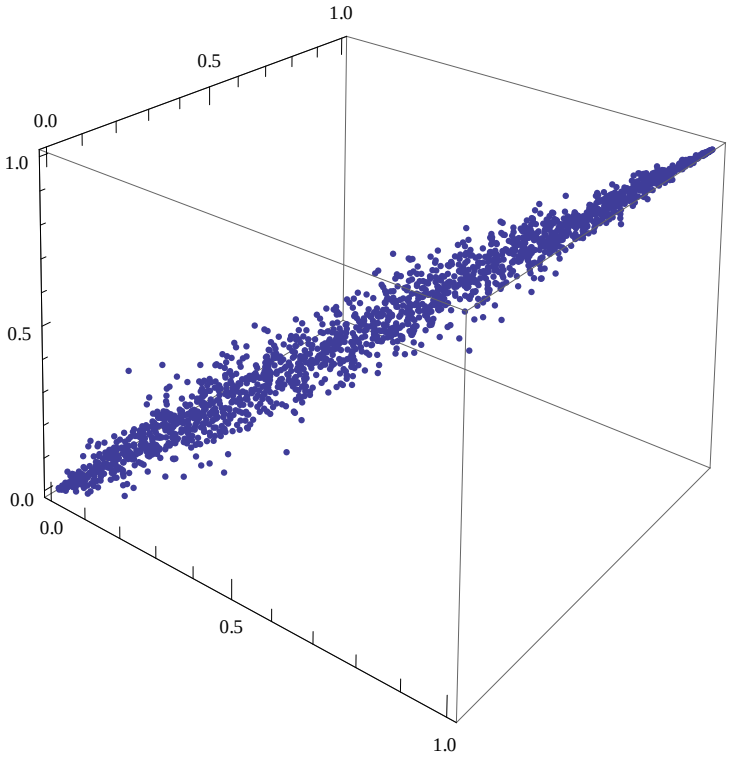
Maximum copula

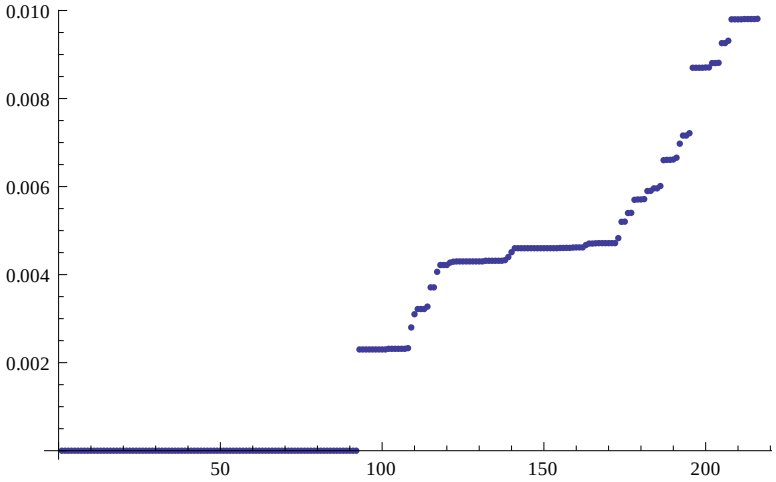
```
SeedRandom[];

U = {}; A = 10;
Timing[For[i = 0, i < 2000, i++,
  x = RandomReal[];
  y = f1[x, RandomReal[], A];
  z = f2[x, y, RandomReal[], A];
  AppendTo[U, {x, y, z}]]]
ListPointPlot3D[U, AspectRatio → 1]
```

```
{1.282, Null}
```



```
M = {}; m = {}; l = Length[U]; h = 1 / 5;
For[i = 0, i ≤ 1, i += h,
 For[j = 0, j ≤ 1, j += h,
  For[k = 0, k ≤ 1, k += h,
   AppendTo[m,
    Length[Select[U, #[[1]] ≤ i && #[[2]] ≤ j && #[[3]] ≤ k &]] / l - c[i, j, k, A] // N]
  ]
 ]]; m = Sort[m]; ListPlot[m]
```




```
CForm[e^-(-(-Log[x])^a + (-1 + a) ProductLog[(-x z2 (-Log[x])^-a Log[x])^(-1/(-1 + a))/(-1 + a)])^(1/a)]
```

```
Power(E,-Power(-Power(0.1730846177216665,a) +
      Power((-1 + a)*ProductLog(1/
          (Power(0.14557566371451522,1/(-1 + a))*(-1 + a)*
            Power(Z2/Power(0.1730846177216665,a),1/(-1 + a)))),a),1/a))
```

```
CForm[For[i = 0, i < 2000, i++,

 ]]
```

```
Null
```

