
Lesson 2 : Mathematica as a Calculator

■ Basic Arithmetic

`2 + 2`

4

`2 / 6`

$\frac{1}{3}$

`N[2 / 6]`

0.333333

`2. / 6`

0.333333

`2 / 0`

Power::infy: Infinite expression $\frac{1}{0}$ encountered. >>

ComplexInfinity

`(3 + 5) * (2 + 6)`

64

`(3 + 5) (2 + 6)`

64

`4!`

24

`100!`

93 326 215 443 944 152 681 699 238 856 266 700 490 715 968 264 381 621 468 592 963 895 217 599 993 229 915 608 941 463 976 156 518 286 253 697 920 827 223 758 251 185 210 916 864 000 000 000 000 000 000 000 000

`(2234 + 33223) (4412 + 17433) - 10 000 000 000 000`

25 881 625 545 748 611 042 058 816 214 411 440 334 195 929 812 949 969 783 713 334 404 757 479 123 664 209 366 924 134 616 148 749 695 910 300 429 225 453 302 425 953 008 688 366 099 503 345 364 262 199 639 985 173 754 460 251 444 135 937 191 382 739 700 725 023 469 830 399 220 357 185 498 642 357 933 727 018 333 920 895 537 166 575 507 347 827 849 712 287 567 222 418 755 018 833 803 776 582 559 396 141 825 777 024 349 324 690 597 485 807 093 455 351 337 640 141 579 318 317 760 235 251 200 274 170 513 036 814 677 991 818 202 145 481 522 803 530 912 805 781 295 603 021 123 861 447 427 438 521 079 654 106 265 729 777 901 327 468 058 228 366 027 150 727 337 603 692 136 019 702 780 296 496 650 918 927 710 947 419 765 307 576 512 787 687 656 084 256 987 161 911 177 413 406 368 366 200 192 795 327 509 421 407 132 098 773 915 901 359 951 966 018 937 472 935 598 983 159 301 279 496 362 365 943 758 105 383 981 904 310 864 156 932 158 907 075 866 159 689 780 532 220 397 255 693 265 780 294 008 116 996 922 672 031 591 914 979 790 995 196 038 196 703 689 094 616 873 858 118 169 625 263 807 277 787 086 557 766 677 303 035 781 601 423 799 708 322 009 731 313

More "Calculator" Operations

2^4

16

2^4

16

π

π

$\pi // N$

3.14159

$N[E]$

2.71828

$E + \pi$

$e + \pi$

$\% // N$

5.85987

$\text{Cos}[\pi / 2]$

0

$\text{Sin}\left[\frac{\pi}{4}\right]$

$\frac{1}{\sqrt{2}}$

$\text{Cos}[2.32]^2 + (\text{Sin}[2.32])^2$

1.

$\text{Sqrt}[2]$

$\sqrt{2}$

$\text{Sqrt}[2.]$

1.41421

$\text{sqrt}[1000^2]$

1000

$\text{sqrt}[-2]$

$i\sqrt{2}$

I

i

? Log

Log[z] gives the natural logarithm of z (logarithm to base e).

Log[b, z] gives the logarithm to base b. >>

Log[E]

1

Log[-3]

$i \pi + \text{Log}[3]$

Log[0]

$-\infty$

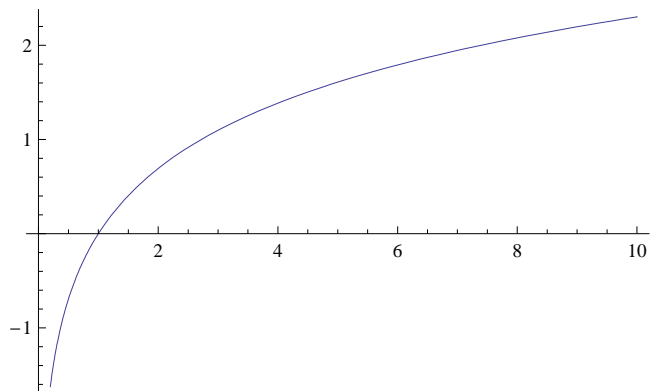
Log[Infinity]

∞

Log[2, 64]

6

Plot[Log[x], {x, 0, 10}]



$\begin{pmatrix} 1 & 2 \\ -2 & 3 \end{pmatrix} \cdot \begin{pmatrix} 1 & 0 & 0 \\ 0 & 2 & 1 \end{pmatrix}$

