```
> restart;
  read("c:/appl/appl7.txt");
```

PROCEDURES:

AllPermutations(n), AllCombinations(n, k), Benford(X), BootstrapRV(Data),
CDF:CHF:HF:IDF:PDF:SF(X, [x])), CoefOfVar(X), Convolution(X, Y),
ConvolutionIID(X, n), CriticalPoint(X, prob), Determinant(MATRIX), Difference(X, Y),
Display(X), ExpectedValue(X, [g]), KSTest(X, Data, Parameters), Kurtosis(X),
Maximum(X, Y), MaximumIID(X, n), Mean(X), MGF(X), Minimum(X, Y),
MinimumIID(X, n), Mixture(MixParameters, MixRVs),
MLE(X, Data, Parameters, [Rightcensor]), MLENHPP(X, Data, Parameters, obstime),
MLEWeibull(Data, [Rightcensor]), MOM(X, Data, Parameters),
NextCombination(Previous, size), NextPermutation(Previous), OrderStat(X, n, r, ["wo"]),
PlotDist(X, [low], [high]), PlotEmpCDF(Data, [low], [high]),
PlotEmpCIF(Data, [low], [high]), PlotEmpSF(Data, Censor),
PlotEmpVsFittedCDF(X, Data, Parameters, [low], [high]),
PlotEmpVsFittedCDF(X, Data, Parameters, [low], [high]),
PlotEmpVsFittedSF(X, Data, Parameters, Censor, low, high),
PPPlot(X, Data, Parameters), Product(X, Y), ProductIID(X, n),
QQPlot(X, Data, Parameters), RangeStat(X, n, ["wo"]), Skewness(X), Transform(X, g),
Truncate(X, low, high), Variance(X), VerifyPDF(X)

Procedure Notation:
X and Y are random variables
Greek letters are numeric or symbolic parameters
x is numeric or symbolic
n and r are positive integers, n >= r
low and high are numeric
g is a function
Brackets [] denote optional parameters
"double quotes" denote character strings
MATRIX is a 2 x 2 array of random variables
A capitalized parameter indicates that it must be
entered as a list --> ex. Data := [1, 12.4, 34, 52.45, 63]

Variate Generation:

ArcTanVariate(alpha, phi), BinomialVariate(n, p, m), ExponentialVariate(lambda),
NormalVariate(mu, sigma), UniformVariate(), WeibullVariate(lambda, kappa, m)

DATA SETS:

BallBearing, HorseKickFatalities, Hurricane, MP6, RatControl, RatTreatment, USSHalfBeak

ArcSinRV(), ArcTanRV(alpha, phi), BetaRV(alpha, beta), CauchyRV(a, alpha), ChiRV(n),

ChiSquareRV(n), ErlangRV(lambda, n), ErrorRV(mu, alpha, d), ExponentialRV(lambda), ExponentialPowerRV(lambda, kappa), ExtremeValueRV(alpha, beta), FRV(n1, n2), GammaRV(lambda, kappa), GeneralizedParetoRV(gamma, delta, kappa), GompertzRV(delta, kappa), HyperbolicSecantRV(), HyperExponentialRV(p, l), HypoExponentialRV(l), IDBRV(gamma, delta, kappa), InverseGaussianRV(lambda, mu), InvertedGammaRV(alpha, beta), KSRV(n), LaPlaceRV(omega, theta), LogGammaRV(alpha, beta), LogisticRV(kappa, lambda), LogLogisticRV(lambda, kappa), LogNormalRV(mu, sigma), LomaxRV(kappa, lambda), MakehamRV(gamma, delta, kappa), MuthRV(kappa), NormalRV(mu, sigma), ParetoRV(lambda, kappa), RayleighRV(lambda), StandardCauchyRV(), StandardNormalRV(), StandardTriangularRV(m), StandardUniformRV(), TRV(n), TriangularRV(a, m, b), UniformRV(a, b), WeibullRV(lambda, kappa)

```
Error, attempting to assign to `DataSets` which is protected.
Try declaring `local DataSets`; see ?protect for details.
```

```
> bf := LogLogisticRV(1, 2);
  bfname := "LogLogisticRV(1, 2)";
```

$$bf := \left[\left[x \to \frac{2\,x}{\left(x^2+1\right)^2}\right], [0, \infty], ["\text{Continuous}", "\text{PDF}"]\right]$$

$$bfname := "\text{LogLogisticRV}(1, 2)" \quad \textbf{(1)}$$

```
> #plot(1/csch(t)+1, t = 0..0.0010);
  #plot(diff(1/csch(t),t), t=0..0.0010);
  #limit(1/csch(t), t=0);
> solve(exp(-t) = y, t);
```

$$-\ln(y) \quad \textbf{(2)}$$

```
> # discarded  -ln(t + 1),  t-> csch(t),t->arccsch(t),t -> tan(t),
> glist := [t -> t^2 , t -> sqrt(t),  t -> 1/t,  t -> arctan(t),  t
  -> exp(t), t -> ln(t), t -> exp(-t), t -> -ln(t),  t -> ln(t+1),
  t -> 1/(ln(t+2)), t -> tanh(t), t -> sinh(t), t -> arcsinh(t),
  t-> csch(t+1),t->arccsch(t+1), t-> 1/tanh(t+1), t->  1/sinh(t+1),
   t->  1/arcsinh(t+1), t->  1/csch(t)+1, t-> tanh(1/t), t->csch
  (1/t), t-> arccsch(1/t), t-> arctanh(1/t)  ]:
  base := t -> PDF(bf, t):
  print(base(x)):

  for i from 15 to 20(glist) do
     print( "i is", i, "  ----------------------------------------
  ----------------------------------------------------------------
  ------------");
     g := glist[i]:
     l := bf[2][1];
     u := bf[2][2];
     Temp := Transform(bf, [[unapply(g(x), x)],[l,u]]);


    #print( "l and u", l, u );
```

```
    #print("g(x)", g(x), "base", base(x),bfname);
    print("f(x)", PDF(Temp, x));
    #print("F(x)", CDF(Temp, x));
    #print("IDF(x)", IDF(Temp));
    #print("S(x)", SF(Temp, x));
    print("h(x)", HF(Temp, x));
    #print("mean and variance", Mean(Temp), Variance(Temp));
    #assume(r > 0); mf := int(x^r*PDF(Temp, x), x = Temp[2][1] ..
  Temp[2][2]);
    #print("MF", mf);
    #print("MGF", MGF(Temp));
    PlotDist(PDF(Temp), 0, 40);
    PlotDist(HF(Temp), 0, 40);
    latex(PDF(Temp,x));
    #print("transforming with", [[x->g(x)],[0,infinity]]);
    #X2 := Transform(bf, [[x->g(x)],[0,infinity]]);
    #print("pdf of X2 = ", PDF(X2,x));
    #print("pdf of Temp = ", PDF(Temp,x));
  od;
```

$$\frac{2\,x}{\left(x^2+1\right)^2}$$

"i is", 15,

" ----------"

$$g := t \to \operatorname{arccsch}(t+1)$$

$$l := 0$$

$$u := \infty$$

$$Temp := \left[\left[y\sim \to \frac{2\,(\sinh(y\sim)-1)\cosh(y\sim)\sinh(y\sim)}{-4\cosh(y\sim)^4+8\sinh(y\sim)\cosh(y\sim)^2-4\sinh(y\sim)+3}\right],\left[0,\ln\left(1+\sqrt{2}\right)\right],\right.$$

