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| **GLIMMPSE: Power Service REST API** |

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# Introduction

The GLIMMPSE software system provides a web based user interface to calculate power and sample size for the general linear multivariate model (GLMM)1 with or without a baseline covariate. The GLIMMPSE system consists of three components:

* GlimmpseFront – an Angular web application which guides the user through choices required to design a study using GLMM.
* GlimmpseBack – Python based web service which processes power and sample size requests
* PyGlimmpse library - low level library containing routines for computing GLMM power

This document describes the REST API for the Glimmpse back end, version 3.0.0. It assumes basic familiarity with [HTTP](http://www.w3.org/Protocols/), [REST](http://www.ics.uci.edu/%7Efielding/pubs/dissertation/top.htm), and the GLMM. For additional background on GLMM power calculations when controlling for a baseline covariate, please see Glueck and Muller2.

## License Information

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## Funding

GLIMMPSE version 3.0.0 is funded by NIDCR 1 R01 DE020832-01A1 to the University of Florida (Keith E. Muller, PI; Deborah Glueck, University of Colorado site PI)

Previous funding was received from an American Recovery and Re-investment Act supplement (3K07CA088811-06S) for NCI grant K07CA088811.

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# GLIMMPSE Back End

The back end of the GLIMMPSE system is a Python FLASK web service which processes requests for power and sample size for the GLMM. The system supports GLMM study designs with fixed predictors (GLMM(F)), or fixed predictors with a single baseline covariate (GLMM(F,g)). The REST API allows users to specify a model, from which we derive the matrices required for GLMM power calculations, and request power, or sample size.

The system is implemented using in python FLASK. Requests to and responses from the back end are encoded as JSON.

# Inputs to Power and Sample Size Calculations: The StudyDesign Object

Power calculations for the GLMM are based on several matrices which describe the study design, choices for regression coefficients, choices for variability, and study hypotheses. Users may request multiple power values in a single request to the power service, including variations such as different statistical tests, Type I error rates, sample sizes, desired power values, and scale factors for regression coefficients and variability. For GLMM(F,g) designs, multiple power methods and quantiles may be specified.

For version 3.0.0 of GLIMMPSE, all requests to the back end must include a JSON encoded StudyDesign object.

A StudyDesign object describes all aspects of a study design relevant to power and sample size calculations. The StudyDesign object takes it’s form based on the ontology detailed in ???. The back end will translate the study design into the appropriate set of matrices. For reasons of efficiency and stability, we do not always calculate a full set of matrices as would typically be done when calculating a GLMM by hand.

## Study Design

|  |  |  |  |
| --- | --- | --- | --- |
| Property | Type | Description | Required |
| \_confidence\_interval | list | If the means (B) or the error covariance (Σe) are sample estimates, then the power values produced from these matrices will be random quantities. To account for this randomness, GLIMMPSE can calculate confidence intervals for power values using the techniques described by Taylor and Muller (1995), Gribbin et al. (2013), and Park (2007). |  |
| \_define\_full\_beta | bool | Bool deciding whether the design specifies the entire Beta matrix or instead only considers a projection of marginal means for independent sampling units included in the hypothesis. | \* |
| \_gaussianCovariate | object | Object describing a Gaussian Covariate |  |
| \_glimmpse\_ui\_version | str | Front end version number |  |
| \_isuFactors | object | Object describing the independent sampling units in the design |  |
| \_power | list | List of target power values if solving for samplesize |  |
| \_quantiles | list | List of quantile values if solving with conditional power |  |
| \_scaleFactor | list | List of means scale factor for |  |
| \_selectedTests | list | [  "Hotelling Lawley Trace",  "Pillai-Bartlett Trace",  "Wilks Likelihood Ratio",  "Box Corrected",  "Geisser-Greenhouse Corrected",  "Huynh-Feldt Corrected",  "Uncorrected"  ] | \* |
| \_solveFor | str | POWER or SAMPLESIZE | \* |
| \_typeOneErrorRate | list | List of type one error rates for the study design | \* |
| \_varianceScaleFactors | list | List of variance scale factors |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Property | Type | Description | Required |
| betweenIsuRelativeGroupSizes | object | Object describing the rations of group sizes of any fixed predictors in the study. |  |
| cMatrix | bool | Object describing the between, C Matrix. | \* |
| marginalMeans | object | Object describing the marginal means. If all marginal means are specified, this represents the Beta matrix. | \* |
| outcomeCorrelationMatrix | Mathjax DenseMatrix | Matrix describing the correlation among the outcomes. | \* |
| theta0 | 2d list[][] | Theta nought matrix, usually defaulted to zero | \* |
| uMatrix | object | Data about the within, U Matrix. | \* |
| variables | object | List of independent sampling units | \* |

