Monte Carlo Integration

Unit Circle

In[1]:=
```
num = 40 000;
Clear[inlist]; Clear[outlist];
inlist = {};
 outlist = {};
numin = 0;
For[m = 1, m ≤ num, m++,
  {
   x = 2 (Random[] - .5);
   y = 2 (Random[] - .5);
   If[x^2 + y^2 ≤ 1, loc = 1, loc = 2];
   If[loc == 1,
    inlist = AppendTo[inlist, {x, y}],  outlist = AppendTo[outlist, {x, y}]];
   numin = numin + 2 - loc;
   percentage[m] = 1.0 numin / m;
  }];
cut[dataset_, number_] := Module[{},
   temp = {};
   For[i = 1, i ≤ Floor[number], i++, temp = AppendTo[temp, dataset[[i]]]];
   Return[temp];
  ];
cut[inlist, 5]
```

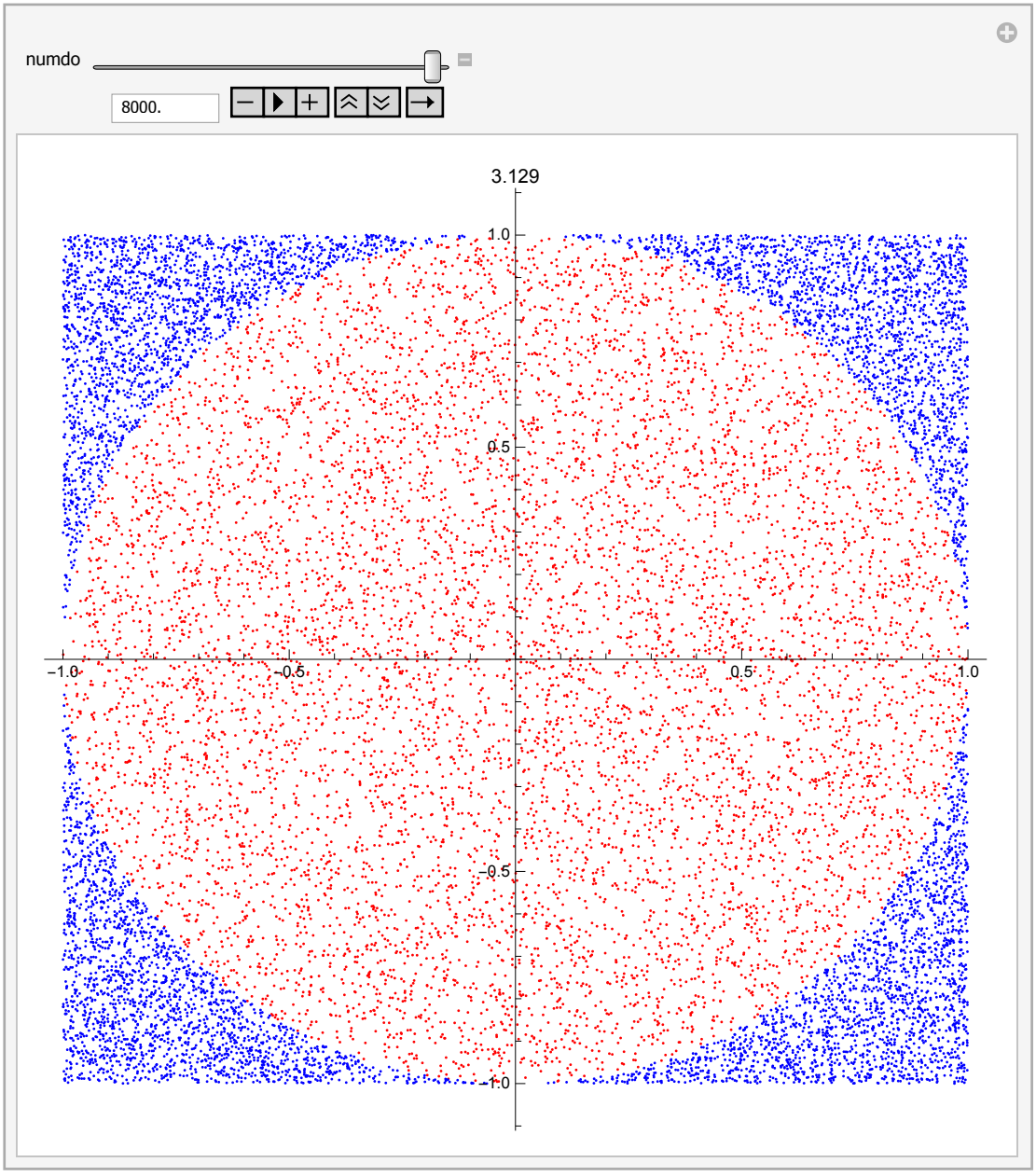
Out[8]=
```
{{-0.955233, -0.00404684}, {-0.326399, -0.110496},
 {-0.318923, -0.339101}, {-0.143886, -0.491398}, {-0.354974, 0.779014}}
```

```
percentage[7000]
```

```
0.786286
```

```
Print["Plot of randomly chosen points inside and outside unit circle, whose area is ",
  1.0 Pi];
Manipulate[ListPlot[{cut[inlist, numdo], cut[outlist, numdo]}, PlotStyle → {Red, Blue},
  AspectRatio → 1, PlotLabel → 4 percentage[Floor[numdo]]], {numdo, 1, .2 num}]
```

```
Plot of randomly chosen points inside and outside unit circle, whose area is 3.14159
```