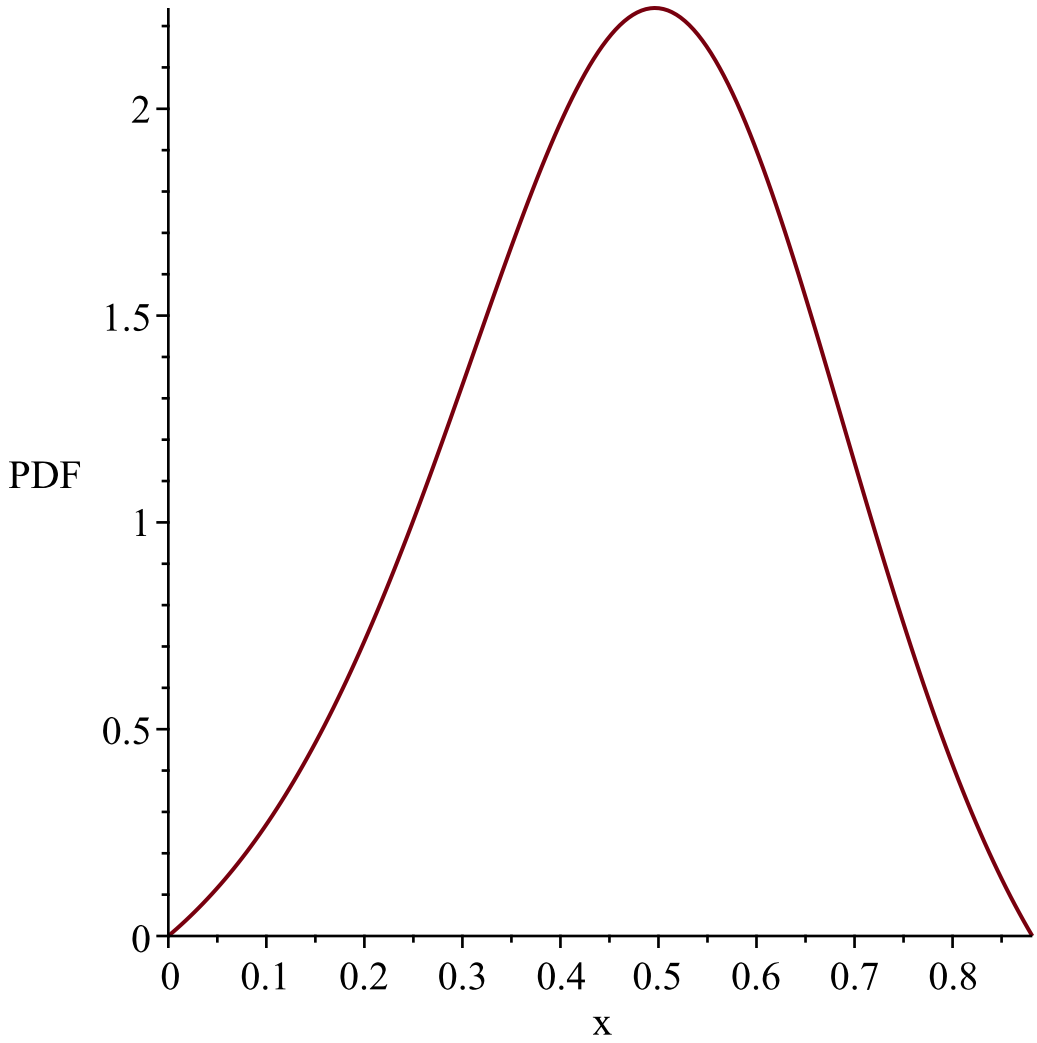
$$\left.\left["\text{Continuous}","\text{PDF}"\right]\right]$$

$$"\text{f(x)}",\ \frac{2\,(\sinh(x)-1)\cosh(x)\sinh(x)}{-4\cosh(x)^4+8\sinh(x)\cosh(x)^2-4\sinh(x)+3}$$

"h(x)",

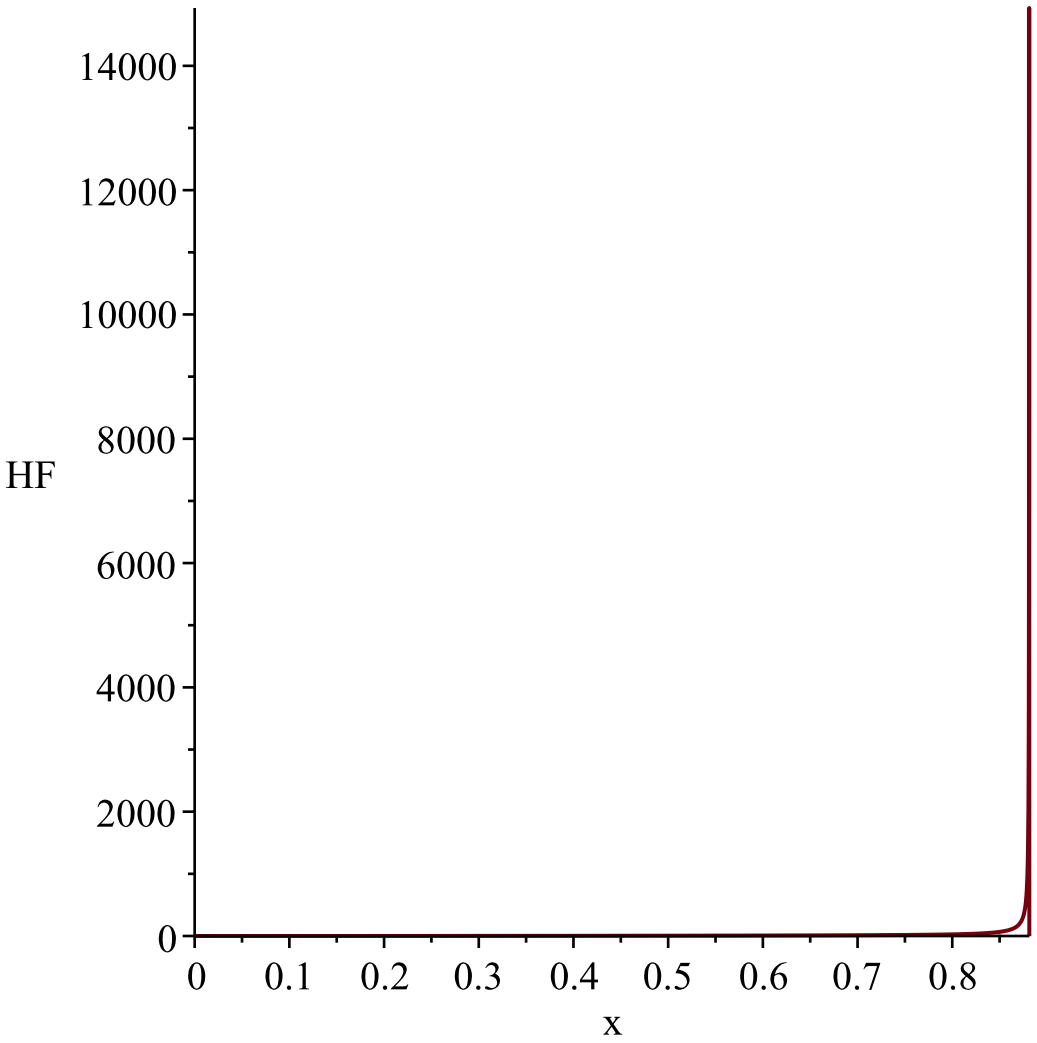
$$\left(4\,(\sinh(x)-1)\cosh(x)\sinh(x)\left(e^{-4x}+2\,e^{-3x}-2\,e^{-x}+1\right)\right)\Big/\left(\left(-4\cosh(x)^4+8\sinh(x)\cosh(x)^2-4\sinh(x)+3\right)\left(e^{-4x}+4\,e^{-3x}+2\,e^{-2x}-4\,e^{-x}+1\right)\right)$$

WARNING(PlotDist): High value provided by user, 40
is greater than maximum support value of the random
variable, $\ln\left(1+\sqrt{2}\right)$
Resetting high to RV's maximum support value



WARNING(PlotDist): High value provided by user, 40 *is greater than maximum support value of the random variable*, $\ln\left(1+\sqrt{2}\right)$

