

Prediction, clustering, and mediation workflows

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All examples use the same 72-row synthetic table and fixed seed. Small settings make the vignette suitable for a laptop or continuous integration.

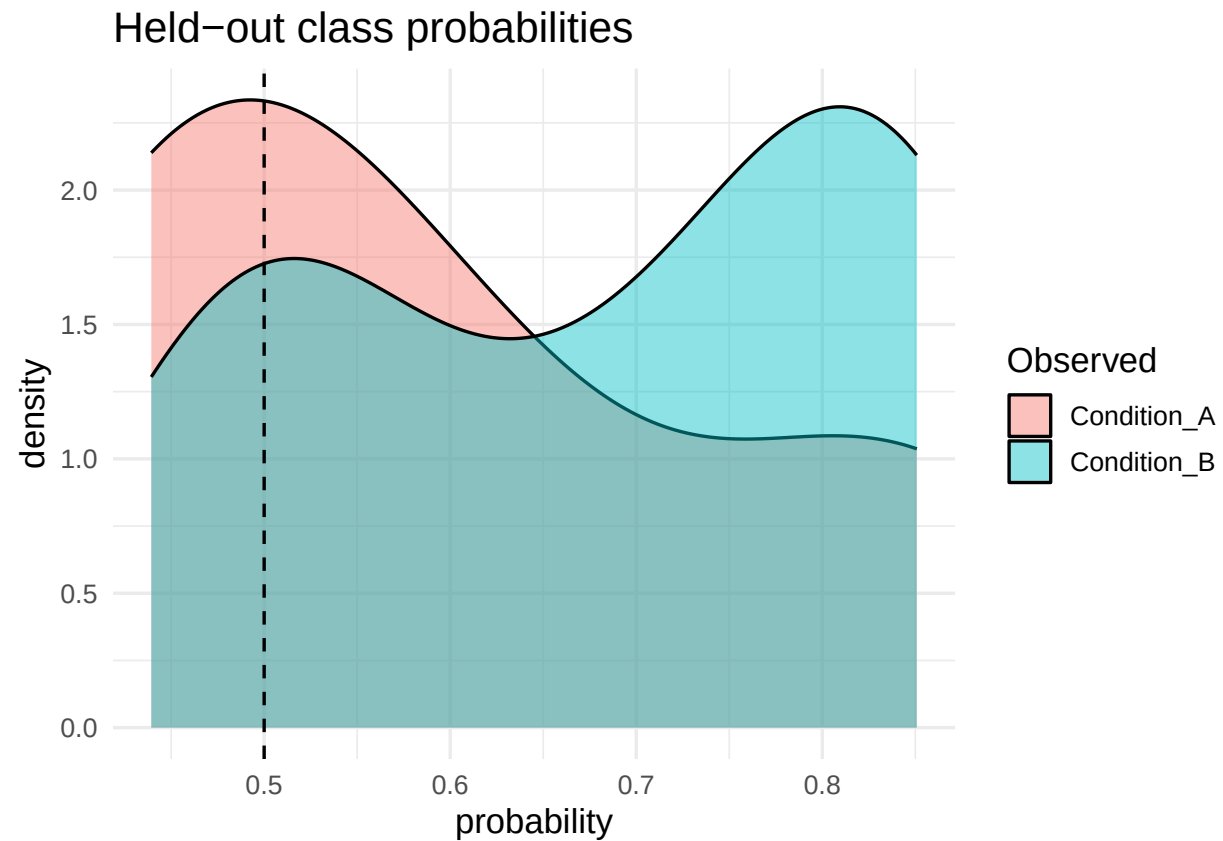
These executable workflows are adaptations informed by the public AI for Beginners, ML for Beginners, and Deep Understanding of Deep Learning repositories credited by `method_citations()`. Those curriculum repositories are not imported as R packages and are not presented as statistical engines.

```
d <- demo_spatial_data(n = 72, seed = 2026)
features <- c("epithelial", "APC", "CTL", "Treg", "T_helper")
mapping <- list(
  x = "x", y = "y", z = NULL, zone = "zone", id = "sample_id",
  outcome = "disease", exposure = "epithelial", mediator = "APC"
)
```