Ellipse x^2 + 4 y^2 = 1

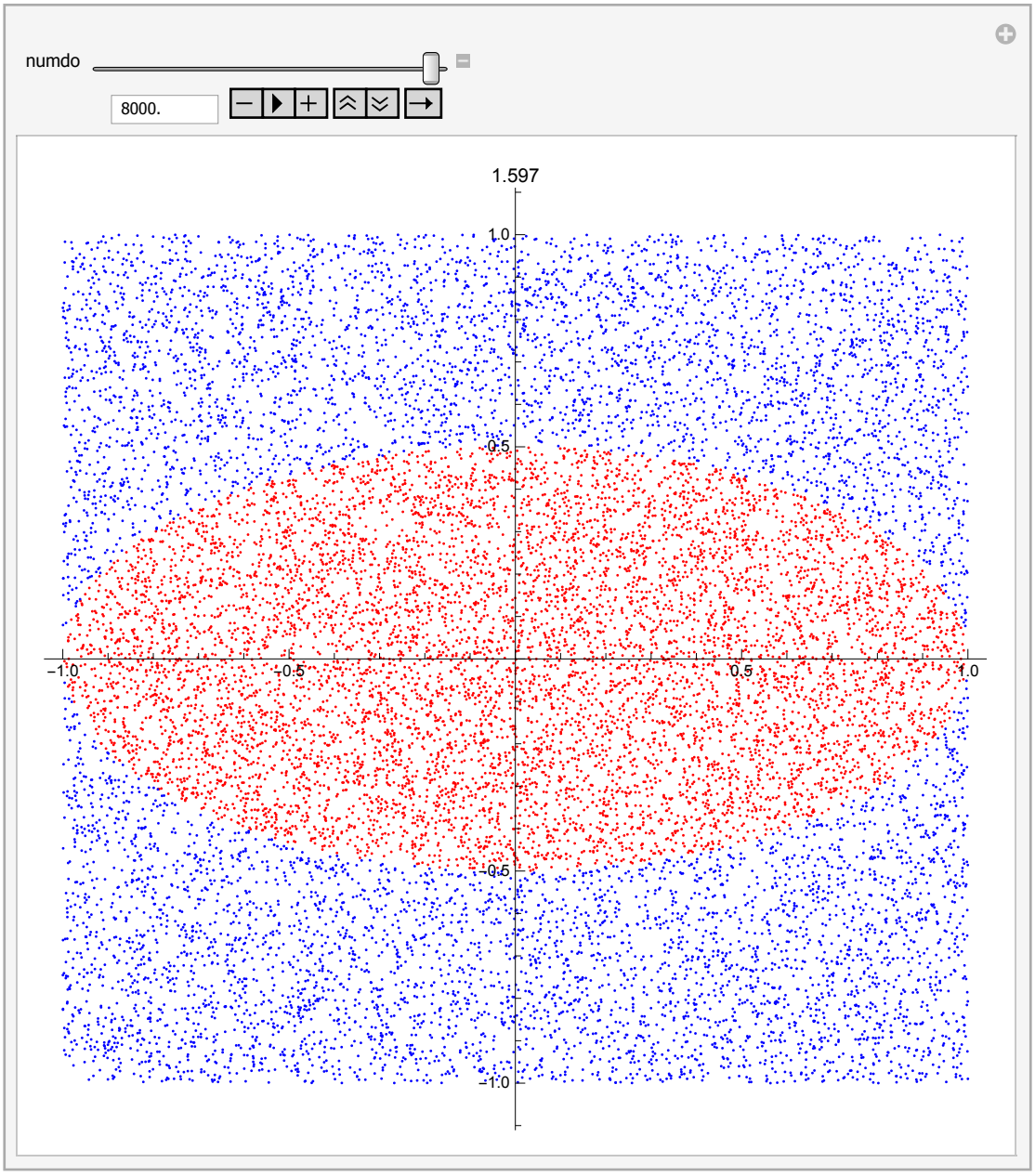
In[31]:=
```
num2 = 40000;
Clear[inlist2]; Clear[outlist2];
inlist2 = {};
 outlist2 = {};
numin = 0;
For[m = 1, m ≤ num2, m++,
  {
   x = 2 (Random[] - .5);
   y = 2 (Random[] - .5);
   If[x^2 + 4 y^2 ≤ 1, loc = 1, loc = 2];
   If[loc == 1,  inlist2 = AppendTo[inlist2, {x, y}],
    outlist2 = AppendTo[outlist2, {x, y}]];
