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LIFESPAN: Longitudinal Study Designer

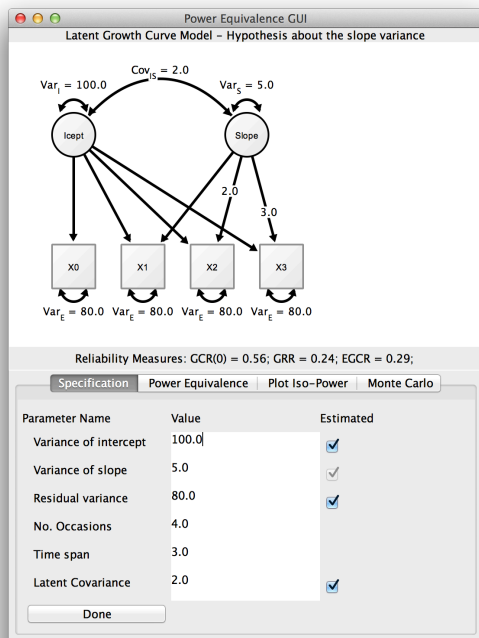
Documentation



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simulate statistical power.

Introduction

The *Longitudinal (Interactive Front-End) Study Designer* (LIFESPAN) enables researchers to sketch a longitudinal study as a SEM and examine power and/or reliability measures for hypotheses about change. Currently, LIFESPAN is limited to latent growth curve models and hypotheses about the variance of change as described by Hertzog et al. (submitted). In future versions, we plan to add indicators and simulation tools for other hypotheses and other research designs.

LIFESPAN offers means to specify a linear latent growth curve model, display the corresponding diagram, derive reliability measures of slope effects (GRR, GCR, and EGCR), to derive alternative study designs with equal reliability as measured by EGCR, to graphically examine trade-offs between parameters while holding EGCR constant and Monte-Carlo-

Main Screen

The default screen of LIFESPAN shows three main elements. The top half of the screen contains a diagram representing the current study design. The center shows a summary bar with a set of effect size measures for slope variance:

- Growth Rate Reliability (GRR)
- Growth Curve Reliability (GCR)
- Effective Growth Curve Reliability (EGCR)

- Effective Error (EFF)

The bottom half contains a control panel with four tabs. Each tab contains a different mode of LIFESPAN. In the following, a separate section is dedicated to each mode of LIFESPAN.

