# From Linear to Machine Learning: An Interactive Shiny Framework for Diagnostic Test Combination in R

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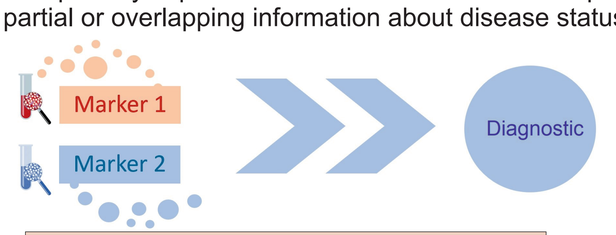
## Introduction

- Accurate diagnosis often requires the integration of multiple biomarkers rather than reliance on a single diagnostic test.
- Combining markers may improve diagnostic discrimination, robustness, and clinical decision-making.
- This is especially important when individual biomarkers provide only partial or overlapping information about disease status.



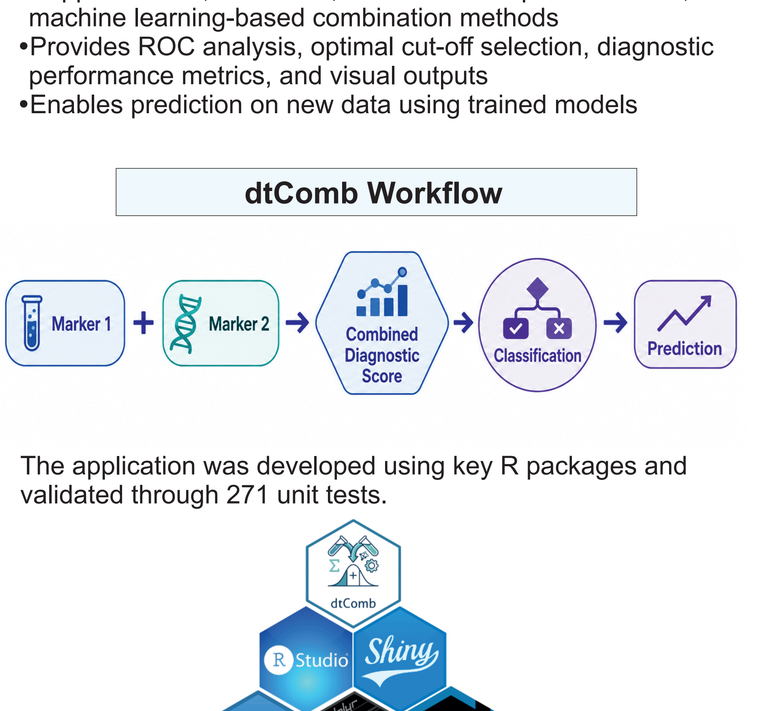

## The Gap

- Existing tools for diagnostic test combination are often limited to a small number of mainly linear methods.
- These tools may not adequately capture non-linear or complex relationships between biomarkers.
- In addition, many available workflows require programming knowledge, which reduces accessibility for clinicians and applied researchers.
- There is therefore a need for an accessible, code-free, and comprehensive platform for diagnostic test combination.

**Drag-and-Drop Interface**

**R Package Backbone (dtComb)**

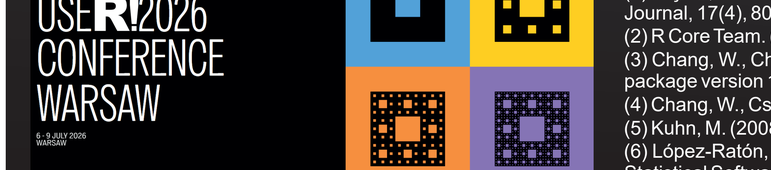
**No Programming Required**




## Key Features of dtComb-Shiny

- Interactive web interface built on the dtComb R package
- Enables users to upload data and select diagnostic markers
- Allows definition of the gold standard variable and event class
- Supports linear, non-linear, mathematical operator-based, and machine learning-based combination methods
- Provides ROC analysis, optimal cut-off selection, diagnostic performance metrics, and visual outputs
- Enables prediction on new data using trained models

## dtComb Workflow




The application was developed using key R packages and validated through 271 unit tests.




## Combination Approaches

dtComb-Shiny provides a comprehensive methodological framework for combining two diagnostic markers through the dtComb R package.

