Maple - Mathematica コマンド対照一覧

このワークシートは、Mathematica ノートブックで記載されたコマンドと同等の Maple コマンドを紹介するための資料です。Mathematica のバージョン及び使用環境、さらには Maple のバージョン及び使用環境によっては双方の計算結果が異なる場合がありますのでご注意下さい。
本資料により Mathematica の計算結果、または Maple の計算結果の妥当性・正当性を保証するものではないことにご注意下さい。本資料のご不明点については、当社 Maple 技術サポートまでお問い合わせ下さい。

本資料中に用いた製品バージョン
Maple 16.00, Windows 版
Mathematica 8.0.0, Windows 版

最終更新：2012年5月29日

Core Language

```
> restart;
```

Table

Maple による計算

```
> seq(i,i=1..10);
```

1, 2, 3, 4, 5, 6, 7, 8, 9, 10

```
> Typesetting:-RuleAssistant();
```

-5, -4.5, -4.0, -3.5, -3.0, -2.5, -2.0, -1.5, -1.0, -0.5, 0., 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

```
>
```

Mathematica による計算

▪ Table

```
In[1]:= Table[i, {i, 1, 10}]
Out[1]= {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}

In[2]:= Table[i, {i, -5, 5, 0.5}]
Out[2]= {-5., -4.5, -4., -3.5, -3., -2.5, -2., -1.5, -1., -0.5,
      0., 0.5, 1., 1.5, 2., 2.5, 3., 3.5, 4., 4.5, 5.}
```

Range

```
> $1..4;
  seq(1..4);
```

1, 2, 3, 4

1, 2, 3, 4

```
> seq(0.5..2.5,0.2);
```

0.5, 0.7, 0.9, 1.1, 1.3, 1.5, 1.7, 1.9, 2.1, 2.3, 2.5

```
>
```

▪ Range

```
In[3]:= Range[4]
Out[3]= {1, 2, 3, 4}

In[4]:= Range[0.5, 2.5, 0.2]
Out[4]= {0.5, 0.7, 0.9, 1.1, 1.3, 1.5, 1.7, 1.9, 2.1, 2.3, 2.5}
```

Part

```
> L := [seq([seq(a[i,j],j=1..8)],i=1..3)];
```

$$L := \left[\left[a_{1,1}, a_{1,2}, a_{1,3}, a_{1,4}, a_{1,5}, a_{1,6}, a_{1,7}, a_{1,8}\right], \left[a_{2,1}, a_{2,2}, a_{2,3}, a_{2,4}, a_{2,5}, a_{2,6}, a_{2,7}, a_{2,8}\right], \left[a_{3,1}, a_{3,2}, a_{3,3}, a_{3,4}, a_{3,5}, a_{3,6}, a_{3,7}, a_{3,8}\right]\right]$$

```
> L[2];
```

$$\left[a_{2,1}, a_{2,2}, a_{2,3}, a_{2,4}, a_{2,5}, a_{2,6}, a_{2,7}, a_{2,8}\right]$$

```
> L[..,2];
```

$$\left[a_{1,2}, a_{2,2}, a_{3,2}\right]$$

```
>
```

■ Part

```
In[5]:= L = Table[a[i, j], {i, 1, 3}, {j, 1, 8}]
Out[5]= {{a[1, 1], a[1, 2], a[1, 3], a[1, 4],
          a[1, 5], a[1, 6], a[1, 7], a[1, 8]},
         {a[2, 1], a[2, 2], a[2, 3], a[2, 4], a[2, 5], a[2, 6],
          a[2, 7], a[2, 8]}, {a[3, 1], a[3, 2], a[3, 3],
          a[3, 4], a[3, 5], a[3, 6], a[3, 7], a[3, 8]}}

In[6]:= Part[L, 2]
Out[6]= {a[2, 1], a[2, 2], a[2, 3], a[2, 4],
         a[2, 5], a[2, 6], a[2, 7], a[2, 8]}

In[7]:= L[[All, 2]]
Out[7]= {a[1, 2], a[2, 2], a[3, 2]}
```

Join, Transpose, Union

```
> a := [1,2,3];
  b := [x,y,z];
```

$$a := [1, 2, 3]$$
$$b := [x, y, z]$$

```
> [a[],b[]];
```

$$[1, 2, 3, x, y, z]$$

```
> [op(a),op(b)];
```

$$[1, 2, 3, x, y, z]$$

```
> c := Matrix([[1,2],[2,3],[3,4]]);
```

$$c := \begin{bmatrix} 1 & 2 \\ 2 & 3 \\ 3 & 4 \end{bmatrix}$$

```
> c^%T;
```

$$\begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 4 \end{bmatrix}$$

```
> a := {x,y,z};
  b := {1,x,y};
```

$$a := \{x, y, z\}$$
$$b := \{1, x, y\}$$

```
> a union b;
```

$$\{1, x, y, z\}$$

```
>
```

■ Join, Transpose, Union

```
In[8]:= Join[{1, 2, 3}, {a, b, c}]
Out[8]= {1, 2, 3, a, b, c}

In[9]:= Transpose[{{1, 2}, {2, 3}, {3, 4}}]
Out[9]= {{1, 2, 3}, {2, 3, 4}}

In[10]:= Union[{x, y, z}, {1, x, y}]
Out[10]= {1, x, y, z}
```

Do

```
> for i from 0 to 5 do
    print(i+1);
  end do;
```

1
2
3
4
5
6

```
> for i in [1,3,4,5,9,13,22,
  32] do
    print(i,type(i,even));
  end do;
```

1, *false*
3, *false*
4, *true*
5, *false*
9, *false*
13, *false*
22, *true*
32, *true*

```
>
```

Do

```
In[11]:= Do[Print[i + 1], {i, 0, 5}]
```

1
2
3
4
5
6

```
In[12]:= Do[Print[{i, EvenQ[i]}],
           {i, {1, 3, 4, 5, 9, 13, 22, 32}}]
```

{1, False}
{3, False}
{4, True}
{5, False}
{9, False}
{13, False}
{22, True}
{32, True}

Nest

```
> foldl((id,v)->f(id),x,1,2,
  3);
```

$f(f(f(x)))$

```
> foldl((id,v)->(id+1)^2,1,1,
  2,3);
```

676

```
>
```

Nest

```
In[13]:= Nest[f, x, 3]
Out[13]= f[f[f[x]]]

In[14]:= Nest[(1 + #)^2 &, 1, 3]
Out[14]= 676
```

ParallelMap

```
> restart;
> f1 := n -> nops(ifactors((10^n-1)/9)[2]);
```

$f1 := n \rightarrow nops\left(ifactors\left(\frac{1}{9}\ 10^n - \frac{1}{9}\right)_2\right)$

```
> Threads:-Map(f1, [$50..60]);
```

[10, 8, 9, 4, 12, 8, 12, 6, 8, 2, 20]

```
>
```

ParallelMap

```
In[15]:= f1[n_] := Length[FactorInteger[(10^n - 1) / 9]]
In[16]:= ParallelMap[f1, Range[50, 60]]
Out[16]= {10, 8, 9, 4, 12, 8, 12, 6, 8, 2, 20}
```

