

Model-Based Calibration Toolbox

For Use with **MATLAB®** and **Simulink®**

- Computation
- Visualization
- Programming
- Simulation

Model-Based Calibration Toolbox
Reference

Version 3



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Model-Based Calibration Toolbox Reference

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Commands — Alphabetical List

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Commands – Categorical List

To use the Model-Based Calibration Toolbox at the command line we provide a number of objects you can use in order to manipulate data, and use that data to build, select and export models. The following sections describe the properties and methods of these objects, divided into categories for the following aspects of modeling:

Handling Data (p. 1-2)

Links to the properties and methods available for data objects.

Handling Projects (p. 1-4)

Links to the properties and methods available for project objects.

Handling Test Plans (p. 1-5)

Links to the properties and methods available for test plan objects.

Handling Models (p. 1-6)

Links to the properties and methods available for model objects.

Handling Data

mbcmodel.data — Properties

Filters	Structure array holding the user-defined filters
IsBeingEdited	Boolean signaling if the data is being edited
IsEditable	Boolean signaling whether data is editable
Name	Name of the project, data, test plan or model.
NumberOfRecords	Total number of records in a data object
NumberOfTests	Total number of tests being used in the model
Owner	The object from which the data was received
RecordsPerTest	Number of records in each test
SignalNames	Names of the signals held by the data
SignalUnits	Names of the units in the data
TestFilters	Structure array holding the user-defined test filters
UserVariables	Structure array holding the user-defined variables

mbcmodel.data — Methods

AddFilter	Add a user-defined filter to a data set
AddTestFilter	Add a user-defined test filter to data set

AddVariable	Add a user-defined variable to data set
Append	Append data to a data set
BeginEdit	Begin an editing session on a data object
CommitEdit	Update temporary changes in the data
DefineNumberOfRecordsPerTest	Define the exact number of records per test
DefineTestGroups	Define rule-based test groupings
ExportToMBCDataStructure	Export data to an MBC data structure
ImportFromFile	Load data from a file
ImportFromMBCDataStructure	Load data from an MBC data structure
ModifyFilter	Modify a user-defined filter in a data set
ModifyTestFilter	Modify a user-defined test filter in a data set
ModifyVariable	Modify a user-defined variable in a data set
RemoveFilter	Remove a user-defined filter from a data set
RemoveTestFilter	Remove a user-defined test filter from a data set
RemoveVariable	Remove a user-defined variable from a data set
RollbackEdit	Undo most recent changes to the data
Value	Get the double data from a data object

Handling Projects

mbcmodel.project — Properties

Data	Array of data objects contained in the project or used in the test plan
Filename	Full path to the file for the project
Modified	Boolean signaling whether project has been modified.
Name	Name of the project, data, test plan or model.
TestPlans	Array of test plan objects contained in the project

mbcmodel.project — Methods

CopyData	Create a data object from a copy of an existing object
CreateData	Create a data object
CreateTestplan	Create a new test plan
Load	Load an existing project file
New	Create a new project file
Remove	Removes the project, test plan, or model.
RemoveData	Remove data from the project
Save	Save project to currently selected filename
SaveAs	Save project to a new file

Handling Test Plans

mbcmodel.testplan — Properties

Data	Array of data objects contained in the project or used in the test plan
InputSignalNames	Names of the signals in the data that are being modeled
InputsPerLevel	Number of inputs at each level in the model
Levels	Number of levels in the hierarchical model
Name	Name of the project, data, test plan or model.
Responses	Array of available responses for the test plan

mbcmodel.testplan — Methods

AttachData	Attach data from the project to this particular test plan
CreateResponse	Create a new response model for the test plan
DetachData	Detach data from the test plan
GetDesignMatrix	Retrieve design points from a test plan.
Remove	Removes the project, test plan, or model.

Handling Models

The following sections list the properties and methods for these model objects:

- “Hierarchical Models” on page 1-6
- “Local Models” on page 1-7
- “Response Models” on page 1-9
- “Models” on page 1-10
- “Model Parameters” on page 1-11

Hierarchical Models

mbcmodel.hierarchicalresponse — Properties

InputSignalNames	Names of the signals in the data that are being modeled
Level	Level in the test plan of this response
LocalResponses	Array of LocalResponses for this response
Name	Name of the project, data, test plan or model.
NumberOfTests	Total number of tests being used in the model
ResponseSignalName	Name of the signal or response feature being modeled

mbcmodel.hierarchicalresponse — Methods

AlternativeModelStatistics	Summary Statistics for alternative models
CreateAlternativeModels	Create a number of alternative models from a model template
DoubleInputData	Data being used as input to this model

DoubleResponseData	Data being used as output to this model for fitting
Export	Make command-line or Simulink export model
OutlierIndices	Indices of the DoubleInputData marked as outliers
PEV	Predicted Error Variance of the model at specified inputs
PredictedValue	Predicted Value of the model at specified inputs
Remove	Removes the project, test plan, or model.
SummaryStatistics	Summary statistics for the response

Local Models

mbcmodel.localresponse — Properties

InputSignalNames	Names of the signals in the data that are being modeled
Level	Level in the test plan of this response
Name	Name of the project, data, test plan or model.
NumberOfTests	Total number of tests being used in the model
ResponseFeatures	Array of ResponseFeatures for this response
ResponseSignalName	Name of the signal or response feature being modeled

mbcmodel.localresponse — Methods

AlternativeModelStatistics	Summary Statistics for alternative models
CreateAlternativeModels	Create a number of alternative models from a model template
DiagnosticStatistics	Diagnostic statistics for the response
DoubleInputData	Data being used as input to this model
DoubleResponseData	Data being used as output to this model for fitting
Export	Make command-line or Simulink export model
MakeHierarchicalResponse	Build a two-stage model from response feature models and optionally run MLE (Maximum Likelihood Estimation)
OutlierIndices	Indices of the DoubleInputData marked as outliers
OutlierIndicesForTest	Indices marked as outliers for a particular test
PEVForTest	Local model Predicted Error Variance for a particular test
PredictedValueForTest	Predicted local model response for a particular test
Remove	Removes the project, test plan, or model.
RemoveOutliers	Remove outliers in the input data by index or rule, and refit models
RemoveOutliersForTest	Remove outliers on a particular test by index or rule and refit models
SummaryStatistics	Summary statistics for the response

Response Models

mbcmodel.response — Properties

AlternativeResponses	Array of alternative responses for this response
InputSignalNames	Names of the signals in the data that are being modeled
Level	Level in the test plan of this response
Name	Name of the project, data, test plan or model.
NumberOfTests	Total number of tests being used in the model
ResponseSignalName	Name of the signal or response feature being modeled

mbcmodel.response — Methods

AlternativeModelStatistics	Summary Statistics for alternative models
ChooseAsBest	Choose best model from alternative responses.
CreateAlternativeModels	Create a number of alternative models from a model template
DiagnosticStatistics	Diagnostic statistics for the response
DoubleInputData	Data being used as input to this model
DoubleResponseData	Data being used as output to this model for fitting
Export	Make command-line or Simulink export model
OutlierIndices	Indices of the DoubleInputData marked as outliers

PEV	Predicted Error Variance of the model at specified inputs
PredictedValue	Predicted Value of the model at specified inputs
Remove	Removes the project, test plan, or model.
RemoveOutliers	Remove outliers in the input data by index or rule, and refit models
SummaryStatistics	Summary statistics for the response

Models

Response objects contain an `mbcmodel.model` object with the following properties and methods.

See also `ModelDialog`, a function for altering model type and settings.

mbcmodel.model — Properties

NumberOfInputs	The number of inputs to the model
Parameters	The parameters in the model
Response	The response for a model object
Status	The model status: fitted, not fitted or best
XData	The X (or input) data for a model
XDataNames	The X data (or input) variable names for a model
YData	The Y (or response) data for a model

mbcmodel.model — Linear Model Properties

ParameterStatistics	Calculates parameter statistics for the linear model
StepwiseRegression	Change stepwise selection status for specified terms

mbcmodel.model — Methods

Fit	Fit the model to new data or its existing data, and provide summary statistics
Jacobian	Calculate the Jacobian matrix for the model at existing or new X points.
PEV	Predicted Error Variance of the model at specified inputs
PredictedValue	Predicted Value of the model at specified inputs
UpdateResponse	Replaces the model in the response

Model Parameters**mbcmodel.modelparameters — Properties**

These properties of the `mbcmodel.modelparameters` object are all read-only. An `mbcmodel.modelparameters` object is contained within the `Parameters` property of an `mbcmodel.model` object.

Names	The parameter names for a model
NumberOfParameters	The number of parameters included in the model
Values	The values of model parameters

mbcmodel.modelparameters — Linear Model Properties

SizeOfParameterSet	The number of parameters for a model
StepwiseSelection	Which model parameters are currently included and excluded
StepwiseStatus	The stepwise status of parameters in the model

mbcmodel.modelparameters — RBF Model Properties

Centers	The centers of an RBF model
Widths	The width data from an RBF model

Commands — Alphabetical List

This chapter is a reference for the properties, methods, and functions in the Model-Based Calibration Toolbox command line interface. Properties and methods are listed alphabetically.

