

کارلومونت روش

(Monte Carlo Method)

```
f1[x_] := Exp[x^2];
exact1 = NIntegrate[f1[x], {x, 0, 1}]
1.46265

Table[f1[x] 0.1, {x, 0, 1, .1}] // Total
Table[f1[x] 0.01, {x, 0, 1, .01}] // Total
Table[f1[x] 0.001, {x, 0, 1, .001}] // Total
1.65309

1.48129

1.46451

xr := RandomReal[{0, 1}];
M = 1000;
Table[MCInt1 = Mean[Table[f1[xr], {M}]];
  Print[MCInt1, {5}];
1.45329
1.44882
1.46574
1.47357
1.43636

xr := RandomReal[{0, 1}];
M = 1000;
Mean[Table[MCInt1 = Mean[Table[f1[xr], {m, 1, M}]], {10}]]
1.45684
```

Integration from a to b:

$$\int_a^b f(x) dx \rightarrow \frac{1}{M} (b - a)$$

$$\sum_{i=1}^M f(x_i)$$

```

f6[x1_, x2_, x3_, x4_(*,x5_,x6_*)] := Exp[x1^2 + x2^2 + x3^2 + x4^2(*+x5^2+x6^2*)];
exact6 = NIntegrate[f6[x1, x2, x3, x4(*,x5,x6*)], {x1, 0, 1},
  {x2, 0, 1}, {x3, 0, 1}, {x4, 0, 1}(*,{x5,0,1},{x6,0,1}*)]; // Timing
Print[
  exact6]
{0.09375, Null}

4.57682

d = 0.01;
disc = Flatten[Table[f6[x1, x2, x3, x4(*,x5,x6*)] d^4, {x1, 0, 1, d}, {x2, 0, 1, d},
  {x3, 0, 1, d}, {x4, 0, 1, d}(*,{x5,0,1,d},{x6,0,1,d}*)]] // Total; // Timing
Print[
  disc]
$Aborted

5.06271

xr := RandomReal[{0, 1}];
M = 10000;
Table[MCInt6 = Mean[Table[f6[xr, xr, xr, xr, xr, xr], {m, 1, M}]];
  Print[MCInt6], {5}] // Timing
9.87059
9.88995
9.78603
9.65615
9.83394
{0.234375, {Null, Null, Null, Null, Null}}

xr := RandomReal[{0, 1}];
M = 10000;
Mean[Table[MCInt6 = Mean[Table[f6[xr, xr, xr, xr, xr, xr], {m, 1, M}]], {10}]]
9.78859

```

است بُعد از مستقل کارلومونت روش در خطا

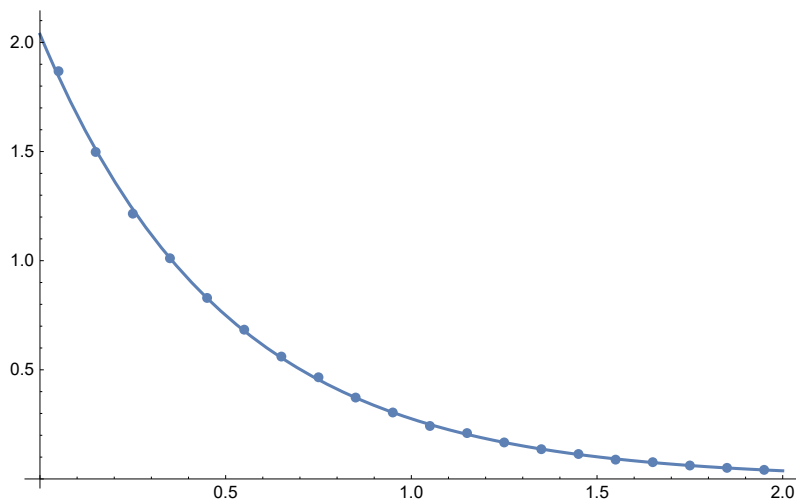
Random Number Generation by Metropolis Method

```

T = 0.5;
rc = 1 / Integrate[Exp[-x/T], {x, 0, 2}];
p[x_] := rc Exp[-x/T];
xt := RandomReal[{0, 2}]
xr := RandomReal[{0, 1}];
M = 10^5;
sample = Table[xi = xt;
  Do[xj = xt;
    If[xj < xi, xi = xj, If[p[xj]/p[xi] > xr, xi = xj, xi]], {20}];
  xi, {M}];

dis = {0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0};
Do[dis[[Ceiling[sample[[i]] * 10]]] ++, {i, M}];
Total[dis] - M
dis/M/0.1
Show[
  ListPlot[Partition[Riffle[{0.05, 0.15, 0.25, 0.35, 0.45, 0.55, 0.65, 0.75, 0.85, 0.95, 1.05,
    1.15, 1.25, 1.35, 1.45, 1.55, 1.65, 1.75, 1.85, 1.95}, dis/M/0.1], 2]],
  Plot[p[x], {x, 0, 2}, PlotRange -> {0, p[0]}, PlotRange -> All]
]
0
{1.8683, 1.4981, 1.2155, 1.0112, 0.8294, 0.6839, 0.5607, 0.4658, 0.3729, 0.3045,
  0.2427, 0.2101, 0.1672, 0.1363, 0.1142, 0.0884, 0.0768, 0.0616, 0.0508, 0.0416}

```



Further Example

Metropolis Meth.

```

p[x_] := x^2 Exp[-x];
xr := RandomReal[{0, 10}];
xt := RandomReal[];
M = 10^3;
sample = Table[xi = xr;
  Do[xj = xr;
    If[p[xj] > p[xi], xi = xj, If[p[xj]/p[xi] > xt, xi = xj, xi]], {10}];
  xi, {M}];

dis = {0, 0, 0, 0, 0, 0, 0, 0, 0, 0}; Do[dis[[Ceiling[sample[[i]]]]] ++, {i, M}];
Total[dis] - M
dis/M/1 // N
Show[
  ListPlot[Partition[Riffle[{0.5, 1.5, 2.5, 3.5, 4.5, 5.5, 6.5, 7.5, 8.5, 9.5}, dis/M/1], 2]],
  Plot[p[x]/NIntegrate[p[t], {t, 0, 10}], {x, 0, 10}, PlotRange -> {0, p[0]}, PlotRange -> All]
]
0
{0.087, 0.244, 0.246, 0.187, 0.113, 0.064, 0.029, 0.016, 0.006, 0.008}

```

