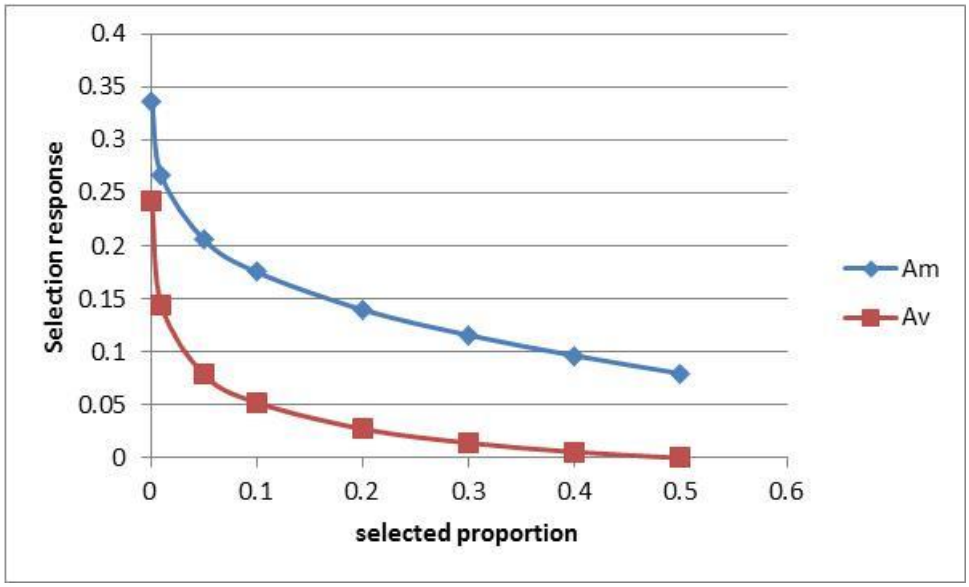
Practical Wednesday afternoon

Antwoorden maken
Vragen waarschijnlijk wat concreter maken

Part 1. Response to mass selection
Use mass_response.r for this exercise. The additive model for Ve is assumed.

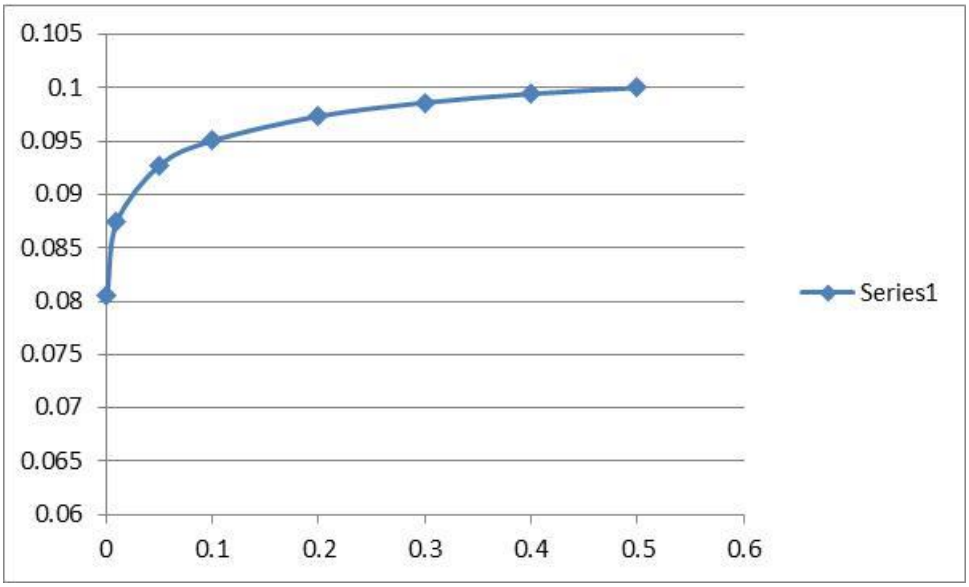
1. Calculate the response in mean and variance when applying mass selection. The additive genetic variance σ^2_{am} in mean is 0.1, environmental variance (σ^2_E) is 0.9 and the genetic variance in Ve (σ^2_{av}) is 0.05. Assume a zero genetic correlation between mean and variance. Change the selection proportion from 50% to 1%. What do you observe?