$\{\{1, 4, 2\}, \{-2, 6, 3\}\}$

% // MatrixForm

$\begin{pmatrix} 1 & 4 & 2 \\ -2 & 6 & 3 \end{pmatrix}$

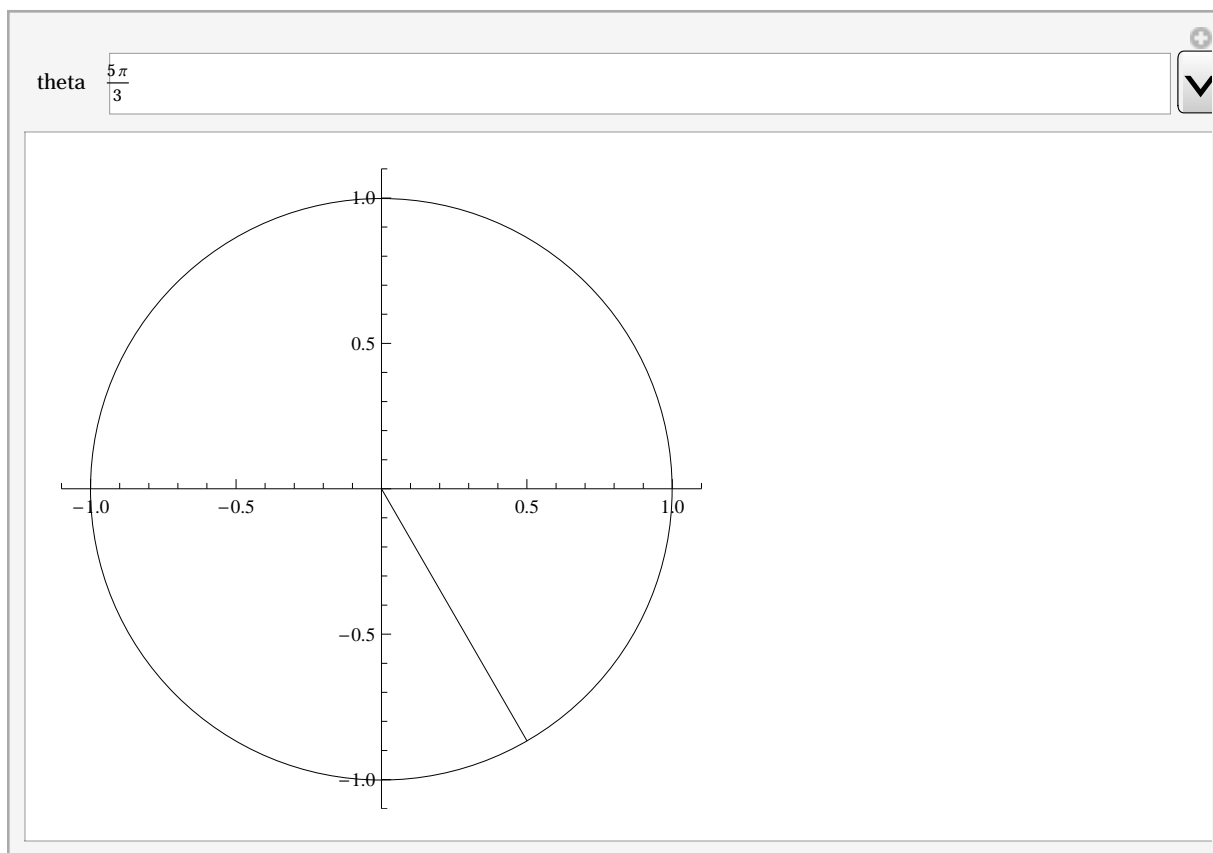
$\text{Cos}\left[\pi \left\{0, \frac{1}{3}, \frac{1}{2}, \frac{2}{3}, 1, \frac{4}{3}, \frac{3}{2}, \frac{5}{3}, 2\right\}\right]$

$\left\{1, \frac{1}{2}, 0, -\frac{1}{2}, -1, -\frac{1}{2}, 0, \frac{1}{2}, 1\right\}$

```

Manipulate[
  Show[Graphics[
    {Circle[{0, 0}, 1],
     Line[{{0, 0}, {Cos[theta], Sin[theta]}]}],
    PlotRange -> {{-1.1, 1.1}, {-1.1, 1.1}}, Axes -> True]],
  {theta,  $\pi \left\{0, \frac{1}{3}, \frac{1}{2}, \frac{2}{3}, 1, \frac{4}{3}, \frac{3}{2}, \frac{5}{3}, 2\right\}}$ ]

