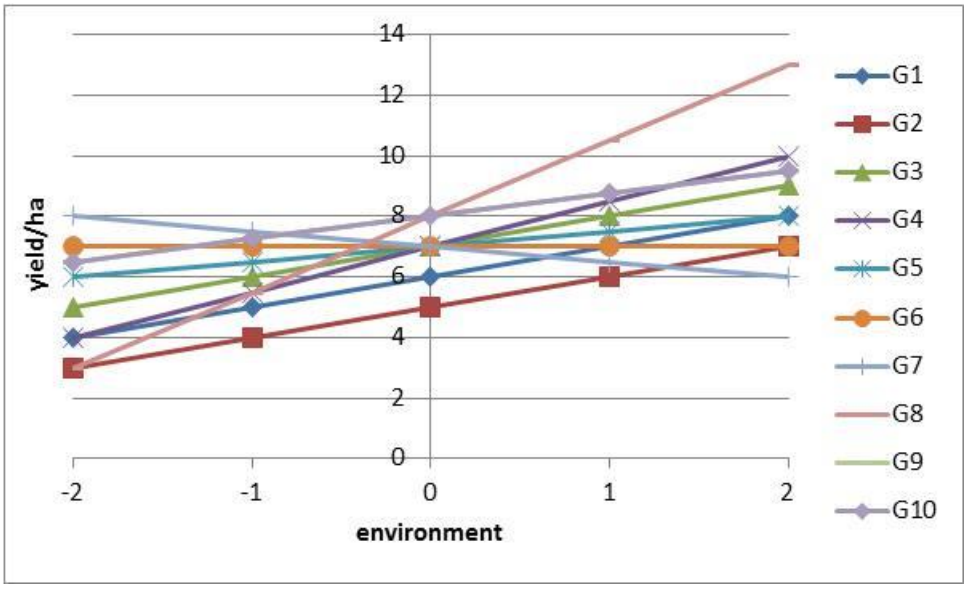
Practical Basic concepts of GxE

Use the Excel sheet 'Practical basic concepts.xls'.

1. Plot the reaction norms in Excel.

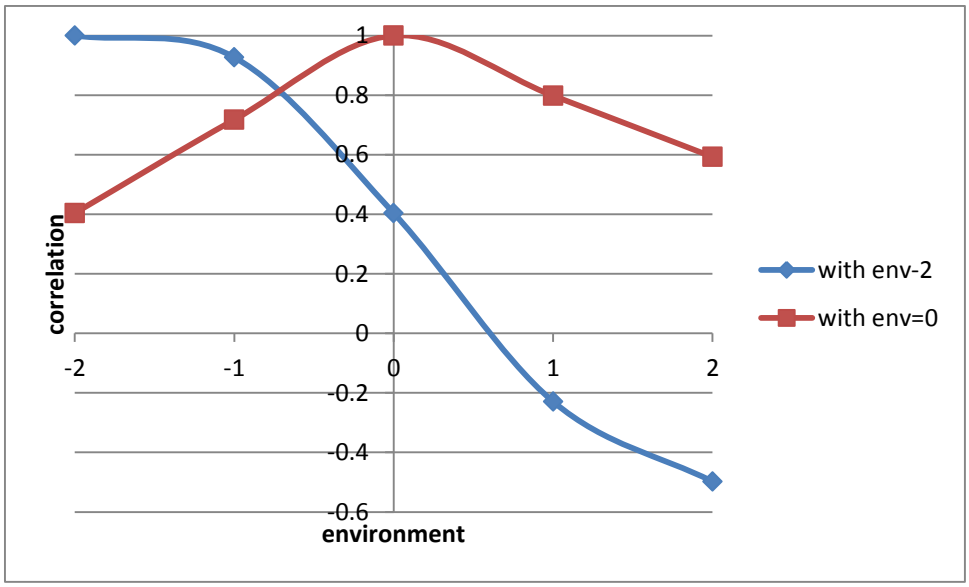


2. Do you observe reranking of genotypes?

There is substantial reranking of genotypes. For instance, the genotype G8 is by far the best one in high environments, but among the poorest in low environments; genotype 7 is about the opposite: best performance in low environments, but bad performance in good environments.

3. Calculate the correlation between environment -2 and 0 with the rest of environments. Hint: sort the table on environment and use the function 'correl'.

env1	env2	correlation
-2	-1	0.927
-2	0	0.404
-2	1	-0.229
-2	2	-0.498
0	-2	0.404
0	-1	0.717
0	1	0.798
0	2	0.593



Correlations are quite low, some are even negative indicating that the ranking order of genotypes switched. The bigger the difference in environments, the lower the correlation.