- AddFilter
- AddTestFilter
- AddVariable
- AlternativeModelStatistics
- AlternativeResponses
- Append
- AttachData
- BeginEdit
- Centers
- ChooseAsBest
- CommitEdit
- CopyData
- CreateAlternativeModels
- CreateData
- CreateProject
- CreateResponse
- CreateTestplan
- Data
- DefineNumberOfRecordsPerTest
- DefineTestGroups
- DetachData
- DiagnosticStatistics
- DoubleInputData

DoubleResponseData
Export
ExportToMBCDataStructure
Filename
Filters
Fit
GetDesignMatrix
ImportFromFile
ImportFromMBCDataStructure
InputSignalNames
InputsPerLevel
IsBeingEdited
IsEditable
Jacobian
Level
Levels
Load
LocalResponses
MakeHierarchicalResponse
ModelDialog
Modified
ModifyFilter
ModifyTestFilter
ModifyVariable
Name
Names
New
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NumberOfRecords
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RemoveData
RemoveFilter
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RemoveTestFilter
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ResponseFeatures
Responses
ResponseSignalName
RollbackEdit
Save
SaveAs
SignalNames
SignalUnits
SizeOfParameterSet
Status
StepwiseRegression
StepwiseSelection
StepwiseStatus
SummaryStatistics
TestFilters
TestPlans
UpdateResponse
UserVariables
Value
Values
Widths
XData
XDataNames
YData

AddFilter

Purpose Add a user-defined filter to a data set

Syntax `D = AddFilter(D, expr)`

Description This is a method of `mbcmodel.data`.

A filter is a constraint on the data set used to exclude some records. You define the filter using logical operators or a logical function on the existing variables.

`D` is the `mbcmodel.data` object you want to filter.

`expr` is an input string holding the expression that defines the filter.

Examples `AddFilter(D, 'AFR < AFR_CALC + 10');`

The effect of this filter is to keep all records where `AFR < AFR_CALC + 20`.

`AddFilter(D, 'MyFilterFunction(AFR, RPM, TQ, SPK)');`

The effect of this filter is to apply the function `MyFilterFunction` using the variables `AFR`, `RPM`, `TQ`, `SPK`.

All filter functions receive an `nx1` vector for each variable and must return an `nx1` logical array out. In that array, `true` (or `1`) indicates a record to keep, and `false` (or `0`) indicates a record to discard.

See Also `ModifyFilter`; `RemoveFilter`; `Filters`; `AddTestFilter`
`ModifyTestFilter`

Purpose Add a user-defined test filter to data set

Syntax `D = AddTestFilter(D, expr)`

Description This is a method of `mbcmodel.data`.

A test filter is a constraint on the data set used to exclude some entire tests. You define the test filter using logical operators or functions on the existing variables.

`D` is your data object

`expr` is the input string holding the definition of the new test filter.

Examples `AddTestFilter(d1, 'any(n>1000)');`

The effect of this filter is to include all tests in which all records have speed (`n`) greater than 1000.

Similar to filters, test filter functions are iteratively evaluated on each test, receiving an `nx1` vector for each variable input in a test, and must return an `1x1` logical array out. In that array, true (or 1) indicates a record to keep, and false (or 0) indicates a test to discard.

```
AddTestFilter(data, 'length(LOGNO) > 6');
```

The effect of this filter is to include all tests with more than 6 records.

See Also `ModifyTestFilter`; `RemoveTestFilter`; `TestFilters`; `AddFilter`

AddVariable

Purpose Add a user-defined variable to data set

Syntax `D = AddVariable(D, expr, units)`

Description This is a method of `mbcmodel.data`.

You can define new variables in terms of existing variables. Note that variable names are case sensitive.

D is your data object

expr is the input string holding the definition of the new variable

units is an optional input string holding the units of the variable

Examples

```
AddVariable(D, 'MY_NEW_VARIABLE = TQ*AFR/2');  
AddVariable(D, 'funcVar = MyVariableFunction(TQ, AFR, RPM)',  
'lb');  
AddVariable(D, 'TQ=tq');
```

The last example could be useful if the signal names in the data do not match the model input factor names in the test plan template file.

See Also

`ModifyVariable`; `RemoveVariable`; `UserVariables`

Purpose

Summary Statistics for alternative models

Syntax

```
S = AlternativeModelStatistics(R)
S = AlternativeModel Statistics(R, Name)
```

Description

This is a method of all model objects: `mbcmodel.hierarchicalresponse`, `mbcmodel.localresponse` and `mbcmodel.response`.

This returns an array (S) of summary statistics of all the alternative model fits, to be used to select the best model. These are the summary statistics seen in the list view at the bottom of the Model Browser GUI in any model view.

You must use `CreateAlternativeModels` before you can compare the alternative responses using `AlternativeModelStatistics`. Then use `ChooseAsBest`.

R is the model object whose alternative response models you want to compare. R could be a local (L), response feature (R) or hierarchical response (HR) model.

S is a structure containing `Statistics` and `Names` fields.

- `S.Statistics` is a matrix of size (number alternative responses x number of statistics)
- `S.Names` is a cell array containing the names of all the statistics

The available statistics vary according to what kind of parent model (two-stage, local, response feature or response) produced the alternative models, and include PRESS RMSE, RMSE, and Two-Stage RMSE.

All the available statistics are calculated unless you specify which you want. You can specify only the statistics you require using the following form:

```
S = AlternativeModel Statistics(R, Name)
```

AlternativeModelStatistics

This returns a double matrix containing only the statistics specified in Name.

Note that you use `SummaryStatistics` to examine the fit of the current model, and `AlternativeModelStatistics` to examine the fit of several alternative child models.

Examples

```
S = AlternativeModel Statistics(R);
```

See Also

```
CreateAlternativeModels; SummaryStatistics; ChooseAsBest
```


Purpose Array of alternative responses for this response

Syntax `altR = get(R, 'AlternativeResponses')`

Description This is a property of the response model object, `mbcmodel.response (R)`. It returns a list of alternative responses used for one-stage or response feature models.

Examples

```
R = get(testplan, 'Responses');
TQ = R(1);
AR = get(TQ, 'AlternativeResponses');
```

See Also `LocalResponses`; `ResponseFeatures`

Append

Purpose Append data to a data set

Syntax `D = Append(D, otherData)`

Description This is a method of `mbcmodel.data`.

You can use this to add new data to your existing data set, `D`.

`otherData` is the input argument holding the extra data to add below the existing data. This argument can either be an `mbcmodel.data` object or a double array. The behavior is different depending on the type.

If `otherData` is an `mbcmodel.data` object then `Append` will look for common `SignalNames` between the two sets of data. If no common `SignalNames` are found then a error will be thrown. Any common signals will be Appended to the existing data and other signals will be filled with `NaN`.

If `otherData` is a double array then it must have exactly the same number of columns as there are `SignalNames` in the data, and a simple `vertcat` (vertical concatenation) is applied between the existing data and `otherData`.

Examples

```
Append(D, CreateData('aDataFile.xls'));
Append(D, rand(10,100));
```

See Also `CreateData`

Purpose Attach data from the project to this particular test plan

Syntax `newD = AttachData(T, D, Property1, Value, Property2, Value...)`

Description This is a method of `mbcmodel.testplan`.

Use it to attach the data you want to model to the test plan.

T is the test plan object, D is the data object.

The following table shows the valid properties and their corresponding possible values. These are the settings shown in the last page of the Data Wizard (if there is a design) in the Model Browser. For more information on the meaning of these settings, refer to the Data Wizard section (under Data) in the Model Browser User's Guide. Note that if the testplan has responses set up the models will be fitted when you attach data.

Property	Value	Default
<code>unmatcheddata</code>	{'all', 'none'}	'all'
<code>moredata</code>	{'all', 'closest'}	'all'
<code>moredesign</code>	{'none', 'closest'}	'none'
<code>tolerances</code>	[1xNumInputs double]	ModelRange/20

Examples `newD = AttachData(T1, D1, 'more data', 'all');`

```
tol = [0.075, 100, 1, 2];
unmatch = 'all';
moredata = 'all';
moredes = 'none';
AttachData(testplan, data ,...
    'tolerances',    tol,...
    'unmatcheddata', unmatch,...
    'moredata',     moredata,...
```

AttachData

```
'moredesign', moredes);
```

See Also

Data; DetachData

Purpose Begin an editing session on a data object

Syntax `D = BeginEdit(D)`

Description This is a method of `mbcmodel.data`.

You must call this method before you can make any changes to a data object.

There are no input arguments. You must call `BeginEdit` before attempting to modify your data object (D in the example below) in any way. An error will be thrown if this condition is not satisfied. Data which cannot be edited (see `IsEditable`) will throw an error if `BeginEdit` is called.

Examples `BeginEdit(D);`

See Also `CommitEdit; RollbackEdit; IsEditable; IsBeingEdited`

Centers

Purpose The centers of an RBF model

Syntax `centers = get(params, 'Centers')`

Description This is a property of `mbcmodel.modelparameters`, for Radial Basis Function (RBF) models only. This returns an array of size `number_of_centers` by `number_of_variables`.

Examples `centers = get(params, 'Centers');`

See Also `Widths`

Purpose Choose best model from alternative responses.