Resetting high to RV's maximum support value




```
2\,{\frac { \left( \sinh \left( x \right) -1 \right) \cosh \left
( x
 \right) \sinh \left( x \right) }{-4\, \left( \cosh \left( x
\right)
 \right) ^{4}+8\,\sinh \left( x \right)  \left( \cosh \left( x
 \right)  \right) ^{2}-4\,\sinh \left( x \right) +3}}
"i is", 16,
   " ----------------------------------------------------------------------------------------------------
   ----------"
```

$$g := t \to \frac{1}{\tanh(t+1)}$$

$$l := 0$$

$$u := \infty$$

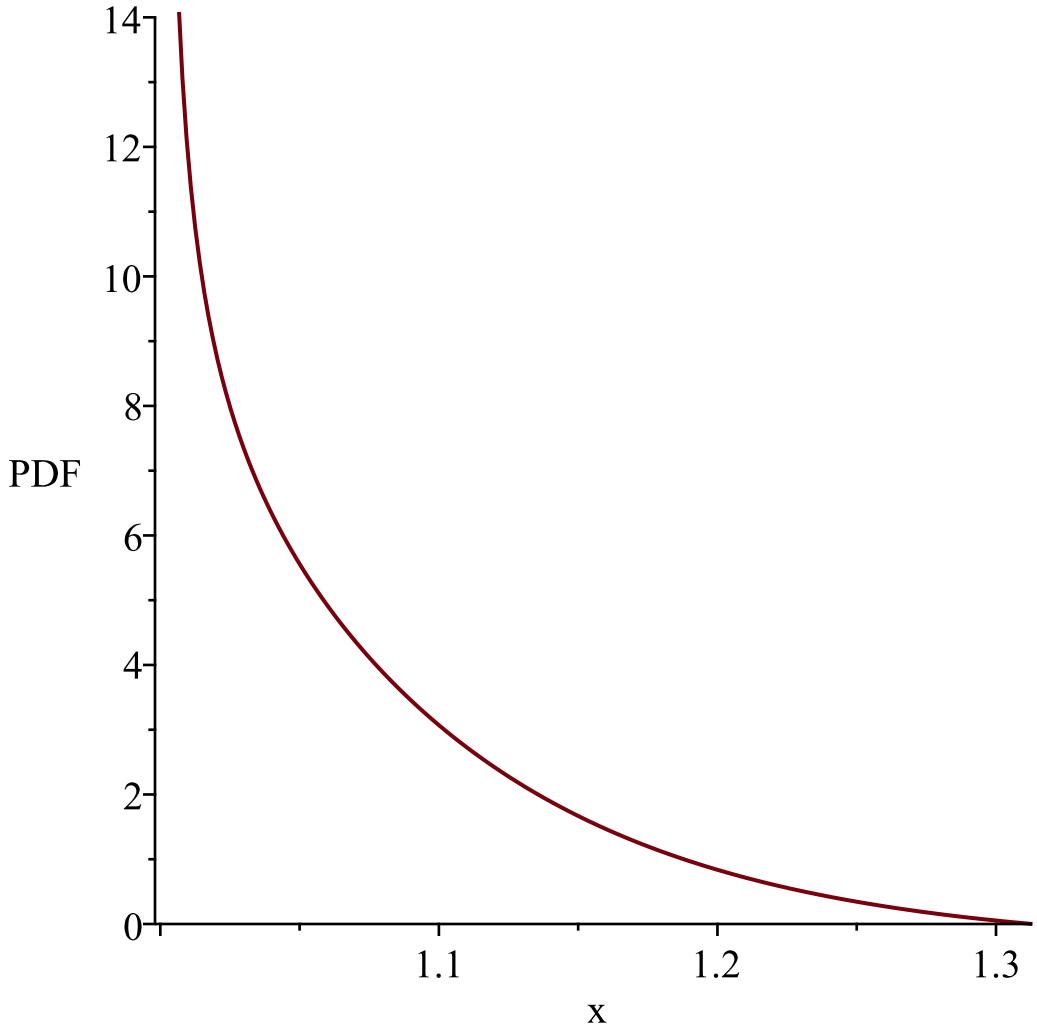
$$Temp := \left[\left[y\sim \to \frac{-2 + 2\,\operatorname{arctanh}\left(\frac{1}{y\sim}\right)}{\left(\operatorname{arctanh}\left(\frac{1}{y\sim}\right)^2 - 2\,\operatorname{arctanh}\left(\frac{1}{y\sim}\right) + 2\right)^2 \left(y\sim^2 - 1\right)} \right], \left[1, \frac{e + e^{-1}}{e - e^{-1}} \right], \right.$$

$$\left["Continuous", "PDF"\right]$$

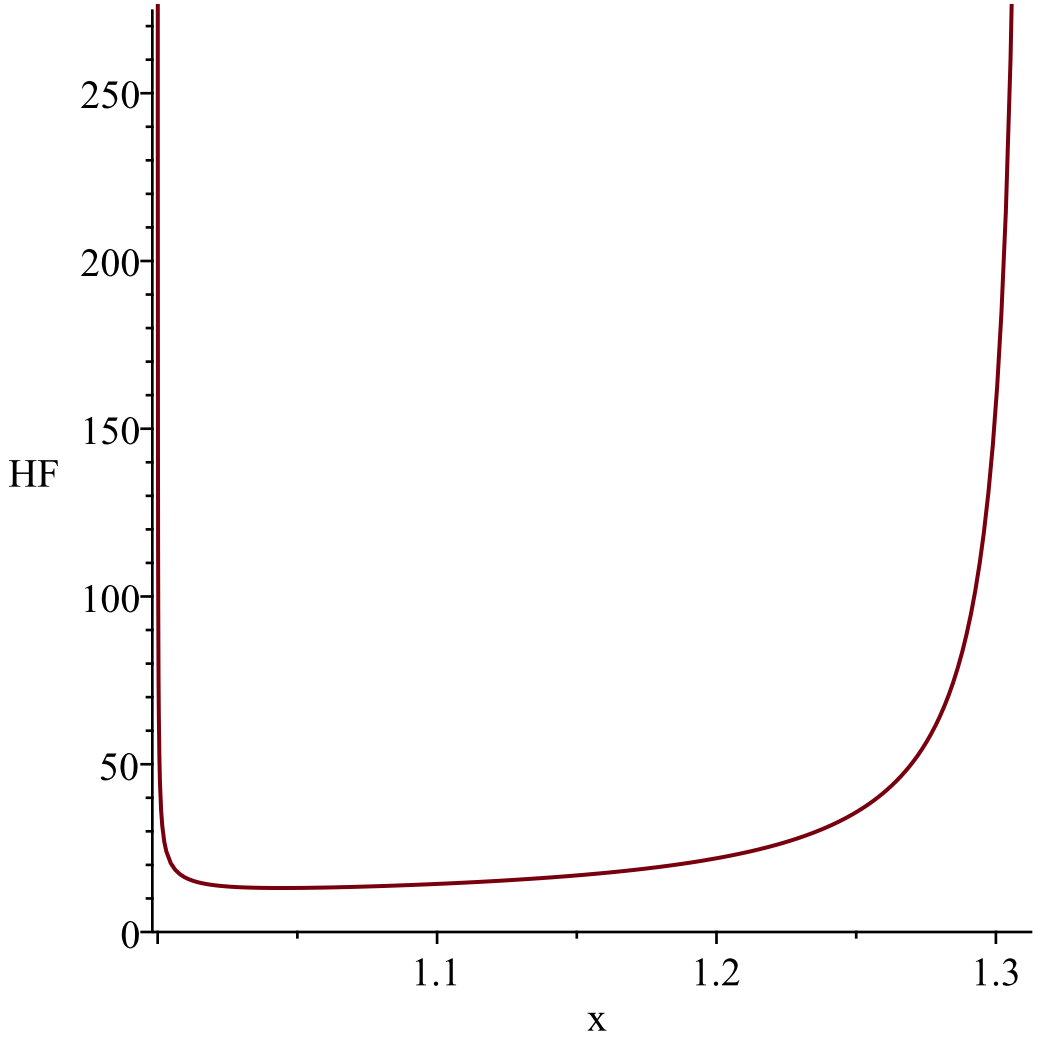
$$"f(x)", \frac{-2 + 2\,\text{arctanh}\left(\frac{1}{x}\right)}{\left(\text{arctanh}\left(\frac{1}{x}\right)^2 - 2\,\text{arctanh}\left(\frac{1}{x}\right) + 2\right)^2 \left(x^2 - 1\right)}$$

$$"h(x)", \frac{2}{\left(-1 + \text{arctanh}\left(\frac{1}{x}\right)\right)\left(x^2 - 1\right)\left(\text{arctanh}\left(\frac{1}{x}\right)^2 - 2\,\text{arctanh}\left(\frac{1}{x}\right) + 2\right)}$$