FileNames

```
> currentdir(kernelopts(mapledir)):
> FileTools:-ListDirectory(".");
["afm", "bin.win", "data", "ETC", "EULA.html", "EULA_en.html",
      "examples", "examplesclassic", "Excel", "extern",
      "Install.html", "Install_en.html", "java", "jre", "lib", "license",
      "MapleToolbox.bat", "MapleToolbox_Windows.exe",
      "Maple_15.01_Windows_Upgrade_InstallLog.log",
      "Maple_15_InstallLog.log", "reader", "readme.txt", "redist",
      "samples", "toolbox", "uninstall", "Users"]
>
```

FileNames

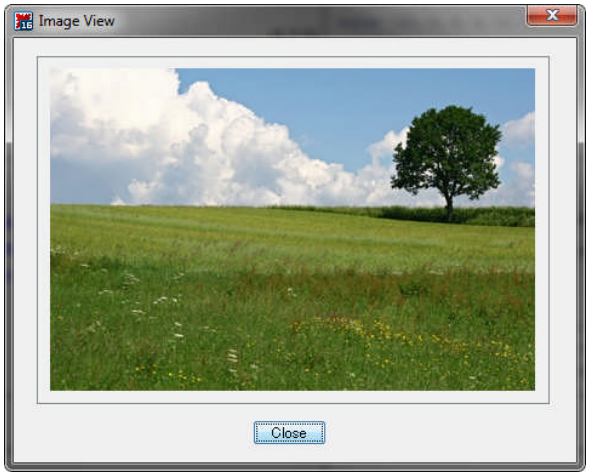
```
In[17]:= SetDirectory[$InstallationDirectory]
Out[17]= C:\Program Files\Wolfram Research\Mathematica\8.0

In[18]:= FileNames[]
Out[18]= {AddOns, Configuration, .CreationID, Documentation,
       Mathematica.exe, math.exe, MathKernel.exe,
       .PatchLevel, SystemFiles, .VersionID}
```

Import

```
> restart;
> currentdir(kernelopts(datadir)):
> img := ImageTools:-Read("images/tree.
  jpg");
```

$$img := \begin{bmatrix} 1..266 \times 1..400 \times 1..3 \text{ Array} \\ \text{Data Type: float}_8 \\ \text{Storage: rectangular} \\ \text{Order: C\_order} \end{bmatrix}$$

```
> ImageTools:-View(img);
```




```
>
```

Import

```
In[19]:= img = Import["ExampleData/rose.gif"]
```

Out[19]=

Mathematics and Algorithms

```
> restart;
```

Expand, Simplify, FunctionExpand

```
> expand((x+y+z)^3);
```

$$x^3+3x^2y+3x^2z+3xy^2+6xyz+3xz^2+y^3+3y^2z+3yz^2+z^3$$

```
> S := diff(int(1/(x^3+1),x),x);
```

$$S := \frac{1}{3\,(x+1)} - \frac{1}{6}\,\frac{2x-1}{x^2-x+1} + \frac{2}{3\left(1+\frac{1}{3}\,(2x-1)^2\right)}$$

```
> normal(S,expanded);
```

$$\frac{1}{x^3+1}$$

```
> simplify(4*arctan(1/5) - arctan(1/239));
```

$$\frac{1}{4}\,\pi$$

```
> simplify(x*GAMMA(x));
```

$$\Gamma(x+1)$$

```
>
```

■ Expand, Simplify, FunctionExpand

```
In[20]:= Expand[(x + y + z)^3]
Out[20]= x^3 + 3 x^2 y + 3 x y^2 + y^3 + 3 x^2 z +
         6 x y z + 3 y^2 z + 3 x z^2 + 3 y z^2 + z^3

In[21]:= S = D[Integrate[1 / (x^3 + 1), x], x]
Out[21]= 1/(3 (1 + x)) - (-1 + 2 x)/(6 (1 - x + x^2)) + 2/(3 (1 + 1/3 (-1 + 2 x)^2))

In[22]:= Simplify[S]
Out[22]= 1/(1 + x^3)

In[23]:= FunctionExpand[4 ArcTan[1 / 5] - ArcTan[1 / 239]]
Out[23]= Pi/4

In[24]:= FullSimplify[x Gamma[x]]
Out[24]= Gamma[1 + x]
```

RandomInteger, RandomReal

```
> restart:
  with(RandomTools);
```

[*AddFlavor, BlumBlumShub, Generate, GetFlavor, GetFlavors, GetState, HasFlavor, LinearCongruence, MersenneTwister, QuadraticCongruence, RemoveFlavor, SetState, returnValueInertProc*]

```
> Generate(list(integer(range=1..10),30));
```

[7, 10, 6, 2, 4, 6, 5, 1, 8, 5, 10, 2, 2, 4, 8, 3, 9, 10, 2, 8, 10, 9, 1, 6, 7, 7, 3, 3, 5, 3]

```
> Generate(list(float(range=-3..3),10));
```

[−0.032444839, −1.431688322, 1.810624848, 2.801695388, 2.582822199, 0.015733791, −2.656899187, −1.081172609, 2.852055212, 1.115607322]

```
>
```

■ RandomInteger, RandomReal

```
In[25]:= RandomInteger[{1, 10}, 30]
Out[25]= {9, 5, 3, 2, 1, 3, 2, 7, 6, 5, 2, 7, 9, 10,
          7, 4, 6, 4, 8, 4, 9, 7, 1, 8, 4, 9, 3, 3, 1, 7}

In[26]:= RandomReal[{-3, 3}, 10]
Out[26]= {1.39224, 0.210714, -1.37863, -0.70807, 0.603412,
          -0.968635, 2.11023, -0.211467, -0.121262, 2.5369}
```

FactorInteger

```
> ifactor(2434500);
```

$$(2)^2\,(3)^2\,(5)^3\,(541)$$

```
> ifactors(2434500);
```

[1, [[2, 2], [3, 2], [5, 3], [541, 1]]]

```
>
```

■ FactorInteger

```
In[27]:= FactorInteger[2 434 500]
Out[27]= {{2, 2}, {3, 2}, {5, 3}, {541, 1}}
```

Coefficient, Numerator, Denominator

```
> restart;
> coeff((1+x)^3,x,2);
                              3
> p := expand((1+x)^10);
p := 1 + 10 x + 45 x^2 + 120 x^3 + 210 x^4 + 252 x^5 + 210 x^6 + 120 x^7
     + 45 x^8 + 10 x^9 + x^10
> coeffs(p,x);
          1, 45, 10, 120, 210, 252, 210, 120, 45, 10, 1
> f := (1+x-x^2)/(y^2-1);
                              f := (1 + x - x^2)/(y^2 - 1)
> numer(f);
                                   1 + x - x^2
> denom(f);
                                     y^2 - 1
>
```

■ Coefficient, Numerator, Denominator

```
In[28]:= Coefficient[(x + 1)^3, x, 2]
Out[28]= 3

In[29]:= CoefficientList[(1 + x)^10, x]
Out[29]= {1, 10, 45, 120, 210, 252, 210, 120, 45, 10, 1}

In[30]:= f = (1 + x - x^2) / (y^2 - 1)
Out[30]= (1 + x - x^2)/(-1 + y^2)

In[31]:= Numerator[f]
Out[31]= 1 + x - x^2

In[32]:= Denominator[f]
Out[32]= -1 + y^2
```

