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STUDY ON THE USE OF DATA FROM MULTIPLE LOCATIONS IN DUS TESTING

Document prepared by an expert from Germany

STUDY ON THE USE OF DATA FROM MULTIPLE LOCATIONS IN DUS TESTING

(Part II: Model equations and explanations)

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Introduction:

1. The following model equations and explanations are additions to document TWC/24/13 considered by the Technical Working Party on Automation and Computer Programs (TWC) at its twenty-forth session, held in Nairobi, from June 19 to 22, 2006. The object of that document was a study on the use of data from two locations in DUS testing of winter oilseed rape in Germany. Normally, for agricultural crops, tests of distinctness, uniformity and stability are conducted at one location in two or three years, but there are some exceptions. In Germany, DUS tests for winter oil seed rape are conducted at two locations.

2. There are at least five possibilities (Option 1 to Option 5) to evaluate statistically the data from the two locations. The aim of this document is to provide clarification of the statistical models used for each option and a graphical explanation.

Methods and models:

3. In the following chapter five different options are described with model equations.

Option 1: Individual consideration of each location

4. Separate assessment of distinctness and uniformity on data from each of the locations by calculation of LSD-values at 1% level (COY-D probability level).

5. The following effects have been included in the model:
- variety
- year
- error for each location

6. The suggested model is:

$$y_{ij1} = \mu_1 + \alpha_{i1} + \underline{\beta}_{j1} + \underline{e}_{ij1} \qquad (1)$$

$$y_{ij2} = \mu_2 + \alpha_{i2} + \underline{\beta}_{j2} + \underline{e}_{ij2} \qquad (2)$$

where

μ_k – mean of location	k=1,2 (number of locations)
α_{ik} – variety effect (fix)	i=1,…, n_v (number of varieties)
$\underline{\beta}_{jk}$ - year effect (random)	j=1,…,n_y (number of years)
$\underline{e}_{ijk}$ – error (random)	

7. The variety description is established either by the variety means of location 1 or of location 2. An illustration is provided in figure 1 in the annex to this document.

8. Option 1 describes the actual situation applied in the German testing system for some agricultural species, such as winter oilseed rape.

Option 2: Combined calculations (years and locations)

9. Assessment of distinctness and uniformity by using a combination of data from both locations (average per variety) by calculation of LSD-values at 1% level (COY-D probability level). Years and locations are separate effects in the model.

10. The following effects have been included in the model:

- variety
- year
- location
- year x location interaction
- variety x year interaction
- variety x location interaction
- error

11. The suggested model is:

$$y_{ijk} = \mu + \alpha_i + \underline{\beta}_j + \gamma_k + \underline{\beta\gamma}_{jk} + \underline{\alpha\beta}_{ij} + \alpha\gamma_{ik} + e_{ijk} \qquad (3)$$

where

μ – overall mean
α_i – variety effect (fix) $i=1,\ldots,n_v$ (number of varieties)
$\underline{\beta}_j$ - year effect (random) $j=1,\ldots,n_y$ (number of years)
γ_k - location effect (fix) k=1,2 (number of locations)
$\underline{\beta\gamma}_{jk}$ – year x location interaction (random)
$\underline{\alpha\beta}_{ij}$ – variety x year interaction (random)
$\alpha\gamma_{ik}$– variety x location interaction (fix)
$\underline{e}_{ijk}$ – error (random)

12. The variety description is established by the overall variety means (average over years and location). An illustration is provided in figure 2 in the annex to this document.

Option 3: Combined calculations (environments)

13. Assessment of distinctness and uniformity by a combination of data from both locations (average per variety) by calculation of LSD-values at 1% level (COY-D probability level). Years and locations are levels of the same effect (environments) in the model.