0.1 Held-out spatial prediction

```
prediction <- run_analysis(
  "spatial_ml", d, mapping, features,
  list(seed = 2026)
)
prediction$summary
#>           Accuracy Test observations
#>           0.7222222      18.0000000
head(prediction$table)
#>      observed predicted probability
#> 1 Condition_B Condition_A  0.4987816
#> 13 Condition_B Condition_B  0.8466535
#> 14 Condition_A Condition_A  0.4393369
#> 16 Condition_B Condition_B  0.5532591
#> 21 Condition_B Condition_B  0.8430269
#> 22 Condition_B Condition_B  0.8208996
```

```
prediction$plot
```

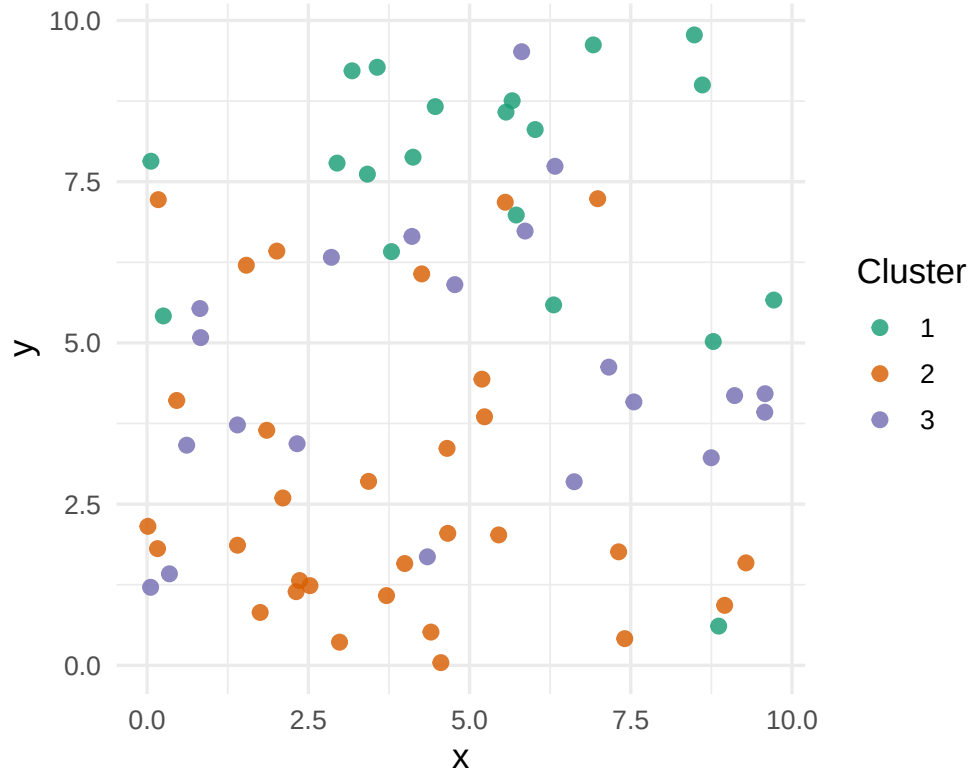


0.2 Spatially weighted clustering

```
clusters <- run_analysis(
  "spatial_clustering", d, mapping, features,
  list(clusters = 3L, spatial_weight = 0.5, seed = 2026)
)
clusters$summary
#>      observations      clusters  spatial_weight between_total_ratio
#>      72.0000000      3.0000000      0.5000000      0.4527596
head(clusters$table)
#>      x      y cluster
#> 1 6.9867347 7.235743      2
#> 2 5.5653051 8.578579      1
#> 3 1.4013996 1.862555      2
#> 4 2.8572331 6.326981      3
#> 5 5.5536901 7.181158      2
#> 6 0.2513115 5.418066      1
```

```
clusters$plot
```