Series

```
> restart;
> series(sin(x),x=x0,11);
sin(x0) + cos(x0) (x - x0) - 1/2 sin(x0) (x - x0)^2 - 1/6 cos(x0) (x
     - x0)^3 + 1/24 sin(x0) (x - x0)^4 + 1/120 cos(x0) (x - x0)^5
     - 1/720 sin(x0) (x - x0)^6 - 1/5040 cos(x0) (x - x0)^7
     + 1/40320 sin(x0) (x - x0)^8 + 1/362880 cos(x0) (x - x0)^9
     - 1/3628800 sin(x0) (x - x0)^10 + O((x - x0)^11)
> series(arccos(x),x=1,1) assuming x>1;
                              O(sqrt(x - 1))
> series((1+1/n)^n,n=infinity,7);
e - 1/2 e/n + 11/24 e/n^2 - 7/16 e/n^3 + 2447/5760 e/n^4 - 959/2304 e/n^5
     + O(1/n^6)
>
```

■ Series

```
In[33]:= Series[Sin[x], {x, x0, 10}]
Out[33]= Sin[x0] + Cos[x0] (x - x0) - 1/2 Sin[x0] (x - x0)^2 -
     1/6 Cos[x0] (x - x0)^3 + 1/24 Sin[x0] (x - x0)^4 +
     1/120 Cos[x0] (x - x0)^5 - 1/720 Sin[x0] (x - x0)^6 -
     Cos[x0] (x - x0)^7/5040 + Sin[x0] (x - x0)^8/40320 +
     Cos[x0] (x - x0)^9/362880 - Sin[x0] (x - x0)^10/3628800 + O[x - x0]^11

In[34]:= Series[ArcCos[x], {x, 1, 1}, Assumptions -> x > 1]
Out[34]= I Sqrt[2] Sqrt[x - 1] + O[x - 1]^(3/2)

In[35]:= Series[(1 + 1/n)^n, {n, Infinity, 5}]
Out[35]= E - E/(2 n) + 11 E/(24 n^2) - 7 E/(16 n^3) + 2447 E/(5760 n^4) - 959 E/(2304 n^5) + O[1/n]^6
```

Collect, Together, TrigExpand

```
> restart;
> collect(expand((1+a+x)^4), x);
```

$$x^4+(4a+4)x^3+(6+6a^2+12a)x^2+(12a+12a^2+4a^3+4)x+1+4a+6a^2+a^4+4a^3$$

```
> normal(a/b+c/d);
```

$$\frac{ad+cb}{bd}$$

```
> expand(sin(x+y+z));
```

$$\sin(x)\cos(y)\cos(z)-\sin(x)\sin(y)\sin(z)+\cos(x)\sin(y)\cos(z)+\cos(x)\cos(y)\sin(z)$$

```
>
```

■ Collect, Together, TrigExpand

```
In[36]:= Collect[Expand[(1 + a + x)^4], x]
Out[36]= 1 + 4 a + 6 a^2 + 4 a^3 + a^4 + (4 + 12 a + 12 a^2 + 4 a^3) x +
         (6 + 12 a + 6 a^2) x^2 + (4 + 4 a) x^3 + x^4

In[37]:= Together[a / b + c / d]
Out[37]= (b c + a d)/(b d)

In[38]:= TrigExpand[Sin[x + y + z]]
Out[38]= Cos[y] Cos[z] Sin[x] + Cos[x] Cos[z] Sin[y] +
         Cos[x] Cos[y] Sin[z] - Sin[x] Sin[y] Sin[z]
```

IdentityMatrix, DiagonalMatrix, HilbertMatrix

```
> restart:
  with(LinearAlgebra):
> IdentityMatrix(3);
```

$$\begin{bmatrix}1&0&0\\0&1&0\\0&0&1\end{bmatrix}$$

```
> DiagonalMatrix([a,b,c]);
```

$$\begin{bmatrix}a&0&0\\0&b&0\\0&0&c\end{bmatrix}$$

```
> HilbertMatrix(3);
```

$$\begin{bmatrix}1&\frac{1}{2}&\frac{1}{3}\\\frac{1}{2}&\frac{1}{3}&\frac{1}{4}\\\frac{1}{3}&\frac{1}{4}&\frac{1}{5}\end{bmatrix}$$

```
>
```

■ IdentityMatrix, DiagonalMatrix, HilbertMatrix

```
In[39]:= IdentityMatrix[3]
Out[39]= {{1, 0, 0}, {0, 1, 0}, {0, 0, 1}}

In[40]:= DiagonalMatrix[{a, b, c}]
Out[40]= {{a, 0, 0}, {0, b, 0}, {0, 0, c}}

In[41]:= HilbertMatrix[3]
Out[41]= {{1, 1/2, 1/3}, {1/2, 1/3, 1/4}, {1/3, 1/4, 1/5}}
```

LinearSolve, NullSpace, Eigenvalues

```
> restart;
> with(LinearAlgebra):
> LinearSolve(Matrix([[a,b],[c,d]]),Vector(
  [x,y]));
```

$$\begin{bmatrix} -\frac{b\,y-x\,d}{a\,d-c\,b} \\ \frac{a\,y-c\,x}{a\,d-c\,b} \end{bmatrix}$$

```
> NullSpace(Matrix([[1,2,3],[4,5,6],[7,8,9]
  ]));
```

$$\left\{\begin{bmatrix} 1 \\ -2 \\ 1 \end{bmatrix}\right\}$$

```
> Eigenvalues(Matrix([[a,b],[c,d]]));
```

$$\begin{bmatrix} \frac{1}{2}\,d+\frac{1}{2}\,a+\frac{1}{2}\,\sqrt{d^2-2\,a\,d+a^2+4\,c\,b} \\ \frac{1}{2}\,d+\frac{1}{2}\,a-\frac{1}{2}\,\sqrt{d^2-2\,a\,d+a^2+4\,c\,b} \end{bmatrix}$$

```
>
```

■ LinearSolve, NullSpace, Eigenvalues

```
In[42]:= LinearSolve[{{a, b}, {c, d}}, {x, y}]
```

$$\text{Out[42]}= \left\{\frac{d\,x-b\,y}{-b\,c+a\,d}, \frac{c\,x-a\,y}{b\,c-a\,d}\right\}$$

```
In[43]:= NullSpace[{{1, 2, 3}, {4, 5, 6}, {7, 8, 9}}]
Out[43]= {{1, -2, 1}}

In[44]:= Eigenvalues[{{a, b}, {c, d}}]
```

$$\text{Out[44]}= \left\{\frac{1}{2}\left(a+d-\sqrt{a^2+4\,b\,c-2\,a\,d+d^2}\right), \frac{1}{2}\left(a+d+\sqrt{a^2+4\,b\,c-2\,a\,d+d^2}\right)\right\}$$