   numin = numin + 2 - loc;
   percentage2[m] = 1.0 numin / m;
  }];
cut[dataset_, number_] := Module[{},
   temp = {};
   For[i = 1, i ≤ Floor[number], i++, temp = AppendTo[temp, dataset[[i]]]];
   Return[temp];
  ];
cut[inlist2, 5]
```

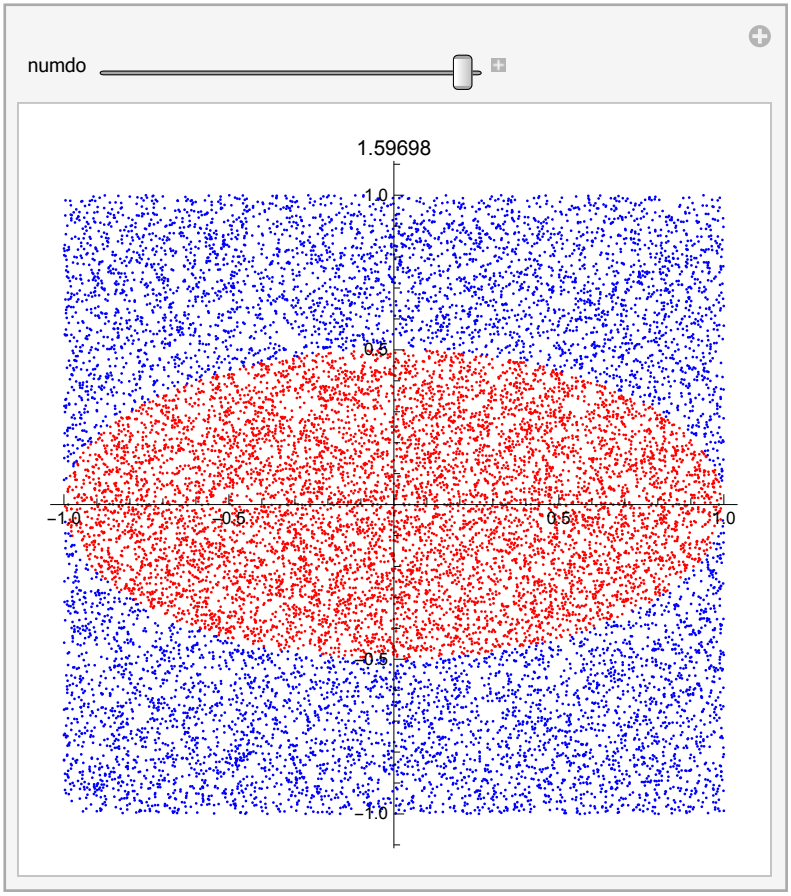
Out[38]=
```
{{0.538867, 0.00513579}, {0.410948, -0.422321},
 {-0.0913104, 0.131053}, {-0.22766, -0.439144}, {-0.506819, 0.232234}}
```

