

# Package ‘TopicTestlet’

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**Title** A Topic Testlet Model for Calibrating Testlet Constructed Responses

**Version** 0.1.0

**Description** Implements the Topic Testlet Model (TTM) as described by Xiong et al. (2025) <[doi:10.1111/jedm.70001](https://doi.org/10.1111/jedm.70001)>.

The package integrates Latent Dirichlet Allocation (LDA) with the Partial Credit Model to account for local item dependence in testlets using latent topics from student textual responses.

**Depends** R (>= 4.0.0)

**Imports** topicmodels, tm, stats

**License** GPL (>= 3)

**Encoding** UTF-8

**RoxygenNote** 7.3.2

**Suggests** knitr, rmarkdown

**VignetteBuilder** knitr

**NeedsCompilation** no

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`aggregate_responses`     *Concatenate Student Responses*

### Description

Aggregates all written responses within a testlet for each student.

### Usage

```
aggregate_responses(response_matrix)
```

### Arguments

`response_matrix`

An N x J matrix of character strings (essays).

### Value

A named character vector of length N.

`ttm_est`                    *Fit the Topic Testlet Model (TTM)*

### Description

Calibrates the TTM using score data and pre-computed topic proportions. Uses a Variational Expectation-Maximization (VEM) approach to estimate student ability ( $\theta$ ), topic penalties ( $\lambda$ ), and item parameters ( $b$ ).

### Usage

```
ttm_est(scores, delta, max_iter = 100, tol = 1e-04)
```

### Arguments

`scores`                  An N x J numeric matrix of item scores (0, 1, ...).

`delta`                    An N x K numeric matrix of topic proportions (from `ttm_lda`).

`max_iter`                Maximum number of EM iterations.

`tol`                    Convergence tolerance.

**Value**

A list containing:

theta	Vector of estimated student abilities.
lambda	Matrix of estimated topic penalties.
gamma	Vector of person-specific testlet effects.
item_params	List of step difficulties for each item.
AIC	Akaike Information Criterion.
BIC	Bayesian Information Criterion.

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**ttm\_lda***Fit LDA and Extract Topic Proportions*

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**Description**

Fits a Latent Dirichlet Allocation model to the text and returns the person-specific topic proportion matrix (delta).

**Usage**

```
ttm_lda(text_vector, k, seed = 1234)
```

**Arguments**

text_vector	A character vector of aggregated student responses.
k	The number of latent topics.
seed	Integer seed for reproducibility.

**Value**

A matrix of dimension N x K containing topic proportions (delta).

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**ttm\_perplexity**      *Calculate Perplexity for Different Topic Numbers*

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**Description**

Calculates the perplexity of LDA models over a range of K topics to help determine the optimal number of topics.

**Usage**

```
ttm_perplexity(text_vector, k_range = 2:5, seed = 1234)
```

**Arguments**

- |             |   |
|-------------|---|
| text_vector | A character vector of aggregated student responses (length N).        |
| k_range     | A numeric vector indicating the number of topics to try (e.g., 2:10). |
| seed        | Integer seed for reproducibility.                                     |

**Value**

A data frame containing K and the corresponding perplexity score.

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