Syntax ChooseAsBest(R, Index)

Description This is a method of the response model object, `mbcmodel.response`. This is the same function as selecting the best model in the Model Selection window of the Model Browser GUI. For a local model `MakeHierarchicalResponse` performs a similar function.

R is the object containing the response model

Index is the number of the response model you want to choose as best. Use `AlternativeResponses` to find the index for each response model, and use `AlternativeModelStatistics` to choose the best fit.

Examples

```
ChooseAsBest(R, AlternativeModel)
RMSE = AlternativeModelStatistics(R, 'RMSE');
[mr, Best] = min(RMSE);
ChooseAsBest(R, Best);
```

See Also `AlternativeResponses`; `AlternativeModelStatistics`; `DiagnosticStatistics`; `MakeHierarchicalResponse`

CommitEdit

Purpose Update temporary changes in the data

Syntax `D = CommitEdit(D)`

Description This is a method of `mbcmodel.data`.

Use this to apply changes you have made to the data, such as creating new variables and applying filters to remove unwanted records.

There are no input arguments. Once you have finished editing your data object `D` you must commit your changes back to the project. Data can only be committed if both `IsEditable` and `IsBeingEdited` are true. `CommitEdit` will throw an error if these conditions are not met.

Examples

```
D = get(P, 'Data');
BeginEdit(D);
AddVariable(D, 'TQ = tq', 'lbft');
AddFilter(D, 'TQ < 200');
DefineTestGroups(D, {'RPM' 'AFR'}, [50 10], 'MyLogNo');
CommitEdit(D);
```

For an example situation which results in `CommitEdit` failing:

```
D = get(p, 'Data');
D1 = get(p, 'Data');
BeginEdit(D1);
tp = get(p, 'Testplan');
Attach(tp, D);
```

Where `p` is an `mbcmodel.project` object, and `D` and `D1` are `mbcmodel.data` objects.

At this point `IsEditable(D1)` becomes false because it is now Attached to the test plan and hence can only be modified from the test plan. If you now enter:

```
OK = get(D1, 'IsEditable')
```


the answer is false.

If you now enter:

```
CommitEdit(D1);
```

An error is thrown because the data is no longer editable. The error message informs you that the data may have been attached to a test plan and can only be edited from there.

See Also

BeginEdit; RollbackEdit; IsEditable; IsBeingEdited

CopyData

Purpose Create a data object from a copy of an existing object

Syntax
`newD = CopyData(P, D)`
`newD = CopyData(P, Index)`

Description This is a method of `mbcmodel.project`.
Use this to duplicate data, for example if you want to make changes for further modeling but want to retain the existing data set. You can refer to the data object either by name or index.

P is the project object.

D is the data object you want to copy.

Index is the index of the data object you want to copy.

Examples `D2 = CopyData(P1, D1);`

See Also `Data`; `CreateData`; `RemoveData`

Purpose

Create a number of alternative models from a model template

Syntax

```
R = CreateAlternativeModels(R, models, criteria)
R = CreateAlternativeModels(R,
LocalModels,LocalCriteria,GlobalModels,GlobalCriteria)
```

Description

This is a method of all model objects: `mbcmodel.hierarchicalresponse`, `mbcmodel.localresponse` and `mbcmodel.response`.

This is the same as the Build Models function in the Model Browser GUI. A selection of child node models are built. The results depend on where you call this method from. Note that the hierarchical model is automatically constructed when `CreateAlternativeModels` is called for a local model.

- This option makes alternative response feature models for each response feature.

```
R = CreateAlternativeModels(R, models, criteria)
```

- `Models` is the list of models (from the model template)
- `Criteria` is the selection criteria for best model (from the statistics available from `AlternativeModelStatistics`).

- This option makes alternative local models as well as alternative response feature models

```
R = CreateAlternativeModels(R,
LocalModels,LocalCriteria,GlobalModels,GlobalCriteria)
```

- `LocalModels` is the list of local models - you must pass in an empty matrix)
- `LocalCriteria` is 'Two-Stage RMSE'
- `GlobalModels` is the list of global models (from the model template)
- `GlobalCriteria` is the selection criteria for best model

CreateAlternativeModels

You construct a model template (such as 'mymodels.mbm') in the Model Browser. From any response (global or one-stage model) with alternative responses (child nodes), select **Model -> Make Template**. You can save the child node model types of your currently selected modeling node as a model template. Alternatively from any response click **Build Models** in the toolbar and create a series of alternative response models in the dialog.

Examples

```
mymodels = 'mymodels.mbm';  
mlist = {};  
load('-mat', mymodels);  
criteria = 'PRESS RMSE';  
CreateAlternativeModels(R, [], 'Two-Stage RMSE', mlist,  
criteria);
```

Note that the model template contains the variable `mlist`.

See Also

`AlternativeModelStatistics`

Purpose Create a data object

Syntax `D = CreateData(filename, filetype)`

`D = CreateData(P, filename, filetype)`

Description The first syntax is a function, the second (using P) is a method of `mbcmodel.project`. They both create a data object for use with command-line MBC. You can use the first syntax to manipulate data independently of any project, and the second method attaches the data to a particular project object.

Use this to create a new data set for modeling.

P is the project object.

`filename` and `filetype` are both optional arguments that are passed to `ImportFromFile` to ensure that there is a quick mechanism for creating data from a file. You must call `BeginEdit` before you can make other changes to the data if you want, such as adding filters.

If you do not specify a `filename` to use the shortcut for loading data, you must call `BeginEdit` and then fill the empty data set by calling `ImportFromFile`. You can then add filters or user variables as before, then call `CommitEdit` to save your changes.

`filename` is a string holding the full path to the file to load.

`filetype` is an optional file type to load. See `xregcheckindataloadingfunction` for the specification of the allowed filetypes. This defaults to 'auto' which will attempt to guess the filetype based on the extension of the file being loaded. i.e. if the file extension is `.xls` then MBC will try the Excel File Loader.

Examples

```
data = CreateData(P, 'D:\MBCWork\data1.xls');
D = CreateData(P);
```

Where P is an `mbcmodel.project` object.

CreateData

See Also

BeginEdit; CopyData; RemoveData; Data; ImportFromFile; CommitEdit

Purpose	Create a project object
Syntax	P = CreateProject
Description	This is a function that creates an <code>mbcmodel.project</code> object. P is the project object.
Examples	<pre>P = CreateProject;</pre>

CreateResponse

Purpose Create a new response model for the test plan

Syntax R = CreateResponse(T, name)

Description This is a method of `mbcmodel.testplan`.
T is the test plan object, R is the new response model.
name is the variable name for the new response.

Examples

```
R = CREATERESPONSE(T, 'torque');  
TQ_response = CreateResponse(testplan, 'TQ');
```

See Also Responses

Purpose Create a new test plan

Syntax `T = CreateTestplan(P, templateFilename, name)`

Description This is a method of the `mbcmodel.project` object.

You need a test plan template to use this method from the command line. You set these up in the Model Browser GUI. This set up includes number of stages, inputs, base models, and designs. If the test plan is used as part of a previous project it is also possible to save response models in the test plan.

Once you have created a new test plan (using a template) you can add data to model, and new responses. Note that the model input signal names specified in the template *must* match the signal names in the data.

P is the project object.

templateFilename is the full name and path to the template file.

name is the optional name for the new test plan object.

Examples

```
T = CreateTestplan(P1, 'd:\MBCwork\TQtemplate1', 'newtestplan')
testplan = CreateTestplan(P, 'example_testplan')
```

See Also `AttachData; CreateResponse; Responses; Data; Levels; InputSignalNames; InputsPerLevel`

Data

Purpose Array of data objects contained in the project or used in the test plan

Syntax
`allD = get(p, 'Data')`
`allD = get(T, 'Data')`

Description This is a property of `mbcmodel.project` and `mbcmodel.testplan`.
It returns an array of `mbcmodel.data` objects. There may be many data objects in a project, but a test plan can only have one or none.

Examples `allD = get(p, 'Data');`

For a project object `p`, this example returns an `nx1` array of all the data objects.

`allD = get(T, 'Data');`

For the test plan object `T`, this example returns a `1x1` array if the test plan has a data object attached, and `0x1` otherwise.

See Also `CreateData`; `RemoveData`; `CopyData`

DefineNumberOfRecordsPerTest

Purpose Define the exact number of records per test

Syntax `D = DefineNumberOfRecordsPerTest(D, number, testnumAlias)`

Description This is a method of `mbcmodel.data`.

You can use this to set one test per record for one-stage modeling.

`number` is the input specifying the number of records to include in each test. Most usually this will be used to specify one test per record.

`testnumAlias` is an optional string input to define the `SignalName` that should be used as the `testnumber` within MBC. Defaults to the index of the test.

Note `testnumAias` uses the first record in the test as the `testnumber`, and `testnumbers` *are* unique so any duplicates will be modified.

Examples

```
DefineNumberOfRecordsPerTest(D, 1);
DefineNumberOfRecordsPerTest(D, 10, 'MYLOGNO');
```

See Also `DefineTestGroups`

DefineTestGroups

Purpose Define rule-based test groupings

Syntax `D = DefineTestGroups(D, variables, tolerances, testnumAlias, reorder)`

Description This is a method of `mbcmodel.data`.

