

# Rlabkey Users Guide

Rlabkey version 2.1.111  
LabKey Server version 10.1

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Document first release March 28, 2010

This User Guide supplements the help files on the individual functions of Rlabkey. It includes an overview of the integration between R and LabKey Server. It also covers specific topics that require interaction with the LabKey Server via the browser. Note that the screenshots of LabKey Server user pages may be different on the version of LabKey to which you are connecting.

## Working with R and LabKey Server together

Rlabkey has been designed to combine the strengths of LabKey Server and the R language platform. R has taken a leadership position as the open source analysis tool of choice for bioinformatics. The combination of the R language, its packaging and distribution architecture, and an active international community of contributors have created a body of statistical and bioinformatics functionality that is widely used and constantly improving.

For more information, see [The R project for Statistical Computing](http://www.r-project.org) (www.r-project.org)

LabKey Server is also an open-source tool for bioinformatics, designed to help researchers organize, analyze, and share their research data. LabKey Server allows labs to organize their data sets by providing a web-accessible shared storage location for data files as well as tools for capturing where, how, and on what sample they were produced. Many data sets require extensive processing to interpret their biological meaning; LabKey manages this processing via a build-in pipeline service. LabKey Server then integrates best-of-breed analysis tools to turn the organized data into research results.

R was first integrated into LabKey Server as a reporting and visualization tool. "[R Views](#)" are scripts run by LabKey Server. They are defined in the context of a specific grid view of a data set, and the dataset is available to the script implicitly as a data frame named labkey.data. R Views are normally used to produce graphs or summary reports that are incorporated into web pages. LabKey then added the first release of the Rlabkey API to enable R scripts running on a client machine to read and write data in LabKey. The second major release of the Rlabkey packages added support for the interactive R user. The new functions in the Rlabkey API enable R users to explore and analyze the data stored in LabKey from many sources. Researchers and statisticians can also use Rlabkey to save their results back to LabKey Server, enabling tracking and aggregation over multiple runs. The combination of R Views and the Rlabkey package makes R useful in many roles on a LabKey Server, as depicted in Figure 1.

For more information, go to [LabKey Software](http://www.labkey.com) (www.labkey.com).

