

Package ‘ccmm’

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Title Compositional Mediation Model

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Description Estimate the direct and indirect (mediation) effects of treatment on the outcome when intermediate variables (mediators) are compositional and high-dimensional. Sohn, M.B. and Li, H. (2017). Compositional Mediation Analysis for Microbiome Studies. (AOAS: In revision).

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ccmm-package

Causal Compositional Mediation Model

Description

Estimate the direct and indirect (mediation) effects of treatment on the outcome when intermediate variables (mediators) are compositional and high-dimensional.

Author(s)

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References

Sohn, M.B. and Li, H. (2017). Compositional Mediation Analysis for Microbiome Studies. (AOAS: In revision)

Examples

```
## Not run:
# Load test data
data(ccmm_test_data);
head(ccmm_test_data);
outcome <- ccmm_test_data[,1];
treatment <- ccmm_test_data[,2];
mediators <- as.matrix(ccmm_test_data[,3:22]);
covariates <- as.matrix(ccmm_test_data[,23:24]);

# Run CCMM
rslt.ccmm <- ccmm(outcome, mediators, treatment, covariates);

# Sensitivity analysis
rslt.sa <- ccmm.sa(outcome, mediators, treatment, covariates);
plot(rslt.sa, type="l", xlab=expression(rho), ylab="TIDE")
abline(h=rslt.ccmm$TIDE, lty=2)
abline(h=0, lty=3)
cisa <- tide.ci.zero.rho(outcome, mediators, treatment, covariates)
csqs <- quantile(cisa, c(0.025, 0.975))
segments(0, csqs[1], 0, csqs[2])

## End(Not run)
```

Description

Estimate the direct and indirect (mediation) effects of treatment on the outcome when intermediate variables (mediators) are compositional and high-dimensional.

Usage

```
ccmm(y, M, tr, x = NULL, w = NULL, method.est.cov = "bootstrap", n.boot = 2000,
sig.level = 0.05, tol = 1e-06, max.iter = 5000)
```

Arguments

| | |
|----------------|--|
| y | Vector of continuous outcomes |
| M | Matrix of compositional data |
| tr | Vector of continuous or binary treatments |
| x | Matrix of covariates |
| w | Vector of weights on samples |
| method.est.cov | One of two options ("bootstrap", "normal") to estimate the variance of indirect effects |
| n.boot | Number of bootstrap samples |
| sig.level | Significance level to estimate bootstrap confidence intervals for direct and indirect effects of treatment |
| tol | Error tolerance |
| max.iter | Maximum number of iteration in a debias procedure |

Value

If method.est.cov is "bootstrap",

| | |
|---------|--|
| DE | Direct effect of treatment on an outcome |
| DE.CI | Bootstrap confidence interval for the direct effect |
| TIDE | Total indirect effect of treatment on an outcome |
| TIDE.CI | Bootstrap confidence interval for the indirect effect |
| IDEs | Component-wise indirect effects of treatment on an outcome |
| IDE.CIs | Bootstrap confidence intervals for the component-wise indirect effects |

If method.est.cov is "normal",

| | |
|--------|--|
| DE | Direct effect of treatment on an outcome |
| Var.DE | Variance of the direct effect |

| | |
|----------|--|
| TIDE | Total indirect effect of treatment on an outcome |
| Var.TIDE | Variance of the indirect effect |
| IDEs | Component-wise indirect effects of treatment on an outcome |
| Var.IDEs | Variances of the component-wise indirect effects |

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References

Sohn, M.B. and Li, H. (2017). Compositional Mediation Analysis for Microbiome Studies (AOAS: In revision)

Examples

```
# Load test data
data(ccmm_test_data);
outcome <- ccmm_test_data[,1];
treatment <- ccmm_test_data[,2];
mediators <- as.matrix(ccmm_test_data[,3:22]);
covariates <- as.matrix(ccmm_test_data[,23:24]);

# Run CCMM
rslt.ccmm <- ccmm(outcome, mediators, treatment, covariates);
```

ccmm.sa

Sensitivity analysis

Description

Estimated total indirect effects (TIDE) given correlation coefficients (ρ)