You can impose rules to collect records of the current data set (D) into groups; these groups are referred to as **tests**. Test groupings are used to define hierarchical structure in the data for two-stage modeling.

Select a variable or variables to group by and set tolerances. The tolerance is used to define groups: on reading through the data, when the value of any specified variable changes by more than the tolerance, a new group is defined.

`variables` is the input cell array of strings holding the `SignalNames` on which to define the test groupings

`tolerances` is the input double array of the same length as `variables` holding the required tolerances for the test grouping definition

`testnumAlias` is an optional string input to define the `SignalName` that should be used as the testnumber within MBC. Defaults to the index of the test.

Note `testnumAlias` uses the first record in the test as the testnumber, and testnumbers *are* unique so any duplicates will be modified.

`reorder` is an optional Boolean indicating that the data should be reordered within the data set. Defaults to `false`.

See the section on Test Groupings (under Data) in the Model Browser User's Guide for more information on these inputs.

Examples

```
DefineTestGroups(D, {'AFR' 'RPM'}, [0.1 30], 'MYLOGNO', false);
```

See Also

```
DefineNumberOfRecordsPerTest; NumberOfTests
```

DetachData

Purpose Detach data from the test plan

Syntax `T = DetachData(T)`

Description This is a method of `mbcmodel.testplan`.
T is the test plan object. A test plan can only use a single data set, so you do not need to specify the data object.

Examples `DetachData(T1);`

See Also `AttachData`

Purpose

Diagnostic statistics for the response

Syntax

```
S = DiagnosticStatistics(R, TestNumbers, Stats)
```

Description

This is a method of the local and response model objects, `mbcmodel.localresponse` and `mbcmodel.response`.

The options available are model-specific and are the same options shown in the drop-down menus of the scatter plots (the top plots) in the local and global (response feature) model views of the toolbox GUI.

S is a structural array containing `Statistics` and `Names` fields.

R is the response model object.

Testnumbers specifies the index into tests for local or hierarchical models.

Stats is an optional input that defines which diagnostic statistics you want from the available list. If you don't specify Stats, you get all available statistics.

A row is set to NaN if that point is removed.

Examples

```
studentRes = DiagnosticStatistics(local, tn, 'Studentized  
residuals');
```

See Also

`SummaryStatistics`; `AlternativeModelStatistics`

DoubleInputData

Purpose Data being used as input to this model

Syntax `X = DoubleInputData(R, TestNumber)`

Description This is a method of all model objects: `mbcmodel.hierarchicalresponse`, `mbcmodel.localresponse` and `mbcmodel.response`. It returns an array (X) containing the input data used for fitting the model.

R is the response model object

TestNumber is an optional input to specify the tests you want.

Examples

```
X = DoubleInputData(R);  
x = DoubleInputData(local, tn);
```

See Also `DoubleResponseData`

Purpose Data being used as output to this model for fitting

Syntax `Y = DoubleResponseData(R, TestNumber)`

Description This is a method of all model objects: `mbcmodel.hierarchicalresponse`, `mbcmodel.localresponse` and `mbcmodel.response`. It returns an array (Y) containing the response data used for fitting the model.

R is the response model object.

TestNumber is an optional input to specify the tests you want.

Examples

```
Y = DoubleResponseData(R);  
y = DoubleResponseData(local, tn);
```

See Also `DoubleInputData`

Export

Purpose Make command-line or Simulink export model

Syntax `M = Export(R, Format)`

Description This is a method of these model objects:
`mbcmodel.hierarchicalresponse`, `mbcmodel.localresponse` and
`mbcmodel.response`.

Format must be 'MATLAB' or 'Simulink'; an error will be thrown if this is incorrect.

You can evaluate models exported to the MATLAB workspace in the same way as when exported from the Model Browser. You can save these models as a '*.mat' file and load them into CAGE.

R is the object containing the response models from the node you are exporting from.

Examples `M = Export(R2, 'MATLAB');`
 `mbt_model = Export(maxTQ, 'MATLAB');`

Purpose Export data to an MBC data structure

Syntax `mbcStruct = ExportToMBCDataStructure (D)`

Description This is a method of `mbcmodel.data`.

It converts the specified data object (D) to the MBC Data Structure format.

An MBC Data Structure is a structure array that contains the following fields:

- `varNames` is a cell array of strings that hold the names of the variables in the data (1xn or nx1)
- `varUnits` is a cell array of strings that hold the units associated with the variables in `varNames` (1xn or nx1). This array can be empty, in which case no units are defined
- `data` is an array that holds the values of the variables (m x n)
- `comment` is an optional string holding comment information about the data.

For more information see the Data Loading Function section (under Technical Documents) in the Model Browser User's Guide. See also `xregcheckindataloadingfunction` for the specification.

Examples `X = ExportToMBCDataStructure(D1);`

See Also `ImportFromMBCDataStructure`

Filename

Purpose Full path to the file for the project

Syntax `Name = get(P, 'Filename')`

Description This is a property of `mbcmodel.project`.

Examples `Name = get(P, 'Filename');`

Purpose Structure array holding the user-defined filters

Syntax `filt = get(D, 'Filters')`

Description This is a property of `mbcmodel.data`.

It returns a structure array holding information about the currently defined filters. The array will be the same length as the number of currently defined filters, with the following fields for each filter:

- `Expression` — The string expression as defined in `AddFilter` or `ModifyFilter`
- `AppliedOK` — Boolean indicating that the filter was successfully applied
- `RemovedRecords` — Boolean vector indicating which records the filter removed. Note that many filters could remove the same record
- `Message` — String holding information on the success or otherwise of the filter

Examples `filters = get(D1, 'Filters');`

See Also `AddFilter`; `ModifyFilter`; `RemoveFilter`

Fit

Purpose Fit the model to new data or its existing data, and provide summary statistics

Syntax `statistics = Fit(model, optional X, optional Y)`

Description This is a method of `mbcmodel.model`.

This fits the model to new data or its existing data. If X and Y are not specified then the existing model XData and YData are used, otherwise X and Y are placed in XData and YData and the model fitted.

The statistics returned are defined by the summary statistics for the response object the model came from. To see these call `SummaryStatistics`. These are the statistics that appear in the Summary Statistics pane of the Model Browser GUI. The statistics returned depend on the model type.

For a linear model, the statistics are:

'Observations', 'Parameters', 'Box-Cox', 'PRESS RMSE', 'RMSE'.

For a neural net model:

'Observations', 'Parameters', 'Box-Cox', 'RMSE', 'R^2'.

Examples

```
statistics = Fit(knot)
statistics =
    27.0000    7.0000    1.0000    3.0184    2.6584
```

See Also `SummaryStatistics`; `UpdateResponse`

Purpose Retrieve design points from a test plan.

Syntax `design = GetDesignMatrix(T)`

Description This is a method of `mbcmodel.testplan`.
It returns a double array holding the values of the design points.

Examples `design = GetDesignMatrix(T);`

ImportFromFile

Purpose Load data from a file

Syntax `D = ImportFromFile(D, filename, filetype)`

Description This is a method of the `mbcmodel.data` object.

First you must use `CreateData`, than `BeginEdit` before you can call `ImportFromFile` to bring data into your new data object, `D`.

Note that you can specify `filename` and `filetype` when you call `CreateData` as a shortcut for loading data from a file. You still need to call `BeginEdit` before you can make changes to the data.

`filename` is a string holding the full path to the file to load.

`filetype` is an optional file type to load. See `xregcheckindataloadingfunction` for the specification of the allowed filetypes. This defaults to 'auto' which will attempt to guess the filetype based on the extension of the file being loaded. i.e. if the file extension is `.xls` then MBC will try the Excel File Loader.

Examples `ImportFromFile(D, 'D:\MBCData\Raw Data\testdata.xls');`

See Also `CreateData`; `BeginEdit`; `ImportFromMBCDataStructure`; `RemoveData`; `Append`

Purpose Load data from an MBC data structure

Syntax `D = ImportFromMBCDataStructure(D, mbcStruct)`

Description This is a method of `mbcmodel.data`.

First you must use `CreateData`, than `BeginEdit` before you can bring data into your new data object.

An MBC Data Structure is a structure array that contains the following fields:

- `varNames` is a cell array of strings that hold the names of the variables in the data (1xn or nx1)
- `varUnits` is a cell array of strings that hold the units associated with the variables in `varNames` (1xn or nx1). This array can be empty, in which case no units are defined
- `data` is an array that holds the values of the variables (m x n)
- `comment` is an optional string holding comment information about the data.

For more information see the Data Loading Function section (under Technical Documents) in the Model Browser User's Guide. See also `xregcheckindataloadingfunction` for the specification.

Examples `ImportFromMBCDataStructure(D, mbcStruct);`

See Also `ImportFromFile`; `CreateData`; `BeginEdit`; `RemoveData`; `Append`; `ExportToMBCDataStructure`

InputSignalNames

Purpose Names of the signals in the data that are being modeled

Syntax `inputs = get(A, 'InputSignalNames')`

Description This is a property of `mbcmodel.testplan` and the modeling objects `mbcmodel.hierarchicalresponse`, `mbcmodel.localresponse` and `mbcmodel.response`.

A can be a test plan (T) or model (L, R, HR) object.