In[39]:=
```
Print["Plot of randomly chosen points inside and
    outside ellipse x^2 + 4 y^2 = 1, whose area is ", 1.0 Pi / 2];
Manipulate[ListPlot[{cut[inlist2, numdo], cut[outlist2, numdo]}, PlotStyle → {Red, Blue},
  AspectRatio → 1, PlotLabel → 4 percentage2[Floor[numdo]]], {numdo, 1, .2 num2}]
```

```
Plot of randomly chosen points inside and outside ellipse x^2 + 4 y^2 = 1, whose area is 1.5708
```

Out[40]=





... Part: Part specification inlist2[[1]] is longer than depth of object.

... Part: Part specification inlist2[[2]] is longer than depth of object.

... Part: Part specification inlist2[[3]] is longer than depth of object.

... General: Further output of Part::partd will be suppressed during this calculation.

... Part: Part specification inlist2[[1]] is longer than depth of object.

... Part: Part specification inlist2[[2]] is longer than depth of object.

... Part: Part specification inlist2[[3]] is longer than depth of object.

... General: Further output of Part::partd will be suppressed during this calculation.

General Region

In[18]:=
```
numn = 40000;
randpoints = {};
For[m = 1, m ≤ numn, m++,
  randpoints = AppendTo[randpoints, {2 (Random[] - .5), 2 (Random[] - .5)}]];
randpoints[[1, 2]]
```

Out[21]= -0.511165

In[22]:=
```
Clear[inlistn]; Clear[outlistn];
inlistn = {};
outlistn = {};
numin = 0;
For[m = 1, m ≤ numn, m++,
  {
   x = randpoints[[m, 1]];
   y = randpoints[[m, 2]];
   If[16 x^2 - 1 ≥ 4 y^2, loc = 1, loc = 2];
   If[loc == 1, inlistn = AppendTo[inlistn, {x, y}],
    outlistn = AppendTo[outlistn, {x, y}]];
   numin = numin + 2 - loc;
   percentagen[m] = 1.0 numin / m;
  }];
cut[dataset_, number_] := Module[{},
   temp = {};
   For[i = 1, i ≤ Floor[number], i++, temp = AppendTo[temp, dataset[[i]]]];
   Return[temp];
  ];
cut[inlistn, 5]
```

Out[28]=
```
{{-0.554499, -0.511165}, {0.825826, -0.7112},
 {-0.924969, -0.968387}, {-0.40627, 0.493031}, {0.763074, 0.481294}}
```

In[29]:=
```
Print["Plot of randomly chosen points inside and outside."];
Manipulate[ListPlot[{cut[inlistn, numdo], cut[outlistn, numdo]}, PlotStyle → {Red, Blue},
  AspectRatio → 1, PlotLabel → 4 percentagen[Floor[numdo]]], {numdo, 20, .2 numn}]
```

```
Plot of randomly chosen points inside and outside.
```

Out[30]=