WARNING(PlotDist): Low value provided by user, 0
is less than minimum support value of random variable
1
Resetting low to RV's minimum support value
WARNING(PlotDist): High value provided by user, 40
is greater than maximum support value of the random
variable, $\frac{e + e^{-1}}{e - e^{-1}}$
Resetting high to RV's maximum support value



WARNING(PlotDist): Low value provided by user, 0
is less than minimum support value of random variable
1
Resetting low to RV's minimum support value
WARNING(PlotDist): High value provided by user, 40
is greater than maximum support value of the random
variable, $\frac{e+e^{-1}}{e-e^{-1}}$
Resetting high to RV's maximum support value




```
{\frac {-2+2\,{\rm arctanh} \left({x}^{-1}\right)}{ \left(
\left(
{\rm arctanh} \left({x}^{-1}\right) \right) ^{2}-2\,{\rm
arctanh}
\left({x}^{-1}\right)+2 \right) ^{2} \left( {x}^{2}-1 \right) }}
"i is", 17,
    " ----------------------------------------------------------------------------------------------------
    ---------"
```

$$g := t \to \frac{1}{\sinh(t+1)}$$

$$l := 0$$

$$u := \infty$$

$$Temp := \left[\left[y\sim \to \frac{2\left(-1+\operatorname{arcsinh}\left(\frac{1}{y\sim}\right)\right)}{\sqrt{y\sim^2+1}\left(\operatorname{arcsinh}\left(\frac{1}{y\sim}\right)^2-2\operatorname{arcsinh}\left(\frac{1}{y\sim}\right)+2\right)^2 |y\sim|}\right], \left[0, \frac{2}{e-e^{-1}}\right],\right.$$

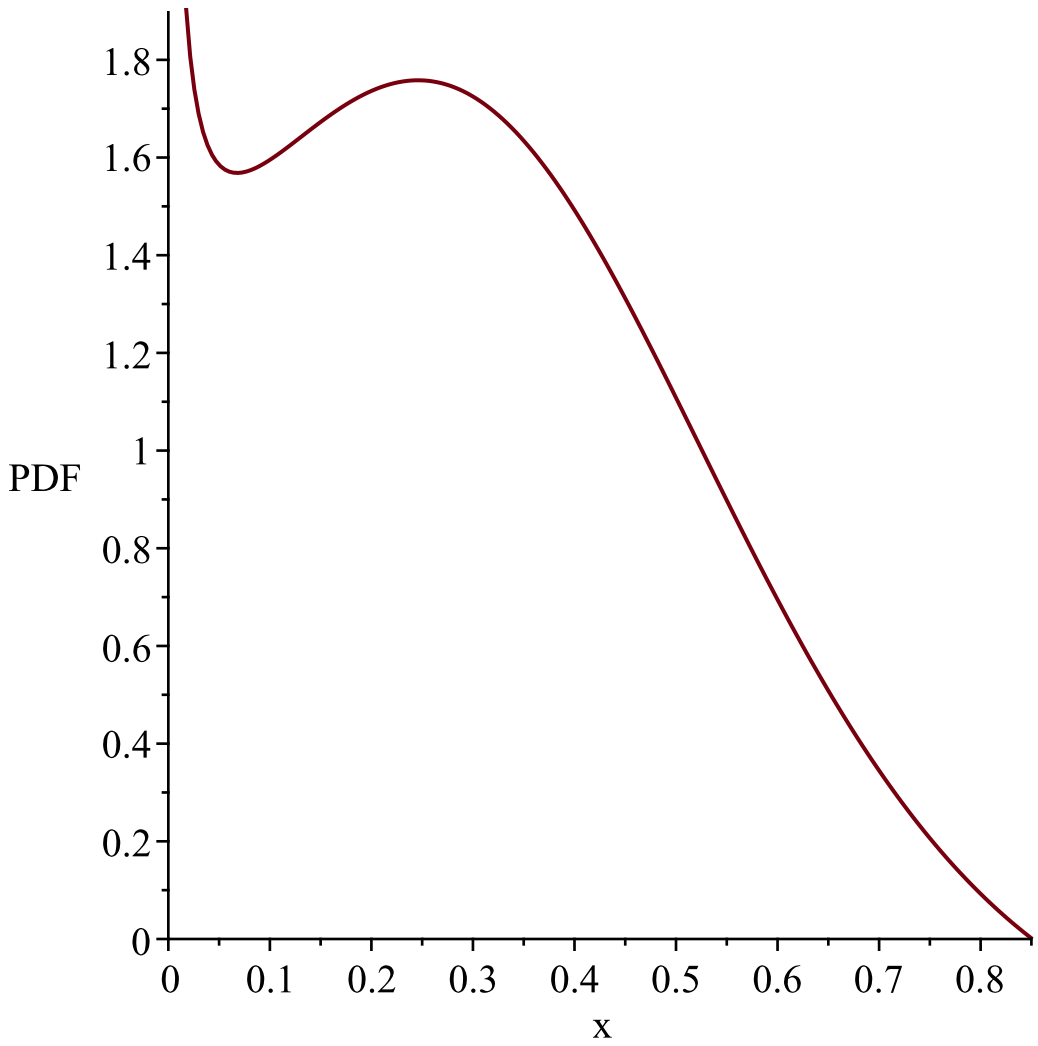
$$\left[\text{"Continuous"}, \text{"PDF"}\right]$$

$$\text{"f(x)"}, \frac{2\left(-1+\operatorname{arcsinh}\left(\frac{1}{x}\right)\right)}{\sqrt{x^2+1}\left(\operatorname{arcsinh}\left(\frac{1}{x}\right)^2-2\operatorname{arcsinh}\left(\frac{1}{x}\right)+2\right)^2|x|}$$

$$\text{"h(x)"}, \left(2\left(-1+\operatorname{arcsinh}\left(\frac{1}{x}\right)\right)\left(\ln\left(\sqrt{x^2+1}+1\right)^2-2\ln\left(\sqrt{x^2+1}+1\right)\ln(x)+\ln(x)^2\right.\right.$$
$$\left.-2\ln\left(\sqrt{x^2+1}+1\right)+2\ln(x)+2\right)\Big) \Big/ \left(\sqrt{x^2+1}\left(\operatorname{arcsinh}\left(\frac{1}{x}\right)^2\right.\right.$$
$$\left.-2\operatorname{arcsinh}\left(\frac{1}{x}\right)+2\right)^2|x|\left(\ln\left(\sqrt{x^2+1}+1\right)^2-2\ln\left(\sqrt{x^2+1}+1\right)\ln(x)+\ln(x)^2\right.$$
$$\left.\left.-2\ln\left(\sqrt{x^2+1}+1\right)+2\ln(x)+1\right)\right)$$