The figure shows that the response in Ve is getting large when the selected proportion is extremely small. In other words, with a very high selection intensity, animals either with a high Am and high Av are selected. Mathematically, the response in Av or Ve is quadratic in the selection intensity.

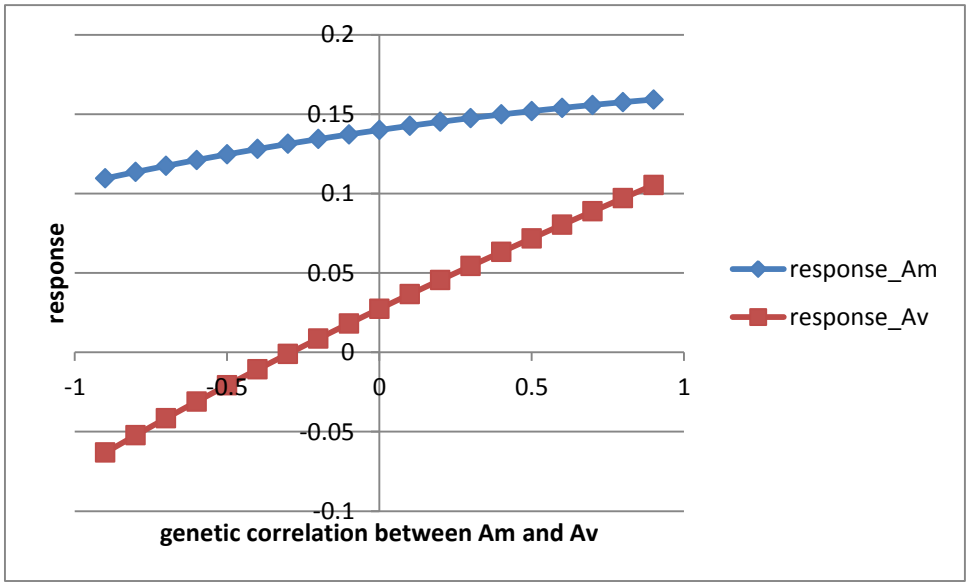
2. What is Ve and the normal heritability in the next generation for different selected proportions?

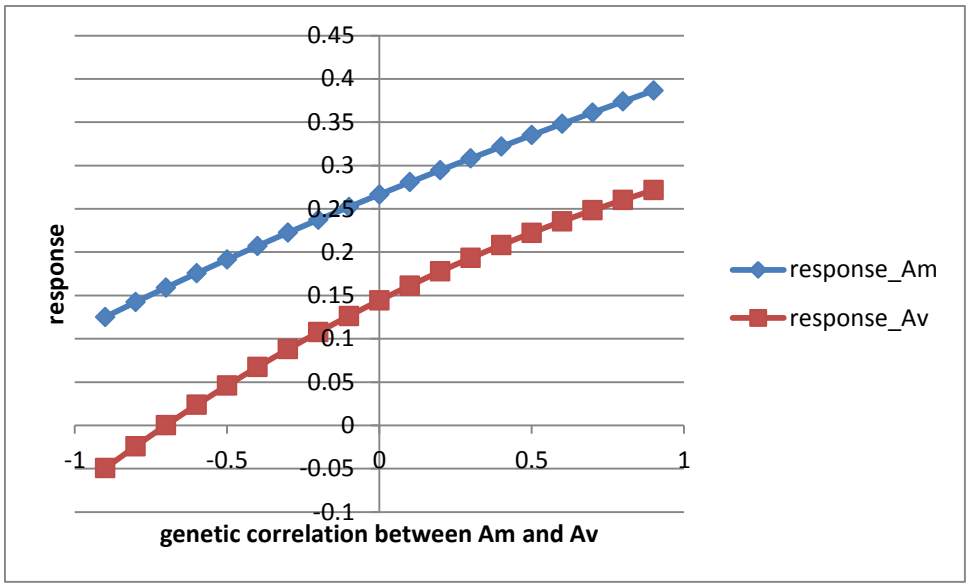
The figure below shows that the heritability is a reduced from 0.1 to 0.08 when selecting very intensely, because the residual variance increases.



3. Use the index in R with P and P^2 and calculate the responses in mean and variance when $r_{am,av}$≠0. The rest of the parameters is the same as in question 1. The selected proportion is either 20% or 1%. Vary $r_{am,av}$ between -1 and 1.