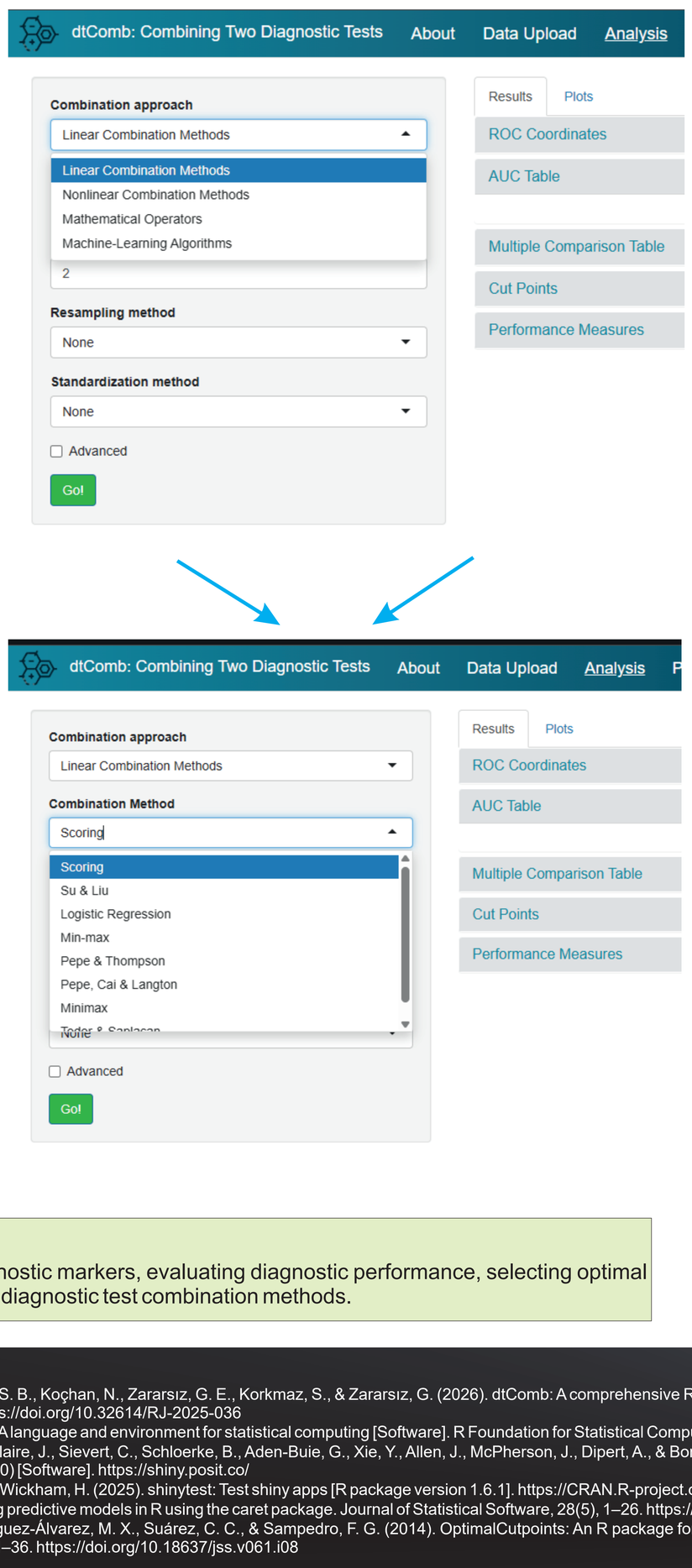
**142**
**Diagnostic Test Combination Methods**

**8 Linear Methods**
Logistic regression, scoring-based methods, ROC-based linear combinations, and more.

**7 Non-linear Methods**
Polynomial models, ridge, lasso, elastic-net, splines, generalized additive models, and more.

**14 Mathematical Operator-Based Methods**
Arithmetic operators and distance-based combinations for generating new diagnostic scores.

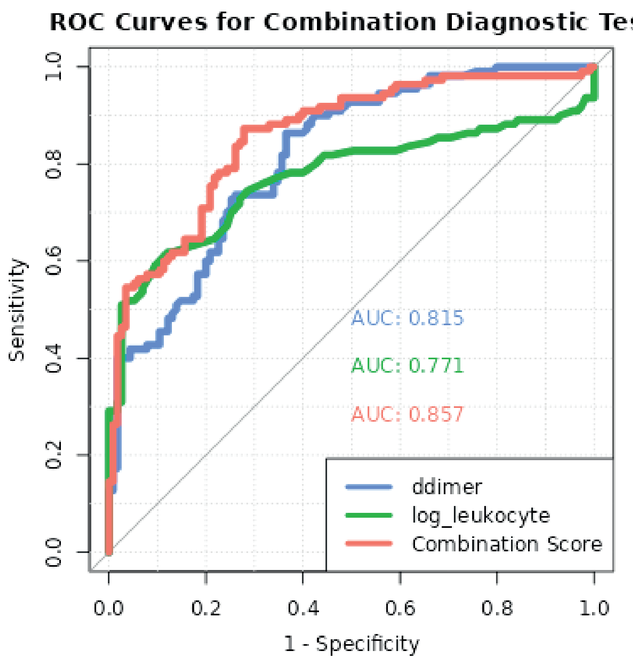
**113 Machine Learning Algorithms**
A wide range of machine learning algorithms for diagnostic test combination.