14. The following effects have been included in the model:

- variety
- environment
- error

15. The suggested model is:

$$y_{ij} = \mu + \alpha_i + \underline{\beta}_j + \underline{e}_{ij} \qquad (4)$$

where

μ – overall mean
α_i – variety effect (fix) $i=1,\ldots,n_v$ (number of varieties)
$\underline{\beta}_j$ - environment effect (random) $j=1,\ldots,n_{env}$ (number of environments)
$\underline{e}_{ij}$ – error (random)

16. The variety description is established by the overall variety means using all combinations of years and locations as environments. The model ignores the year x location interaction and constitutes a simplification compared to the model in Option 2. The illustration is the same as for Option 2, figure 2 in the annex to this document.

Option 4: Combined calculations on a single location level

17. Assessment of distinctness and uniformity by using a combination of data from both locations (average per variety and location) by calculation of LSD-values at 1% level (COY-D probability level). Years and locations are separate effects in the model, as in Option 2. LSD-values are calculated on level of one location by using of the same error as in Option 2.

18. The following effects have been included in the model:

- variety
- year
- location
- year x location interaction
- variety x year interaction
- error

19. The suggested model is:

$$y_{ijk} = \mu_{ik} + \underline{\beta}_j + \gamma_k + \underline{\beta\gamma}_{jk} + \underline{\alpha\beta}_{ij} + e_{ijk} \qquad (5)$$

where

μ_{ik} – mean of variety i at location k (fix) $i=1,\ldots,n_v$ (number of varieties)
$\underline{\beta}_j$ - year effect (random) $j=1,\ldots,n_y$ (number of years)
γ_k - location effect (fix) k=1,2 (number of locations)
$\underline{\beta\gamma}_{jk}$ – year x location interaction (random)
$\underline{\alpha\beta}_{ij}$ – variety x year interaction (random)
$\underline{e}_{ijk}$ – error (random)

20. The variety description is established either by the variety means of location1 or of location 2. The complete data set is used to calculate the analysis of variance, as in Option 2 to estimate the variance components. An illustration is provided in figure 3 in the annex to this document.

21. The test of variety means μ_{ik} on individual levels of location uses the variety x location interaction in addition to the variety effect α_i. The variety differences may become larger. Option 2 uses only the "average" variety effect α_i.

Option 5: conduction and evaluation of a single DUS test at one location

22. Assessment of distinctness and uniformity on data of a single location by calculation of LSD-values at 5% level (COY-D probability level).

23. The standard probability level of COY-D is 1%. To distinguish the same number of varieties at one location, as is currently achieved with two locations, would require a decrease of the probability level for the remaining location (see document TWC/24/13, conclusions, paragraphs 9-11).

24. The following effects have been included in the model:

- variety
- year
- error for the single location

25. The suggested model is:

$$y_{ij} = \mu + \alpha_i + \underline{\beta}_j + \underline{e}_{ij} \qquad (6)$$

where

μ – mean
α_i – variety effect (fix) $i=1,..,n_v$ (number of varieties)
$\underline{\beta}_j$ - year effect (random) $j=1,\ldots,n_y$ (number of years)
$\underline{e}_{ij}$ – error (random)

26. The variety description is established by the variety means at one location. An illustration is provided in figure 4 in the annex to this document.

Results and Conclusions:

27. The Results and conclusions are the same as in document TWC/24/13.

Literature:

Meyer, U. & Laidig, F. (2006): Study on the use of data from multiple locations in DUS testing, Biuletyn Oceny Odmian (Cultivar Testing Bulletin) 32, 29-39

[Annex follows]

ANNEX

Figure 1: Individual consideration of each location (Option 1)