Usage

```
ccmm.sa(y, M, tr, x = NULL, w = NULL, stp = 0.01)
```

Arguments

| | |
|-----|---|
| y | Vector of continuous outcomes |
| M | Matrix of compositional data |
| tr | Vector of continuous or binary treatments |
| x | Matrix of covariates |
| w | Vector of weights on samples |
| stp | Increment of the correlation coefficient |

Value

Matrix of rho and TIDE

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References

Sohn, M.B. and Li, H. (2017). Compositional Mediation Analysis for Microbiome Studies (AOAS: In revision)

Examples

```
# Load test data
data(ccmm_test_data);
outcome <- ccmm_test_data[,1];
treatment <- ccmm_test_data[,2];
mediators <- as.matrix(ccmm_test_data[,3:22]);
covariates <- as.matrix(ccmm_test_data[,23:24]);

rslt.sa <- ccmm.sa(outcome, mediators, treatment, covariates);
```

ccmm.sensitivity *Sensitivity analysis*

Description

Estimate the total indirect effect (TIDE) given a correlation coefficient

Usage

```
ccmm.sensitivity(rh, y, M, tr, x = NULL, w = NULL)
```

Arguments

| | |
|----|---|
| rh | Correlation coefficient |
| y | Vector of continuous outcomes |
| M | Matrix of compositional data |
| tr | Vector of continuous or binary treatments |
| x | Matrix of covariates |
| w | Vector of weights on samples |

Value

Estimated TIDE given a correlation coefficient

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References

Sohn, M.B. and Li, H. (2017). Compositional Mediation Analysis for Microbiome Studies (AOAS: In revision)

Examples

```
# Load test data
data(ccmm_test_data);
outcome <- ccmm_test_data[,1];
treatment <- ccmm_test_data[,2];
mediators <- as.matrix(ccmm_test_data[,3:22]);
covariates <- as.matrix(ccmm_test_data[,23:24]);

ccmm.sensitivity(rh=0, outcome, mediators, treatment, covariates);
```

| | |
|----------------|------------------|
| ccmm_test_data | <i>Test Data</i> |
|----------------|------------------|

Description

Contains artificial 200 samples with a continuous outcome variable y , a continuous treatment tr , 20 compositional mediators M and 2 covariates X . The true direct and indirect effects of treatment on the outcome both are 1.00. The true component-wise indirect effects ($M1$ - $M20$) are 0.693, -0.425, 0.135, -0.057, -0.268, 0.970, -0.843, 0.805, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000.

Usage

```
data(ccmm_test_data)
```

| | |
|------------------|--|
| tide.ci.zero.rho | <i>Bootstrap samples of TIDE with zero correlation</i> |
|------------------|--|

Description

Generate bootstrap samples of the total indirect effect (TIDE) when the correlation coefficient is zero

Usage

```
tide.ci.zero.rho(y, M, tr, x = NULL, w = NULL, n.boot=2000)
```

Arguments

| | |
|---------------|---|
| <i>y</i> | Vector of continuous outcomes |
| <i>M</i> | Matrix of compositional data |
| <i>tr</i> | Vector of continuous or binary treatments |
| <i>x</i> | Matrix of covariates |
| <i>w</i> | Vector of weights on samples |
| <i>n.boot</i> | Number of bootstrap samples |

Value

bootstrap samples of TIDE

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References

Sohn, M.B. and Li, H. (2017). Compositional Mediation Analysis for Microbiome Studies (AOAS: In revision)

Examples

```
# Load test data
data(ccmm_test_data);
outcome <- ccmm_test_data[,1];
treatment <- ccmm_test_data[,2];
mediators <- as.matrix(ccmm_test_data[,3:22]);
covariates <- as.matrix(ccmm_test_data[,23:24]);

cisa <- tide.ci.zero.rho(outcome, mediators, treatment, covariates, n.boot=200)
```

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