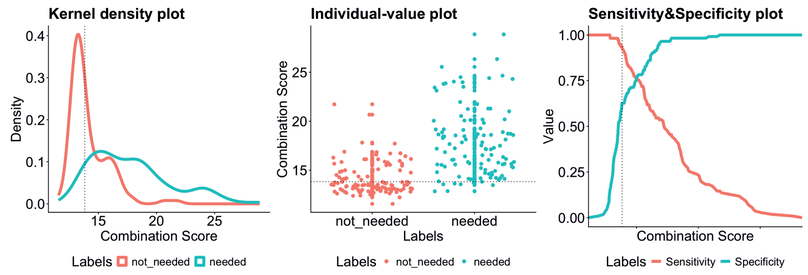

## dtComb-Shiny Outputs

The output panel is designed to guide users from model evaluation to clinical interpretation. It enables side-by-side assessment of individual biomarkers and combined diagnostic scores, supporting the identification of the best-performing combination method and the most appropriate decision threshold for future classification.

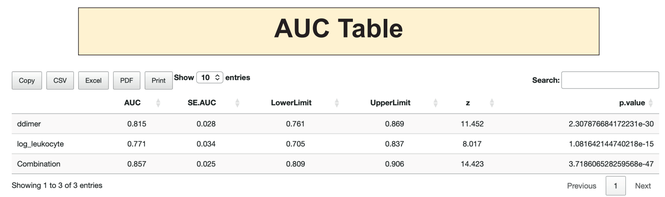
### ROC Curves



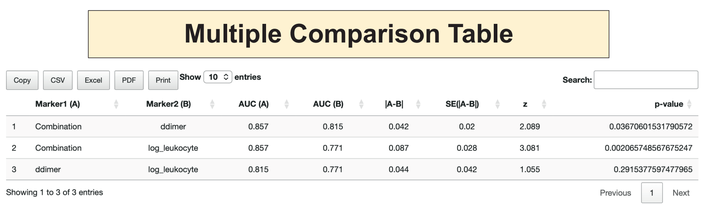

### Kernel density plots, individual-value plots, and sensitivity&specificity curves



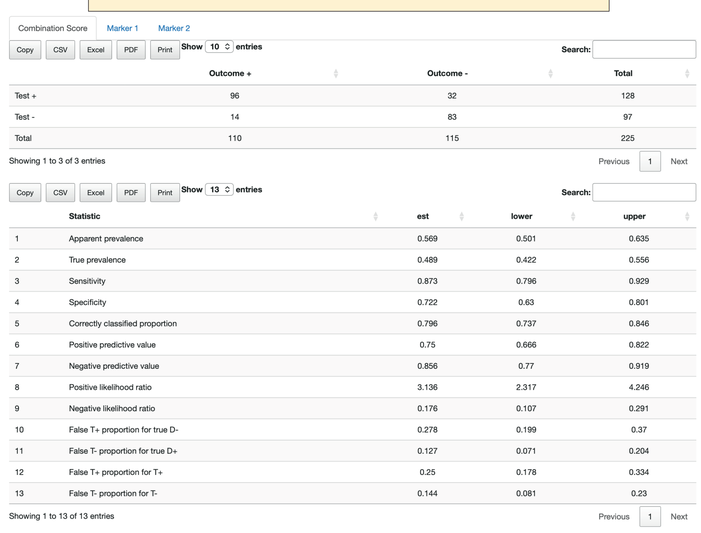

### AUC Table



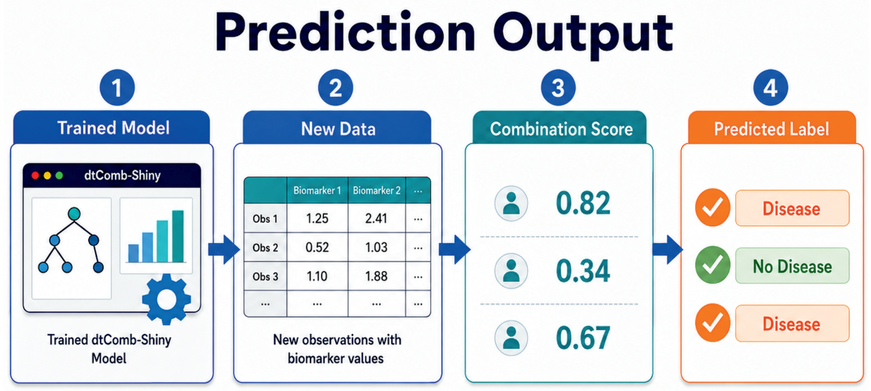

### Multiple Comparison Table




### Performance Measures




## Prediction Output




## CONCLUSION

dtComb-Shiny offers an accessible, code-free platform for combining diagnostic markers, evaluating diagnostic performance, selecting optimal cut-off points, and generating predictions for new observations through 142 diagnostic test combination methods.

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