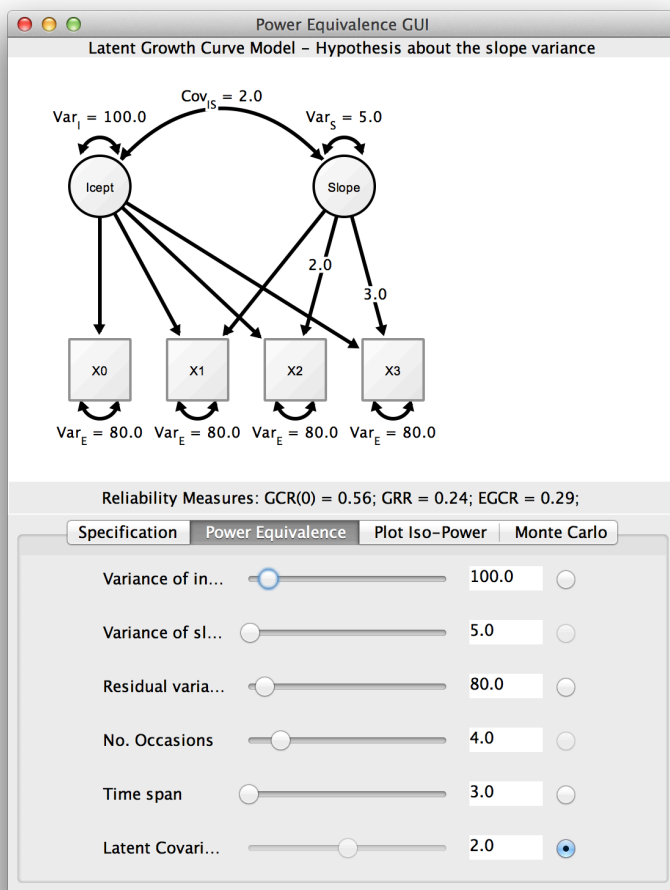
Model Specification

In specification mode, you are able to change model parameters of the study design. LIFESPAN is currently limited to study designs of repeated measures of a single variable modeled as a linear latent growth curve model. That is, both intercept and change are represented as a random effects over persons. Parameters subject to change are the variance of latent intercept, the variance of latent slope, the covariance between latent intercept and slope, the residual variance fixed over measurement occasions, the number of measurement occasions, the total time span of the study. Values of these parameters can be changed by entering a number in the respective text field in the center column. Changes are not reflected in the model until button “Done” is pressed. By default, LIFESPAN assumes that four parameters are freely estimated in the model: variance of intercept, variance of slope, residual variance, and latent covariance. If any of these parameters is assumed to be known and fixed, this can be indicated in the third column titled “Estimated”. Since LIFESPAN is concerned with hypotheses about the variance of change, the parameter “variance of slope” must always be freely estimated and is thus always shown but greyed out.

As soon as all changes are made, and button “Done” is pressed, changes are reflected in the diagram and in the reliability measures.

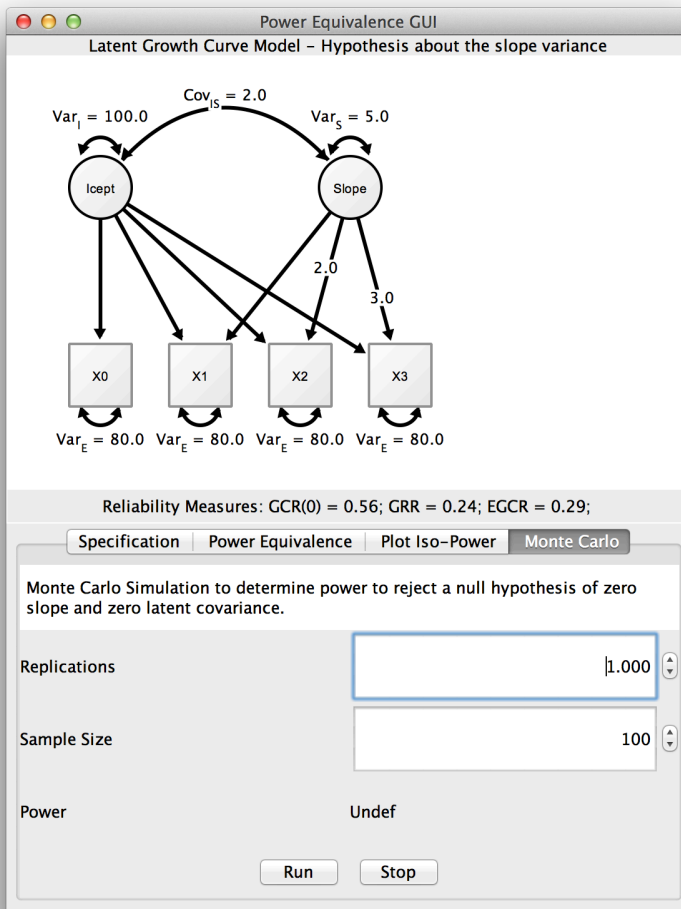
EGCR Equivalent Designs

LIFESPAN allows the derivation of EGCR-equivalent designs, i.e., alternative designs with the same EGCR as the initial design. That is, we can ask questions like: “How much does the residual error change if I increase the total time span by 5 units while holding EGCR constant?”.