```



■ Basic Symbolic Calculations

```
(a + b) ^ 2
```

```
(a + b) ^ 2
```

```
Expand[%]
```

```
a2 + 2 a b + b2
```

```
Expand[(a + b + c + d) ^ 2]
```

```
a2 + 2 a b + b2 + 2 a c + 2 b c + c2 + 2 a d + 2 b d + 2 c d + d2
```

```
% // Simplify
```

```
(a + b + c + d) ^ 2
```

```
D[x4, x]
```

```
4 x3
```

```
Integrate[x^4, x]
```

$$\frac{x^5}{5}$$

```
Integrate[1/Sqrt[2 π] E^(-x^2/2), {x, -Infinity, Infinity}]
```

```
1
```

```
D[x^Sin[x^Cos[x]], x]
```

$$x^{\sin[x^{\cos[x]}}} \left(x^{\cos[x]} \cos[x^{\cos[x]}] \log[x] \left(\frac{\cos[x]}{x} - \log[x] \sin[x] \right) + \frac{\sin[x^{\cos[x]}}{x} \right)$$

$$\sum_{i=0}^{\infty} 3^i$$

```
Sum::div: Sum does not converge. >>
```

$$\sum_{i=0}^{\infty} 3^i$$

$$\sum_{i=0}^{\infty} \left(\frac{1}{2}\right)^i$$

```
2
```

```
Sum[a^i, {i, 0, 10}]
```

$$1 + a + a^2 + a^3 + a^4 + a^5 + a^6 + a^7 + a^8 + a^9 + a^{10}$$

```
% // FullSimplify
```

$$1 + a (1 + a (1 + a + a^2) (1 + a^3 + a^6))$$

$$\%68 = \frac{a^{10+1} - 1}{a - 1}$$

$$1 + a (1 + a (1 + a + a^2) (1 + a^3 + a^6)) = \frac{-1 + a^{11}}{-1 + a}$$

```
% // Simplify
```

```
True
```

```
(a + b)^2 == a^2 + ab + b^2 // Simplify
```

```
ab == 2 a b
```

Solve[$x^3 + x^2 - x + 1 == 0, x$]

$$\left\{ \left\{ x \rightarrow \frac{1}{3} \left(-1 - \frac{4}{(19 - 3\sqrt{33})^{1/3}} - (19 - 3\sqrt{33})^{1/3} \right) \right\} \right\},$$

$$\left\{ x \rightarrow -\frac{1}{3} + \frac{2(1 + i\sqrt{3})}{3(19 - 3\sqrt{33})^{1/3}} + \frac{1}{6}(1 - i\sqrt{3})(19 - 3\sqrt{33})^{1/3} \right\},$$

$$\left\{ x \rightarrow -\frac{1}{3} + \frac{2(1 - i\sqrt{3})}{3(19 - 3\sqrt{33})^{1/3}} + \frac{1}{6}(1 + i\sqrt{3})(19 - 3\sqrt{33})^{1/3} \right\}$$

Solve[$2x + 4 == 8, x$]

{ $x \rightarrow 2$ }

$2x + 4 /. x \rightarrow 2$

8

Solve[$ax^2 + bx + c == 0, x$]

$$\left\{ \left\{ x \rightarrow \frac{-b - \sqrt{b^2 - 4ac}}{2a} \right\}, \left\{ x \rightarrow \frac{-b + \sqrt{b^2 - 4ac}}{2a} \right\} \right\}$$

Solve[$\{x^3 + y^3 == 1, x^2 + y^2 == 1\}, \{x, y\}$]

{ $x \rightarrow 0, y \rightarrow 1$ }, { $x \rightarrow 0, y \rightarrow 1$ }, { $x \rightarrow 1, y \rightarrow 0$ }, { $x \rightarrow 1, y \rightarrow 0$ },

$$\left\{ x \rightarrow \frac{-5i + \sqrt{2}}{4i + \sqrt{2}}, y \rightarrow \frac{1}{2}(-2 + i\sqrt{2}) \right\}, \left\{ x \rightarrow \frac{5i + \sqrt{2}}{-4i + \sqrt{2}}, y \rightarrow \frac{1}{2}(-2 - i\sqrt{2}) \right\}$$

■ Basic File Input Output

{1, 2, 3, 4, 5} >> testFile.txt

Directory[]

C:\Documents and Settings\user\My Documents

FileNames[]