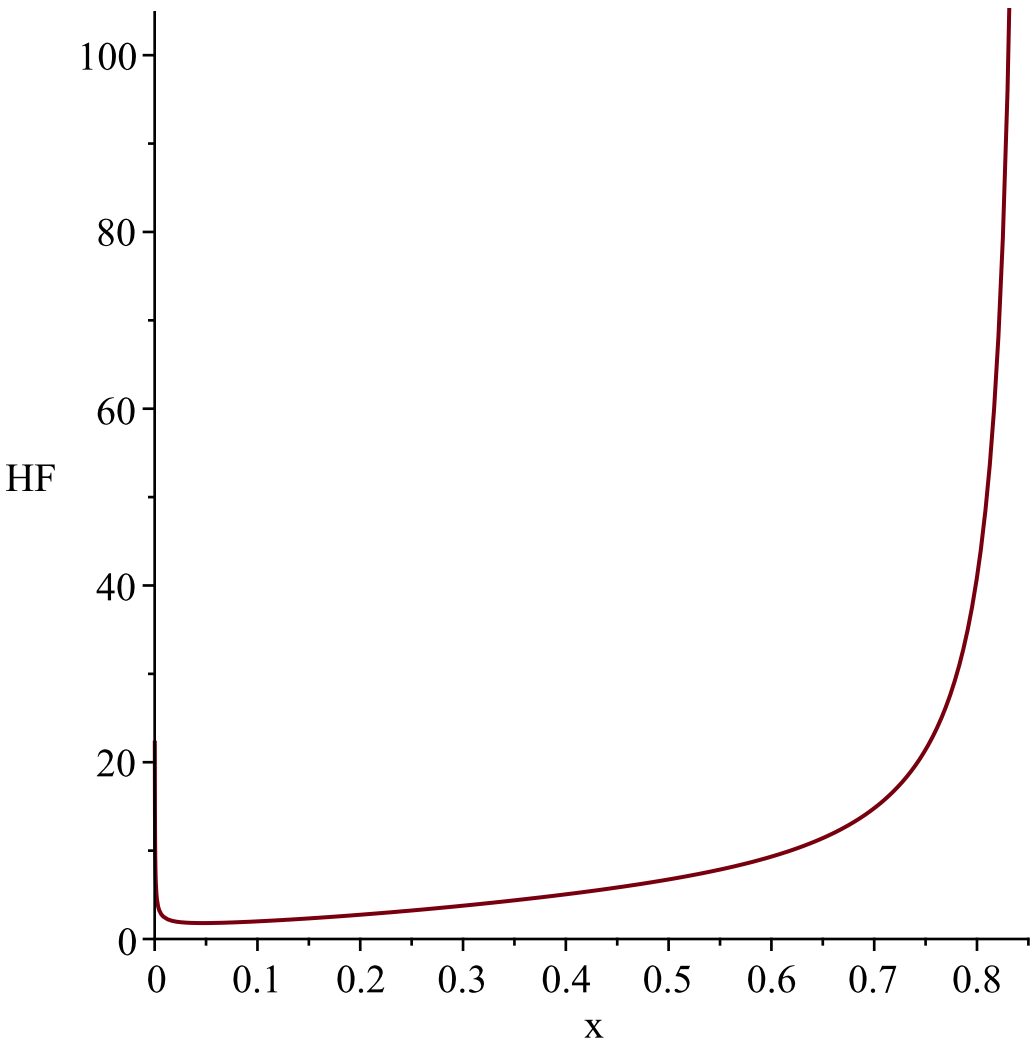
WARNING(PlotDist): High value provided by user, 40 *is greater than maximum support value of the random variable,* $\frac{2}{e-e^{-1}}$

Resetting high to RV's maximum support value



WARNING(PlotDist): High value provided by user, 40 *is greater than maximum support value of the random variable,* $\frac{2}{e - e^{-1}}$

Resetting high to RV's maximum support value




```
2\,{\frac {-1+{\rm arcsinh} \left({x}^{-1}\right)}{\sqrt {{x}^
{2}+1}
 \left(  \left( {\rm arcsinh} \left({x}^{-1}\right) \right) ^{2}
-2\,
{\rm arcsinh} \left({x}^{-1}\right)+2 \right) ^{2} \left| x
\right| }}
"i is", 18,
    " ----------------------------------------------------------------------------------------------------
    ----------"
```

$$g := t \to \frac{1}{\operatorname{arcsinh}(t+1)}$$

$$l := 0$$

$$u := \infty$$

$$Temp := \left[\left[y\sim \right.\right.$$

$$\left. \to \left(2\left(-1+\sinh\left(\frac{1}{y\sim}\right)\right)\cosh\left(\frac{1}{y\sim}\right)\right) \middle/ \left(y\sim^{2}\left(\cosh\left(\frac{1}{y\sim}\right)\right)^{4}\right.\right.$$

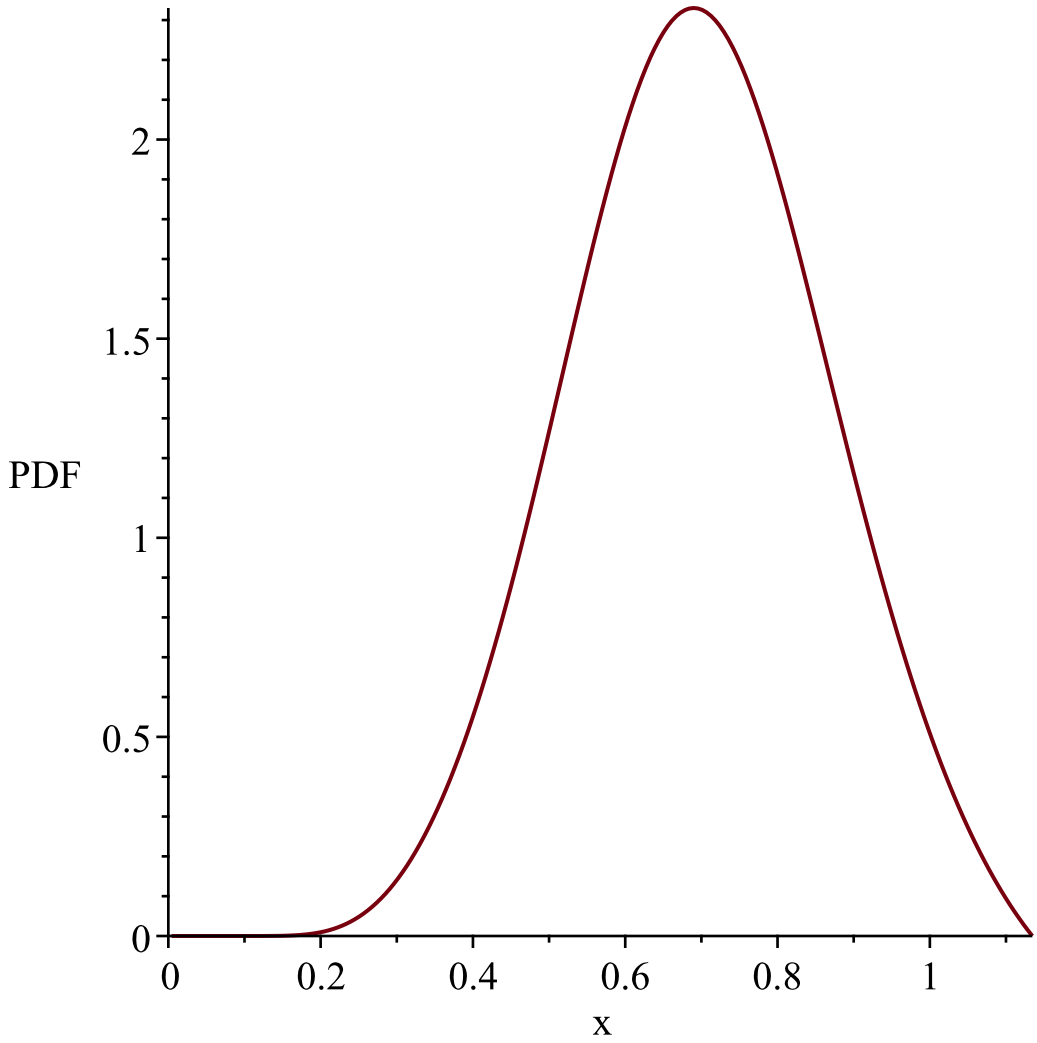
$$-4\cosh\left(\frac{1}{y\sim}\right)^2\sinh\left(\frac{1}{y\sim}\right)+6\cosh\left(\frac{1}{y\sim}\right)^2-4\sinh\left(\frac{1}{y\sim}\right)-3\Bigg)\Bigg],\left[0,\ \frac{1}{\ln\left(1+\sqrt{2}\right)}\right],\left["\text{Continuous}","\text{PDF}"\right]\Bigg]$$