## ISU Factors

# REST API

## Calculating Power

New power calculations are "created" with the following URI:

POST /calculate

The entity body should contain a JSON encoded StudyDesign object with \_solve for set to POWER.

Power results are returned as a JSON encoded array of Result objects.

{"status": 200, "mimetype": "application/json", "results": [{"test": "Hotelling Lawley Trace", "power": 1.0, "lower\_bound": null, "upper\_bound": null, "model": {"essence\_design\_matrix": [[1.0, 0.0], [0.0, 1.0]], "repeated\_rows\_in\_design\_matrix": 10, "full\_beta": false, "hypothesis\_beta": [[0.75], [0.2]], "c\_matrix": [[1.0, -1.0]], "u\_matrix": [[1.0]], "sigma\_star\_outcome\_component": [[0.0004]], "sigma\_star\_repeated\_measure\_component": [[1]], "sigma\_star\_cluster\_component": [[1]], "sigma\_star\_gaussian\_adjustment": null, "sigma\_star": [[0.0004]], "theta\_zero": [[0]], "alpha": 0.05, "total\_n": 20, "theta": [[0.55]], "m": [[2.0]], "nu\_e": 18, "hypothesis\_sum\_square": [[1.5125000000000002]], "error\_sum\_square": [[0.007200000000000001]], "errors": [], "test": "Hotelling Lawley Trace", "target\_power": null, "smallest\_group\_size": 10, "means\_scale\_factor": 1, "variance\_scale\_factor": 1, "smallest\_realizable\_design": null, "delta": [[0.15125000000000002]], "groups": [1, 1], "power\_method": "conditional", "quantile": null, "confidence\_interval": null, "orthonormalize\_u\_matrix": true}},]}

## Calculating Sample Size

New sample size calculations are "created" with the following URI:

POST /calculate

The entity body should contain a JSON encoded StudyDesign object with

\_solveFor set to SAMPLESIZE.

Power results are returned as a JSON encoded array of Result objects. These differ slightly in content from power results.

{"status": 200, "mimetype": "application/json", "results": [{"test": "Hotelling Lawley Trace", "samplesize": 6, "power": 0.9999905391368346, "lower\_bound": null, "upper\_bound": null, "model": {"essence\_design\_matrix": [[1.4142135623730951, 0.0], [0.0, 1.0]], "repeated\_rows\_in\_design\_matrix": 1, "full\_beta": false, "hypothesis\_beta": [[2], [33]], "c\_matrix": [[1.0, -1.0]], "u\_matrix": [[1.0]], "sigma\_star\_outcome\_component": [[16.0]], "sigma\_star\_repeated\_measure\_component": [[1]], "sigma\_star\_cluster\_component": [[1]], "sigma\_star\_gaussian\_adjustment": null, "sigma\_star": [[16.0]], "theta\_zero": [[0]], "alpha": 0.05, "total\_n": 3, "theta": [[-31.0]], "m": [[1.5]], "nu\_e": 1, "hypothesis\_sum\_square": [[640.6666666666666]], "error\_sum\_square": [[16.0]], "errors": [], "test": "Hotelling Lawley Trace", "target\_power": 0.9, "smallest\_group\_size": 1, "means\_scale\_factor": 1, "variance\_scale\_factor": 1, "smallest\_realizable\_design": 1, "delta": [[640.6666666666666]], "groups": [2, 1], "power\_method": "conditional", "quantile": null, "confidence\_interval": null, "orthonormalize\_u\_matrix": false}}]}

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Author: Alasdair Macleod  
Last Updated: June 2020