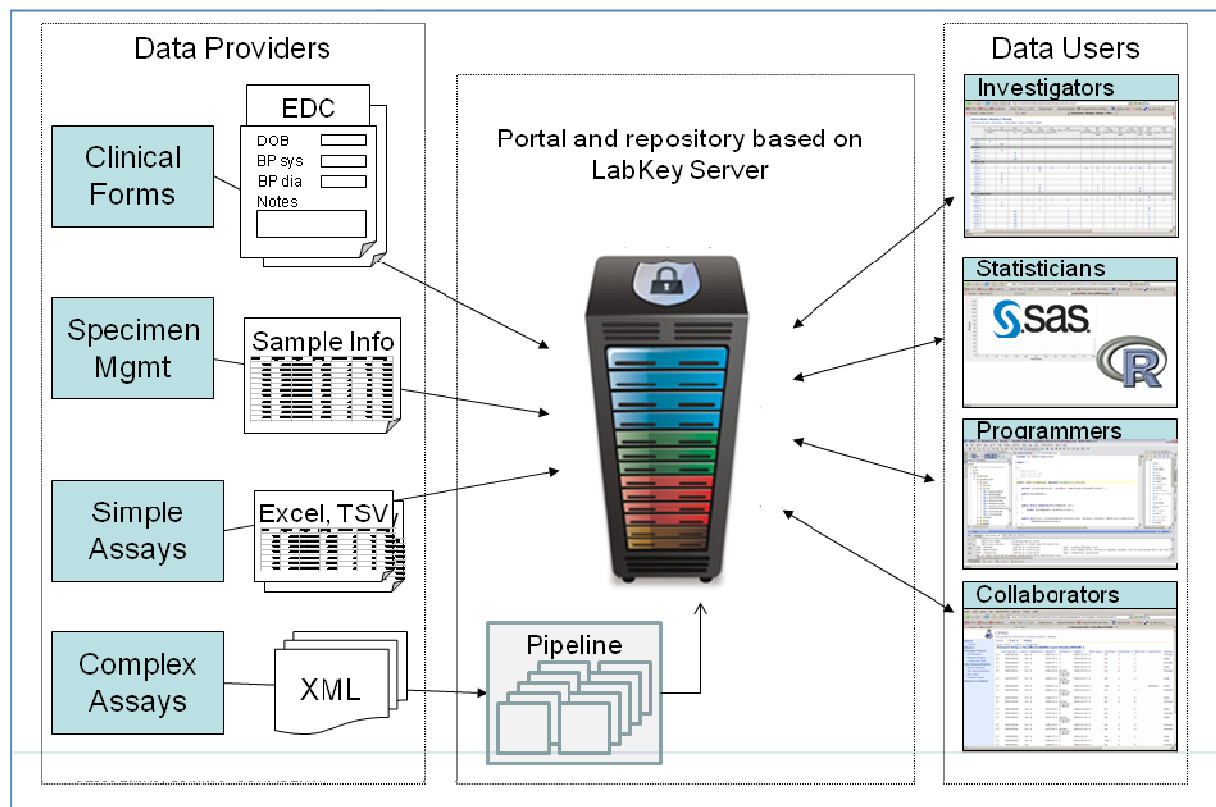


FIGURE 1.

## Overview of the Rlabkey API

There are two basic types of functions available in Rlabkey. The "stateless" functions are those whose names begin with the prefix "labkey." The parameters of these stateless functions contain all the information required to read or update their target data. `labkey.SelectRows` is a good example:

```
rows <- labkey.selectRows(baseUrl="http://localhost:8080/labkey",
                          folderPath="/apisamples",
                          schemaName="lists",
                          queryName="AllTypes")
```

The parameters to `labkey.SelectRows` specify the server address, the project and folders within the server that are the context of the rows to select, plus the schema name and query name of the data to retrieve. Additional parameters allow specification of column lists, row filters and sort order of the returned data frame. Almost all of the parameters to the stateless functions are specified as strings.

In contrast, the session-based functions in Rlabkey version 2 are designed to be used in sets. A simple example that retrieves the same result as the function above is the following:

```
session<-getSession(baseUrl="http://localhost:8080/labkey",
                    folderPath="/apisamples")
schema <- getSchema(session, "lists")
rows<- getRows(session, schema$AllTypes)
```

There are two primary advantages to the session-style functions for an interactive R user:

- **Efficiency:** The user need only specify the `baseUrl` and `folderPath` once, and it is saved in the `session` object where it can be used to do multiple selects or updates against various data sets. The function names are shorter to save typing. Also, the arguments are usually object-valued, so the R editor can usually provide statement completion choices as the user types.
- **Discovery:** The object returned by `getSchema` is a list of *all available* query objects within that schema on the server. These query objects in turn are a list of their fields and field attributes. These schema objects allow the R user to discover what is available on the server. Field attributes for "lookup" fields also can connect to other queries, effectively executing joins without the user needing to know SQL.

All of the Rlabkey APIs can be used in an R View script as well as on client machines.

## User logins and passwords

To access most data on LabKey Server, the user must be logged in to LabKey and have the appropriate permissions to the data. (The exception is when the anonymous "Guest" user has been given access permission. See [security topics](#) for details.) Rlabkey connects using login information stored in a `netrc` file. The `netrc` file contains configuration and login information for the File Transfer Protocol client (ftp) and other programs such as CURL.

On a UNIX system this file should be named `.netrc` (dot netrc) and on windows it should be named `\_netrc` (underscore netrc). The file should be located in the user's home directory and the permissions on the file should be unreadable for everybody except the owner.

To create the `\_netrc` on a windows machine, first create an environment variable called 'HOME' that is set to your home directory (c:/Users/<User-Name> on Vista) or any directory you want to use. In that directory, create a text file named `\_netrc` (note that it is underscore netrc, not dot netrc like it is on UNIX).

The following three lines must be included in the `.netrc` or `\_netrc` file either separated by white space (spaces, tabs, or newlines) or commas.

```
machine <remote-machine-name>
login <user-email>
password <user-password>
```

One example would be:

```
machine localhost
login peter@labkey.com
password mypass
```

Another example would be:

```
machine atlas.scharp.org login vobench@fhcrc.org password mypass
```

Multiple such blocks can exist in one file. Also, a netrc file is not used by functions in an R View script.

## Using Rlabkey to save analysis results

You must define an assay on the LabKey Server in order to use the saveResults function. The following steps go through the basic steps. (See the [Assays](#) topic on LabKey.org for more details.)

