Variables defined for use in other parts of the library. Here the variable is "correlationMatrixValue"


```
{
    "name": "Gaussian Copula Library",
    "objectType": "sipModel",
    "libraryType": "SIPmath_3_0",
    "dateCreated": "2021-07-03",
    "version": "0",
    "provenance": "SLS 4-23-21",
    "globalVariables": [
        {
            "name": "correlationMatrixValue",
            "value": {
                "columns": [
                    "Accounts",
                    "Products",
                    "Orders",
                    "Fulfillment"
                ],
                "rows": [
                    "Accounts",
                    "Products",
                    "Orders",
                    "Fulfillment"
                ],
                "matrix": [
                    {
                        "row": "Accounts",
                        "col": "Accounts",
                        "value": 1.00
                    },
                    {
                        "row": "Accounts",
                        "col": "Products",
                        "value": 0.00
                    },
                    {
                        "row": "Accounts",
                        "col": "Orders",
                        "value": 0.00
                    },
                    {
                        "row": "Accounts",
                        "col": "Fulfillment",
                        "value": 0.00
                    },
                    {
```

```
                "row": "Products",
                "col": "Products",
                "value": 1.00
            },
            {
                "row": "Products",
                "col": "Orders",
                "value": 0.00
            },
            {
                "row": "Products",
                "col": "Fulfillment",
                "value": 0.75
            },
            {
                "row": "Orders",
                "col": "Orders",
                "value": 1.00
            },
            {
                "row": "Orders",
                "col": "Fulfillment",
                "value": 0.00
            },
            {
                "row": "Fulfillment",
                "col": "Fulfillment",
                "value": 1.00
            }
        ]
    }
],
"U01": {
    "rng": [
        {
            "name": "HDR4",
            "function": "HDR_2_0",
            "arguments": {
                "counter": "PM_Index",
                "entity": 9039920,
                "varId": 4,
                "seed3": 0,
                "seed4": 0
            }
```

U01 section refers to a uniform random variable on 0 to 1.

rng stands for random number generator, which in this case is named HDR101 and is an HDR2.0 function (current HDR Generator with an iteration counter and 4 seeds). In theory other RNGs could be supported as well.

The arguments of the HDR are the Monte Carlo iteration counter (PM_Index), and the four seeds as specified.

```
},
{
    "name": "HDR5",
    "function": "HDR_2_0",
    "arguments": {
        "counter": "PM_Index",
        "entity": 9039920,
        "varId": 5,
        "seed3": 0,
        "seed4": 0
    }
},
{
    "name": "HDR6",
    "function": "HDR_2_0",
    "arguments": {
        "counter": "PM_Index",
        "entity": 9039920,
        "varId": 6,
        "seed3": 0,
        "seed4": 0
    }
},
{
    "name": "HDR7",
    "function": "HDR_2_0",
    "arguments": {
        "counter": "PM_Index",
        "entity": 9039920,
        "varId": 7,
        "seed3": 0,
        "seed4": 0
    }
},
{
    "name": "HDR8",
    "function": "HDR_2_0",
    "arguments": {
        "counter": "PM_Index",
        "entity": 9039920,
        "varId": 8,
        "seed3": 0,
        "seed4": 0
    }
}
```

```
    ],
    "copula": [
        {
            "name": "Gaussian",
            "function": "GaussianCopula",
            "arguments": {
                "correlationMatrix": {
                    "type": "globalVariables",
                    "value": "correlationMatrixValue"
                },
                "rng": [
                    "HDR4",
                    "HDR5",
                    "HDR6",
                    "HDR7"
                ]
            },
            "copulaLayer": [
                "cl1",
                "cl2",
                "cl3",
                "cl4"
            ]
        }
    ]
},
"sips": [
    {
        "name": "Accounts",
        "ref": {
            "source": "copula",
            "name": "Gaussian",
            "copulaLayer": "cl1"
        },
        "function": "Metalog_1_0",
        "arguments": {
            "aCoefficients": [
                9.872717622,
                1.678242357,
                2.54967822,
                3.535388319,
                -13.40905029
            ]
        },
        "metadata": {
```

The Copula section starts here.

Most analytical platforms have a Gaussian Copula function.

The correlation matrix, an argument of the Gaussian Copula, was defined earlier under Global Variables.

The SIPs section starts here. This example has five: four SIPs joined through the copula and a single independent SIP.

This SIP is named Accounts and is driven by a U01 in the copula layer named “cl1”.

The function is a Metalog 1.0 (current formulation of the Metalog).

The arguments are the “a” coefficients and, optionally, bounds.

