Altair

HyperWorks

Altair HyperStudy 2019 Tutorials

HS-1705: Simple Fit Study

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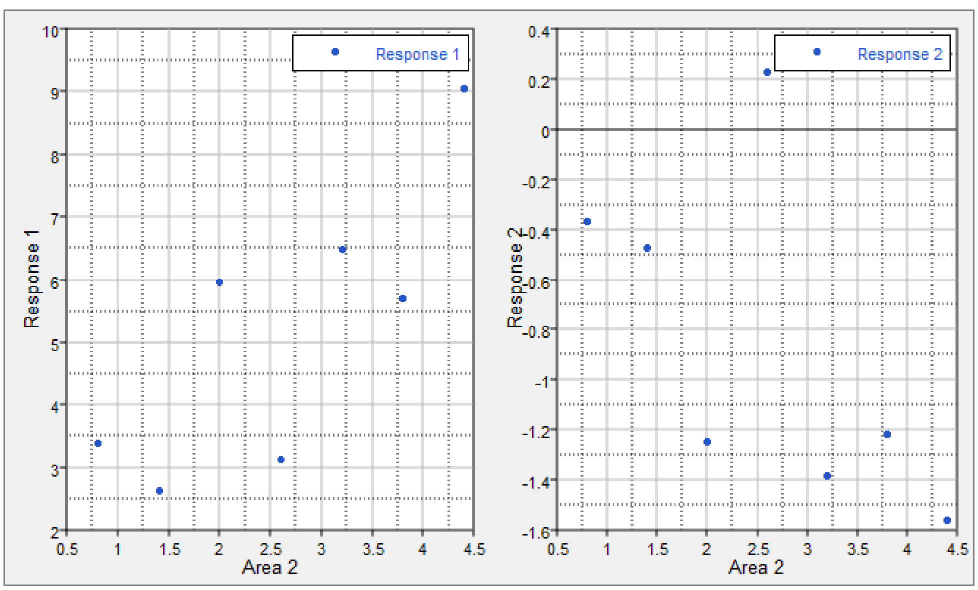
This tutorial demonstrates how to run a DOE study on simple functions defined using a Templex template.

The base input template defines two input variables; DV1 and DV2, labeled X and Y, respectively. The objective of the study is to investigate the two input variables X, Y forming the two functions: X+Y and 1/X + 1/Y – 2.

Before running this tutorial, you must complete tutorial HS-1700: Simple DOE Study or you can import the archive file `HS-1700.hstx`, available in `<hst.zip>/HS-1705/`.

Step 1: Run a Space Filling DOE Study

1. In the **Explorer**, right-click and select ***Add*** from the context menu.
2. In the **Add - HyperStudy** dialog, select ***DOE*** and click ***OK***.
3. Go to the **Specifications** step.
4. In the work area, set the **Mode** to ***Hammersley***.
5. Click ***Apply***.
6. Go to the **Evaluate** step.
7. Click ***Evaluate Tasks***. The evaluation results display in the work area.
8. Go to the **Post-Processing** step.
9. Click the ***Scatter*** tab to view a plot which illustrates the dependency between Area 2 and Response 1 and Response 2.
   a. Using the **Channel** selector, set the **X Axis** to ***Area 2*** and the **Y Axis** to both ***Response 1*** and ***Response 2***.
   b. Compare the scatter plots to determine if the runs are distributed homogeneously throughout the design space.



Step 2: Run a FIT Study

1. In the **Explorer**, right-click and select ***Add*** from the context menu.
1. In the **Add - HyperStudy** dialog, select ***Fit*** and click ***OK***.
2. Go to the **Select Matrices** step.
3. Click ***Add Matrix***.
4. In the **Add - HyperStudy** dialog, add one matrix.
5. In the work area, set **Matrix Source** to ***Doe 2 (doe_2)***.

	Active	Label	Varname	Type	Matrix Source	Matrix Origin	Status
1	☑	FitMatrix 1	fitmatrix_1	Input	DOE 2 (doe_2)	DoeDOE 2	Import Pending

6. Click ***Import Matrix***.
7. Go to the **Specifications** step.
8. In the work area, set the **Mode** to ***Least Squares Regression (LSR)***.
9. Click ***Apply***.
10. Go to the **Evaluate** step.
11. Click ***Evaluate Tasks***.
12. Go to the **Post-Processing** step.
13. Click the **Residuals** tab to review the residuals of both output responses.

    The data in the table shows the differences in the actual values and the predictions from the constructed Fit. The **Percent Error** column of Response_1 is numerically zero for all six runs; whereas the **Percent Error** column of Response_2 is up to 35%. The LSR fitting for Response_1 is acceptable, but the LSR fitting for Response_2 is rather large.
14. Click the **Diagnostics** tab to review the overall Fit quality.

    Several measures are shown to indicate the relative quality of the Fit. The **R-Square** value can be interpreted as the percentage of variance in the data that can be explained by the Fit. For Response_1, the Fit captures 100% of the data variance; this makes sense as Response_1 is actually a linear function so the first order regression matches the actual data with no error. For Response_2, it is shown below that the Fit explains about 90% of the variance.

	Criterion	Input Matrix	Cross-Validation Matrix	Validation Matrix
1	R-Square	1.0000000	1.0000000	N/A
2	R-Square Adjusted	1.0000000	N/A	N/A
3	Multiple R	1.0000000	1.0000000	N/A
4	Relative Average Absolute Error	9.93e-07	1.63e-06	N/A
5	Maximum Absolute Error	3.68e-06	5.32e-06	N/A
6	Root Mean Square Error	2.45e-06	3.85e-06	N/A
7	Number of Samples	7	7	0

Regression Terms   f() Regression Equation

	Terms	Lower	Values	Upper	Standard Error	t-value	p-value
1	intercept	-6.91e-06	2.19e-06	1.13e-05	3.28e-06	0.6671520	0.5411901
2	m_1_DVAR1^1	0.9999962	0.9999989	1.0000015	9.57e-07	1044608.5	5.04e-24
3	m_1_DVAR2^1	0.9999973	1.0000003	1.0000033	1.09e-06	914033.71	8.60e-24

15. With first order least squares, you have a Fit which explains most of the data's variance, but it still has a relatively high prediction error. Go back to the **Specifications** step and try different methods until you find an acceptable fitting for both output responses.