QRDecomposition, SingularValueDecomposition

```
> restart;
> with(LinearAlgebra):
> evalf(QRDecomposition(Matrix([[1,2,3],[4,
  5,6]])));
```

$$\begin{bmatrix} 0.2425356251 & 0.9701425000 \\ 0.9701425000 & -0.2425356251 \end{bmatrix},$$

$$\begin{bmatrix} 4.123105626 & 5.335783751 & 6.548461876 \\ 0. & 0.7276068750 & 1.455213750 \end{bmatrix}$$

```
> SingularValues(Matrix([[1,2],[1,2]]),
  output=['U','S','Vt']);
```

$$\begin{bmatrix} -0.707106781186547 & -0.707106781186547 \\ -0.707106781186547 & 0.707106781186547 \end{bmatrix},$$

$$\begin{bmatrix} 3.16227766016838 \\ 0. \end{bmatrix},$$

$$\begin{bmatrix} -0.447213595499958 & -0.894427190999916 \\ -0.894427190999916 & 0.447213595499958 \end{bmatrix}$$

```
>
```

■ QRDecomposition, SingularValueDecomposition

```
In[45]:= N[QRDecomposition[{{1, 2, 3}, {4, 5, 6}}]]
Out[45]= {{{0.242536, 0.970143}, {0.970143, -0.242536}},
          {{4.12311, 5.33578, 6.54846},
           {0., 0.727607, 1.45521}}}

In[46]:= N[SingularValueDecomposition[{{1, 2}, {1, 2}}]]
Out[46]= {{{0.707107, -0.707107}, {0.707107, 0.707107}},
          {{3.16228, 0.}, {0., 0.}},
          {{0.447214, -0.894427}, {0.894427, 0.447214}}}
```

D, Integrate, NIntegrate

```
> restart;
> diff(sin(x)/x,x);
```

$$\frac{\cos(x)}{x} - \frac{\sin(x)}{x^2}$$

```
> int(cos(x)^2,x);
```

$$\frac{1}{2}\cos(x)\sin(x) + \frac{1}{2}x$$

```
> int(sqrt(x+sqrt(x)),x=1..3);
```

$$-\frac{7}{12}\sqrt{2} - \frac{1}{4}\ln\left(1+\sqrt{2}\right) - \frac{3}{16}\ln(3) + \frac{7}{4}\sqrt{\sqrt{3}+3} + \frac{1}{6}\sqrt{3}\sqrt{\sqrt{3}+3} + \frac{1}{4}\ln\left(3+\sqrt{3}\sqrt{\sqrt{3}+3}\right)$$

```
> evalf(%);
```

3.661538688

```
> int(BesselJ(0,x)/(1+x),x=0..1,numeric);
```

0.6465434265

```
>
```

■ D, Integrate, NIntegrate

```
In[47]:= D[Sin[x] / x, x]
```

$$\text{Out[47]=}\ \frac{\text{Cos}[x]}{x} - \frac{\text{Sin}[x]}{x^2}$$

```
In[48]:= Integrate[Cos[x]^2, x]
```

$$\text{Out[48]=}\ \frac{x}{2} + \frac{1}{4}\text{Sin}[2x]$$

```
In[49]:= Integrate[Sqrt[x + Sqrt[x]], {x, 1, 3}]
```

$$\text{Out[49]=}\ \frac{1}{24}\left(-14\sqrt{2} + 42\sqrt{3+\sqrt{3}} + 4\sqrt{3\left(3+\sqrt{3}\right)} - 3\,\text{Log}\left[3+2\sqrt{2}\right] + 3\,\text{Log}\left[1+2\sqrt{3}+2\sqrt{3+\sqrt{3}}\right]\right)$$

```
In[50]:= N[%]
```

$$\text{Out[50]=}\ 3.66154$$

```
In[51]:= NIntegrate[BesselJ[0, x] / (1 + x), {x, 0, 1}]
```

$$\text{Out[51]=}\ 0.646543$$

Solve, NSolve, DSolve

```
> restart;
> solve(a*x^2+1=0,x);
```

$$-\frac{1}{\sqrt{-a}}, \frac{1}{\sqrt{-a}}$$

```
> solve([x^2+y^2=1,y-2*x^2+3/2=0],[x,y],
  explicit);
```

$$\left[\left[x=\frac{1}{4}\sqrt{10-2\sqrt{5}}, y=-\frac{1}{4}-\frac{1}{4}\sqrt{5}\right], \left[x=-\frac{1}{4}\sqrt{10-2\sqrt{5}}, y=-\frac{1}{4}-\frac{1}{4}\sqrt{5}\right], \left[x=\frac{1}{4}\sqrt{10+2\sqrt{5}}, y=\frac{1}{4}\sqrt{5}-\frac{1}{4}\right], \left[x=-\frac{1}{4}\sqrt{10+2\sqrt{5}}, y=\frac{1}{4}\sqrt{5}-\frac{1}{4}\right]\right]$$

```
> fsolve(x^5-2*x+3=0,x);
```

−1.423605849

```
> RootFinding:-Homotopy([x^2+y^3-1,2*x+3*
  y-4]);
```

[[$x = 7.936409582 + 0.\,I$, $y = -3.957606388 - 0.\,I$], [$x = 0.7192952096 - 0.2556787521\,I$, $y = 0.8538031936 + 0.1704525014\,I$], [$x = 0.7192952090 + 0.2556787520\,I$, $y = 0.8538031940 - 0.1704525013\,I$]]

```
> yx := diff(y(x),x):
> dsolve({yx+y(x)=a*sin(x),y(0)=0});
```

$$y(x) = -\frac{1}{2}a\cos(x) + \frac{1}{2}a\sin(x) + \frac{1}{2}e^{-x}a$$

```
> dsolve({yx=y(x)*(1-y(x)/27),y(0)=a});
```

$$y(x) = -\frac{27a}{-a + e^{-x}a - 27e^{-x}}$$

```
> s := dsolve({yx=y(x)*cos(x+y(x)),y(0)=1},
  numeric);
```

$s :=$ **proc**(x_rkf45) ... **end proc**

```
> plots[odeplot](s,[x,y(x)],0..30);
```

■ Solve, NSolve, DSolve, NDSolve

```
In[52]:= Solve[a*x^2 + 1 == 0, x]
```

$$\text{Out[52]=}\ \left\{\left\{x \to -\frac{i}{\sqrt{a}}\right\}, \left\{x \to \frac{i}{\sqrt{a}}\right\}\right\}$$

```
In[53]:= Solve[x^2 + y^2 == 1 && y - 2*x^2 + 3/2 == 0, {x, y}]
```

$$\text{Out[53]=}\ \left\{\left\{x \to -\frac{1}{2}\sqrt{\frac{1}{2}\left(5-\sqrt{5}\right)}, y \to \frac{1}{4}\left(-1-\sqrt{5}\right)\right\}, \left\{x \to \frac{1}{2}\sqrt{\frac{1}{2}\left(5-\sqrt{5}\right)}, y \to \frac{1}{4}\left(-1-\sqrt{5}\right)\right\}, \left\{x \to -\frac{1}{2}\sqrt{\frac{1}{2}\left(5+\sqrt{5}\right)}, y \to \frac{1}{4}\left(-1+\sqrt{5}\right)\right\}, \left\{x \to \frac{1}{2}\sqrt{\frac{1}{2}\left(5+\sqrt{5}\right)}, y \to \frac{1}{4}\left(-1+\sqrt{5}\right)\right\}\right\}$$

```
In[54]:= NSolve[x^5 - 2*x + 3 == 0, x, Reals]
```