Metadata includes the Minimum, Mean, Maximum, and three specific trials for calibration. In addition, Density data is included for creating a line graph of the density function.

```
            "min": 0,
            "mean": 10,
            "Trial1": 5.91064824323855,
            "Trial2": 3.99951401423695,
            "Trial3": 3.61593085127843,
            "max": 38.59529574,
            "density": [
                0.004109283,
                0.042110568,
                0.091705010,
                0.110006024,
                0.122020569,
                0.134235996,
                0.147896307,
                0.161461431,
                0.167672333,
                0.152978674,
                0.117263845,
                0.080513010,
                0.053583880,
                0.035823821,
                0.024233148,
                0.016480777,
                0.011221878,
                0.008189092,
                0.005478863,
                0.004659543,
                0.003840222,
                0.003020901,
                0.002201580,
                0.001382259,
                0.000562938
            ]
        }
    },
    {
        "name": "Products",
        "ref": {
            "source": "copula",
            "name": "Gaussian",
            "copulaLayer": "cl2"
        },
        "function": "Metalog_1_0",
        "arguments": {
            "aCoefficients": [
```

```
                10.28359942,
                1.433048092,
                1.737463084,
                3.927285373,
                -13.45782811
            ]
        },
        "metadata": {
            "min": 0,
            "mean": 10,
            "Trial1": 4.81850430027545,
            "Trial2": 16.264999616127,
            "Trial3": 9.21182344011462,
            "max": 33.17541333,
            "density": [
                0.002930180,
                0.018377025,
                0.043616484,
                0.071502559,
                0.088976553,
                0.101891981,
                0.114180833,
                0.127937682,
                0.144722341,
                0.165708773,
                0.189118409,
                0.198621052,
                0.162260460,
                0.103661376,
                0.062148829,
                0.037849594,
                0.023736807,
                0.015023748,
                0.010251008,
                0.006852863,
                0.005627723,
                0.004402584,
                0.003177444,
                0.001952305,
                0.000727165
            ]
        }
    },
    {
        "name": "Orders",
```

```
"ref": {
    "source": "copula",
    "name": "Gaussian",
    "copulaLayer": "cl3"
},
"function": "Metalog_1_0",
"arguments": {
    "aCoefficients": [
        8.526657058,
        4.390832871,
        7.645594813,
        -11.34424622,
        -27.90451926
    ]
},
"metadata": {
    "min": 0.677003797,
    "mean": 10,
    "Trial1": 8.84993813887317,
    "Trial2": 5.73877017205265,
    "Trial3": 7.90854997496018,
    "max": 97.99099759,
    "density": [
        0.003085439,
        0.163024200,
        0.244463356,
        0.195975175,
        0.078683936,
        0.042542229,
        0.026881900,
        0.018374301,
        0.013142720,
        0.009717621,
        0.007312950,
        0.005589352,
        0.004199015,
        0.003404700,
        0.002639063,
        0.001993546,
        0.001794539,
        0.001595532,
        0.001396525,
        0.001197518,
        0.000998511,
        0.000799504,
```

```
                0.000600498,
                0.000401491,
                0.000202484
            ]
        }
    },
    {
        "name": "Fulfillment",
        "ref": {
            "source": "copula",
            "name": "Gaussian",
            "copulaLayer": "cl4"
        },
        "function": "Metalog_1_0",
        "arguments": {
            "aCoefficients": [
                8.93145879,
                3.863446641,
                6.494528709,
                -8.804090192,
                -25.50440804
            ]
        },
        "metadata": {
            "min": 0,
            "mean": 10,
            "Trial1": 6.7522436646553,
            "Trial2": 11.4933053690752,
            "Trial3": 5.97047076730257,
            "max": 81.7851472,
            "density": [
                0.002767633,
                0.072390279,
                0.167524386,
                0.233154649,
                0.180694181,
                0.080367009,
                0.044352128,
                0.028071658,
                0.019103988,
                0.013629953,
                0.009891279,
                0.007367607,
                0.005657935,
                0.004324130,
```

```
                0.003407833,
                0.002491536,
                0.002132153,
                0.001894541,
                0.001656929,
                0.001419317,
                0.001181705,
                0.000944093,
                0.000706481,
                0.000468870,
                0.000231258
            ]
        }
    },
    {
        "name": "Marketing",
        "ref": {
            "source": "rng",
            "name": "HDR8"
        },
        "function": "Metalog_1_0",
        "arguments": {
            "aCoefficients": [
                9.872717622,
                1.678242357,
                2.54967822,
                3.535388319,
                -13.40905029
            ]
        },
        "metadata": {
            "min": 0,
            "mean": 10,
            "Trial1": 4.97377773402723,
            "Trial2": 5.26303264347232,
            "Trial3": 11.3668582781926,
            "max": 38.59529574,
            "density": [
                0.004109283,
                0.042110568,
                0.091705010,
                0.110006024,
                0.122020569,
                0.134235996,
                0.147896307,
```


Because “Marketing” is independent, its “ref” points back to the rng section instead of to the copula.

```
                    0.161461431,
                    0.167672333,
                    0.152978674,
                    0.117263845,
                    0.080513010,
                    0.053583880,
                    0.035823821,
                    0.024233148,
                    0.016480777,
                    0.011221878,
                    0.008189092,
                    0.005478863,
                    0.004659543,
                    0.003840222,
                    0.003020901,
                    0.002201580,
                    0.001382259,
                    0.000562938
                ]
            }
        }
    ]
}
```