Spatially weighted phenotype clusters

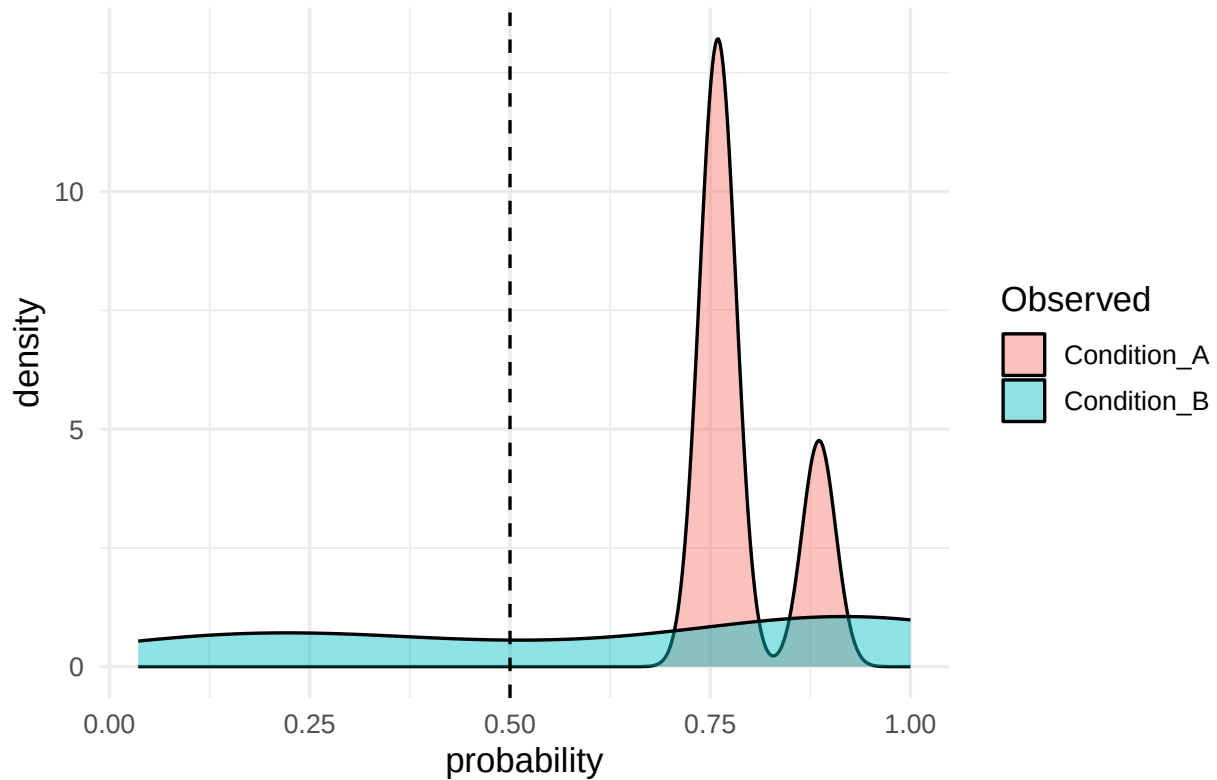


0.3 Shallow-neural prediction

The `nnet` package is a suggested dependency. The model below has only four hidden units and a small dataset.

```
if (requireNamespace("nnet", quietly = TRUE)) {  
  neural <- run_analysis(  
    "neural_prediction", d, mapping, features,  
    list(hidden_units = 4L, decay = 0.02, seed = 2026)  
  )  
  neural$summary  
}  
#>      accuracy test_observations hidden_units weight_decay  
#>      0.4444444      18.0000000         4.0000000      0.0200000  
  
if (exists("neural")) neural$plot
```

Held-out shallow-network probabilities



0.4 Mediation with a small bootstrap

For this synthetic execution check, `epithelial` is mapped to exposure, `APC` to mediator, and `CTL` to outcome. Twenty-five bootstrap replicates keep rendering fast; a real analysis requires settings justified for the study.