$$\text{"f(x)"},\ \frac{2\left(-1+\sinh\left(\frac{1}{x}\right)\right)\cosh\left(\frac{1}{x}\right)}{x^2\left(\cosh\left(\frac{1}{x}\right)^4-4\cosh\left(\frac{1}{x}\right)^2\sinh\left(\frac{1}{x}\right)+6\cosh\left(\frac{1}{x}\right)^2-4\sinh\left(\frac{1}{x}\right)-3\right)}$$

$$\text{"h(x)"},\ -\left(2\left(e^{\frac{4}{x}}-4\,e^{\frac{3}{x}}+6\,e^{\frac{2}{x}}+4\,e^{\frac{1}{x}}+1\right)\left(-1+\sinh\left(\frac{1}{x}\right)\right)\cosh\left(\frac{1}{x}\right)\right)\Big/\left(x^2\left(e^{\frac{4}{x}}-4\,e^{\frac{3}{x}}+2\,e^{\frac{2}{x}}+4\,e^{\frac{1}{x}}+1\right)\left(-\cosh\left(\frac{1}{x}\right)^4+4\cosh\left(\frac{1}{x}\right)^2\sinh\left(\frac{1}{x}\right)-6\cosh\left(\frac{1}{x}\right)^2+4\sinh\left(\frac{1}{x}\right)+3\right)\right)$$

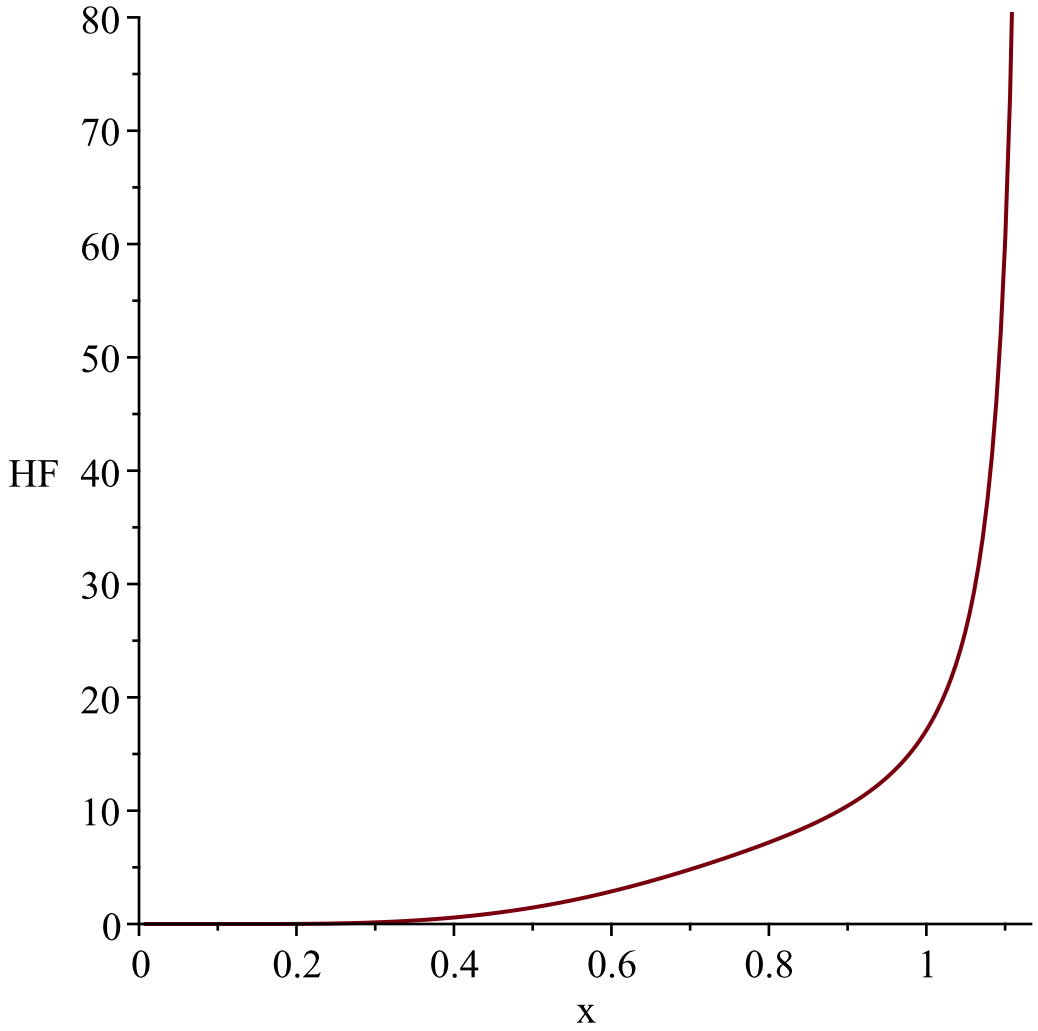
WARNING(PlotDist): High value provided by user, 40 *is greater than maximum support value of the random variable,* $\frac{1}{\ln\left(1+\sqrt{2}\right)}$

Resetting high to RV's maximum support value



WARNING(PlotDist): High value provided by user, 40 *is greater than maximum support value of the random variable,* $\frac{1}{\ln(1+\sqrt{2})}$

Resetting high to RV's maximum support value




```
2\,{\frac { \left( -1+\sinh \left( {x}^{-1} \right)  \right)
\cosh
 \left( {x}^{-1} \right) }{{x}^{2} \left(  \left( \cosh \left(
{x}^{-1
} \right)  \right) ^{4}-4\, \left( \cosh \left( {x}^{-1} \right)

 \right) ^{2}\sinh \left( {x}^{-1} \right) +6\, \left( \cosh
\left( {x
}^{-1} \right)  \right) ^{2}-4\,\sinh \left( {x}^{-1} \right) -3
 \right) }}
```

"i is", 19,

" ----------

---------"