$$\text{Out[54]=}\ \{\{x \to -1.42361\}\}$$

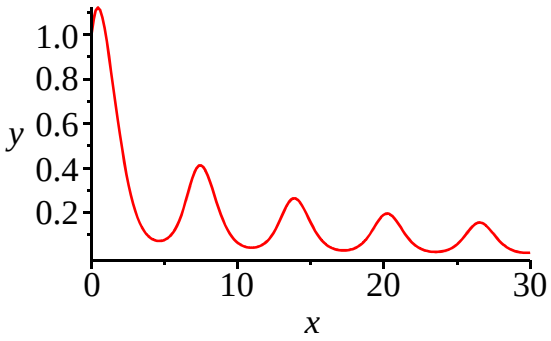
```
In[55]:= NSolve[{x^2 + y^3 == 1, 2*x + 3*y == 4}, {x, y}]
```

$$\text{Out[55]=}\ \{\{x \to 7.93641, y \to -3.95761\}, \{x \to 0.719295 + 0.255679\,i, y \to 0.853803 - 0.170453\,i\}, \{x \to 0.719295 - 0.255679\,i, y \to 0.853803 + 0.170453\,i\}\}$$

```
In[56]:= DSolve[{y'[x] + y[x] == a*Sin[x], y[0] == 0}, y[x], x]
```

$$\text{Out[56]=}\ \left\{\left\{y[x] \to -\frac{1}{2}a\,e^{-x}\left(-1 + e^{x}\,\text{Cos}[x] - e^{x}\,\text{Sin}[x]\right)\right\}\right\}$$

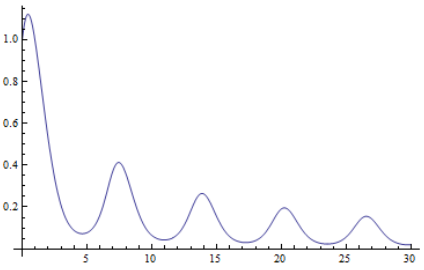
```
>
>
>
```




```
>
```

```
In[57]:= DSolve[{y'[x] == y[x] * (1 - y[x] / 27), y[0] == a}, y[x], x]
Solve::ifun : Inverse functions are being used by Solve, so some
    solutions may not be found; use Reduce for complete solution information. >>
Out[57]= {{y[x] → 27 a e^x / (27 - a + a e^x)}}

In[58]:= s = NDSolve[{y'[x] == y[x] * Cos[x + y[x]], y[0] == 1}, y, {x, 0, 30}]
Out[58]= {{y → InterpolatingFunction[{{0., 30.}}, <>]}}

In[59]:= Plot[Evaluate[y[x] /. s], {x, 0, 30}, PlotRange → All]
```

Out[59]=



FindMinimum, FindFit

```
> restart;
> with(Optimization):
> Minimize(x*cos(x),initialpoint={x=2});
```

[−3.28837139559089664, [x = 3.42561845948191]]

```
> Minimize(-100/((x-1)^2+(y-1)^2+1)-200/(
  (x+1)^2+(y+2)^2+1),
           {x^2+y^2>=3},
           initialpoint={x=2},
  iterationlimit=100000);
```

[−207.159896982008718, [x = −0.994861339362079, y = −1.99229199959060]]

```
> val := [seq([x,ithprime(x)],x=1..20)];
```

val := [[1, 2], [2, 3], [3, 5], [4, 7], [5, 11], [6, 13], [7, 17], [8, 19], [9, 23], [10, 29], [11, 31], [12, 37], [13, 41], [14, 43], [15, 47], [16, 53], [17, 59], [18, 61], [19, 67], [20, 71]]

```
> Statistics:-NonlinearFit(a*x*ln(b+c*x),
  val,x,
  output='parametervalues');
```

[a = 1.42076034408232, b = 1.65558645367954, c = 0.534640076132195]

```
>
```

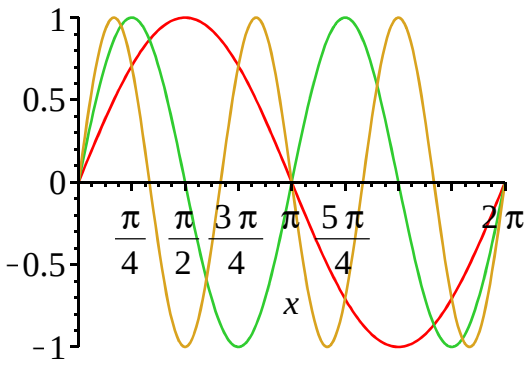
```
■ FindMinimum, FindFit

In[60]:= FindMinimum[x * Cos[x], {x, 2}]
Out[60]= {-3.28837, {x → 3.42562}}

In[61]:= FindMinimum[
          {-100 / ((x - 1)^2 + (y - 1)^2 + 1) - 200 / ((x + 1)^2 + (y + 2)^2 + 1),
           x^2 + y^2 > 3}, {{x, 2}, y}, MaxIterations → 100 000]
Out[61]= {-103.063, {x → 1.23037, y → 1.21909}}

In[62]:= val = Table[Prime[x], {x, 20}]
Out[62]= {2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71}

In[63]:= FindFit[val, a * x * Log[b + c * x], {a, b, c}, x]
Out[63]= {a → 1.42076, b → 1.65558, c → 0.534645}
```

Visualization and Graphics

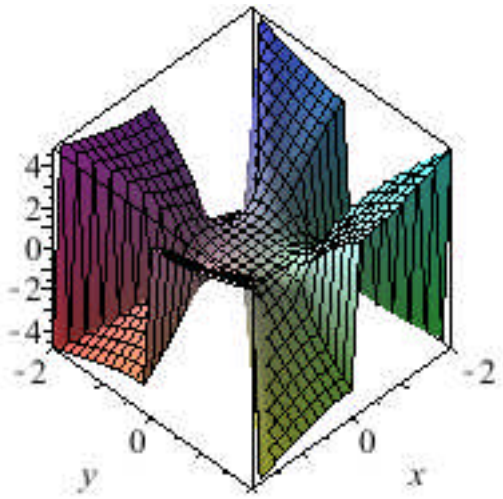
```
> restart;
```

Plot, Plot3D

```
> restart;
> plot({sin(x),sin(2*x),sin(3*x)},x=0..2*
  Pi);
```



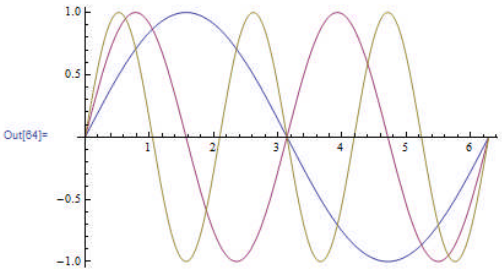

```
> plot3d(Im(arcsin((x+I*y)^4)),x=-2..2,y=
  -2..2,axes=boxed);
```