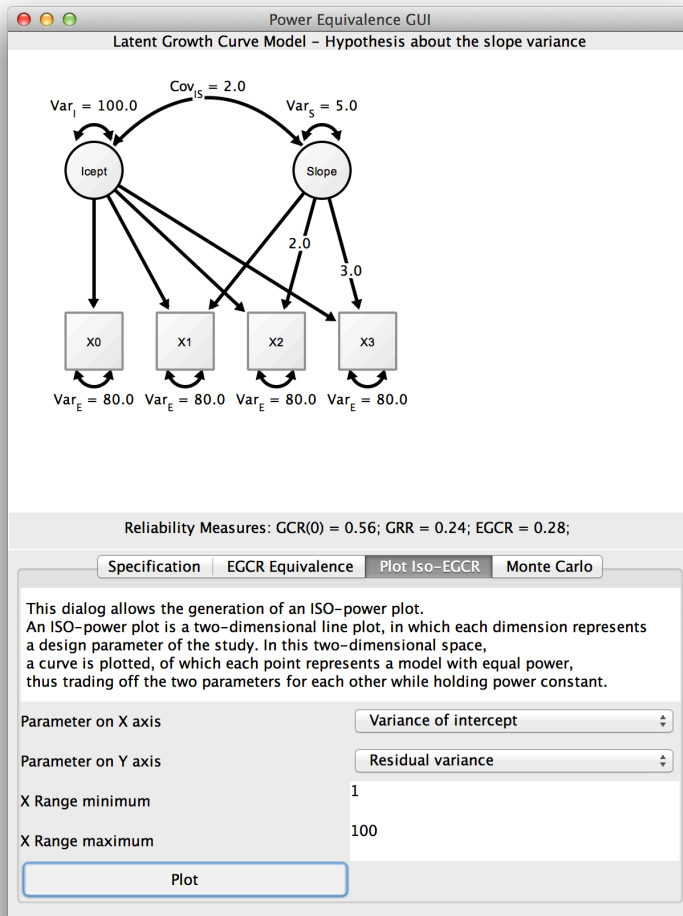
Monte Carlo Power Simulation

LIFESPAN allows to estimate power of a 2-df test of zero slope and zero covariance. To this end, LIFESPAN simulates data under the specified model and estimates parameter under the specified model and a restricted version, in which slope and covariance are fixed at value 0.0. The ratio of statistical significant LR tests between the two models is an estimate of power to reject a false null hypothesis. The number of Monte Carlo trials can be specified by adjusting the number „Replications“. The hypothetical sample size for the test is specified by adjusting the number „Sample Size“. Before the simulation is started, statistical power is marked as undefined „Undef“. The Monte Carlo simulation is started by pressing the „Run“ button and can be aborted by hitting „Stop“. While the simulation is running, the current simulation trial is shown in the power display as an indicator of the simulation progress.



