DTU Vet
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Pooling Efficiency of Different Sampling Schemes

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Background

Pooling samples can reduce the number of tests required. However, the efficiency gain in terms of reduced number of tested samples using the different pooling schemes is unknown for different prevalence.

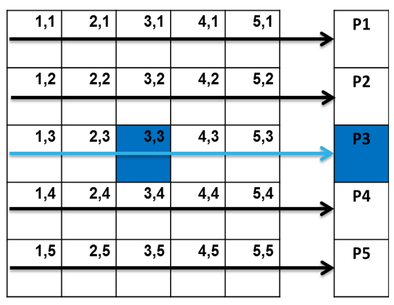
Objective

To evaluate the pooling efficiency of different pooling schemes for different prevalence.

Different pooling schemes

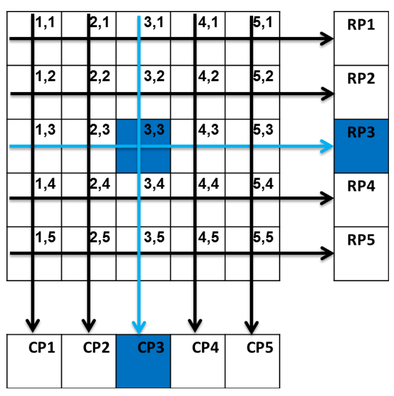
One dimensional pooling (1D)

- Pooling individual samples either column or row wise.
- Members of positive pools need retesting.



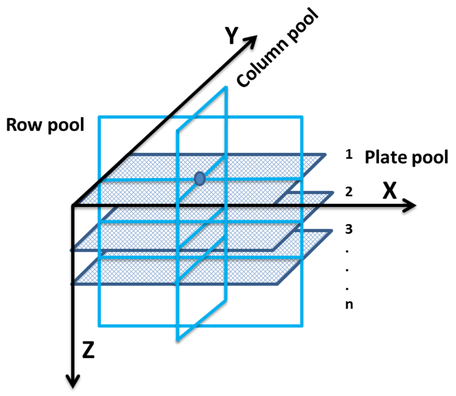
Two dimensional pooling (2D)

- Pooling individual samples both row and column wise.
- Intersection of positive row and column pools need retesting.



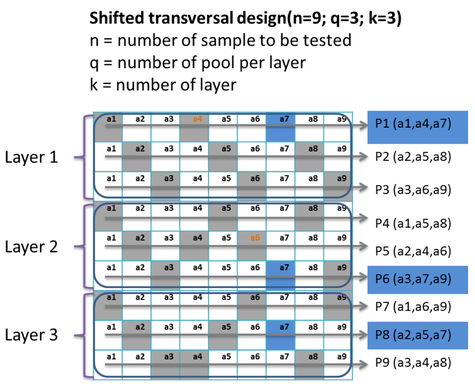
Three dimensional pooling (3D)

- Pooling individual samples row, column and plate wise.
- Intersection of positive row, column and plate need retesting.

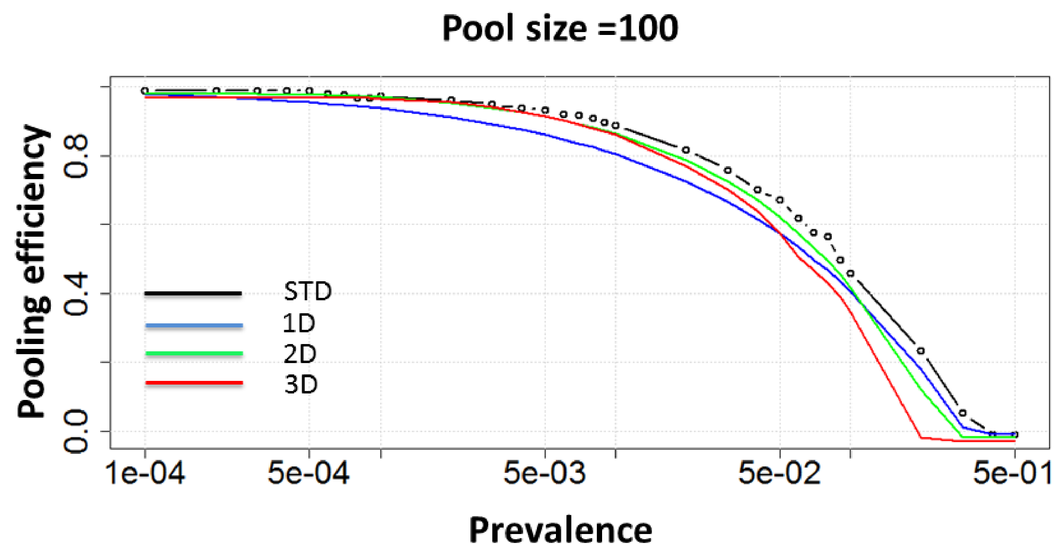


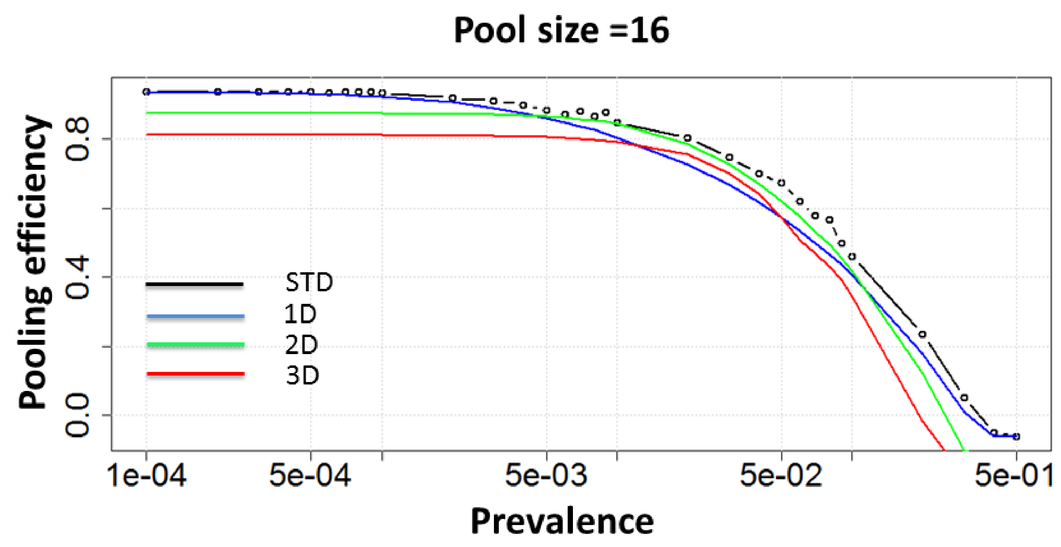
Shifted transversal design (STD)

- Shifting samples between layers to restrict their co-occurrence in pool sets.
- Intersection of different sets ascertains the positive samples.



Results





Conclusions

- Larger pool size maximizes pooling efficiency, at low prevalence.
- Smaller pool size maximizes pooling efficiency, at high prevalence.
- STD provides highest efficiency.

Simulation study

- Create a Boolean matrix for a range of prevalence and pool size.
- Pool samples from the matrix according to pooling schemes.
- Calculate the number of tests required for each matrix.
- Monte Carlo simulation of previous steps 10,000 times.
- Averaged the number of test required and calculated pooling efficiency.
- Proportion of test require = (Total pools need testing + Individual samples need testing (true positive + ambiguous sample)/Total samples.
- Pooling efficiency = 1 - (Proportion of test require).

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