

# *Forward Sampling*

RAVEN workshop

Date



PSA 2015 - April 26<sup>th</sup> 2015, Sun Valley (ID)

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# *The the Input Structure*

```
<Simulation debug='False'>  
  <RunInfo></RunInfo>  
  <Distributions></Distributions>  
  <Samplers></Samplers>  
  <DataObjects></DataObjects>  
  <Models></Models>  
  <Databases></Databases>  
  <Steps></Steps>  
  <OutStreamManager></OutStreamManager>  
</Simulation>
```

## ***RunInfo***

```
<Runinfo>

  <WorkingDir>.</WorkingDir>

  <Files>workshop_function.py,output_basicStatistics.csv</Files>

  <Sequence>runGrid,runStratified,runDoE,OutstreamDoE,runMC,OutstreamMC,PP</Sequence>

  <batchSize>100</batchSize>

</Runinfo>
```

# *Distributions*

```
<Distributions>
  <Normal name='x1_distrib'>
    <mean>0.5<mean>
    <sigma>0.1<sigma>
    <lowerBound>0<lowerBound>
    <upperBound>1<upperBound>
  </Normal>

  <Normal name='x2_distrib'>
    <mean>2<mean>
    <sigma>0.2<sigma>
  </Normal>

  <Uniform name='x3_distrib'>
    <lowerBound>4<lowerBound>
    <upperBound>1<upperBound>
  </Uniform>
</Distributions>
```

# ***Samplers***

```
<Samplers>
  <Grid name='GridSampler'>
    ...
  </Grid>

  <LHS name='StratifiedSampler'>
    ...
  </LHS>

  <ResponseSurfaceDesign name='DoESampler'>
    ...
  </ResponseSurfaceDesign>

  <MonteCarlo name='DoESampler'>
    ...
  </MonteCarlo >
</Samplers>
```

# *GridSampler*

```
<Grid name='GridSampler'>
  <variable name='x1'>
    <distribution>x1_distrib</distribution>
    <grid type='CDF' lowerBound='0.0' construction='equal' steps='10' >0.1</grid>
  </variable>
  <variable name='x2'>
    <distribution>x2_distrib</distribution>
    <grid type='value' lowerBound='0.9' construction='equal' steps='8' >0.1</grid>
  </variable>
  <variable name='x3'>
    <distribution>x3_distrib</distribution>
    <grid type='CDF' construction='custom'>0.1 0.3 0.4 0.7 0.9</grid>
  </variable>
</Grid>
```

# ***StratifiedSampler***

```
<Stratified name='StratifiedSampler'>
  <variable name='x1'>
    <distribution>x1_distrib</distribution>
    <grid type='CDF' lowerBound='0.0' construction='equal' steps='500' >0.002</grid>
  </variable>
  <variable name='x2'>
    <distribution>x2_distrib</distribution>
    <grid type='CDF' upperBound='1.0' construction='equal' steps='500' >0.002</grid>
  </variable>
  <variable name='x3'>
    <distribution>x3_distrib</distribution>
    <grid type='value' construction='equal' steps='500'>0.006</grid>
  </variable>
</Stratified>
```

# DoESampler

```
<ResponseSurfaceDesign
name='DoESampler'>
  <ResponseSurfaceDesignSettings>
    <algorithm_type>BoxBehnken</
algorithm_type>
    <ncenters>1</ncenters>
  <ResponseSurfaceDesignSettings>
    <distribution>x1_distrib</
distribution>
    <boundaries type='CDF'>
      <lower>0</lower>
      <upper>1</upper>
    </boundaries>
  </variable>
```

```
<variable name='x2'>
  <distribution>x2_distrib</
distribution>
  <boundaries type='value'>
    <lower>-5</lower>
    <upper>7</upper>
  </boundaries>
</variable>
<variable name='x3'>
  <distribution>x3_distrib</
distribution>
  <boundaries type='CDF'>
    <lower>0.1</lower>
    <upper>0.9</upper>
  </boundaries>
</variable>
</ResponseSurfaceDesign>
```



## *MCsampler*

```
<MonteCarlo name='MCsampler'>
  <sampler_init><limit>5000</limit></sampler_init>
  <variable name='x1'>
    <distribution>x1_distrib</distribution>
  </variable>
  <variable name='x2'>
    <distribution>x2_distrib</distribution>
  </variable>
  <variable name='x3'>
    <distribution>x3_distrib</distribution>
  </variable>
</MonteCarlo>
```

# DataObjects

```
<DataObjects>
  <TimePointSet name='outStratified'>
    <Input>x1,x2,x3</Input>
    <Output>y1,y2,y3,y4</Output>
  </TimePointSet>
  <TimePointSet name='outGrid'>
    <Input>x1,x2,x3</Input>
    <Output>y1,y2,y3,y4</Output>
  </TimePointSet>
  <TimePointSet name='outMC'>
    <Input>x1,x2,x3</Input>
    <Output>y1,y2,y3,y4</Output>
  </TimePointSet>
  <TimePointSet name='outDoE'>
    <Input>x1,x2,x3</Input>
    <Output>y1,y2,y3,y4</Output>
  </TimePointSet>
  <TimePointSet name='dummy'>
    <Input>x1,x2,x3</Input>
    <Output>OutputPlaceholder</Output>
  </TimePointSet>
</DataObjects>
```

# Models

```
<Models>
  <ExternalModel name='PythonModule' subType='' ModuleToLoad='./workshop_function'>
    <variable>x1</variable>
    <variable>x2</variable>
    <variable>x3</variable>
    <variable>y1</variable>
    <variable>y2</variable>
    <variable>y3</variable>
    <variable>y4</variable>
  </ExternalModel>
  <PostProcessor>
    <what>all</what>
    <parameters>x1,x2,x3,y1,y2,y3,y4</parameters>
  </PostProcessor>
</Models>
```