P=20%



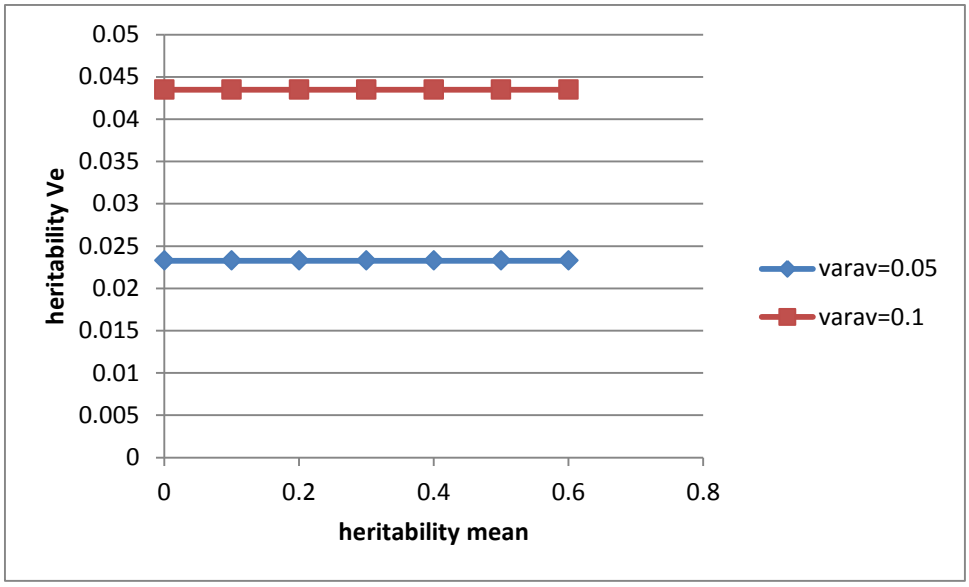


These figures illustrate that the response in Av is a correlated response to Am, but also that the response in Am increases with higher genetic correlation, especially with a high selection intensity.

4. Calculate the heritability of Ve for different values of varav and varam assuming the additive model for Ve. Make a plot of the heritability of Ve as a function of the heritability of the mean.

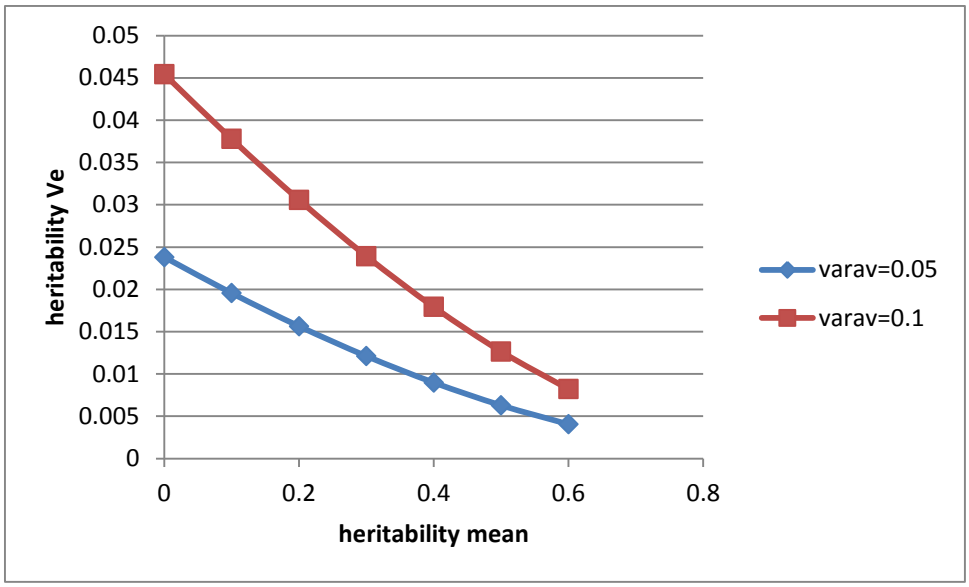
The heritability is calculated as:

$$h_v^2 = \frac{\sigma_{av}^2}{2\sigma_P^4 + \sigma_{av}^2}$$



The figure shows that the heritability of Ve is independent of the heritability of the mean when assuming the additive model for Ve.

5. Calculate the heritability of Ve for different values of varav (0.05 and 0.1) and varam assuming the exponential model for Ve. Make a plot of the heritability of Ve as a function of the heritability of the mean. What do you observe in comparison with question 4?