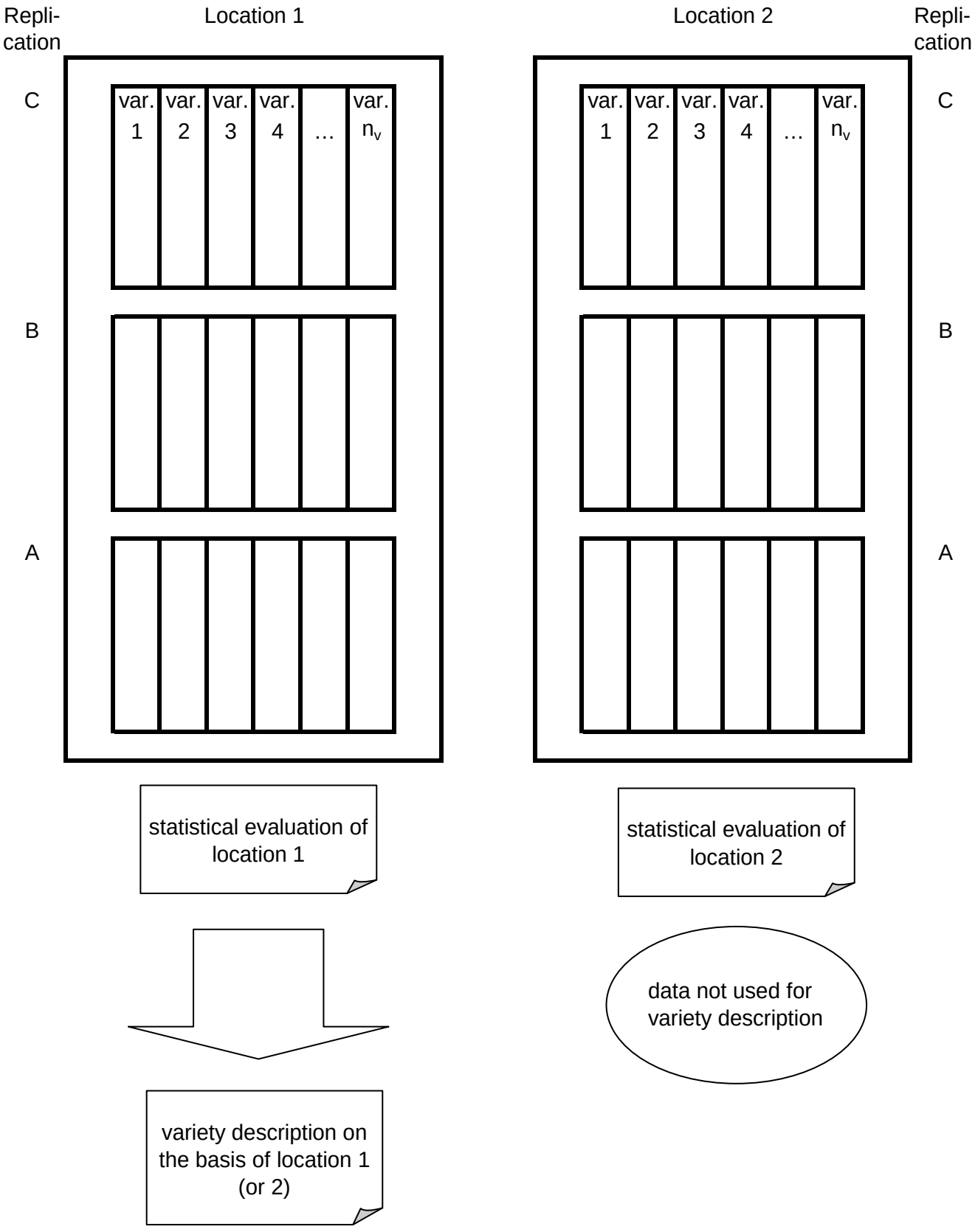


Figure 2: Combined calculation including years and locations (Option 2) or Combined calculation using environments (Option 3)