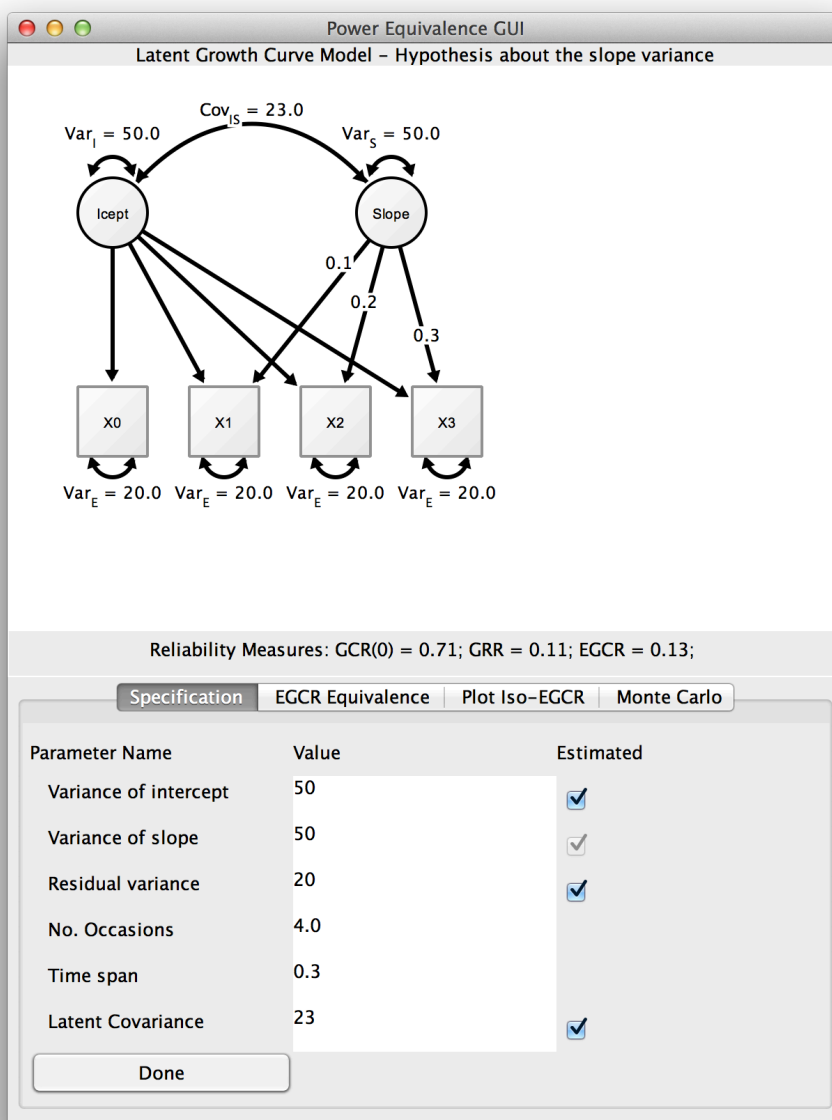
Plot ISO-EGCR Curves

While the “Equivalence” mode allows to trade parameters against each other using sliders, the “Plot” mode allows to generate curves of these parameter trade-offs. Users can choose two parameters for which an ISO-EGCR curve is plotted, i.e., all points on the curve correspond to model parameterization which generate the same EGCR.