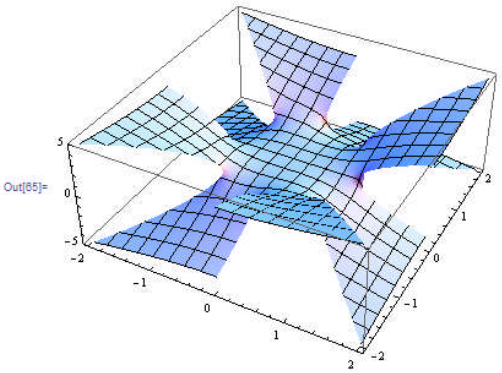

```
>
```

■ Plot, Plot3D

```
In[64]:= Plot[{Sin[x], Sin[2*x], Sin[3*x]}, {x, 0, 2*Pi}]
```

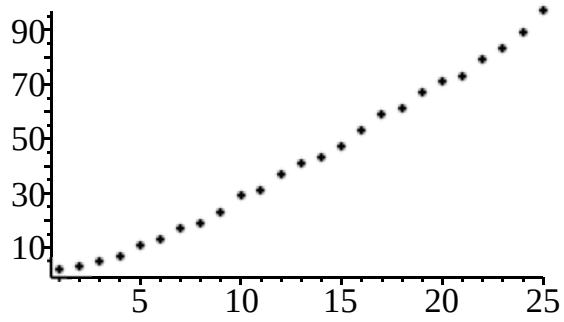



```
In[65]:= Plot3D[Im[ArcSin[(x + I*y)^4]], {x, -2, 2}, {y, -2, 2}]
```

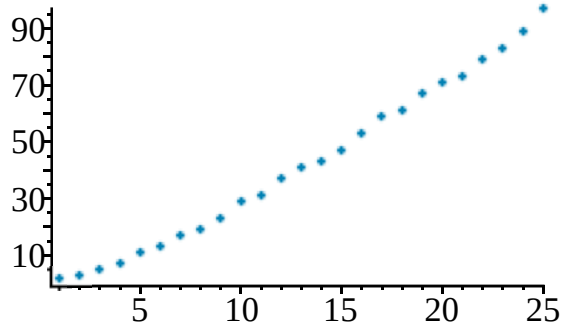


ListPlot

```
> with(plots):
> pointplot([seq([i,ithprime(i)],i=1..25)])
  ;
```




```
> Statistics:-PointPlot([seq(ithprime(i),i=
  1..25)]);
```

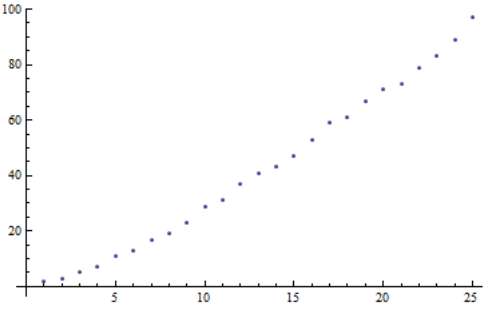



```
>
```

■ ListPlot

```
In[66]:= ListPlot[Prime[Range[25]]]
```

Out[66]=

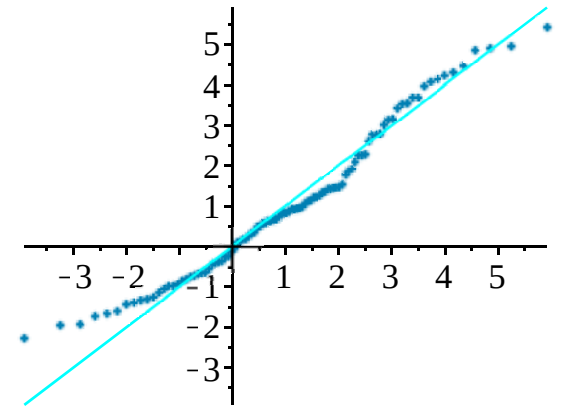


ProbabilityPlot

```
> restart;
> with(Statistics):
> X := RandomVariable(Normal(1,2)):
> data := Sample(X,100);
```

$$data := \begin{bmatrix} 1 .. 100\ Vector_{row} \\ Data\ Type: float_{8} \\ Storage: rectangular \\ Order: Fortran\_order \end{bmatrix}$$

```
> ProbabilityPlot(data, Normal(1,2));
```




```
>
```

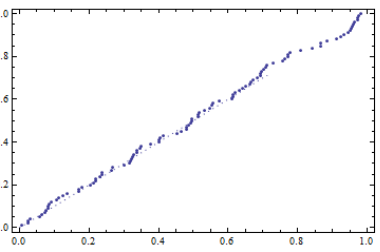
■ ProbabilityPlot

```
In[67]:= data = RandomVariate[NormalDistribution[1, 2], 100]
```

Out[67]= {0.529449, 4.7939, 2.36714, -0.609597, 4.67691, 1.35774, 0.0156879, -3.17773, -1.95838, 1.33887, 0.0547013, 0.516558, 1.78239, -1.30546, 2.19177, -1.64336, 1.96022, 1.31306, 1.44986, -2.0953, 2.00818, 0.981856, 0.0411881, 3.42739, 5.29949, 0.378924, 0.943126, 0.092602, 0.209726, 4.26235, -0.481339, 1.68232, -2.20952, 3.43853, 5.15018, -1.42595, -2.33728, 0.155848, 1.13382, -0.27435, -1.55679, 3.20497, 2.68864, 0.508242, 1.13122, -0.664276, 2.91879, 0.869592, -0.539137, -1.92712, 1.70459, 1.0172, 2.13172, -1.00978, -2.02526, -3.13819, -0.929624, 2.64595, -0.732296, 5.53034, 0.0828164, 2.15907, 2.58808, -2.92792, 4.50243, 1.02018, 0.146357, -1.0065, -4.24287, 4.91191, 0.94691, -1.81167, 3.6358, 2.22687, 1.67424, 1.03048, 0.577055, 2.07922, 4.1419, 2.65537, 1.12357, 4.64078, -0.628665, 3.94934, 4.73027, 2.24999, 1.82837, 0.80114, -0.0764679, 5.17732, 1.22582, -0.302865, 1.65601, 2.54729, 1.97739, -1.90087, -0.484388, 1.88955, 2.12968, 0.223842}