1. In R, write out a sample result table as a tab-separated text file without NA indicators, quotes or row names

```
write.table(topTable, "c:/temp/limmaResults.txt",  
            sep="\t", na=" ", quote=FALSE, row.names=FALSE)
```

2. Login to LabKey Server via a browser
3. If you don't already have a project to work in, define a new project where the results will be stored. Choose the Folder type of "Assay".

The screenshot shows the LabKey Server 'Create Project' page. On the left is a sidebar with a 'Projects' section containing links: 'Manage Site', 'Admin Console', 'Site Admins', 'Site Developers', 'Site Users', 'Site Groups', 'Create Project', 'Home', 'Permanent Link', 'Support', and 'Help'. The 'Create Project' link is highlighted. The main content area is titled 'Admin Console > Create Project'. It features a 'New project' section with a 'Name' field containing 'miRNA Analysis'. Below this is a 'Folder Type' section with a list of options: 'Collaboration', 'Assay' (selected), 'Flow', 'MS1', 'MS2', 'Microarray', 'Study', 'Workbook', and 'Custom'. Each option has a brief description. At the bottom of the 'New project' section are 'Next' and 'Cancel' buttons. Red arrows are overlaid on the image, pointing to the 'Name' field, the 'Assay' folder type, and the 'Next' button.

FIGURE 2

Leave the permission settings at their defaults for now.

4. On the home page (also called the "Dashboard") of the project in which the assay results will be stored, you should have an Assay List. (If one is not visible, use the drop-down adjacent to the Add Web Part button to select Assay List and then click the button.) On this Assay List, select the New

Assay Design button.

The screenshot shows the LabKey Server interface. On the left is a navigation sidebar with sections: Project Folders (miRNA Analysis), Projects (Manage Project, Manage Site), Admin Console, Site Admins, Site Developers, Site Users, Site Groups, Create Project, Home, Permanent Link, Support, and Help. The main content area is titled 'Assay Dashboard' and contains an 'Assay List' section. A message states: 'No assay designs are available in this folder. [New Assay Design]'. Below this, a paragraph explains that each assay type provides pages to load and process data, and a new assay design is needed before using an assay type. Another paragraph refers to the 'assay administrator help topic'. A red box highlights the 'New Assay Design' button, which is next to a 'Manage Assays' button. Below these buttons is a table with columns: Name, Description, Type, Created, and Modified. The table is currently empty, showing 'No data to show.'. At the bottom, there is a '<Select Part>' dropdown menu and an 'Add Web Part' button.

FIGURE 3

Then select the "General" assay type from the list and press Next:

The screenshot shows the 'New Assay Design' page in the LabKey Server. The left sidebar is identical to Figure 3. The main content area has a breadcrumb 'Assay Dashboard >' and the title 'New Assay Design'. A paragraph explains that each assay is a customized version of a particular assay type. Another paragraph mentions that if you have an existing assay design to import in the XAR file format (a .xar file), you can import it directly. A third paragraph states: 'To create a new assay design, please choose which assay type you would like to use.' Below this are five radio button options: CBC (Imports Complete Blood Count data files.), ELISpot (Imports raw data files from CTL and AID instruments.), General (Imports data from simple Excel or TSV files.), IAVI Elisa (The ELISA assay IAVI uses for rabbit experiments. Loads Excel files and...), and Luminex. The 'General' option is selected and highlighted with a red box. At the bottom, there are 'Next' and 'Cancel' buttons, with the 'Next' button also highlighted by a red box.

FIGURE 4

5. You now are presented with the General Assay Designer page.

Assay Dashboard >

## General Assay Designer

Save & Close Save Cancel

### Assay Properties

Name (Required)

Description

### Validation and Transformation Scripts

Data Transform ?

QC Validation ?

### Batch Fields

The user is prompted for batch properties once for each set of runs they import. The batch is a convenience to let users set properties using them. This is the first step of the import process.

	Name	Label	Type	Lookup
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	ParticipantVisitRes	Participant Visit Re	Text (String)	<input type="checkbox"/> (none)
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	TargetStudy	Target Study	Text (String)	<input type="checkbox"/> study.Study

Add Field Import Fields Export Fields Infer Fields from File

### Run Fields

The user is prompted to enter run level properties for each file they import. This is the second step of the import process.

No fields have been defined.

