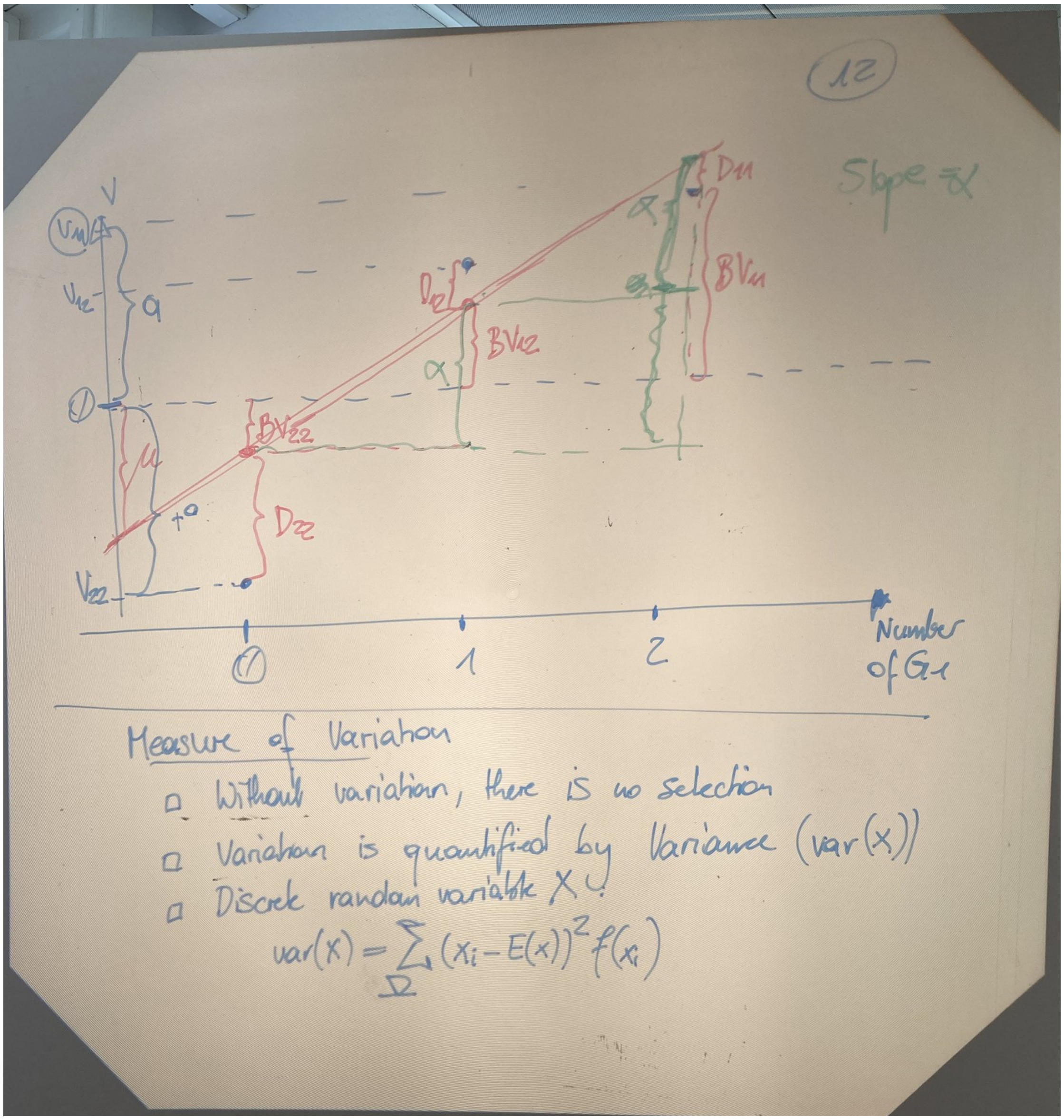
G_1G_2: $\Delta_{12} = V_{12} - BV_{12} = d - (q-p)\alpha = \dots$
$$= (p-q)a + 2pqd + 2pqd$$
$$= \mu + 2pqd$$
$$= \mu + D_{12}$$