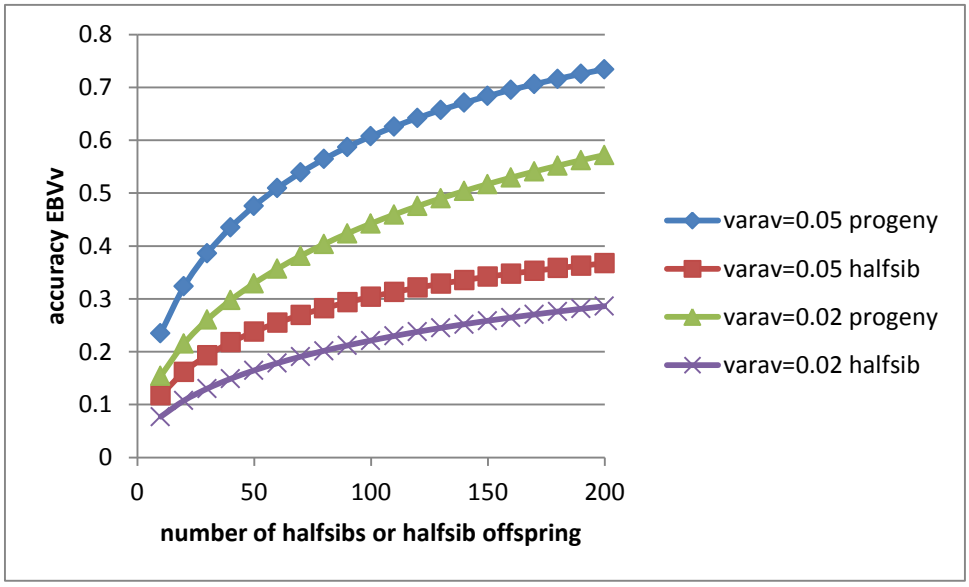
The calculation is slightly more complicated. First, one needs to convert the genetic variance in the exponential model to the additive model:

Varav_add=

The figure shows that the heritability of Ve decreases when the heritability of the mean increases. This is caused by that the heritable variation in the squared phenotype decreased when the heritability of the mean increases because the residual variance decreases. In the exponential model the genetic variance and the size of the residual variance are affecting each other. See also the lecture by Piter of Wednesday morning.

Part 2. Information of relatives and response to selection in variance
Use the R-code response to selection sibs.R. The additive model is assumed for Ve.

6. Calculate the accuracy of selection on Ve as a function of number of half-sib or half-sib offspring (10 – 200). Assume σ^2_{am} in mean is 0.1, environmental variance (σ^2_E) is 0.9 and the genetic variance in Ve (σ^2_{av}) is 0.05 or 0.02. Make a plot.



The figure shows that the accuracy is twice as high with half-sib offspring as with half-sibs; the same as with ordinary traits. Furthermore, if varav is small, accuracies are quite low, especially with sib selection.

7. What is the response in variance when selecting the best 10% in both sexes using the parameters as in question 1 and assuming 50 half-sibs as information to estimate the breeding values for Ve.

The response is 0.0933.

8. Determine the responses in variance in the next 5 generations. Does the accuracy change? Why?

generation	accuracy	h2v	Ve_1	varp1
1	0.223	0.020	0.993	1.093
2	0.210	0.017	1.081	1.181
3	0.199	0.015	1.163	1.263
4	0.189	0.013	1.241	1.341
5	0.181	0.012	1.315	1.415

The accuracy was reduced, because the heritability decreased as a consequence of that the phenotypic variance increased.