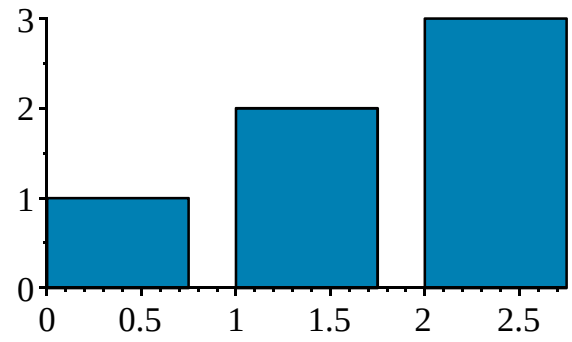
```
In[68]:= ProbabilityPlot[data]
```

Out[68]=

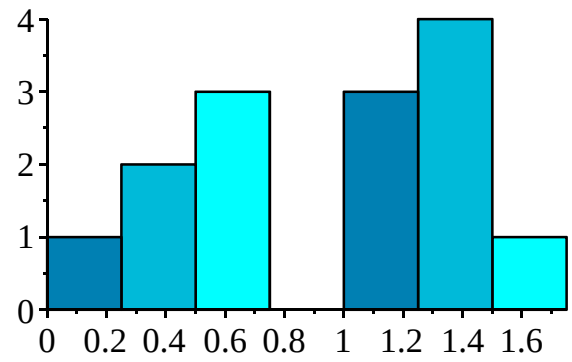


BarChart

```
> restart;
> with(Statistics):
> ColumnGraph([1,2,3]);
```



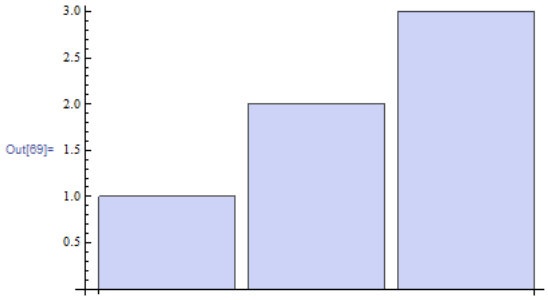

```
> ColumnGraph([[1,3],[2,4],[3,1]]);
```



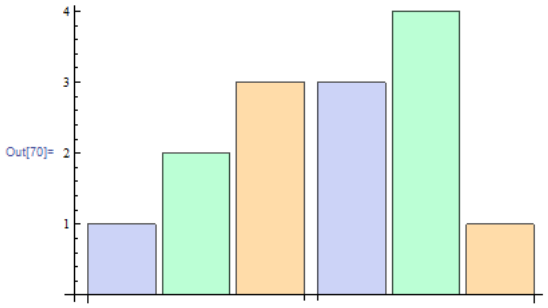

```
>
```

■ BarChart

```
In[69]:= BarChart[{1, 2, 3}]
```

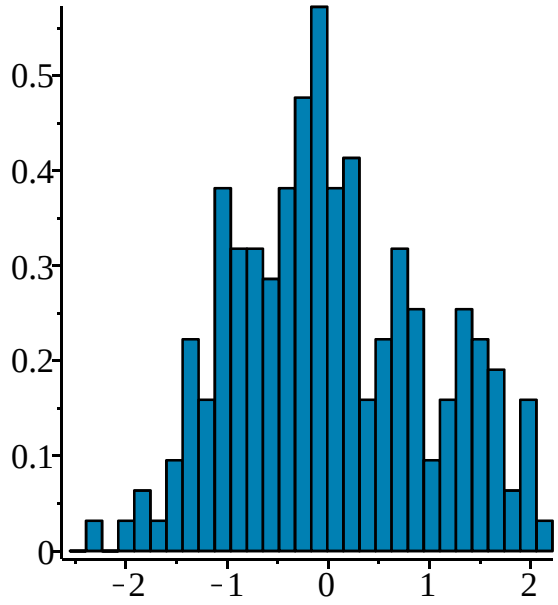



```
In[70]:= BarChart[{{1, 2, 3}, {3, 4, 1}}]
```

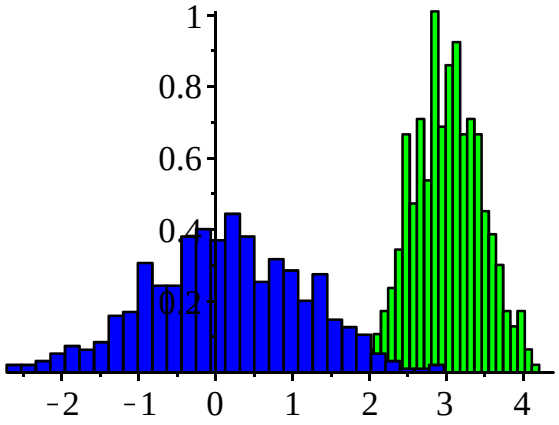


Histogram

```
> restart;
> with(Statistics):
> data := Sample(RandomVariable
  (NormalDistribution(0,1)),200):
> Histogram(data, axes=frame);
```




```
> data1 := Sample(RandomVariable
  (NormalDistribution(0,1)),500):
  data2 := Sample(RandomVariable
  (NormalDistribution(3,1/2)),500):
> g1 := Histogram(data1,color=blue):
  g2 := Histogram(data2,color=green):
  plots[display](g1,g2);
```

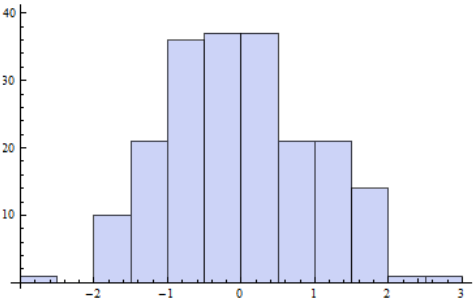



```
>
```

■ Histogram

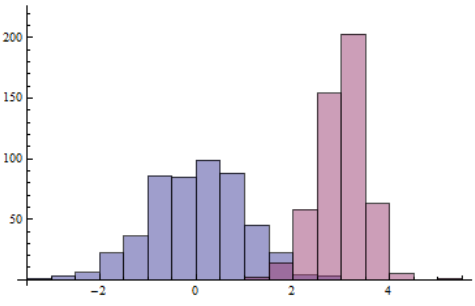
```
In[71]:= data = RandomReal[NormalDistribution[0, 1], 200];

In[72]:= Histogram[data]
```

Out[72]=




```
In[73]:= data1 = RandomReal[NormalDistribution[0, 1], 500];
         data2 = RandomReal[NormalDistribution[3, 1 / 2], 500];

In[75]:= Histogram[{data1, data2}]
```

Out[75]=



Data Manipulation

```
> restart;
```

Import, Export

```
> restart;
> fname := cat(kernelopts(datadir),
  "/Excel/ExperimentalData.xls");
```

fname :=
"C:\Program Files\Maple 15\data/Excel/ExperimentalData.xls"

```
> data := ExcelTools:-Import(fname);
```

$$data := \begin{bmatrix} 1..12 \times 1..7\ Array \\ Data\ Type:\ anything \\ Storage:\ rectangular \\ Order:\ Fortran\_order \end{bmatrix}$$

```
> data[1..2,1..-1];
```

[["Time", "Concentration A", "Concentration CO2", "Concentration AT", "Concentration B", "Concentration C", "Concentration A.B"], [0., 0.54399, 0.00121, 0.0048, 0.00722, 0.00079, 0.34423]]

```
> data := Matrix([seq(seq([x1,x2,evalf(sin
  (x1)+x2)],
            x1=-3.0..3.0,0.1),
            x2= 0.0..6.0,0.2)]):
> ExportMatrix("C:/temp/data.csv", data,
  delimiter=",");
```

