# Growth Curve Analysis Tool

GCAT version 6.0.1

1. **Introduction**

GCAT is a web based tool for summarizing microbial growth curves using mathematical modeling. The user interface requires no programming and calls on an R package of the same name which processes input data files, models the curves, calculates important growth parameters from the fits, and returns both graphical and tabular output.

1. **Testing Scope**
   1. **The Entire Work Flow**

* Check single plate and multi-plate datasets from default\_examples
* Check two sets of Settings
  + Default settings with user-entered Media background = 0.04
  + Legacy settings: Media background = first OD reading; OD transform log(x+) with  = 1; Inoculation time point = 2.
* Check two types of Growth Curve model
  + Sigmoid curve
  + Loess (smoothing parameter = 0.1 for single plate; 0.5 for multi-plate)
  1. **Efficacy of model formulas**
* Verify that fitting is successful in all wells that have growth
  + Single plate default example: all non-empty wells should be successfully fit. F06 and F11 also have growth and should be successfully fit, even though they were supposed to be empty.
  + Multiple plate default example: all wells should be successfully fit
* Cursory inspection of plots to see that “reasonable” sigmoid curves are fit by the model. *Please direct questionable fit failures to Yury.* (Note that, in the single plate dataset with default settings, the loess curve will plunge at the lower end. This is expected behavior, as time point 1 is much lower than the rest).
* When a model fits the data successfully, the model should be “reasonably” close to the numbered data points on the plots*. Use your best judgment here. The model should have a similar shape as well. Direct questionable fits to Yury.*
* Legacy settings should produce output files that have the same values as GCAT 4.
  1. **Browser and Operating System Compatibility**
* The client side common browsers such as Firefox, Chrome, Safari and IE
* The results can be download and the files can be unzipped on all applicable OS
* The output zip file should contain 3 heat map PDF files for each plate.
* And make sure the heatmap color ranges correspond to the output spreadsheet values for each well.
  1. **Data Validation**
* Any invalid data input should be rejected
* These error messages should look nice, e.g. no rails code error messages.
  1. **The User Interface**
* Layout
* Tooltip Text

1. **Testing Details & Tasks**
   1. For both Single Plate and Multi Plate Workflows
2. Upload Input Data File (CSV format)

* If an Excel file is uploaded, a “nice” error should be displayed to user.
* List of invalid test files:
  + 133 Well H1-H3 M200.csv: Unrecognized encoding.
  + 133 Well H1-H3 M200 UTF-8 fixed.csv: Fixed encoding but the number of columns is not correct. (Have temperature column)
  + 133 Well H1-H3 M200 UTF-8 fixed noT.csv: Fixed encoding and wrong number of columns, but have missing data point at well A6 time point 14.
* All valid .csv should be able to be created.

1. Set up analysis parameters
2. OD Transform

* Test log(x+)
* Using the Single-Plate Example File
* For OD transform set the radio button to log(x+).
* Enter the number 0.1 in the text box below.
* Create Assay.
* Diff the output\_gcat.fit output file generated by the test against default output file.
* Should diff clean (if you cannot diff the files just visually inspect outputs)

1. Inoculation time point

* Test inoculation parameter
* Using the Single-Plate Example File
* Enter the number 3 in the inoculation timepoint text box
* Create Assay

1. Growth threshold

* **Bad parameter test**
* Using the Single-Plate Example File
* Set the growth rate to the value of 1.37 (for example)
* Create Assay
* The effect of this should be to exclude all well-fits except well #63 (G8)
* Verify that the desired result occurs, or at least that wells with Max. Values < 1.37 get skipped
  1. Points to ignore
* Validate that numbers entered into the **Points to ignore** textbox appear greyed out rather than black.
* Ensure that invalid input is rejected gracefully. This includes:
* Negative values
* Non numeric strings
* Values > total number of points analyzed
  1. Timestamp format
* Timestamp field should not appear as an option when single-plate option is selected
* When multi-plate option is selected, verify that that the list of timestamp format options includes the format for all test files used.
  1. Output table
* Should contain all column that Results Data Table in Results Page
* Retest Trac ticket #1200
  1. Browser and Operating System Compatibility
* Firefox 32.0.1 on Windows 7
* Google Chrome Version 37.0.2062.120 m on Windows 7
* IE 10 on Windows 7
* Firefox 32.0.1 on OS X 10.9.4
* Google Chrome Version 37.0.2062.122 on OS X 10.9.4
* Safari 7.0.6 on OS X 10.9.4
  1. User Form
* Check layout
* Check Tooltip Text
* Check Mouse Click
* Check Email sending
* Send an email to the link provide at the bottom of the main page.
  + Ask Nate (or current GCAT project member) if he/she received the email
* Check Links(user manual etc)
* Download all example files and the instruction guide. Verify that they can be accessed.
* Retest Trac ticket #1364
  1. Results Page (When Loess not selected)
* Clicking plate in results page downloads zip file
* Numeric values in table are should either be two significant digits or in scientific notation (e.g. nothing like 9.0000000000000000000000000087 or 8.333333)
* Results Data Table shouldn’t overflow black border on page (see gcat3 for example)
* If Model is listed as “Richards”, there should be a numeric value in the shape.par and shape.par.SE columns.
* lag time, spec growth, lower asymptote, upper asymptote, and shape (if Richards) values should all have a corresponding SE (standard error) value in the table
* Clicking numbered links in the row column should open the corresponding plot in a tab in your browser
* RSS column should exist and have a numeric value for all fitted well rows
  1. Using Loess
* Loess uses a different R function/ algorithm to model the data. It has an optional smoothing parameter that can be used. Some distinctions:
  + No parameter estimates are returned internally, therefore there will be no SE values in the table.
  + The plots should only list the smoothing parameter rather than lag time, spec growth,etc.
* Test several smoothing parameter values between 0 and 1. Smaller values should result in a more “jagged” model (play around with it to get a feel for what I mean). Conversely larger values will result in smoother curves at the expense of greater residuals. Test that changing the smoothing parameter has this effect

1. **Testing Schedule**

Time period: 3-4 days

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| --- | --- | --- |
| **Starting Date** | **Complete Date** | **Objectives** |
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# Deliverables

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| --- | --- | --- |
| **Deliverable** | **Responsibility** | **Completion Date** |
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