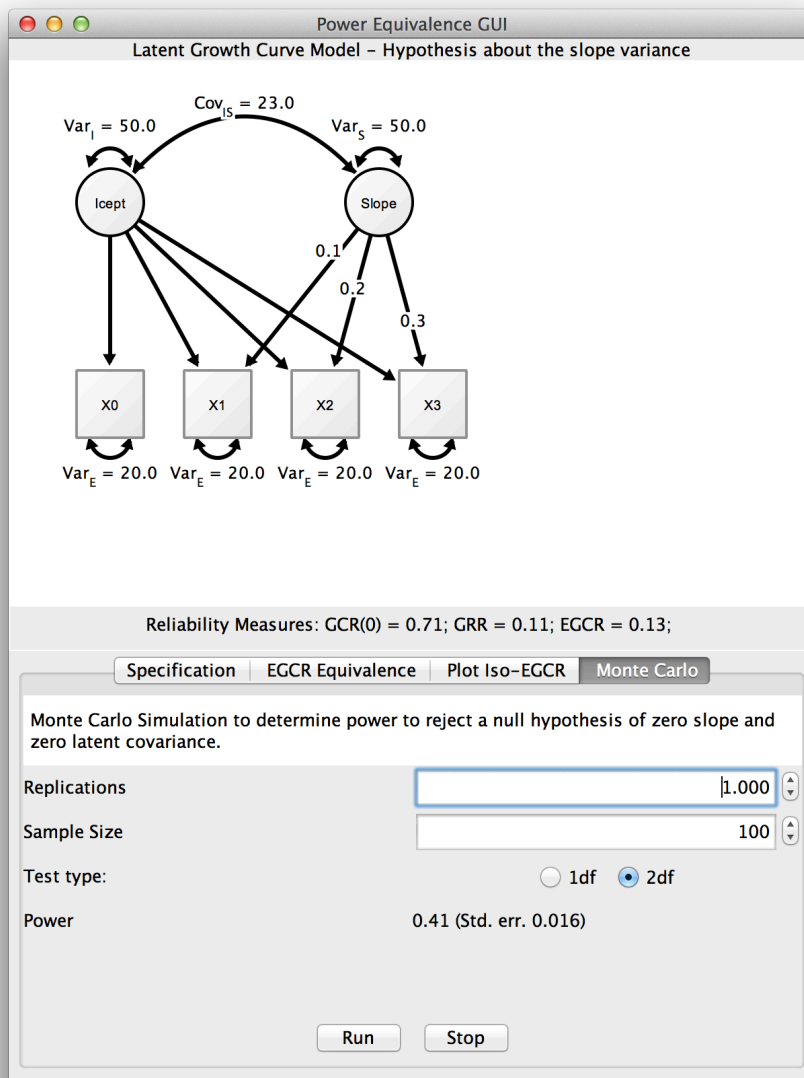


Example I: Determine Power of a Study Design

Here, we estimate statistical power of a model. The baseline model has four observations at time points 0, 0.1, 0.2, 0.3, a slope variance of 50, residual error variance of 20, a sample size of 100. For an intercept variance of 50 and an intercept-slope-covariance of 23. Statistical power is at .4. We first switch to the model specification tab and enter these values:



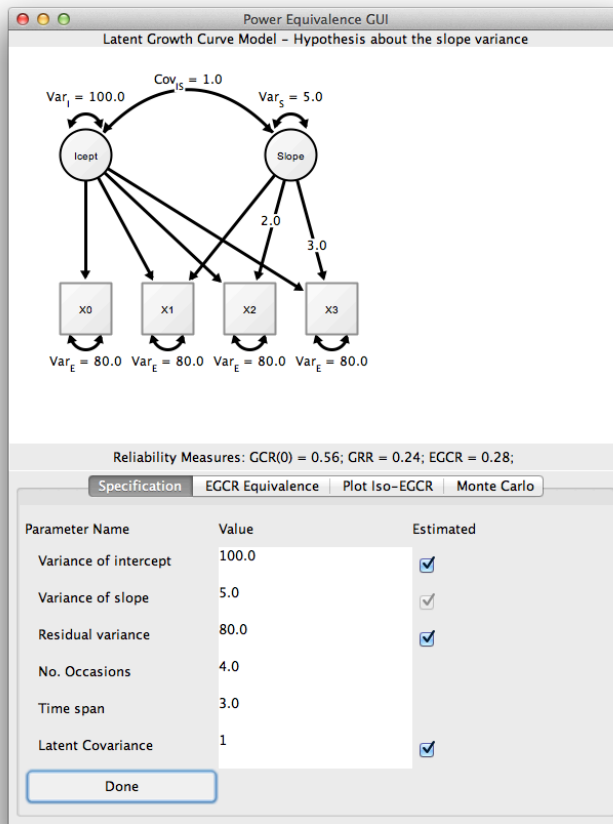
As can be seen from the summary bar in the center of the screen, GRR is .11 and EGCR is .12. We switch to the Monte Carlo tab and simulate power for this condition with a 2df test. Enter the desired number of replications (1000), sample size (100), and select the 2df test, then push button "Run".



In 405 out of 1000 trials, the LR statistic was significant, i.e., power was estimated to be 41% with a standard error of about 1%.

Example II: Does Intercept Variance Matter for Power?