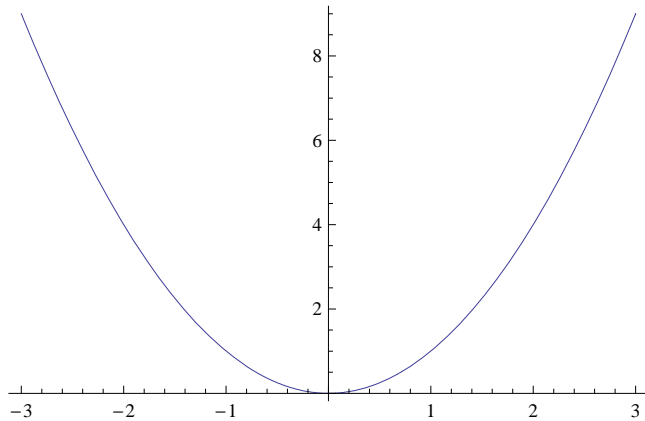
{39-43.pdf, 3BufferManipulate.nb, 3BufferManipulate_v2.nb, 6704-04-Notes-GIM.pdf, ACM_valueTools_20080427aYNbal.pdf, AppleRace24.25_8.doc, á÷üä îðèâø íâçéðã_âú.htm, backUp1_11_06.nri, bib.lnk, BOOKLETphd.doc, CaseyKathyInvitation.ppt, CurrentTrainingPlan.xls, desktop.ini, DirugRoad2007.xls, endobj, Enterprise Guide Sample.lnk, FixDiskFullIssue.sit, fullrefman.pdf, îêôíú ìñáâ.doc, îêôíú ìñáâ (î÷âöð).doc, îêôíú ìñáâ (øñéú).doc, July Trip Plan.xls, LEdProjects, lshort.pdf, Masters_Climbing_v2.doc, MosheTeaching, MVI_4093.avi, My Google Gadgets, My Music, My Pictures, My SAS Files, My Shapes, My SlickEdit Config, My Videos, My Web Sites, natbib.pdf, NokiaLifeblogData,OldData, proceedingsInforms2007.pdf, SAS Configuration Information, solvingPi.nb, spider.sav, Symantec, takanon.doc, temp, testFile.txt, Test.txt, ùàìâî ìûúúó.doc, Utilities, WStadjeNotesComments1.doc, YONI_DATA.lnk, ZbThumbnail.info}

<< testFile.txt

{1, 2, 3, 4, 5}

Basic Graphics

```
Plot[x2, {x, -3, 3}]
```

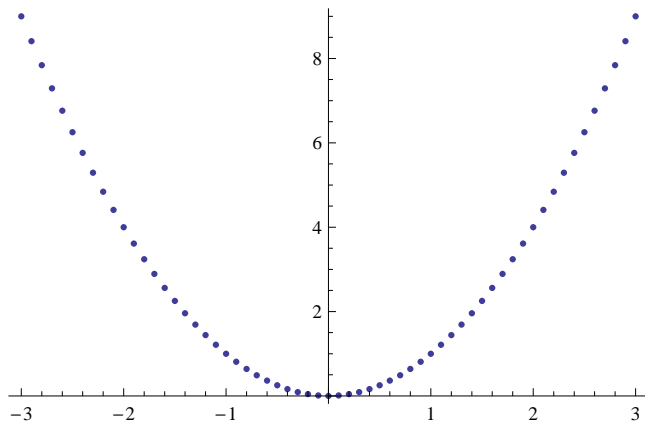


```
Table[i2, {i, -3, 3, .1}]
```

```
{9., 8.41, 7.84, 7.29, 6.76, 6.25, 5.76, 5.29, 4.84, 4.41, 4., 3.61,
 3.24, 2.89, 2.56, 2.25, 1.96, 1.69, 1.44, 1.21, 1., 0.81, 0.64, 0.49,
 0.36, 0.25, 0.16, 0.09, 0.04, 0.01, 2.77334×10-32, 0.01, 0.04, 0.09, 0.16,
 0.25, 0.36, 0.49, 0.64, 0.81, 1., 1.21, 1.44, 1.69, 1.96, 2.25, 2.56, 2.89,
 3.24, 3.61, 4., 4.41, 4.84, 5.29, 5.76, 6.25, 6.76, 7.29, 7.84, 8.41, 9.}
```

```
tbl = Table[i2, {i, -3, 3, .1}];
```

```
ListPlot[tbl, DataRange → {-3, 3}]
```



```
? Factorial
```