Examples

```
inputs = get(T, 'InputSignalNames');
InputFactors = get(thisRF, 'InputSignalNames');
```

See Also `SignalNames`

Purpose Number of inputs at each level in the model

Syntax `L = get(T, 'InputsPerLevel')`

Description This is a property of `mbcmodel.testplan`.

This is a vector of length `Levels`. Each element defines the number of inputs at that level. See for an explanation of the levels in a test plan.

Examples

```
L = get(T, 'InputsPerLevel')
L =
    2    4
```

This answer means the test plan `T` has 2 local inputs and 4 global inputs.

See Also `Levels`; `Level`

IsBeingEdited

Purpose Boolean signaling if the data is being edited

Syntax `OK = get(D, 'IsBeingEdited')`

Description This is a property of `mbcmodel.data`.
This Boolean property indicates that the data is currently being edited. It also indicates that previously there was a successful call to `BeginEdit` and hence that whatever changes have been applied can be undone by calling `RollbackEdit`. It does not indicate that a call to `CommitEdit` will necessarily succeed. See `CommitEdit` for an example of this case.

Examples `OK = get(D, 'IsBeingEdited');`

See Also `BeginEdit`; `IsEditable`; `CommitEdit`; `RollbackEdit`

Purpose Boolean signaling whether data is editable

Syntax `OK = get(d, 'IsEditable')`

Description This is a property of `mbcmodel.data`.

This Boolean property indicates if a particular piece of data is editable. The following rules apply

- If the data was created using `mbcmodel.CreateData` and was not Attached to a test plan it is editable.
- If the data was created or retrieved from the project and was not Attached to a test plan it is editable.
- If the data was Attached to a test plan and was subsequently retrieved from that test plan it is editable.

Examples

```
D = get(p, `Data`);  
D1 = get(p, `Data`);  
BeginEdit(D1);  
tp = get(p, `Testplan`);  
Attach(tp, D);
```

Where `p` is an `mbcmodel.project` object, and `D` and `D1` are `mbcmodel.data` objects.

At this point `get(D1, 'IsEditable')` becomes false because `D1` is now Attached to the test plan and hence can only be modified from the test plan. If you now enter:

```
OK = get(D1, 'IsEditable')
```

the answer is false.

See Also

`BeginEdit`; `IsBeingEdited`; `CommitEdit`; `RollbackEdit`

Jacobian

Purpose Calculate the Jacobian matrix for the model at existing or new X points.

Syntax `J = Jacobian(model, optional X)`

Description This is a method of `mbcmodel.model`.

This calculates the Jacobian matrix for the model at existing or new X points. If X is not specified then the existing XData is used. The Jacobian is the regression matrix for linear models and RBF models.

The Jacobian matrix (for linear and RBF models) is the same as the Regression Matrix in the Design Evaluation Tool GUI. These matrices only include the terms currently selected in the model.

If all terms are included (none removed by Stepwise) then the Jacobian (for linear and RBF models) is the same as the Full FX matrix found in the Design Evaluation Tool GUI. The Jacobian matrix only includes the currently selected model terms.

To determine the condition number, use the MATLAB command `cond(J)`.

Examples `J = Jacobian(knot);`

See Also XData

Purpose Level in the test plan of this response

Syntax `level = get(R, 'Level')`

Description This is a property for all model objects:
`mbcmodel.hierarchicalresponse`, `mbcmodel.localresponse` and
`mbcmodel.response`.

R is the response for which you want the level.

The level is usually 0 for hierarchical models, usually 1 for local models, and usually 2 or 1 for response models. See for an explanation of what Level indicates about a response.

Examples `level = get(R, 'Level');`

See Also Levels

Levels

Purpose Number of levels in the hierarchical model

Syntax `levels = get(T, 'Levels')`

Description This is a property of `mbcmodel.testplan`.
See for an explanation of what Levels mean.

Examples `levels = get(T, 'Levels');`

See Also `Level`

Purpose Load an existing project file

Syntax `P = Load(P, Filename)`

Description This is a method of `mbcmodel.project`.

P is a project object, and `Filename` is the full path to the project you want to load.

Examples `P2 = Load(P2, 'D:/MBCwork/TQproject2');`

See Also `New`

LocalResponses

Purpose Array of LocalResponses for this response

Syntax `local = get(R, 'LocalResponses')`

Description This is a property of the `mbcmodel.hierarchicalresponse` object.
It returns the local model response objects that belong to the hierarchical response R.
See for an explanation of the relationship between the different response types.

Examples `local = get(TQ_response, 'LocalResponses');`

Purpose Build a two-stage model from response feature models and optionally run MLE (Maximum Likelihood Estimation)

Syntax OK = MakeHierarchicalResponse(L,MLE)

Description This is a method of `mbcmodel.localresponse`.

This performs a similar function to `ChooseAsBest` for response models. You can call `MakeHierarchicalResponse` directly, or indirectly by calling `CreateAlternativeModels` for a local model. If you call `CreateAlternativeModels` for a local model, `MakeHierarchicalResponse` will be called automatically.

An error will be thrown if the local and response models are not ready to calculate a two-stage model. This can be the case if you have created alternative models and not chosen the best. A sufficient number of response features models to calculate the two-stage model must be selected.

L is the local model object

MLE can be true or false. If true, MLE will be calculated.

Examples OK = MakeHierarchicalResponse(L, true)

See Also ChooseAsBest

ModelDialog

Purpose Opens the Model Setup dialog where you can alter the model type

Syntax `[newModel, OK] = ModelDialog(oldModel)`

Description This is a function that you can only apply to `mbcmodel.model` objects. This opens the **Model Setup** dialog where you can choose new model types and settings. If you click **Cancel** to dismiss the dialog, `OK = false` and `newModel = oldModel`. If you click **OK** to close the dialog, then `OK = true` and `newModel` is your new chosen model setup. Data and response remain the same as `oldModel`. The new model is refitted when you click OK.

Call `UpdateResponse` to put the new model type back into the response.

Examples `[RBF, OK] = ModelDialog(Cubic);`

See Also `UpdateResponse; Fit`

Purpose Boolean signaling whether project has been modified.

Syntax `Name = get(P, 'Modified')`

Description This is a property of `mbcmodel.project`.

Examples `Name = get(Project, 'Modified');`

ModifyFilter

Purpose Modify a user-defined filter in a data set

Syntax `D = ModifyFilter(D, Index, expr)`

Description This is a method of `mbcmodel.data`.

You call this method to modify the expression that defines existing filters.

`D` is a data object.

`Index` is the input index to indicate which of the available filters you wish to modify. Use the property `Filters` to find the index for each filter.

`expr` is the input string holding the expression that defines the filter, as for `AddFilter`.

Examples `ModifyFilter(D, 3, 'AFR < AFR_CALC + 20');`

The effect of this filter is to modify filter number 3 to keep all records where `AFR < AFR_CALC + 20`.

```
ModifyFilter(D, 2, 'MyNewFilterFunction(AFR, RPM, TQ, SPK)');
```

This modifies filter number 2 to apply the function `MyNewFilterFunction`.

See Also `AddFilter`; `RemoveFilter`; `Filters`

Purpose Modify a user-defined test filter in a data set

Syntax `D = ModifyTestFilter(D, Index, expr)`

Description This is a method of `mbcmodel.data`.

You call this method to modify the expression that defines existing filters.

`D` is a data object.

`Index` is the input index to indicate which of the available test filters you wish to modify. Use the property `TestFilters` to find the index for each test filter.

`expr` is the input string holding the expression that defines the test filter, as for `AddTestFilter`.

Examples `ModifyTestFilter(d1, 2, 'any(n>2000)');`

The effect of this is to modify test filter number 2 to include all tests in which any records have speed (`n`) greater than 1000.

See Also `AddTestFilter`; `RemoveTestFilter`; `TestFilters`

ModifyVariable

Purpose Modify a user-defined variable in a data set

Syntax `D = ModifyVariable(D, Index, expr, units)`

Description This is a method of `mbcmodel.data`.

You call this method to modify the expression that defines existing variables.

`D` is a data object.

`Index` is the input index to indicate which of the available variables you wish to modify. Use the property `UserVariables` to find the index for each variable.

`expr` is the input string holding the expression that defines the variable, as for `AddVariable`

`units` is an optional input string holding the units of the variable

Examples `ModifyVariable(D, 2, 'MY_NEW_VARIABLE = TQ*AFR/2');`

See Also `AddVariable`; `RemoveVariable`; `UserVariables`

Purpose Name of the project, data, test plan or model.

Syntax `name = get(A, 'Name')`

Description This is a property of project, data, test plan, and response objects. 'A' can be any test plan (T), data (D), project (P) or model (L, R, HR) object. You can change the names of these objects as follows:

```
set(A, `Name`, newName)
```

For response (output or Y data) signal names, see `ResponseSignalName`.

For model parameter names, see `Names`, and for model object input names, see `XDataNames`.

For testplan and response object input names, see `InputSignalNames`, and for data objects, see `SignalNames`.

Examples `ResponseFeatureName = get(thisRF, 'Name');`

See Also `Names`; `InputSignalNames`; `SignalNames`; `XDataNames`; `ResponseSignalName`

Names

Purpose The parameter names for a model

Syntax `N = get (params, 'Names')`

Description This is a property of `mbcmodel.modelparameters`. It returns the names of all the parameters in the model. These are read-only.