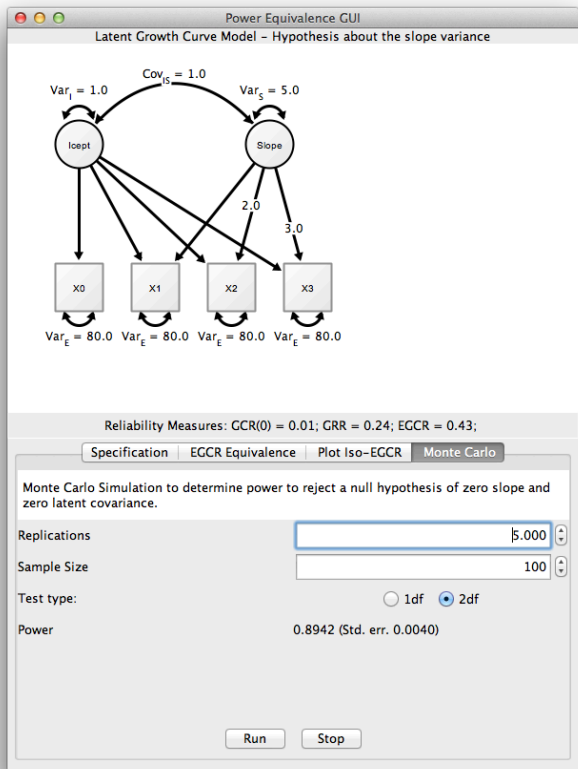
We specify a baseline model as follows. Variance of intercept is 100, variance of slope is 5, residual variance is 80, number of occasions is 4, time span is 3, latent covariance is 1.



GRR for this model is .24 and EGCR is .28.

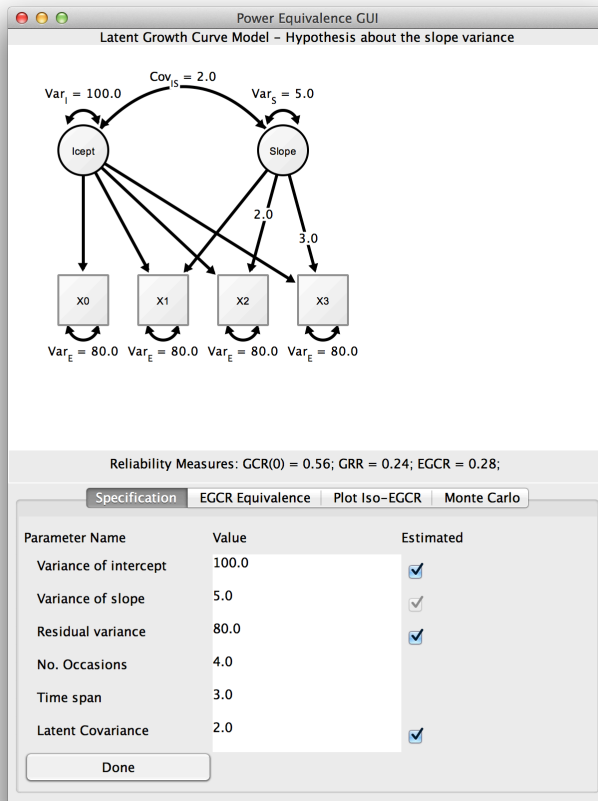
We switch to „Monte Carlo“ mode and simulate with 5000 replications the power for a 2df test. The power to reject the null hypothesis of no variance in change with the 2df is estimated as 0.49 (and, of course, this value will be slightly different for you as it will be based on a different Monte Carlo sample).

Switch back to „specification“ tab, and change the variance of intercept to 1.0 and press „Done“ button. While GRR stays at .24, EGCR goes up to .43 implying a higher reliability. Back in „Monte Carlo“ panel, let's repeat the simulation. Power to reject the null hypothesis is .89 for the 2df test.