FUnction Definitions

```
Exit[]
```

```
$Assumptions =
 a > 1 && 0 < Z < 1 && 0 < x < 1 && 0 < y < 1 && 0 < z < 1 && 0 < Z1 < 1 && 0 < Z2 < 1 && A > 1
```

```
c[x_, y_, z_, a_] := Exp[-((-Log[x])^a + (-Log[y])^a + (-Log[z])^a)^(1 / a)]
```

```
Simplify[D[c[x, y, 1, a], x]]
```

```
Solve[% == Z2, y]
```

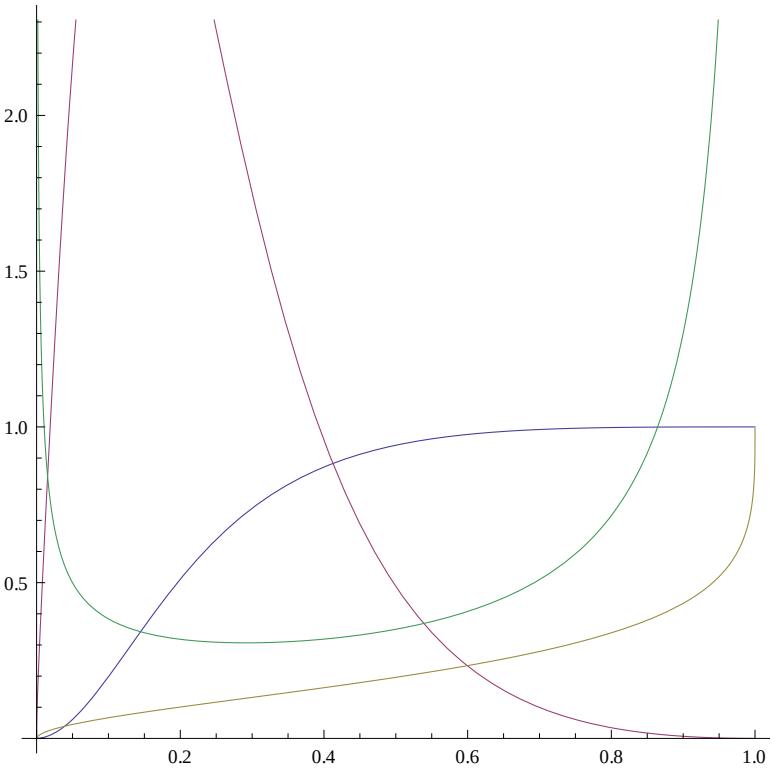
```
f1 = Compile[{{x, _Real}, {Z2, _Real}, {a, _Real}},
  e^-(-(-Log[x])^a + ((-1 + a) ProductLog[(-x Z2 (-Log[x])^-a Log[x])^-1/(-1 + a)/(-1 + a)]))^a)^1/a];

Simplify[D[D[c[x, y, z, a], x], y] / D[D[c[x, y, 1, a], x], y]]

ddc[x_, y_, z_, a_] := e^((-Log[x])^a + (-Log[y])^a)^1/a - ((-Log[x])^a + (-Log[y])^a + (-Log[z])^a)^1/a
  (-1 + a + ((-Log[x])^a + (-Log[y])^a + (-Log[z])^a)^1/a)
  ((-Log[x])^a + (-Log[y])^a / ((-Log[x])^a + (-Log[y])^a + (-Log[z])^a))^(2 - 1/a) /
   (-1 + a + ((-Log[x])^a + (-Log[y])^a)^1/a)

f2[x_, y_, z3_, a_] :=
 FindRoot[ddc[x, y, z, a] - z3, {z, 0.0000000000001, 1}, Method → "Brent"][[1, 2]]

aa = 3.00001; xx = 0.1; yy = 0.7;
Plot[{ddc[xx, yy, y, aa], D[ddc[xx, yy, sy, aa], sy] /. sy → y, f2[xx, yy, y, aa],
  Simplify[Simplify[1 / D[ddc[xx, yy, sy, aa], sy]] /. sy -> f2[xx, yy, y, aa]]},
 {y, 0, 1}, AspectRatio → 1]
```




```
y =.
```

f2[xx, yy, y, aa]

FindRoot::nlnum: The function value $\{2.00524\times10^{-17}-1.\,y\}$ is not a list of numbers with dimensions {1} at {z} = $\{1.\times10^{-13}\}$.