$$g := t \to \frac{1}{\operatorname{csch}(t)} + 1$$

$$l := 0$$

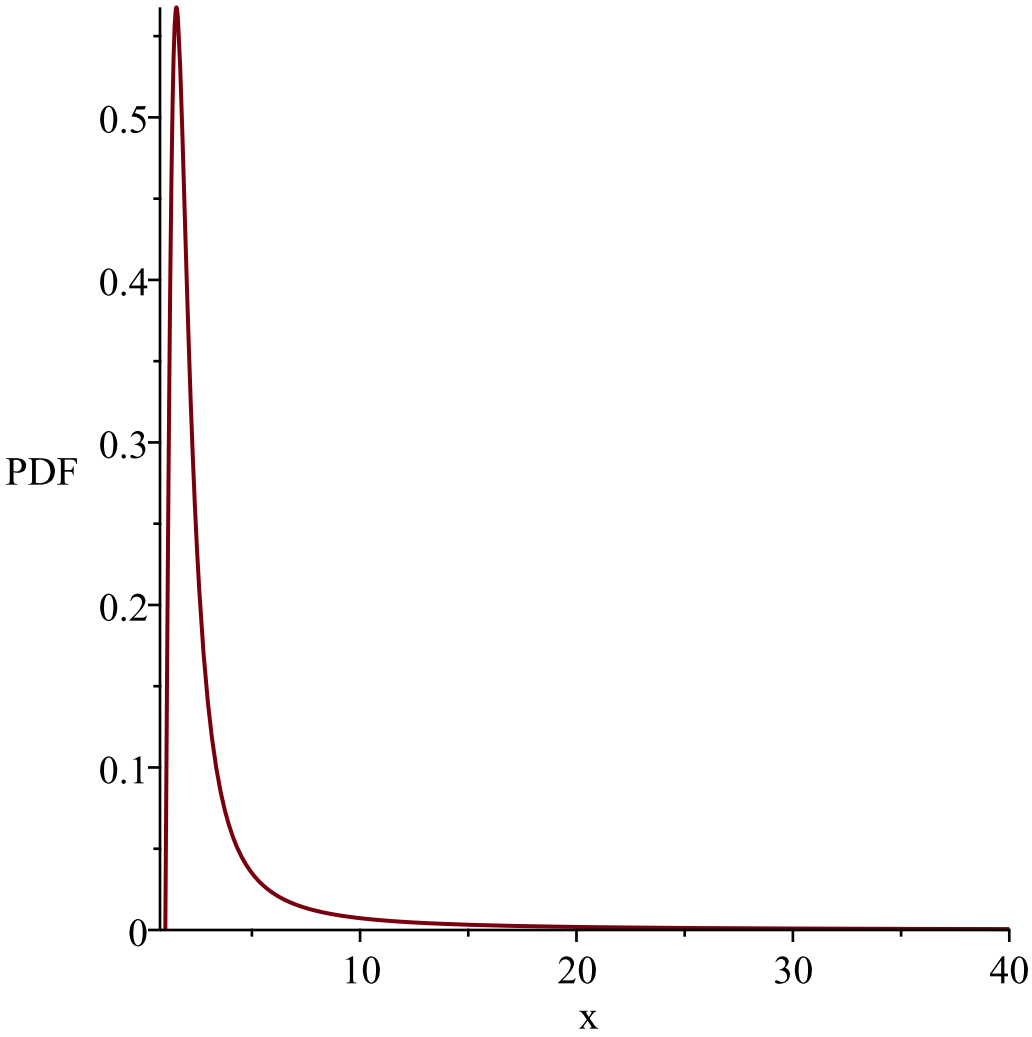
$$u := \infty$$

$$Temp := \left[\left[y\sim \to \frac{2\,\operatorname{arccsch}\left(\frac{1}{y\sim - 1}\right)}{\sqrt{y\sim^2 - 2\,y\sim + 2}\,\left(\operatorname{arccsch}\left(\frac{1}{y\sim - 1}\right)^2 + 1\right)^2} \right], [1,\ \infty], [\text{"Continuous"}, \text{"PDF"}]\right]$$

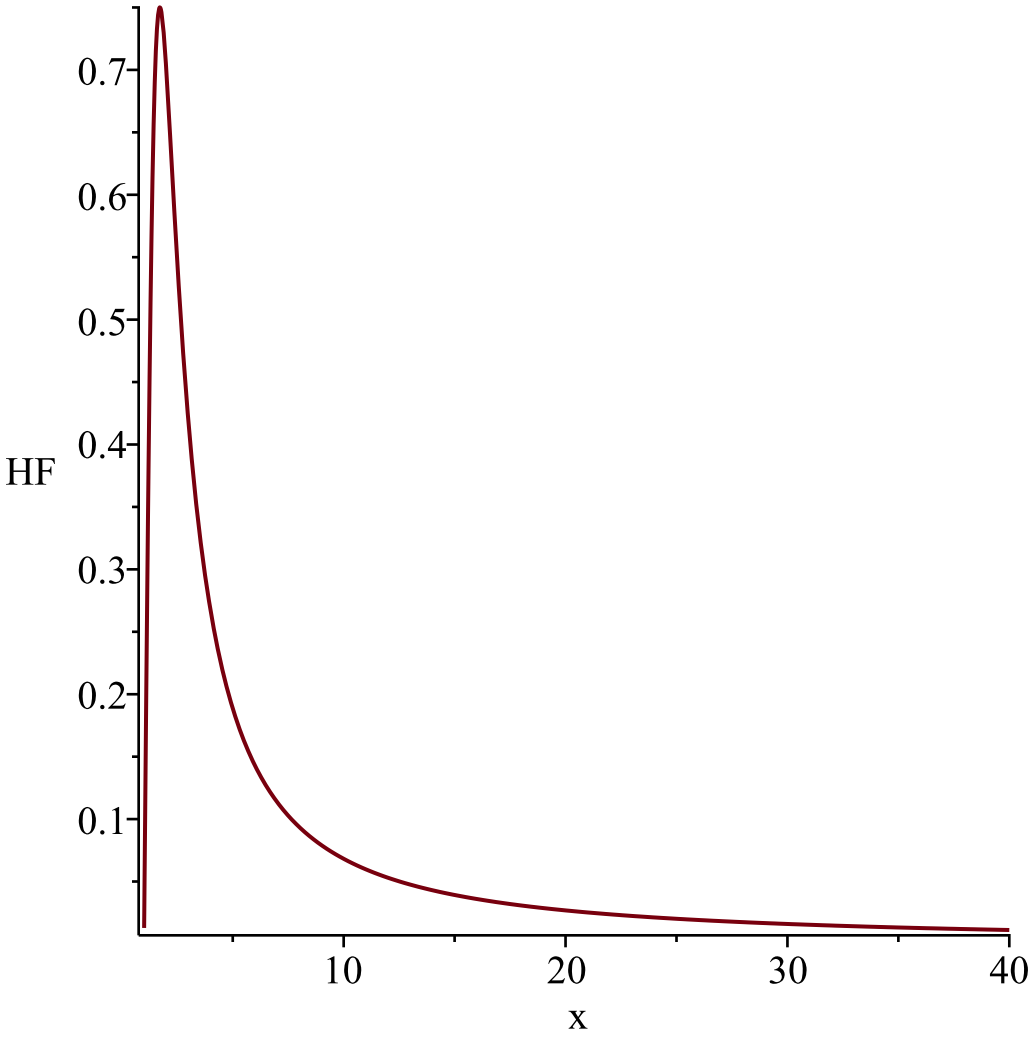
$$\text{"f(x)"},\ \frac{2\,\operatorname{arccsch}\left(\frac{1}{x-1}\right)}{\sqrt{x^2 - 2\,x + 2}\,\left(\operatorname{arccsch}\left(\frac{1}{x-1}\right)^2 + 1\right)^2}$$

$$\text{"h(x)"},\ -\left(2\,\operatorname{arccsch}\left(\frac{1}{x-1}\right)\right) \Big/ \left(\sqrt{x^2 - 2\,x + 2}\,\left(\operatorname{arccsch}\left(\frac{1}{x-1}\right)^2 + 1\right)^2 \left(-1 + 2\left(\int_1^x \frac{\operatorname{arccsch}\left(\frac{1}{t-1}\right)}{\sqrt{t^2 - 2\,t + 2}\,\left(\operatorname{arccsch}\left(\frac{1}{t-1}\right)^2 + 1\right)^2}\,dt\right)\right)\right)$$

WARNING(PlotDist): Low value provided by user, 0
is less than minimum support value of random variable
1
Resetting low to RV's minimum support value



WARNING(PlotDist): Low value provided by user, 0
is less than minimum support value of random variable
1
Resetting low to RV's minimum support value




```
2\,{\frac {{\rm arccsch} \left( \left( x-1 \right) ^{-1}\right)}
{
\sqrt {{x}^{2}-2\,x+2} \left(  \left( {\rm arccsch} \left( \left
( x-1
 \right) ^{-1}\right) \right) ^{2}+1 \right) ^{2}}}
```