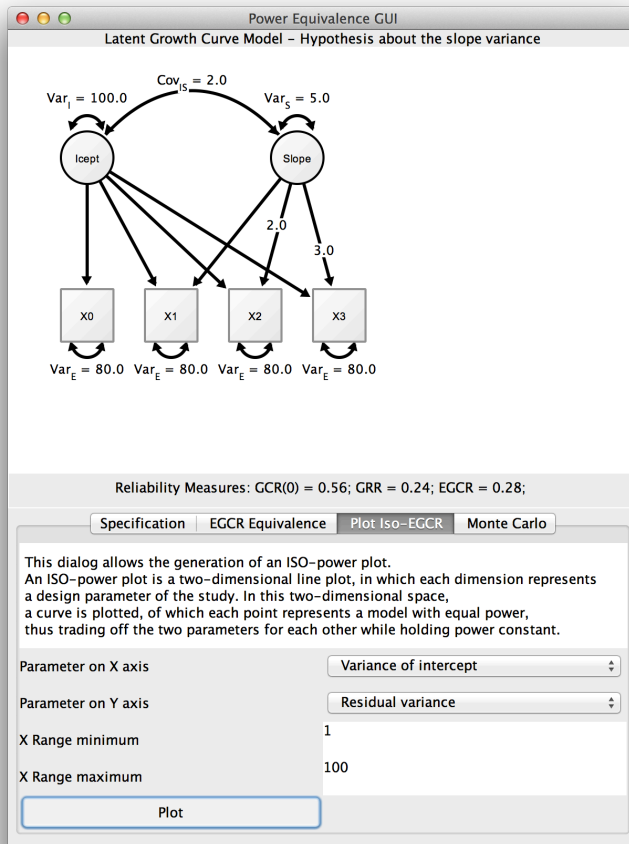


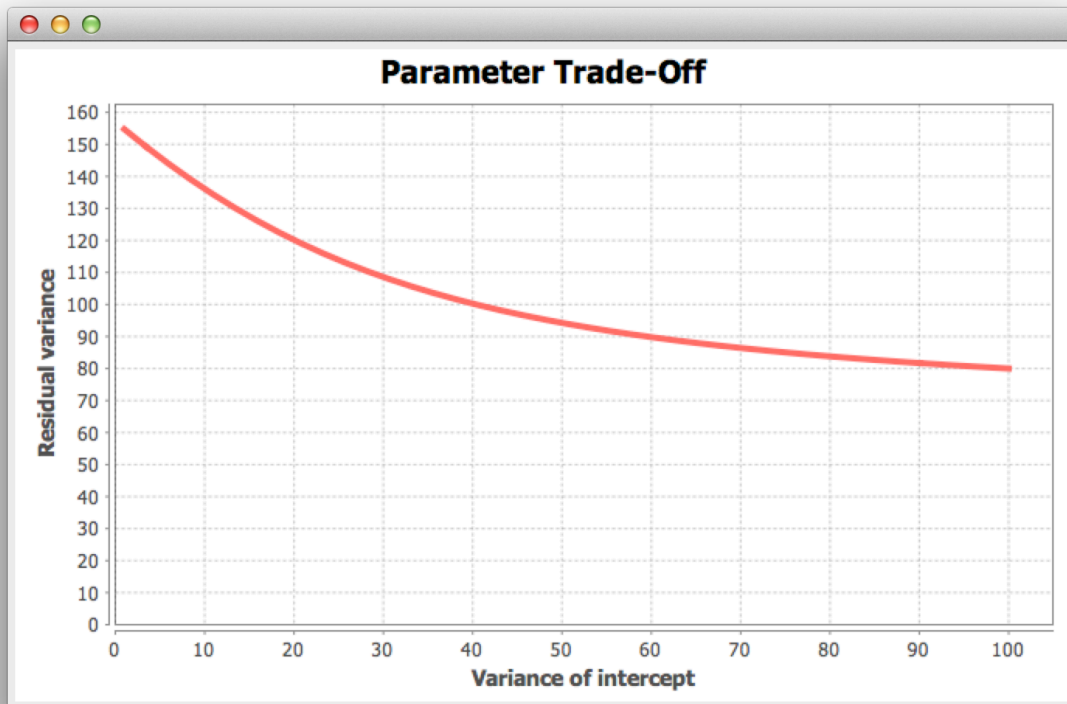
Example III: Plot an ISO-EGCR curve

We start by specifying a baseline model. Switch to „specification“ mode and enter the values as shown in the following screen shot:



In the following, we create a curve that illustrates the trade-off between variance of intercept and residual variance for constant EGCRs. Switch to „Plot ISO-EGCR“ mode and choose variance of intercept as x-axis parameter, residual variance as y-axis parameter and adjust the x-axis range from 1 to 100 as in the following screen shot. Then press button „Plot“.





The resulting plot shows points for intercept variance and residual variance with equal EGCR.

Contact

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