$-y$

Simplify[Simplify[1 / D[ddc[xx, yy, sy, aa], sy]] /. sy -> f2[xx, yy, y, aa]]

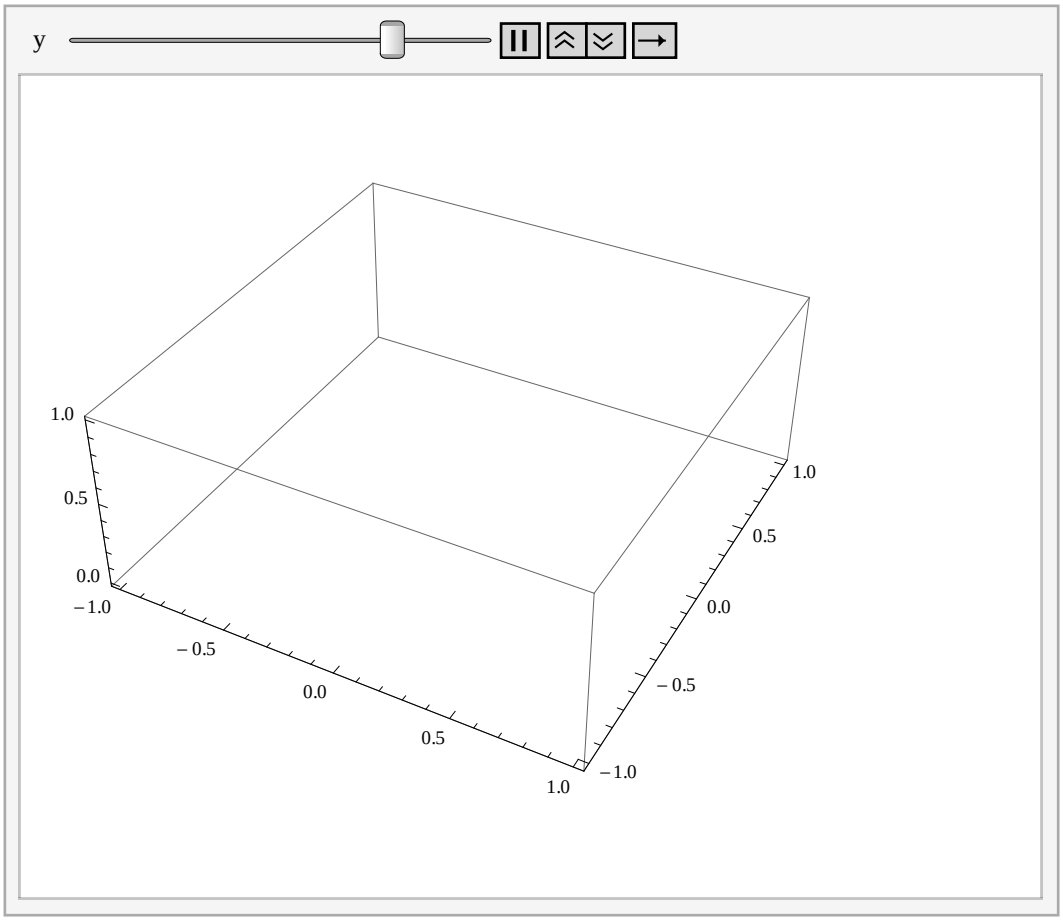
FindRoot::nlnum: The function value $\{2.00524\times10^{-17}-1.\,y\}$ is not a list of numbers with dimensions {1} at {z} = $\{1.\times10^{-13}\}$.

$$-\left(e^{\left(12.2535+(-\text{Log}[-y])^{3.00001}\right)^{0.333332}}\,y\,\left(12.2535+(-\text{Log}[-y])^{3.00001}\right)^{0.666668}\right)\Big/$$
$$\left(\left(\left(151.703+151.702\,\left(12.2535+(-\text{Log}[-y])^{3.00001}\right)^{0.333332}\right)\left(\frac{1}{12.2535+(-\text{Log}[-y])^{3.00001}}\right)^{1.66667}+\right.\right.$$
$$\left.\left.\left(1517.03\,\left(12.2535+(-\text{Log}[-y])^{3.00001}\right)^{0.666668}+758.511\,\left(12.2535+(-\text{Log}[-y])^{3.00001}\right)^{1.}\right)\left(\frac{1}{12.2535+(-\text{Log}[-y])^{3.00001}}\right)^{2.66667}\right)(-\text{Log}[-y])^{2.00001}\right)$$

c2[x, y, z]

c2[0.124265, 0.107698, 0.0986968]

```
Animate[Plot3D[c[x, y, z, 3], {x, 0, 1}, {z, 0, 1}], {y, 0, 1}]
```




```
c2[
```

c2