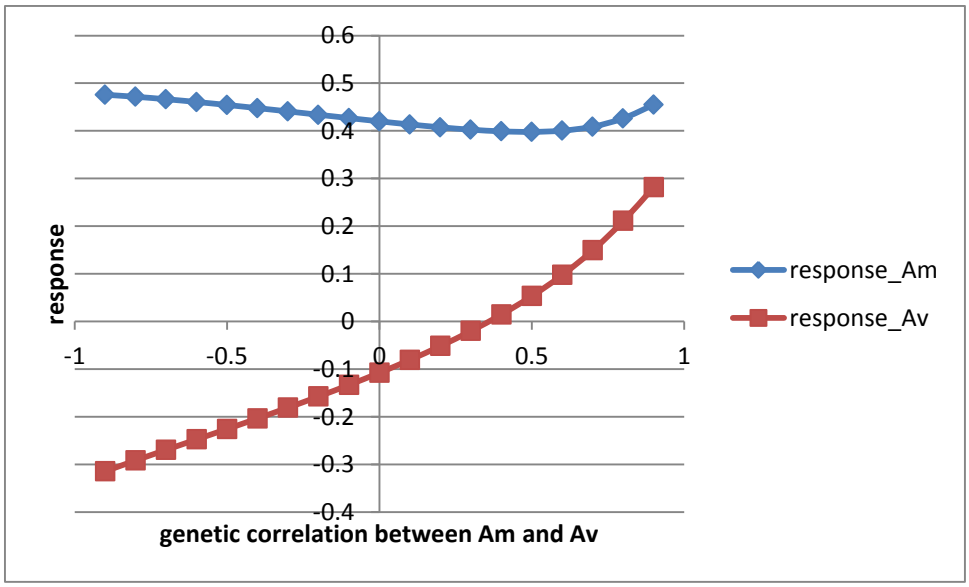
9. Make an index using economic weights of 1.0 and -1.0 for mean and variance. Use either 50 half-sibs or 50 half-sib progeny. Use the same parameters as in question1. Calculate the response in Am and Av. Compare the responses to selection in Am and Av.

With progeny testing:
Delta_Am: 0.4199443 delta_Av: -0.1076979
With sib testing
Delta_Am: 0.2099721 delta_Av: -0.05384894

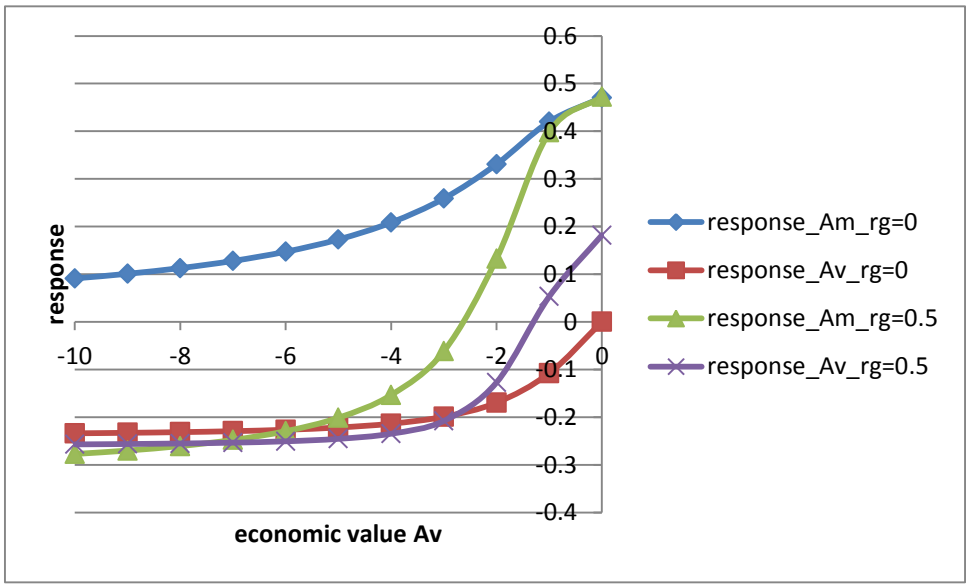
In this case the responses are exactly half with half-sib instead of half-sib progeny. In case, in which also own performance is used, sib testing has a lower response in Av than half of the response with half-sib progeny.

10. Assume 50 half-sib progeny for breeding value estimation and economic values of 1.0 and -1.0. Change the genetic correlation between Am and Av from -0.9 to 0.9. Make a plot of the responses in Am and Av.

The figure shows that when the genetic correlation is smaller than 0.4, it is possible to obtain a favourable response in Av with breeding goal. If the genetic correlation is higher, it is difficult to decrease the variance.



11. Assume 50 half-sib progeny for breeding value estimation. Change the economic value on Av from 0 to -100. Assume the genetic correlation between mean and variance is 0 or 0.5. Make a plot.



Results were not changing much when the economic value was smaller than -10, therefore, the figure shows only the economic value of Av varying between 0 and -10. When putting more emphasis on reducing Av, it is harder to increase Am, especially with an unfavourable positive genetic correlation.