Examples

```
N = get (paramsknot, 'Names')
N =
'1'
'N'
'N^2'
'N*L'
'N*A'
'L'
'L^2'
'L*A'
'A'
'A^2';
```

See Also `NumberOfParameters`; `Values`; `Name`

Purpose Create a new project file

Syntax P = New(P)

Description This is a method of `mbcmodel.project`. Use this to modify a project object to make a new project from scratch. Note the current project gets removed from memory when you open a new one.

P is the new project object.

Examples `New(P);`

See Also `Load`

NumberOfInputs

Purpose The number of inputs to the model

Syntax `N = get(model, 'NumberOfInputs')`

Description This is a property of `mbcmodel.model`. It returns the number of inputs to the model.

Examples `N = get(knot, 'NumberOfInputs');`

See Also `XData`

Purpose The number of parameters included in the model

Syntax `N = get (knotparams, 'NumberOfParameters')`

Description This is a read-only property of `mbcmodel.modelparameters`, for linear models only.

The number returned is the number of parameters currently in the model (you can remove some parameters by using `StepwiseRegression`). To see which parameters are currently in the model, use `StepwiseSelection`. Only parameters listed as 'in' are currently included.

To see the the total possible number of parameters in a linear model, use `SizeOfParameterSet`.

Use `Names` and `Values` to get the parameter names and values.

Examples `N = get (knotparams, 'NumberOfParameters');`

See Also `SizeOfParameterSet`; `StepwiseSelection`; `StepwiseRegression`; `Names`; `Values`

NumberOfRecords

Purpose Total number of records in a data object

Syntax `get(D, 'NumberOfRecords')`

Description This is a property of data objects: `mbcmodel.data`.

Examples `numRecords = get(Data, 'NumberOfRecords');`

Purpose Total number of tests being used in the model

Syntax `numtests = get(A, 'NumberOfTests')`

Description This is a property of all model objects: `mbcmodel.hierarchicalresponse`, `mbcmodel.localresponse` and `mbcmodel.response`, and data objects `mbcmodel.data`. 'A' can be any model or data object.

Examples `numTests = get(TQ_response, 'NumberOfTests');`

See Also `DefineTestGroups`

OutlierIndices

Purpose Indices of the DoubleInputData marked as outliers

Syntax `indices = OutlierIndices(R)`

Description This is a method of all model objects: `mbcmodel.hierarchicalresponse`, `mbcmodel.localresponse` and `mbcmodel.response`.

Examples

```
ind = OutlierIndices(R);  
bad = OutlierIndices(thisRF);
```

See Also `DoubleInputData`

- Purpose** Indices marked as outliers for a particular test
- Syntax** `indices = OutlierIndicesForTest(R, TestNumber)`
- Description** This is a method of the local model object, `mbcmodel.localresponse`. This shows the current records discarded as outliers. You can use `'.'` to use all tests.
- Examples**

```
ind = OutlierIndicesForTest(R, '.');
bad = OutlierIndicesForTest(local, tn);
```
- See Also** `OutlierIndices`

Owner

Purpose The object from which the data was received

Syntax `O = get(D1, 'Owner')`

Description This is a property of `mbcmodel.data`.

- This is empty if the data was created using `mbcmodel.CreateData`
- This is an `mbcmodel.project` object if the data was extracted from a project
- This is an `mbcmodel.testplan` object if the data was extracted from a test plan

Examples `O = get(D1, 'Owner');`

Purpose The parameters in the model

Syntax `P = get(model, 'Parameters')`

Description This is a property of `mbcmodel.model`, that contains an object `mbcmodel.model.parameters`. This object contains a number of read-only parameters that describe the model.

All models have these properties:

- `SizeOfParameterSet`
- `Names`
- `Values`

Linear models also have these properties:

- `StepwiseStatus`
- `NumberOfParameters`
- `StepwiseSelection`

Radial Basis Function (RBF) models have all the above properties and these additional properties:

- `Centers`
- `Widths`

Examples `P = get(knot, 'Parameters');`

See Also `SizeOfParameterSet; Names; Values; StepwiseStatus; NumberOfParameters; StepwiseSelection; Centers; Widths`

ParameterStatistics

Purpose Calculates parameter statistics for the linear model

Syntax `values = ParameterStatistics(linearmodel, optional statType)`

Description This is a method of `mbcmodel.model`, for linear models only. This calculates parameter statistics for the linear model. If you don't specify `statType`, then a structure with all valid types is output. `statType` may be a string specifying a particular statistic or a cell array of string specifying a number of statistics to output. If `statType` is a string, then `values` is an array of doubles. If `statType` is a cell array of strings, then `values` is a cell array of array of doubles.

The valid types are:

'Alias'

'Covariance'

'Correlation'

'VIFsingle'

'VIFmultiple'

'VIFpartial'

'Stepwise'

These types (except Stepwise) appear in the Design Evaluation tool; see the documentation for this tool for details of these matrices.

The Stepwise field contains the values found in the Stepwise table. In this array (and in the Stepwise GUI) you can see for each parameter in the model: the value of the coefficient, the standard error of the coefficient, the t value and Next PRESS (the value of PRESS if the status of this term is changed at the next iteration). See the documentation for the Stepwise table. You can also see these Stepwise values when you use `StepwiseRegression`.

Examples

```
values = ParameterStatistics(knot)
values =
    Alias: [7x3 double]
    Covariance: [7x7 double]
    Correlation: [7x7 double]
    VIFsingle: [5x5 double]
    VIFmultiple: [7x1 double]
    VIFpartial: [5x5 double]
    Stepwise: [10x4 double]

values.Stepwise
ans =
    1.0e+003 *
    0.0190    0.0079    0.0210    NaN
    0.0000    0.0000    0.0210    1.9801
    0.0000    0.0000    0.0200    0.2984
   -0.0000    0.0000    0.0200    0.2768
    0.0000    0.0000    0.0200    0.2890
   -0.0526    0.0367    0.0210    0.2679
    0.0911    0.0279    0.0210    0.3837
   -0.0041    0.0024    0.0210    0.2728
   -0.0178    0.0095    0.0200    0.2460
    0.0001    0.0000    0.0210    0.3246
```

See Also

StepwiseRegression

PEV

Purpose Predicted Error Variance of the model at specified inputs

Syntax `pev = PEV(R, X)`

Description This is a method of the hierarchical, response and model objects: `mbcmodel.hierarchicalresponse`, `mbcmodel.response`, and `mbcmodel.model`.

R is the model object, and X is the array of input values where you want to evaluate the PEV of the model.

Note that for an `mbcmodel.model` and `mbcmodel.response` objects only, the the X is optional. That is, the syntax is:

```
PEV = PEV(model, optional X)
```

This calculates the Predicated Error Variance at X. If X is not specified, then X is the existing input values. An array is returned of PEV values evaluated at each data point.

Examples `pev = PEV(R, X);`

See Also `PEVForTest`

Purpose Local model Predicted Error Variance for a particular test

Syntax `pev = PEVforTest(L, TestNumber, X)`

Description This is a method of the local model object, `mbcmodel.localresponse`.
L is the local model object.
TestNumber is the test for which you want to evaluate the model PEV.
X is the array of inputs where you want to evaluate the PEV of the model.

Examples `pev = PEVforTest(L, TestNumber, X);`

See Also PEV

PredictedValue

Purpose Predicted Value of the model at specified inputs

Syntax `y = PredictedValue(R,X)`

Description This is a method of the hierarchical, response and model objects: `mbcmodel.hierarchicalresponse`, `mbcmodel.response`, and `mbcmodel.model`.

R is the model object, and X is the array of inputs where you want to evaluate the output of the model.

Note that for an `mbcmodel.model` and `mbcmodel.response` objects only, the X is optional. That is, the syntax is:

```
y = PredictedValue(model, optional X)
```

This calculates the predicted value at X. If X is not specified then the X is the existing input values. An array is returned of predicted values evaluated at each data point.

Note that you cannot evaluate model output for a hierarchical model until you have constructed it using `MakeHierarchicalResponse` (or `CreateAlternativeModels`). If you have created alternative response feature models then a best model must be selected. If you have made changes such as removing outliers since choosing a model as best, you may need to choose a new best model.

Examples

```
y = PredictedValue(R, X);  
modelPred = PredictedValue(thisRF, x);
```

See Also `PredictedValueForTest`; `ChooseAsBest`

Purpose Predicted local model response for a particular test

Syntax `y = PredictedValueForTest(L, TestNumber, X)`

Description This is a method of the local model object, `mbcmodel.localresponse`.
L is a local model object.
TestNumber is the test for which you want to evaluate the model
X is the array of inputs where you want to evaluate the output of the model.

Examples `y = PredictedValueForTest(L, TestNumber, X);`

See Also PredictedValue

RecordsPerTest

Purpose Number of records in each test

Syntax `get(D, 'RecordsPerTest')`

Description This is a property of data objects: `mbcmodel.data`. It returns an array, of length `NumberOfTests`, containing the number of records in each test.

Examples `numRecords = get(Data, 'RecordsPerTest');`

Purpose Removes the project, test plan, or model.

Syntax OK = Remove(A)

Description This is a method of all the non-data objects: projects, test plans and all models.