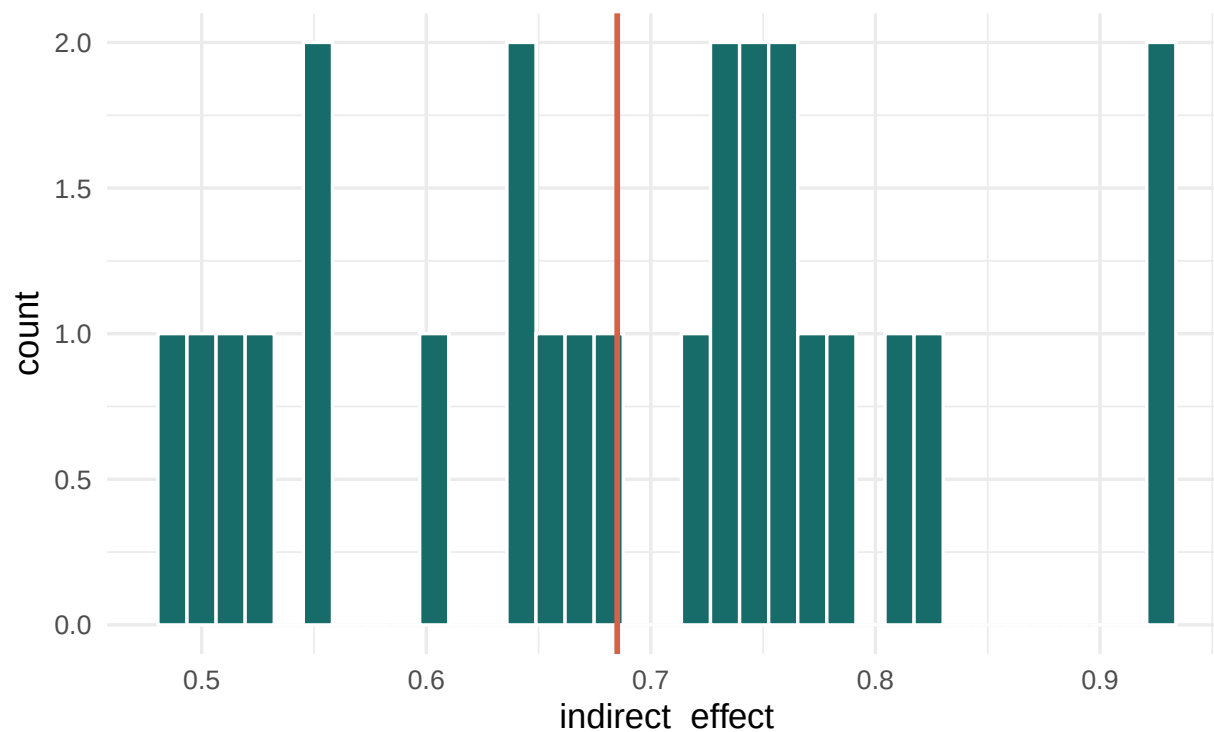
```
mediation_mapping <- mapping
mediation_mapping$outcome <- "CTL"
mediation <- run_analysis(
  "mediation", d, mediation_mapping, features,
  list(bootstrap = 25L, seed = 2026)
)
```

```
mediation$table
#>      effect  estimate
#> 1 Indirect  0.6850187
#> 2 Direct   -0.4415923
#> 3 Total    0.2434264
#> 4 Indirect CI lower  0.4928987
#> 5 Indirect CI upper  0.9242528
```

```
mediation$plot
```

Bootstrap distribution of the indirect effect

Percentile 95% CI: 0.493 to 0.924



These workflows return predictive, clustering, and model-based mediation quantities. The code demonstrates execution and object structure; it does not validate biological labels, clinical utility, or causal identification.

```
method_citations("spatial_ml")
#> [1] "Bhadury, S. (2026). SpatialMethodsWorkbench: Spatial Methods Workbench (Version 0.2.1) [Compute
#> [2] "Roberts, D. R. et al. (2017). Cross-validation strategies for data with temporal, spatial, hier
#> [3] "Microsoft. ML for Beginners curriculum. Upstream: https://github.com/microsoft/ML-For-Beginners
method_citations("neural_prediction")
#> [1] "Bhadury, S. (2026). SpatialMethodsWorkbench: Spatial Methods Workbench (Version 0.2.1) [Compute
#> [2] "Microsoft. AI for Beginners curriculum. Upstream: https://github.com/microsoft/AI-For-Beginners
#> [3] "Cohen, M. X. A Deep Understanding of Deep Learning. Upstream: https://github.com/mikexcohen/DeepLearning
#> [4] "Venables, W. N. and Ripley, B. D. (2002). Modern Applied Statistics with S. Springer. https://www.springer.com/9780387952643
#> [5] "Roberts, D. R. et al. (2017). Cross-validation strategies for structured data. Ecography 40(8):
```