G_2G_2: $\Delta_{22} = V_{22} - BV_{22} = \dots = \mu + D_{22}$; $D_{22} = -2p^2d$

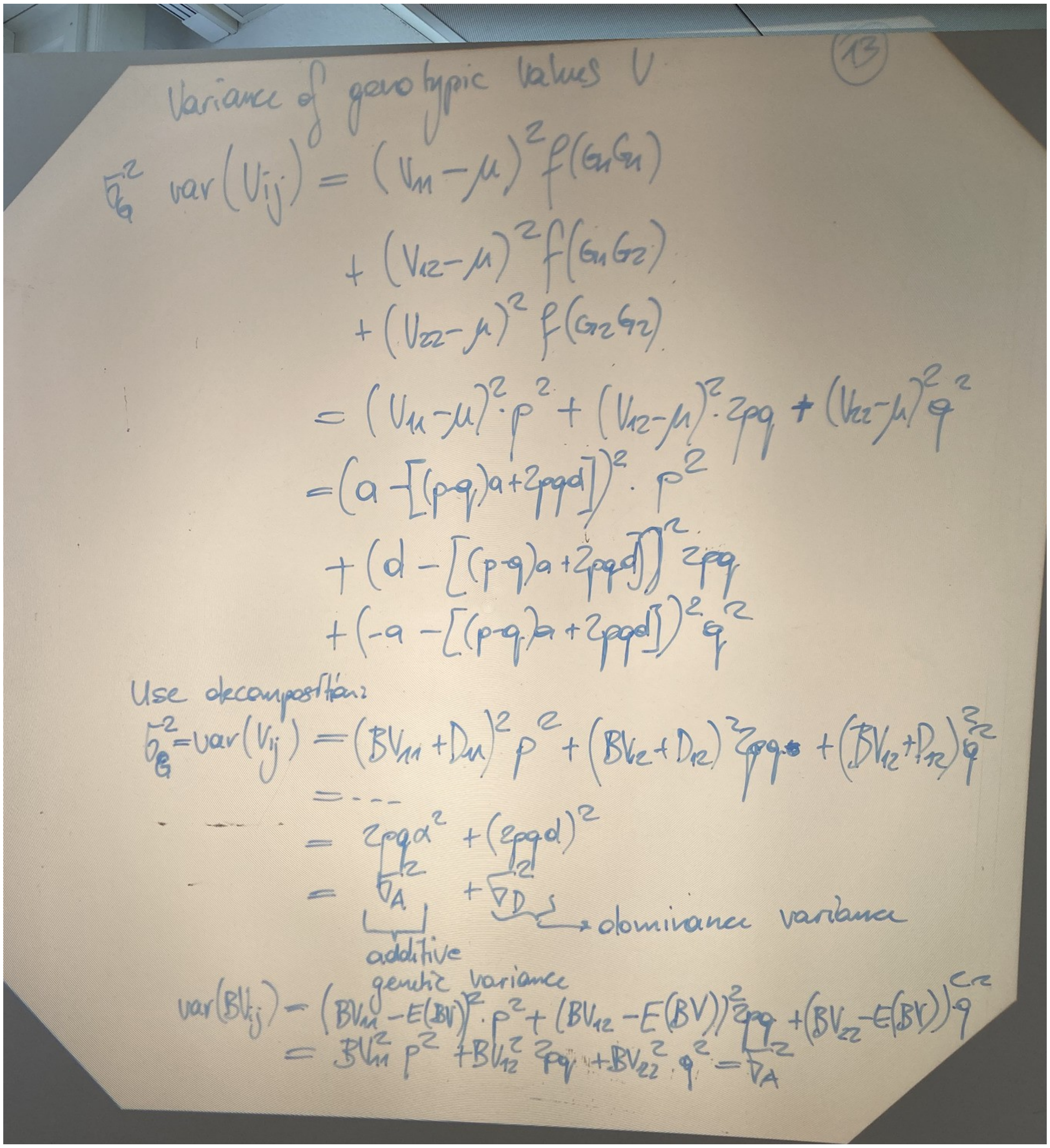
OHP Picture 11



OHP Picture 12



OHP Picture 13



OHP Picture 14