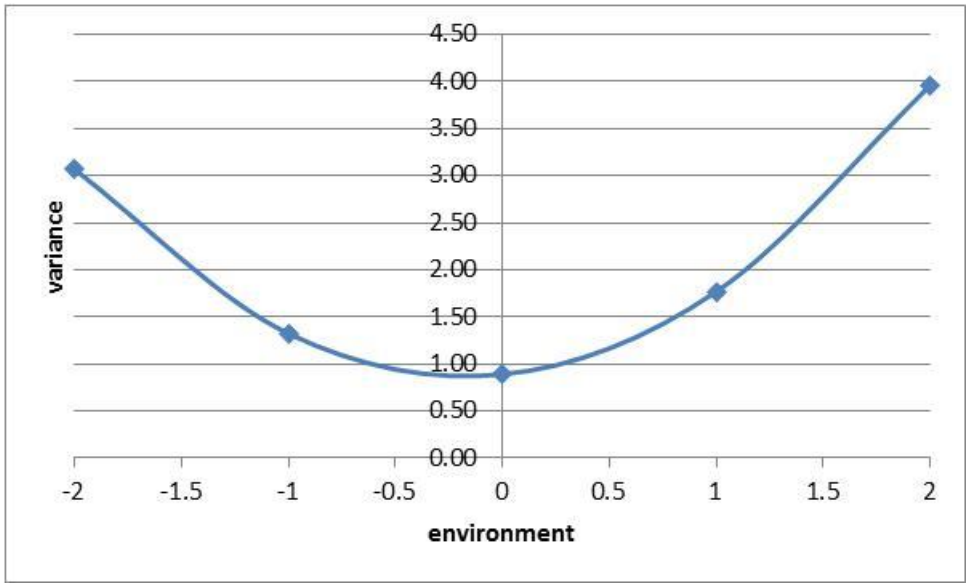
4. Do you observe heterogeneity of variance between environments?

Visually, it seems that the variance is lowest in average environments and higher in both extremes.

5. Calculate the variance in the five environments.

	variance	SD
-2	3.07	1.75
-1	1.32	1.15
0	0.89	0.94
1	1.77	1.33
2	3.96	1.99

Linear reaction norms lead to a quadratic relationship between the variance and the environment as shown below.



6. What is the most sensitive genotype?

The most sensitive genotype is genotype 8 with a slope of 2.5.

Concepts of stability

7. What is the most stable genotype with respect to type 1 stability?

Type 1 stability means that the reaction norm should have a slope close or equal to zero. Genotype 6 has a slope of zero because b=-1 compensating for the average slope of 1

8. What is the most stable genotype(s) with respect to type 2 stability?

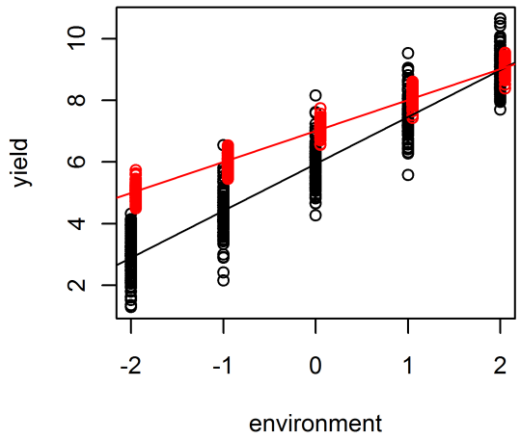
The most stable genotypes with respect to type 2 stability are genotypes 1, 2 and 3, because they have a b-value of zero, or in other words their reaction norms have the average slope of 1.

9. Which genotype(s) has/have the highest performance across environments assuming equal frequencies of environments?

Genotypes 8, 9 and 10 have the highest average performance across the five environments; they all have a g-value of 2.

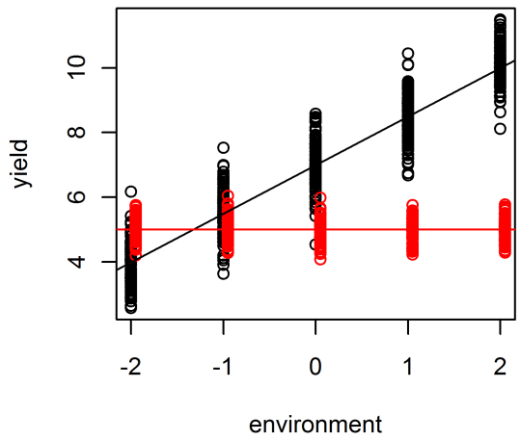
Use R-code 'stability.r'

10. You can vary the parameters mu (overall mean), b (slope as deviation from 1), vare (residual variance) and g (deviation from overall mean). Make two genotypes: one with a high predictability and one with a low predictability and make a plot. Play around with the input values to get some feel for differences in slope and variability. Look also at the coefficient of determination.



The black genotype has a higher variance per environment than the red genotype. The R^2 of genotype 1 is 0.906 and the R^2 of genotype 2 is 0.976. The genotype with a small variance has the highest R^2 as expected. Note that $R^2 = 0$ when the slope is about zero, even if the variance is smaller.

11. Let's consider genotype 1: g=1, b=0.5 and vare =0.5; genotype 2: g1=-1, b=-1, vare=0.1. Which genotype would you prefer in fields with a low average yield, i.e. -2sd?



Genotype 2 (red) is preferred in low environments because in most years it would have a higher yield. It is an example of a static stable genotype.

12. Please specify characteristics for preferred varieties, when weather conditions will vary more due to climate change and the use of fertilizer needs to be reduced.

When weather conditions would vary more, it is expected that yearly differences in yield become larger. So it would be desirable to have varieties with higher stability between years, i.e. a lower variance. With respect to the reduced use of fertilizer and assuming

that the x-axis is for instance amount of nitrogen or phosphorus, it would be desirable to have varieties with a low sensitivity to lower amounts of nitrogen/phosphorus, e.g. a lower slope.