Add Field Import Fields Export Fields Infer Fields from File

### Data Fields

The user is prompted to enter data values for row of data associated with a run, typically done as uploading a file. This is part of the import process.

	Name	Label	Type	Lookup
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	SpecimenID	Specimen ID	Text (String)	<input type="checkbox"/> (none)
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	ParticipantID	Participant ID	Text (String)	<input type="checkbox"/> (none)
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	VisitID	Visit ID	Number (Double)	<input type="checkbox"/> (none)
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Date	Date	DateTime	<input type="checkbox"/> (none)

Add Field Import Fields Export Fields Infer Fields from File

Save & Close Save Cancel

Figure 5

This page is broken into four sections, namely the properties of the assay definition itself, metadata properties that apply to a "batch" of one or more runs, metadata properties of individual runs, and then the data properties that are the rows of the data frames (result sets) to be uploaded. "Metadata" refers to property values describing the results as a whole, including any necessary information about how they were calculated that is not recorded in the data frame itself.

In our example we will be assuming a single run per batch, and we will record two example properties recording the versions of the R packages used, just for illustration.

- a. Give the assay a name and a description. Avoid spaces or special characters in the name.
- b. In the Batch Fields section,
  - i. Remove the pre-defined Batch properties by clicking the X next to each
  - ii. Press Add field to add text fields named LimmaVersion and RlabkeyVersion.

Assay Dashboard > **General Assay Designer** Admin ▾

Save & Close Save Cancel

**Assay Properties**

Name (Required)

Description

**Validation and Transformation Scripts**

Data Transform ?

QC Validation ?

**Batch Fields**

The user is prompted for batch properties once for each set of runs they import. The batch is a convenience to let users set properties that seldom change in one place and import many runs using them. This is the first step of the import process.

Name	Label	Type	Lookup	Display	Validators	Advanced
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> LimmaVersion		Text (String)	(none)			
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> RlabkeyVersion		Text (String)	(none)			

Add Field Import Fields Export Fields Infer Fields from File

Description

URL ?

Figure 6

- c. In the Data Fields section,
  - i. Press the Infer Fields from File button (OK to prompt of deleting existing fields ).
  - ii. In the Infer Fields dialog press the Browse button and navigate to the file written out in step 1. Then press Submit. The bottom part of the page should now look like

**Run Fields**

The user is prompted to enter run level properties for each file they import. This is the second step of the import process.

No fields have been defined.

Add Field Import Fields Export Fields Infer Fields from File

**Data Fields**

The user is prompted to enter data values for row of data associated with a run, typically done as uploading a file. This is part of the second step of the upload process.

Name	Label	Type	Lookup
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> ProbeName		Text (String)	(none)
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> GeneName		Text (String)	(none)
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> logFC		Number (Double)	(none)
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> t		Number (Double)	(none)
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> P_Value	P.Value	Number (Double)	(none)
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> adj_P_Val	adj.P.Val	Number (Double)	(none)
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> B		Number (Double)	(none)

Add Field Import Fields Export Fields Infer Fields from File

Save & Close Save Cancel

Figure 7

If the column names of your data frame contained characters that aren't allowed in the Data Field names of an assay, they should be replaced by underscores as shown above. If the field names and

types inferred by LabKey Server look correct, press Save & Close. Your newly defined assay should now appear in the list:

Assay Dashboard				
Assay List				
New Assay Design		Manage Assays		
Name ▲	Description	Type	Created	Modified
LimmaTopTable	This assay stores the calculated results of the .miRNATwoGroupDifferentialExpression.	General	2010-03-26	2010-03-26

Figure 8

- You are now ready to save results sets from R. The highlighted names in the code block below correspond to the names you defined in the preceding steps. Note that there is a built-in property of Batch Name that you will likely want to define. In this code the batch name will be "Batch <timestamp>". Also note that the topTable rows being saved are only those which have a B value greater than 0.

```
s<-getSession(baseUrl="http://localhost:8080/labkey", folderPath="/miRNA Analysis")

## get the versions of the currently loaded limma and Rlabkey libraries,
## taken from installed.packages()
>ipdf <- data.frame(installed.packages(), stringsAsFactors=FALSE)
>bprops <- list(LimmaVersion=ipdf["limma", "Version"],
               RlabkeyVersion=ipdf["Rlabkey", "Version"])

## format as a list of lists
bpl<- list(name=paste("Batch ", as.character(date())),properties = bprops)

## call saveResults
>assaybatch <-saveResults(s, assayName="LimmaTopTable",
                        resultDataFrame=topTable[topTable$B>0, ],batchPropertyList= bpl)
```