# *Python External Model*

```
def run(self, Input):  
    a = 1.0  
    b = 2.0  
    c = 3.0  
    l = 1.0  
    self.y1 = self.x1  
    self.y2 = self.x1  
    self.y3 = a*self.x1 + b*self.x2 - c*self.x3  
    self.y4 = self.x1*self.x1 + self.x1*self.x2*self.x3  
    self.y5 = math.exp(l*self.x1)
```

# Models

```
<Models>
  <ExternalModel name='PythonModule' subType='' ModuleToLoad='./workshop_function'>
    <variable>x1</variable>
    <variable>x2</variable>
    <variable>x3</variable>
    <variable>y1</variable>
    <variable>y2</variable>
    <variable>y3</variable>
    <variable>y4</variable>
  </ExternalModel>
  <PostProcessor>
    <what>all</what>
    <parameters>x1,x2,x3,y1,y2,y3,y4</parameters>
  </PostProcessor>
</Models>
```

# *OutputStreamManager*

```
<OutputStreamManager>
  <Print name='out_dump'>
    <type>csv</type>
    <type>outMC</type>
  </Print>
  <Plot name='plotLocationStratified' dim='3' >
    <plotSetting>
      <plot>
        <type>scatterd</type>
        <x>outStratified|Input|x1<x>
        <y>outStratified|Input|x2<y>
        <z>outStratified|Input|x3<z>
        <colorMap>outStratified|Output|y4<colorMap>
      </plot>
    </plotSetting>
    <action>
      <how>screen<how>
      <title><text>Location Stratified and Y4<text><title>
    </action>
  </Plot>
  ...
</OutputStreamManager>
```

# Steps

```
<Steps>
  <MultiRun name='runGrid' pauseAtEnd='True'>
    ...
  </MultiRun>
  <MultiRun name='runStratified' pauseAtEnd='True'>
    ...
  </MultiRun>
  <MultiRun name='runDoE' pauseAtEnd='True'>
    ...
  </MultiRun>
  <MultiRun name='OutstreamDoE' pauseAtEnd='True'>
    ...
  </MultiRun>
  <MultiRun name='runMC' pauseAtEnd='True'>
    ...
  </MultiRun>
  <MultiRun name='OutstreamMC' pauseAtEnd='True'>
    ...
  </MultiRun>
  <MultiRun name='PP' pauseAtEnd='True'>
    ...
  </MultiRun>
</Steps>
```

## Steps: *runGrid*

```
<MultiRun name='runGrid' pauseAtEnd='True'>
  <Input    name='DataObjects'    type='TimePointSet' >dummy</Input>
  <Model     name='Models'         type='ExternalModel'>PythonModule</Model>
  <Sampler   name='Samplers'       type='Grid'         >GridSampler</Sampler>
  <Output    name='DataObjects'    type='TimePointSet' >outGrid</Output>
  <Output    name='OutStreamManager' type='Plot'          >plotLocationGrid</Output>
</MultiRun>
```



## ***Steps: runStratified***

```
<MultiRun name='runStratified' pauseAtEnd='True'>
  <Input    name='DataObjects'      type='TimePointSet' >dummy</Input>
  <Model    name='Models'           type='ExternalModel'>PythonModule</Model>
  <Sampler  name='Samplers'         type='Stratified'   >StratifiedSampler</Sampler>
  <Output   name='DataObjects'      type='TimePointSet' >outStratified</Output>
  <Output   name='OutStreamManager' type='Plot'         >plotLocationStratified</Output>
  <Output   name='OutStreamManager' type='Plot'         >plotLocationStratifiedY4</Output>
</MultiRun>
```

## ***Steps: runDoE, OutstreamDoE***

```
<MultiRun name='runDoE'>
  <Input    name='DataObjects'      type='TimePointSet' >dummy</Input>
  <Model    name='Models'           type='ExternalModel'>PythonModule</Model>
  <Sampler  name='Samplers' type='ResponseSurfaceDesign' >StratifiedSampler</Sampler>
  <Output    name='DataObjects'      type='TimePointSet' >outDoE</Output>
</MultiRun>
<IOStep name='OutstreamDoE' pauseAtEnd='True'>
  <Input    name='DataObjects'      type='TimePointSet'>outDoE</Input>
  <Output    name='OutStreamManager' type='Plot'           >plotLocationDoE</Output>
</IOStep>
```

## ***Steps: runMC, OutstreamMC, PP***

```
<MultiRun name='runMC'>
  <Input    name='DataObjects'    type='TimePointSet' >dummy</Input>
  <Model    name='Models'         type='ExternalModel'>PythonModule</Model>
  <Sampler  name='Samplers'       type='MonteCarlo'   >MCsampler</Sampler>
  <Output   name='DataObjects'    type='TimePointSet' >outMC</Output>
</MultiRun>
<IOStep name='OutstreamMC' pauseAtEnd='True'>
  <Input    name='DataObjects'    type='TimePointSet'>outMC</Input>
  <Output   name='OutStreamManager' type='Plot'           >plotLocationMC</Output>
  <Output   name='OutStreamManager' type='Print'          >outMC</Output>
</IOStep>
<PostProcess name='PP'>
  <Input    name='DataObjects'    type='TimePointSet'>outMC</Input>
  <Model    name='Models'         type='PostProcessor'>StatisticsOutput</Model>
  <Output   name='Files'          type=''             >output_basicStatistics</Output>
</PostProcess>
```