A can be any project, test plan or model object.

Datum models cannot be removed if they are in use by other models.

Examples OK = Remove(R3);

RemoveData

Purpose Remove data from the project

Syntax P = RemoveData(P, D)
P = RemoveData(P, Index)

Description This is a method of `mbcmodel.project`.
You can refer to the data object either by name or index.
P is the project object.
D is the data object you want to remove.
Index is the index of the data object you want to remove.

Examples `RemoveData(P, D);`

See Also `CreateData; Data; CopyData`

Purpose Remove a user-defined filter from a data set

Syntax `D = RemoveFilter(D, Index)`

Description This is a method of the `mbcmodel.data` object.
Index is the input index indicating the filter to remove. Use the property `Filters` to find out which filters are present.

Examples `RemoveFilter(D1, 3);`

See Also `AddFilter; Filters`

RemoveOutliers

Purpose Remove outliers in the input data by index or rule, and refit models

Syntax `R = RemoveOutliers(R, Selection);`
`R = RemoveOutliers(L, LocalSelection, GlobalSelection)`

Description This is a method of the local model object, `mbcmodel.localresponse` and the response feature model object `mbcmodel.response`.

All the response feature models are refitted after the local models are refitted. Outlier selection is applied to all tests.

For a response model:

- R is a response object
- Selection specifies either a set of indices or the name of an outlier selection function, of the following form:

```
Indices = myMfile(model, data, factorName)
```

The factors are the same as defined in `DiagnosticStatistics`

- data contains the factors as columns of a matrix
- factorNames is a cell array of the names for each factor

For a local model:

- LocalSelection is the local outlier selection indices or function
- GlobalSelection is the global outlier selection indices or function

Outlier selection functions must conform to this prototype:

```
Indices = myMfile(model, data, factorName)
```

The factors are the same as appear in the scatter plot in the Model Browser.

- data contains the factors as columns of a matrix

- factorNames is a cell array of the names for each factor

Examples

```
outlierind = [1 4 6 7];  
RemoveOutliers(thisRF, outlierind);
```

See Also

RemoveOutliersForTest

RemoveOutliersForTest

Purpose Remove outliers on a particular test by index or rule and refit models

Syntax `R = RemoveOutliers(L, TestNumber, LocalSelection, GlobalSelection);`

Description This is a method of the local model object, `mbcmodel.localresponse`. All the response feature models are refitted after the local models are refitted.

`L` is the local model object.

`TestNumber` is the single test number to refit.

`LocalSelection` is either a set of indices or the name of a local outlier selection function.

`GlobalSelection` is either a set of indices or the name of a global outlier selection function.

Outlier selection functions must take the following form:

```
Indices= myMfile(model, data, factorName);
```

The factors are the same as defined in `DiagnosticStatistics`.

`data` contains the factors as columns of a matrix.

`factorNames` is a cell array of the names for each factor.

Examples `RemoveOutliersForTest(local, tn, indices);`

See Also `RemoveOutliers`

Purpose Remove a user-defined test filter from a data set

Syntax `D = RemoveTestFilter(D, Index)`

Description This is a method of `mbcmodel.data`.
D is the data object.
Index is the input index indicating the filter to remove.
Use the property `TestFilters` to find the index of the test filter you want to remove.

Examples `RemoveTestFilter(D1, 2);`

See Also `AddTestFilter; TestFilters`

RemoveVariable

Purpose Remove a user-defined variable from a data set

Syntax `D = RemoveVariable(D, Index)`

Description This is a method of `mbcmodel.data`.

D is the data object.

Index is the input index indicating the variable to remove.

Use `UserVariables` to find the index of the variable you want to remove.

Examples `RemoveVariable(D1, 2);`

See Also `AddVariable`; `UserVariables`

Purpose The response for a model object

Syntax `R = get(model, 'Response')`

Description This is a property of `mbcmodel.model`. It returns the response the model object came from (e.g. a response object).

If you make changes to the model object (for example by changing the model type using `ModelDialog`) you must use `UpdateResponse` to return the new model object to the response in the project.

.

Examples `R = get(knot, 'Response');`

See Also `UpdateResponse; ModelDialog`

ResponseFeatures

Purpose Array of ResponseFeatures for this response

Syntax `RFs = get(L, 'ResponseFeatures')`

Description This is a property of the local model object, `mbcmodel.localresponse`.
L is the local response.

See “Understanding Model Structure” for an explanation of the relationships between local responses and other responses.

Examples `RFs = get(local, 'ResponseFeatures');`

Purpose Name of the signal or response feature being modeled

Syntax `ysignal = get(R, 'ResponseSignalName')`

Description This is a property of all model objects:
`mbcmodel.hierarchicalresponse`, `mbcmodel.localresponse` and
`mbcmodel.response`.

R can be a hierarchical response, local response or response.

Examples `yName = get(local, 'ResponseSignalName');`

See Also `InputSignalNames`

Responses

Purpose Array of available responses for the test plan

Syntax `R = get(T, 'Responses')`

Description This is a property of `mbcmodel.testplan`.
T is the test plan object.
See for an explanation of the relationship between test plans and responses.

Examples `R = get(T, 'Responses');`

Purpose Undo most recent changes to the data

Syntax `D = RollbackEdit(D)`

Description This is a method of `mbcmodel.data`. Use this if you change your mind about changes you have made to the data since you called `BeginEdit`, such as importing or appending data, applying filters or creating new user variables.

There are no input arguments. If for your data object `D`, `IsBeingEdited` is true, then `RollbackEdit` will return it to the same state as it was when `BeginEdit` was called. If `IsEditable(D)` is true then you can still modify it, if not it will revert to being read-only. See the example below.

Examples

```
D = get(P, 'Data');
BeginEdit(D);
AddVariable(D, 'TQ = tq', 'lbft');
AddFilter(D, 'TQ < 200');
DefineTestGroups(D, {'RPM' 'AFR'}, [50 10], 'MyLogNo');
RollbackEdit(D);
```

This returns the data object `D` to the same state as when `BeginEdit` was called. If the data object `IsEditable` then the returned object will still return true for `IsBeingEdited`, else it will not be editable.

For an example case where `IsEditable` is false and `IsBeingEdited` is true:

```
D = get(p, 'Data');
D1 = get(p, 'Data');
BeginEdit(D1);
tp = get(p, 'Testplan');
Attach(tp, D);
```

Where `p` is an `mbcmodel.project` object, and `D` and `D1` are `mbcmodel.data` objects.

RollbackEdit

At this point `IsEditable` for `D1` becomes false because it is now attached to the test plan and hence can only be modified from the test plan. However

```
OK = get (D1, 'IsBeingEdited')
```

will still be true at this point, and trying to call `CommitEdit` will fail.

See Also

`BeginEdit`; `CommitEdit`; `IsBeingEdited`

Purpose Save project to currently selected filename

Syntax `OK = Save(P, Name)`

Description This is a method of `mbcmodel.project`.

Examples `OK = Save(proj, 'Example.mat');`

See Also `SaveAs`

SaveAs

Purpose	Save project to a new file
Syntax	OK = SaveAs(P, Name)
Description	This is a method of mbcmodel.project.
Examples	<pre>OK = SaveAs(proj, 'Example.mat');</pre>
See Also	Save

Purpose Names of the signals held by the data

Syntax `names = get (D, 'SignalNames')`

Description This is a property of `mbcmodel.data`.
This is a cell array of strings that hold the names of the signals within the data. These names can be used to reference the appropriate signals in the `Value` method. The subset of these names that are being used for modeling may also be found in the test plan and responses `InputSignalNames` properties.

Examples `names = get (D, 'SignalNames');`

See Also `SignalUnits`; `InputSignalNames`; `Value`

SignalUnits

Purpose	Names of the units in the data
Syntax	<code>units = get(D, 'SignalUnits')</code>
Description	<p>This is a property of <code>mbcmodel.data</code>. D is the data object. It returns a cell array of strings holding the units of the signals.</p>
Examples	<pre>units = get(D, 'SignalUnits');</pre>
See Also	<code>SignalNames</code>

Purpose The number of parameters for a model

Syntax `N = get (params, 'SizeOfParameterSet')`

Description This is a property of `mbcmodel.modelparameters`. It returns the total possible number of parameters in the model. Note that not all of these terms are necessarily currently included in the model, as you may remove some using `StepwiseRegression`.

Call `NumberOfParameters` to see how many terms are currently included in the model. Call `StepwiseSelection` to see which terms are included and excluded.

Use `Names` and `Values` to get the parameter names and values.

Examples `N = get (knotparams, 'SizeOfParameterSet')`

See Also `NumberOfParameters`; `StepwiseSelection`; `Names`; `Values`

Status

Purpose The model status: fitted, not fitted or best

Syntax `S = get(model, 'Status')`

Description This is a property of `mbcmodel.model`. It returns a string: 'Fitted' if the model is fitted, 'Not fitted' if the model is not fitted (for example there is not enough data to fit the model), or 'Best' if the model has been selected as best from some alternative models. A model must be Fitted before it can be selected as Best.