After saving two assay results in this way, clicking on the name of your assay in the Assay List will bring up the Runs view listing the datasets you have saved. Click on the Assay Id link to see the results of a single run, or the "view results" link to see the data across multiple runs. These data can also be queried and retrieved from R. In this example, they will belong to a data set named "LimmaTopTable Data"



Assay Dashboard > LimmaTopTable Batches >									
LimmaTopTable Runs									
This assay stores the calculated results of the .miRNATwoGroupDifferentialExpression.									
[manage assay design >>] [view batches] [view runs] [view results] [view copy-to-study history]									
Views ▼	Export ▼	Print	Page Size ▼	Delete	Show Results	Copy to Study	Import Data		
<input type="checkbox"/>	Flag	Assay Id ▼	Created	Created By	Protocol	Run Groups	Batch	Limma Version	Rlabkey Version
<input type="checkbox"/>		Assay Run Fri Mar 26 17:18:53 2010	2010-03-26 17:18	peter@labkey.com	LimmaTopTable		Batch Fri Mar 26 17:18:52 2010	3.2.1	2.1.110
<input type="checkbox"/>		Assay Run Fri Mar 26 17:17:20 2010	2010-03-26 17:17	peter@labkey.com	LimmaTopTable		Batch Fri Mar 26 17:17:20 2010	3.2.1	2.1.110

FIGURE 9



## Organizing multiple assay results

You may want to create separate folders within a project to hold results for different users. Segregating results into user-specific folders can be useful for security restrictions (not all users are allowed to view other user's data), to allow QC review before consolidation, or for simple organizational reasons. For consistency across subfolders, all users should use the same Assay, defined at the project level as described above. To refer to this definition, users must be given read permissions at the project level.

To create subfolders, use the Folders link under Manage Project

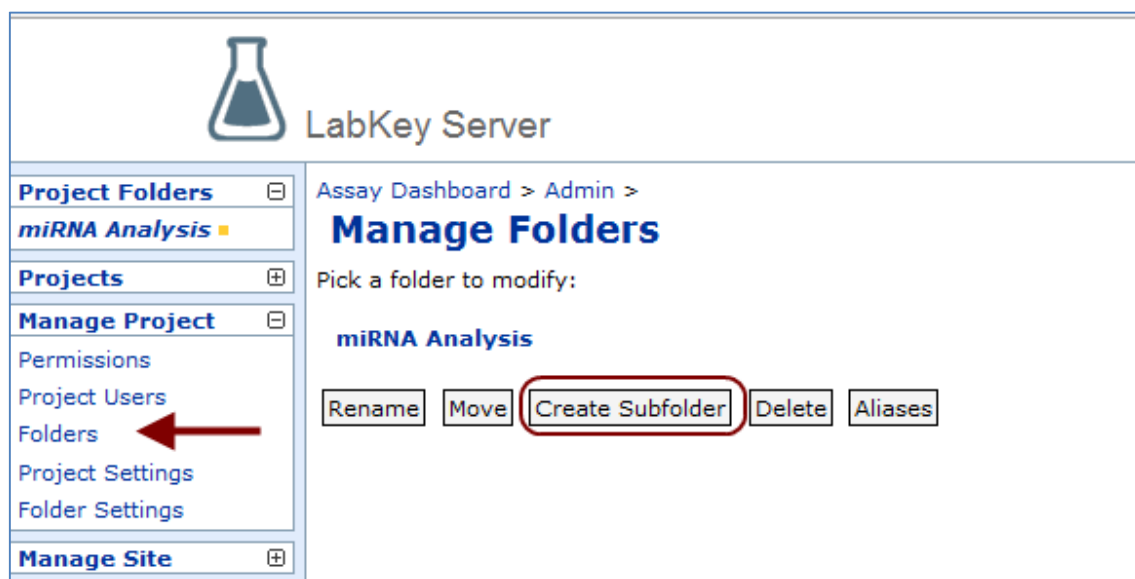


Figure 10

To save results to a folder named "johnd" within the project described in the previous section, the only difference in the R code is to use the full path to the subfolder:

```
s<-getSession(baseUrl="http://localhost:8080/labkey",  
              folderPath="/miRNA Analysis/johnd")
```