"i is", 20,

" ----------"

$$g := t \to \tanh\left(\frac{1}{t}\right)$$

$$l := 0$$

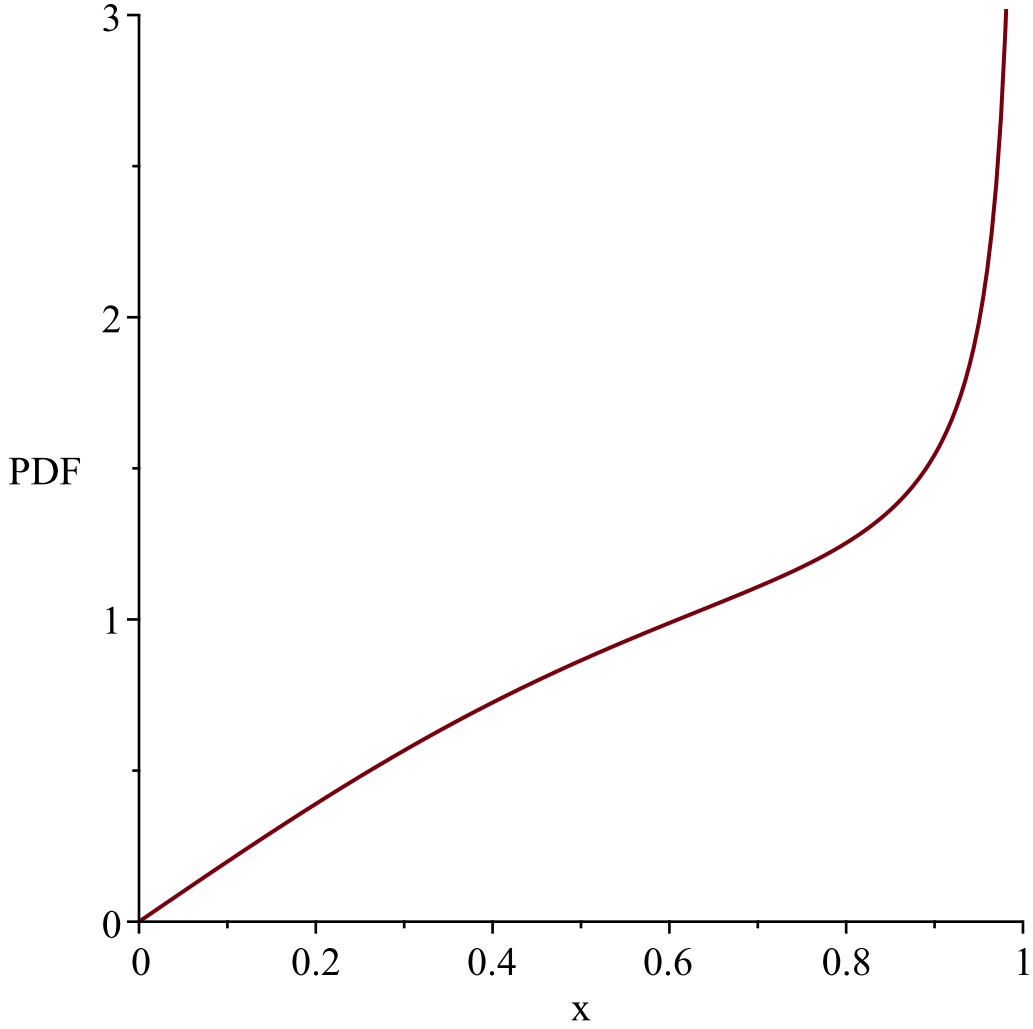
$$u := \infty$$

$$Temp := \left[\left[y\sim \to -\frac{2\,\operatorname{arctanh}(y\sim)}{\left(\operatorname{arctanh}(y\sim)^2+1\right)^2\left(y\sim^2-1\right)}\right], [0, 1], ["Continuous", "PDF"]\right]$$

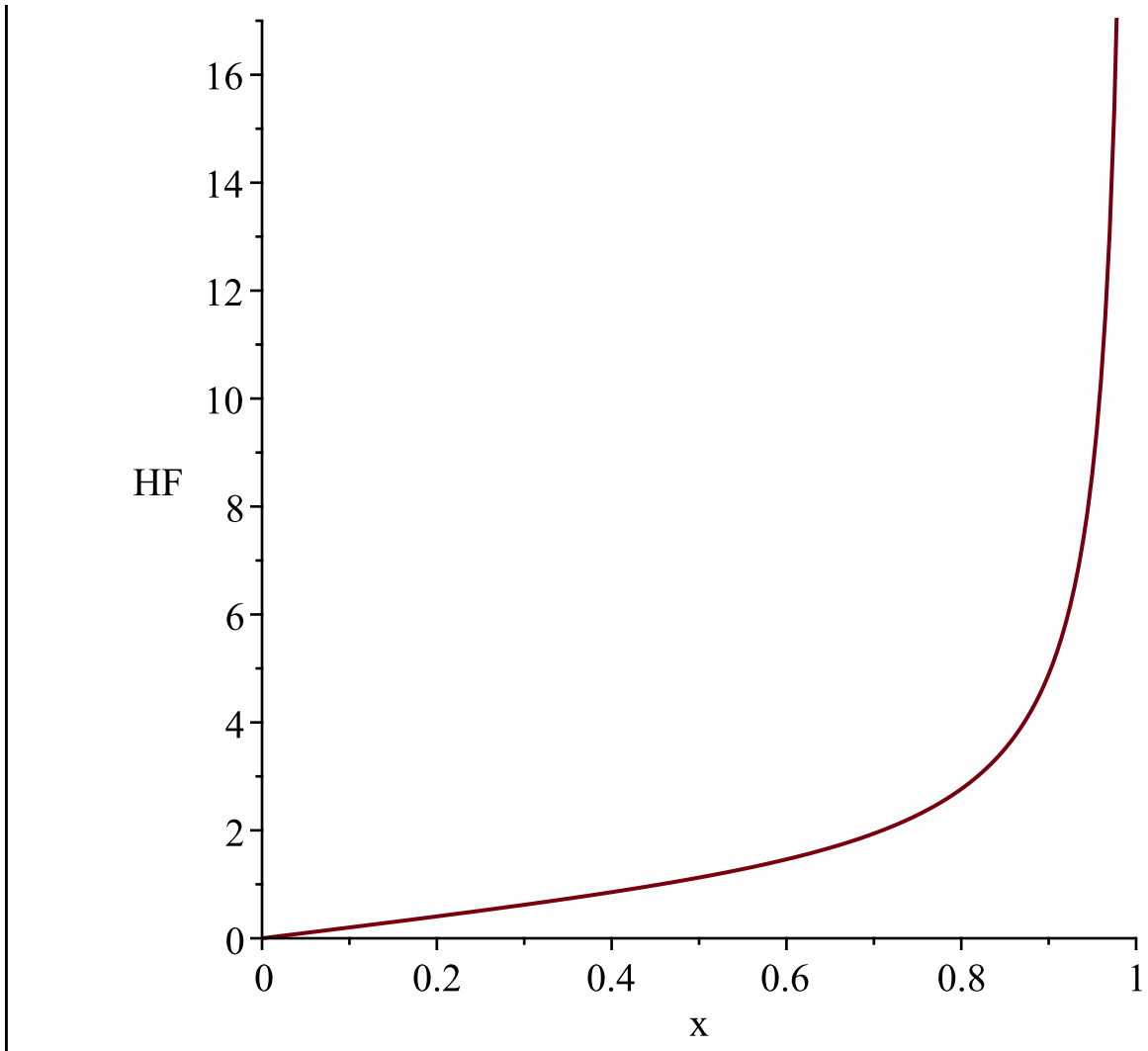
$$"f(x)",\ -\frac{2\,\operatorname{arctanh}(x)}{\left(\operatorname{arctanh}(x)^2+1\right)^2\left(x^2-1\right)}$$

$$"h(x)",\ -\frac{2\,\operatorname{arctanh}(x)}{\left(\operatorname{arctanh}(x)^2+1\right)\left(x^2-1\right)}$$

WARNING(PlotDist): High value provided by user, 40 *is greater than maximum support value of the random variable*, 1
Resetting high to RV's maximum support value



WARNING(PlotDist): High value provided by user, 40 *is greater than maximum support value of the random variable*, 1
Resetting high to RV's maximum support value




```
-2\,{\frac {{\rm arctanh} \left(x\right)}{ \left(  \left(
{\rm arctanh} \left(x\right) \right) ^{2}+1 \right) ^{2} \left(
{x}^{2
}-1 \right) }}
```