37771

```
> data := ImportMatrix("C:/temp/data.csv",
  source=csv):
> data[1..2,1..-1];
```

$$\begin{bmatrix} -3.0 & 0. & -0.1411200081 \\ -2.9 & 0. & -0.2392493292 \end{bmatrix}$$

```
>
```

Import, Export

```
In[76]:= fname = "C:\\Program Files\\Maple 16\\data\\Excel\\ExperimentalData.xls"
Out[76]= C:\Program Files\Maple 16\data\Excel\ExperimentalData.xls

In[77]:= data = Import[fname][[1]];

In[78]:= data[[{1, 2}, All]]
Out[78]= {{Time, Concentration A, Concentration CO2, Concentration AT,
          Concentration B, Concentration C, Concentration A.B},
         {0., 0.54399, 0.00121, 0.0048, 0.00722, 0.00079, 0.34423}}

In[79]:= data = Table[{x1, x2, N[Sin[x1] + x2]}, {x1, -3.0, 3.0, 0.1},
           {x2, 0.0, 6.0, 0.2}];

In[80]:= Export["C:\\temp\\dataFile.csv", Flatten[data]]
Out[80]= C:\temp\dataFile.csv

In[81]:= data = Import["C:\\temp\\dataFile.csv"];

In[82]:= data[[{1, 2}, All]]
Out[82]= {{-3.}, {0.}}
```

Map, Apply

```
> restart;
> map(f,[[x1,x2],[y1,y2]]);
```

$$[f([x1, x2]), f([y1, y2])]$$

```
> apply(f,[x1,x2],[y1,y2]);
```

$$f([x1, x2], [y1, y2])$$

```
> map(x->x^2,[1,2,3,4]);
```

$$[1, 4, 9, 16]$$

```
>
```

Map, Apply

```
In[83]:= Map[f, {{x1, x2}, {y1, y2}}]
Out[83]= {(1 + x - x^2)/(-1 + y^2) [{x1, x2}], (1 + x - x^2)/(-1 + y^2) [{y1, y2}]}

In[84]:= Apply[f, {{x1, x2}, {y1, y2}}]
Out[84]= (1 + x - x^2)/(-1 + y^2) [{x1, x2}, {y1, y2}]

In[85]:= Map[#^2 &, {1, 2, 3, 4}]
Out[85]= {1, 4, 9, 16}
```

Select, DeleteCases

```
> restart;
> select(x->is(x>2),[1,2,4,7,6,2]);
                        [4, 7, 6]
> select(x->`and`(`modp`(x,3)=1,`modp`(x,5)
  =1),[$1..100]);
                [1, 16, 31, 46, 61, 76, 91]
> remove(x->type(x,integer),[1,1,x,2,3,y,9,
  y]);
                        [x, y, y]
>
```

Select, DeleteCases

```
In[86]:= Select[{1, 2, 4, 7, 6, 2}, # > 2 &]
Out[86]= {4, 7, 6}

In[87]:= Select[Range[100], Mod[#, 3] == 1 && Mod[#, 5] == 1 &]
Out[87]= {1, 16, 31, 46, 61, 76, 91}

In[88]:= DeleteCases[{1, 1, x, 2, 3, y, 9, y}, _Integer]
Out[88]= {x, y, y}
```

Length, Count

```
> restart;
> nops([1,2,3,4]);
                          4
> nops(1+x+x^2+x^3);
                          4
> map(nops,[[1,2],[2,3,4],
  [3]]);
                      [2, 3, 1]
> nops(select(has,[a,b,c,b,
  a,c,b,c],b));
                          3
> nops(select(type,[a,2,3,x,
  3,1],integer));
                          4
>
```

Length, Count

```
In[89]:= Length[{1, 2, 3, 4}]
Out[89]= 4

In[90]:= Length[1 + x + x^2 + x^3]
Out[90]= 4

In[91]:= Map[Length, {{1, 2}, {2, 3, 4}, {3}}]
Out[91]= {2, 3, 1}

In[92]:= Count[{a, b, c, b, a, c, b, c}, b]
Out[92]= 3

In[93]:= Count[{a, 2, 3, x, 3, 1}, _Integer]
Out[93]= 4
```

MovingAverage, MovingMedian

```
> restart;
> with(Statistics):
> MovingAverage([$1..10],2);
[1.50000000000000, 2.50000000000000, 3.50000000000000,
      4.50000000000000, 5.50000000000000,
      6.50000000000000, 7.50000000000000,
      8.50000000000000, 9.50000000000000]
> MovingMedian([1,2,5,6,1,4,3],3);
                    [2., 5., 5., 4., 3.]
>
```

MovingAverage, MovingMedian

```
In[94]:= MovingAverage[N[Range[10]], 2]
Out[94]= {1.5, 2.5, 3.5, 4.5, 5.5, 6.5, 7.5, 8.5, 9.5}

In[95]:= MovingMedian[{1, 2, 5, 6, 1, 4, 3}, 3]
Out[95]= {2, 5, 5, 4, 3}
```

Fourier, InverseFourier

```
> restart;
> with(DiscreteTransforms):
> abs(FourierTransform(Vector[row]([1,1,2,
  2,1,1,0,0])));
[2.828427125, 1.306562965, 0., 0.5411961002, 0., 0.5411961002,
     0., 1.306562965]
> InverseFourierTransform(Vector[row]([0,0,
  0,1,0,0,0]));
[0.377964473009227196 + 0. I, -0.340534223354457821
     + 0.163992638802840901 I, 0.235656994386163722
     - 0.295504524253051738 I, -0.084150075363194011
     + 0.368488114549789080 I, -0.084150075363194011
     - 0.368488114549789080 I, 0.235656994386163722
     + 0.295504524253051738 I, -0.340534223354457821
     - 0.163992638802840901 I]
>
```

■ Fourier, InverseFourier

```
In[96]:= Abs[Fourier[{1, 1, 2, 2, 1, 1, 0, 0}]]
Out[96]= {2.82843, 1.30656, 0., 0.541196, 0., 0.541196, 0., 1.30656}

In[97]:= InverseFourier[{0, 0, 0, 1, 0, 0, 0}]
Out[97]= {0.377964 + 0. i, -0.340534 - 0.163993 i, 0.235657 + 0.295505 i,
  -0.084105 - 0.368488 i, -0.084105 + 0.368488 i,
  0.235657 - 0.295505 i, -0.340534 + 0.163993 i}
```

StringSplit, StringCount

```
> restart;
> with(StringTools):
> Split("192.168.0.1",".");
                ["192", "168", "0", "1"]
> Split("123  2.3  4  6");
            ["123", "", "2.3", "", "4", "", "6"]
> remove(type,%,"");
                ["123", "2.3", "4", "6"]
> map(Reverse,Split("cat in the hat"));
                ["tac", "ni", "eht", "tah"]
>
```

■ StringSplit, StringCases

```
In[98]:= StringSplit["192.168.0.1", "."]
Out[98]= {192, 168, 0, 1}

In[99]:= StringSplit["123  2.3  4  6"]
Out[99]= {123, 2.3, 4, 6}

In[100]:= StringCases["cat in the hat", x : LetterCharacter .. ↦ StringReverse[x]]
Out[100]= {tac, ni, eht, tah}
```