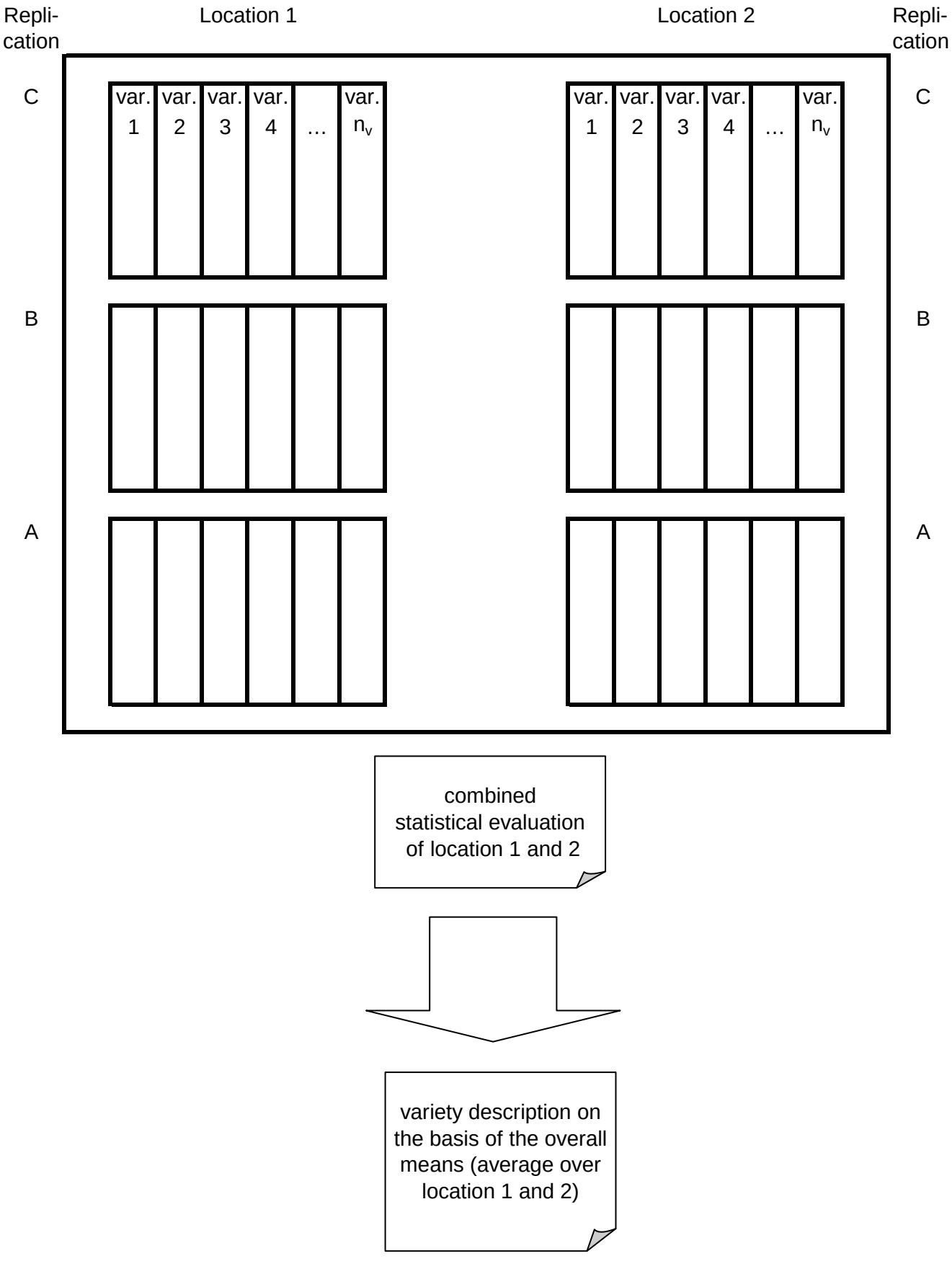


Figure 3: Combined calculations on a single location level (Option 4)