Examples

```
S = get(knot, 'Status')
S =
    `Fitted`
```

See Also `ChooseAsBest;`

Purpose Change stepwise selection status for specified terms

Syntax `S = StepwiseRegression(model, optional toggleTerms)`

Description This is a method of `mbcmodel.model`, for linear models only. This method returns the Stepwise table (as in the Stepwise values for `ParameterStatistics`). Leave out `toggleTerms` to get the current Stepwise values. You can choose to remove or include parameters using `StepwiseRegression`, as long as their `StepwiseStatus` is `Step`.

The Stepwise values returned are the same as those found in the table in the Stepwise GUI. For each parameter, the columns are: the value of the coefficient, the standard error of the coefficient, the t value and Next PRESS (the value of PRESS if the status of this term is changed at the next iteration). Look for the lowest Next PRESS to indicate which terms to toggle in order to improve the predictive power of the model.

Call `StepwiseRegression` to toggle between in and out for particular parameters. `toggleTerms` can be either an index that specifies which parameters to toggle, or an array or logical where a true value indicates that a toggle should occur. The example shown toggles parameter 4, after inspection of the Next PRESS column indicates changing the status of this term will result in the lowest PRESS. `StepwiseRegression` returns the new Stepwise values after toggling a parameter.

Use `StepwiseStatus` (on the child `modelparameters` object) to see which parameters have a status of `Step`; these can be toggled between in and out using `StepwiseRegression` (on the parent model object).

Use `StepwiseSelection` (on the child `modelparameters` object) to view which terms are in and out, as shown in the example.

Examples

```
S = StepwiseRegression(knot)
S =
```

```
1.0e+003 *
```



```
'in'  
'in'  
'in'  
  
>> StepwiseRegression(knot, 4);  
params = get(knot, 'Parameters');  
N = get (params, 'StepwiseSelection')  
  
N =  
  'in'  
  'in'  
  'out'  
  'out'  
  'out'  
  'in'  
  'in'  
  'in'  
  'in'  
  'in'
```

See Also

StepwiseSelection; StepwiseStatus

StepwiseSelection

Purpose Which model parameters are currently included and excluded

Syntax `N = get (paramsknot, 'StepwiseStatus')`

Description This is a read-only property of `mbcmodel.modelparameters`, for linear models only. It returns a status for each parameter in the model, in or out, depending on whether the term is included or excluded. You can choose to remove or include parameters using `StepwiseRegression`, as long as their `StepwiseStatus` is `Step`. Call `StepwiseRegression` (on the parent model object) to toggle between in and out for particular parameters.

Examples

```
N = get (paramsknot, 'StepwiseSelection')
N =
    'in'
    'in'
    'out'
    'out'
    'out'
    'in'
    'in'
    'in'
    'in'
    'in'
```

See Also `StepwiseRegression`; `StepwiseStatus`; `NumberOfParameters`

Purpose The stepwise status of parameters in the model

Syntax `N = get (paramsknot, 'StepwiseStatus')`

Description This is a method of `mbcmodel.modelparameters`, for linear models only. It returns the stepwise status of each parameter in the model.

The stepwise status for each term can be Always, Never or Step. The status determines whether you can use the `StepwiseRegression` function to throw away terms in order to try to improve the predictive power of the model.

- Always - Always included in the model
- Never - Never included in the model
- Step - You can choose whether to include or exclude this term. Do this by using `StepwiseRegression` to toggle between in and out for particular parameters.

Use `StepwiseSelection` to find out which terms are currently included and excluded.

Examples

```
N = get (paramsknot, 'StepwiseStatus')
N =
    'Always'
    'Step'
    'Step'
    'Step'
    'Step'
    'Step'
    'Step'
    'Step'
    'Step'
    'Step'
    'Step'
    'Step'
```

See Also `StepwiseRegression`; `StepwiseSelection`

SummaryStatistics

Purpose Summary statistics for the response

Syntax `S = SummaryStatistics(R, Name)`

Description This is a method of all model objects: `mbcmodel.hierarchicalresponse`, `mbcmodel.localresponse`, `mbcmodel.response`, and `mbcmodel.model`.

These are the statistics that appear in the Summary Statistics pane of the Model Browser GUI.

R is the response object.

S is a structure array containing `Statistics` and `Names` fields for the response R.

Name is an optional input where you can specify which statistics you want. If you do not use Name all statistics are calculated.

Examples `S = SummaryStatistics(R2);`

See Also `DiagnosticStatistics`; `AlternativeModelStatistics`

Purpose Structure array holding the user-defined test filters

Syntax `testf = get (D, 'TestFilters')`

Description This is a property of `mbcmodel.data`.

It returns a structure array holding information about the currently defined test filters for the data object `D`. The array will be the same length as the number of currently defined test filters, with the following fields for each filter:

- **Expression** — The string expression as defined in `AddTestFilter` or `ModifyTestFilter`.
- **AppliedOK** — Boolean indicating that the filter was successfully applied.
- **RemovedTests** — Boolean vector indicating which tests the filter removed. Note that many filters could remove the same test.
- **Message** — String holding information on the success or otherwise of the filter.

Examples `testf = get (D, 'TestFilters');`

See Also `AddTestFilter`; `ModifyTestFilter`; `RemoveTestFilter`

TestPlans

Purpose Array of test plan objects contained in the project

Syntax `tps = get (P, 'TestPlans')`

Description This is a property of `mbcmodel.project`.
P is the project object.

Examples `tps = get (P, 'TestPlans');`

Purpose Replaces the model in the response

Syntax `UpdateResponse(model)`

Description This is a method of `mbcmodel.model`. This takes the model and places it back into the response it came from. Appropriate action is taken if a refit is necessary because you have modified either the model, response data or model data in the interim. For example, if you have changed the model type, the new model is fitted to the response data. If you have changed the response data (e.g. removed an outlier), the model is fitted to the new response data.

Note that when changing the model type or settings (using the `ModelDialog` command) the response is not refitted until you call `UpdateResponse`.

Examples `UpdateResponse(knot);`

See Also `ModelDialog`

UserVariables

Purpose Structure array holding the user-defined variables

Syntax `userV = get(D, 'UserVariables')`

Description This is a property of `mbcmodel.data`.

This returns a structure array holding information about the currently defined filters. The array will be the same length as the number of currently defined variables, with fields

- Variable — variable name
 - Expression — The string expression as defined in `AddVariable` or `ModifyVariable`
 - Units — The string defining the units
 - AppliedOK — Boolean indicating that the variable expression was successfully applied
 - Message — String holding information on the success or otherwise of the variable

Examples `myvars = get(D1, 'UserVariables')`

This returns the following information about the user-defined variable in the example data object D1:

```
Variable: 'BSFC'  
Expression: 'BSFC = FUELFLO./(BTQ.*(ENGSPEED*2*pi/60))'  
Units: 'kg/Nm'  
AppliedOK: 1  
Message: 'Variable successfully added'
```

Variable is the parsed name of the variable being added. Note that this might differ from the string used in `AddVariable` because the `SignalName` must be a valid MATLAB variable name, and hence MBC will parse and modify the input string appropriately.

See Also

AddVariable; ModifyVariable; RemoveVariable

Value

Purpose Get the double data from a data object

Syntax `val = Value(D, varNames, testNumbers)`

Description This is a method of `mbcmodel.data`.

Use this to extract particular data values.

`varNames` is an optional input that specifies either the name of the signal that you want to extract (such as 'SPK') or an array of names (`{'SPK' 'AFR' 'TQ'}`) the indices of the signals (`[1 4 5]`). Defaults to `':'` meaning all.

`testNumbers` is an optional input that specifies which test indices you want. Defaults to `':'` meaning all.

`val` outputs the double values held in the data.

Examples

```
dblValues = Value(D, 'SPK', 1);  
dblValues = Value(D, {'SPK' 'AFR'}, ':');  
dblValues = Value(D, [1 3 4 5]);  
dblValues = Value(D, ':', [1 4 6 8]);
```

See Also `SignalNames`

Purpose The values of model parameters

Syntax `vals = get (paramsknot, 'Values')`

Description This is a read-only property of `mbcmodel.modelparameters`. It returns the value of each parameter in the model. Use `Names` to find out the names of these terms.

Examples `vals = get (paramsknot, 'Values');`

See Also `Names`

Widths

Purpose The width data from an RBF model

Syntax `Width = get(params, 'Widths')`

Description This is a property of `mbcmodel.modelparameters`, for Radial Basis Function (RBF) models only.

Width is usually a single value, but can also be of size 1 by number of variables in the case of the width per dimension algorithm, or number of centers by number of variables in the case of tree regression.

Examples `Width = get(params, 'Widths');`

See Also `Centers`

Purpose The X (or input) data for a model

Syntax `D = get (model, 'XData')`

Description This is a property of `mbcmodel.model`. It returns an array of the input variable data currently in the model.

Examples `D = get (knot, 'XData');`

See Also `XDataNames`; `YData`

XDataNames

Purpose The X data (or input) variable names for a model

Syntax `D = get (model, 'XDataNames')`

Description This is a property of `mbcmodel.model`. It returns the names of the input variables in the data.

Examples `D = get (knot, 'XDataNames');`

See Also `XData`

Purpose The Y (or response) data for a model

Syntax `D = get (model, 'YData')`

Description This is a property of `mbcmodel.model`.
It returns an array of the response data currently in the model.

Examples `D = get (knot, 'YData');`

See Also `XData`