

# Package ‘IsingFitBO’

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**Type** Package

**Title** Ising Model Estimation with Bayesian Optimization

**Version** 0.1.0

**Date** 2025-05-12

**Description** An extension of the IsingFit package (van Borkulo et al., 2014) that implements Bayesian Optimization for lambda hyperparameter tuning. This adaptation retains the original network estimation logic while adding automated hyperparameter selection. Licensed under GPL-2 as a derivative work.

**License** GPL-2

**Depends** R (>= 3.5.0)

**Imports** glmnet,  
qgraph,  
GauPro

**URL** <https://github.com/renatoUFG/IsingFitBO>

**BugReports** <https://github.com/yourusername/IsingFitBO/issues>

**RoxygenNote** 7.3.2

**Encoding** UTF-8

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IsingFitBO	<i>Network Estimation Using eLasso Method with Bayesian Optimization</i>
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## Description

An extension of the IsingFit package that implements Bayesian Optimization for lambda hyperparameter tuning. This adaptation retains the original network estimation logic while adding automated hyperparameter selection. Licensed under GPL-2 as a derivative work.

**Usage**

```
IsingFitBO(
  x,
  method = "BayesOpt",
  family = "binomial",
  AND = TRUE,
  niter = 20,
  plot = TRUE,
  gamma_hyp = 0.25,
  ...
)
```

**Arguments**

<code>x</code>	Input matrix (nobs x nvars) where each row represents an observation of the variables. Must be cross-sectional data.
<code>method</code>	Either "BayesOpt" (default) for Bayesian Optimization or "Grid" for predefined grid search with nine lambda values.
<code>family</code>	Currently only "binomial" is supported (for binary data).
<code>AND</code>	Logical indicating whether to use AND-rule (TRUE) or OR-rule (FALSE) to define network edges. Defaults to TRUE.
<code>niter</code>	Number of iterations for Bayesian Optimization. Default is 20.
<code>plot</code>	Logical indicating whether to plot the resulting network. Default is TRUE.
<code>...</code>	Additional arguments passed to <code>qgraph</code> .
<code>gamma</code>	Hyperparameter gamma value for extended BIC (between 0 and 1). Default is 0.25.

**Value**

An object of class 'IsingFit' containing:

<code>weiadj</code>	Weighted adjacency matrix
<code>thresholds</code>	Variable thresholds
<code>q</code>	qgraph object (class 'qgraph')
<code>gamma</code>	Used gamma hyperparameter value
<code>AND</code>	Logical indicating AND-rule usage
<code>time</code>	Computation time
<code>asymm.weights</code>	Asymmetrical weighted adjacency matrix before AND/OR rule
<code>lambda.values</code>	Optimal tuning parameter values per node

**Note**

This function extends the original `IsingFit` package (van Borkulo et al., 2014). The Bayesian Optimization feature was added in 2025.

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## References

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- Foygel, R., & Drton, M. (2011). Bayesian model choice and information criteria in sparse generalized linear models. *arXiv preprint arXiv:1112.5635*.
- Ravikumar, P., Wainwright, M. J., & Lafferty, J. D. (2010). High-dimensional Ising model selection using l1-regularized logistic regression. *The Annals of Statistics*, 38, 1287-1319.
- van Borkulo, C. D., Borsboom, D., Epskamp, S., Blanken, T. F., Boschloo, L., Schoevers, R. A., & Waldorp, L. J. (2014). A new method for constructing networks from binary data. *Scientific Reports* 4, 5918. DOI:10.1038/srep05918.

## Examples

```
library(IsingSampler)

# Simulate dataset
N <- 6 # Number of nodes
nSample <- 1000 # Number of samples

# Generate random graph structure
Graph <- matrix(sample(0:1, N^2, TRUE, prob = c(0.8, 0.2)) * runif(N^2, 0.5, 2)
Graph <- pmax(Graph, t(Graph)) # Symmetrize
diag(Graph) <- 0 # No self-loops
Thresh <- -rowSums(Graph)/2 # Thresholds

# Simulate data
Data <- IsingSampler(nSample, Graph, Thresh)

# Fit model with Bayesian Optimization
Res <- IsingFitBO(Data, method = "BayesOpt", niter = 20, gamma = 0.25)

# Plot results
if (require("qgraph")) {
  layout(t(1:2))
  qgraph(Res$weiadj, fade = FALSE, title = "Estimated Network")
  qgraph(Graph, fade = FALSE, title = "True Network")
}
```

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plot.IsingFitBO

*Plot Method for IsingFitBO Objects*


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## Description

Visualizes the results of an Ising model estimation with Bayesian optimization.

## Usage

```
## S3 method for class 'IsingFitBO'
plot(x, ...)
```

**Arguments**

x	An object of class 'IsingFitBO'
...	Additional arguments passed to plot functions
type	Plot type: "network" (default), "convergence", or "parameters"
main	Plot title (optional)

**Value**

Invisibly returns the plot object. For "network" type, returns a 'qgraph' object.

**See Also**

[qgraph](#) for network visualization options

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print.IsingFitBO	<i>Print Method for IsingFitBO Objects</i>
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**Description**

Displays concise output of Ising model estimation results.

**Usage**

```
## S3 method for class 'IsingFitBO'
print(x, ...)
```

**Arguments**

x	An object of class 'IsingFitBO'
...	Additional arguments

**Value**

Invisibly returns the input object.

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summary.IsingFitBO	<i>Summary Method for IsingFitBO Objects</i>
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**Description**

Provides comprehensive summary statistics for Ising model estimation results.

**Usage**

```
## S3 method for class 'IsingFitBO'
summary(object, ...)
```

**Arguments**

<code>object</code>	An object of class ‘ <code>IsingFitBO</code> ’
<code>...</code>	Additional arguments
<code>digits</code>	Number of significant digits (default=3)

**Value**

An object of class ‘`summary.IsingFitBO`’ containing network properties and optimization details.

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