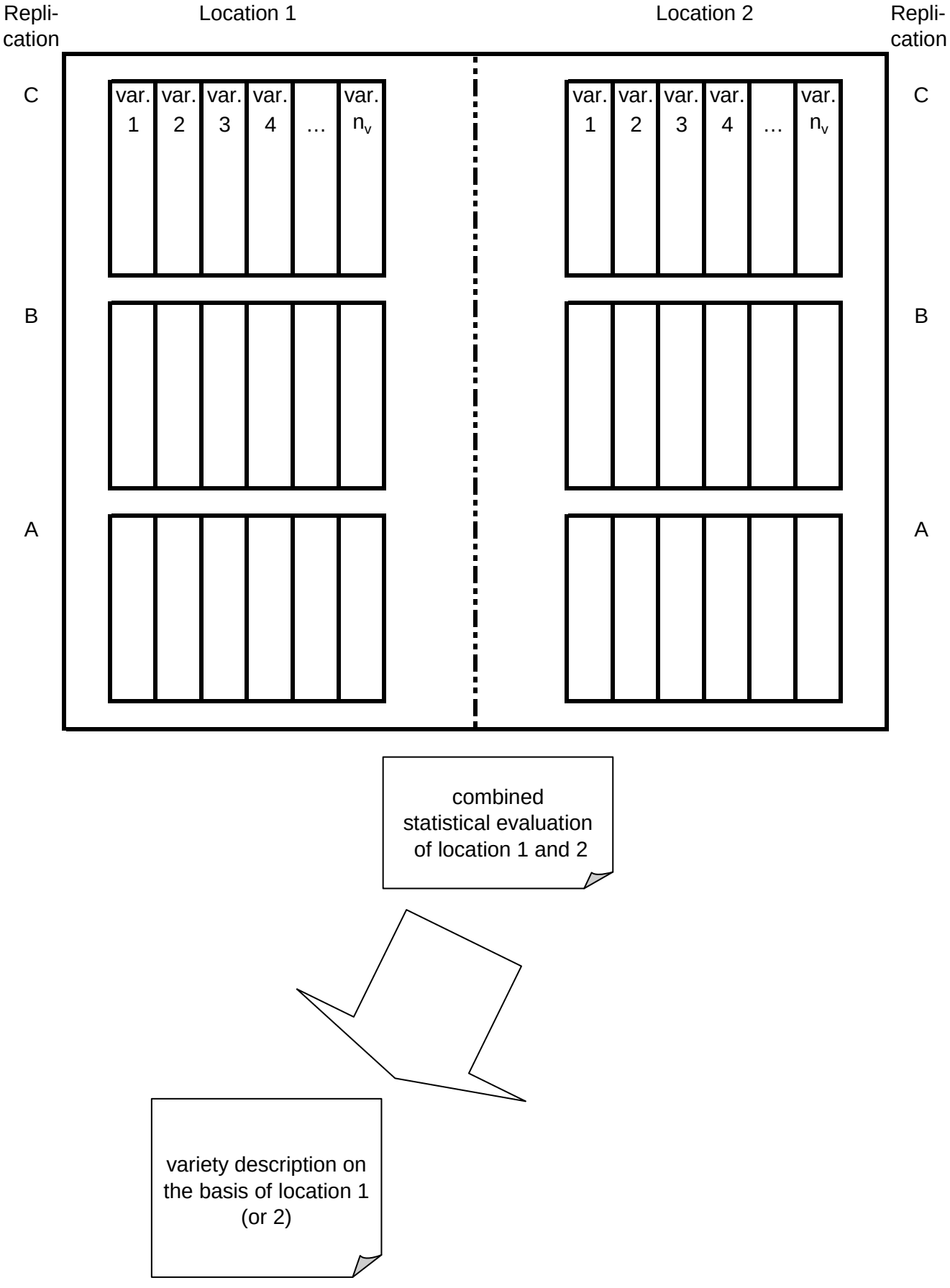
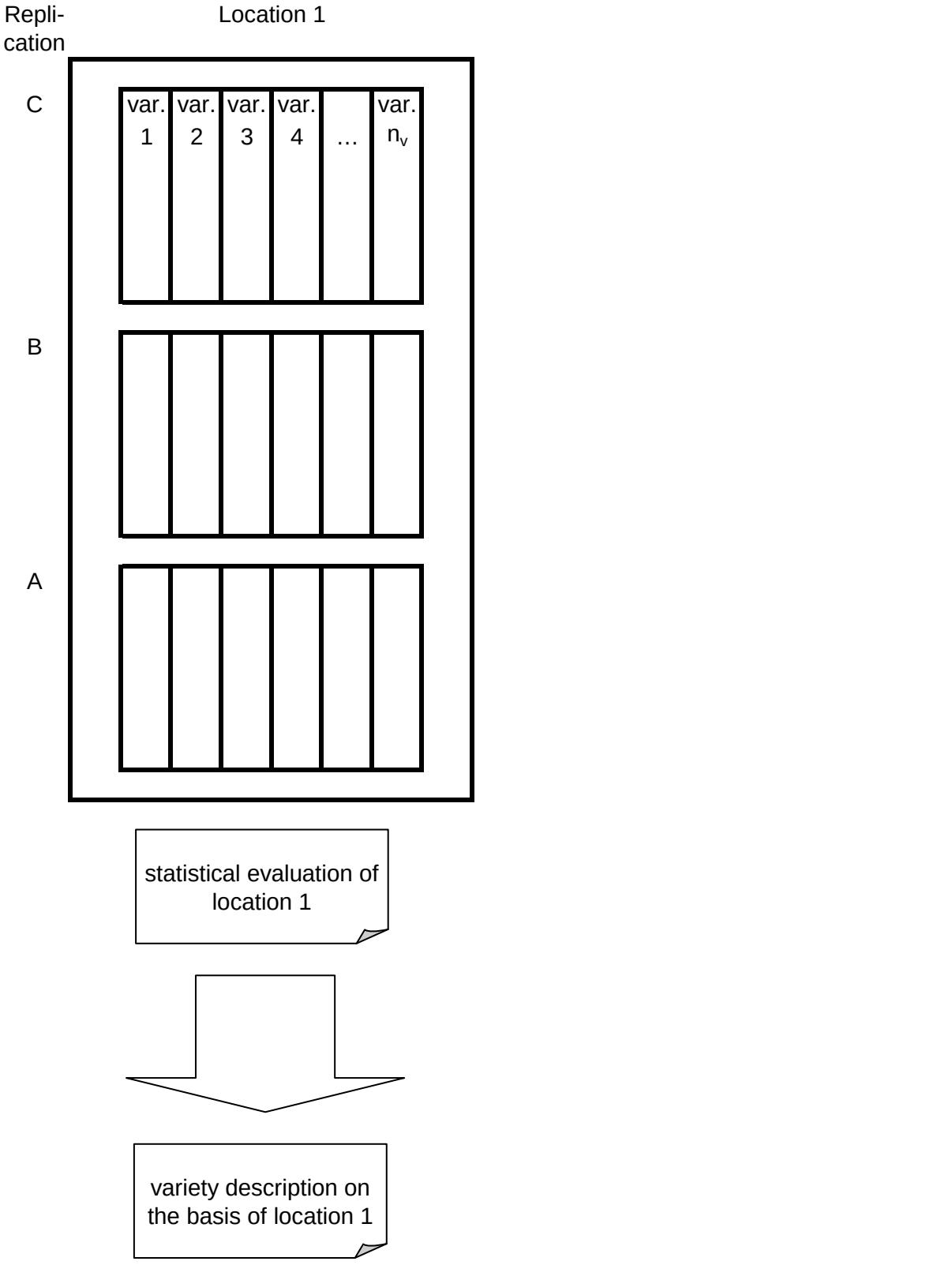


Figure 4: Conduction and evaluation of a single DUS test at one location (Option 5)



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