$n!$ gives the factorial of n . >>

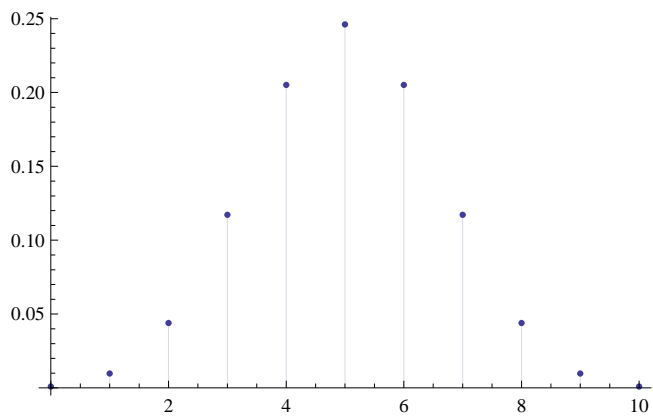
```
n = 10; p = 0.5;
```

```
binTable = Table[ $\frac{n!}{(n-k)! k!} p^k (1-p)^{n-k}$ , {k, 0, n}];
```

```
Total[binTable]
```

```
1.
```

```
ListPlot[binTable, Filling -> Axis, DataRange -> {0, n}]
```



```
Clear[p];
```

```
In[3]:= n = 10;
```

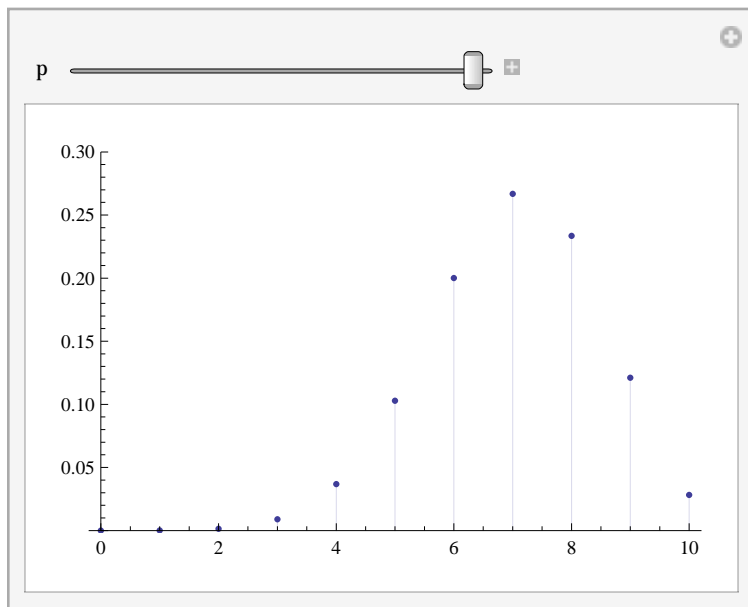
```
Manipulate[
```

```
ListPlot[Table[ $\frac{n!}{(n-k)! k!} p^k (1-p)^{n-k}$ , {k, 0, n}],
```

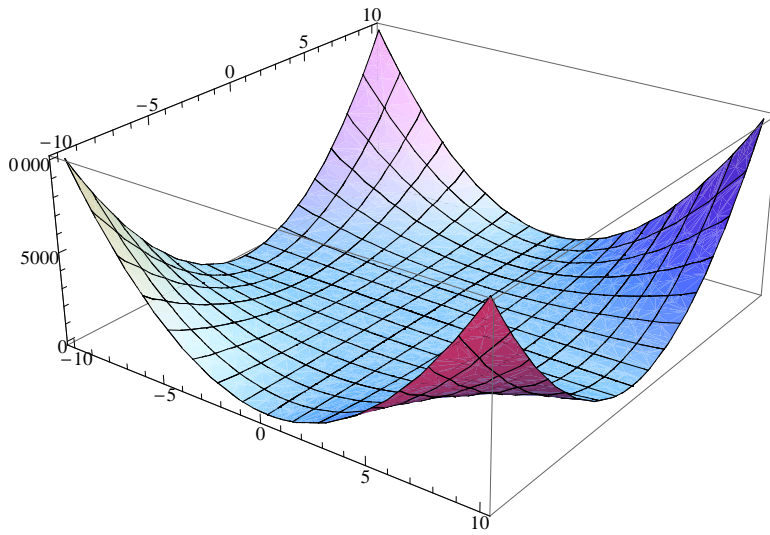
```
PlotRange -> {0, 0.3}, Filling -> Axis, DataRange -> {0, n}],
```

```
{p, 0.3, 0.7}]
```

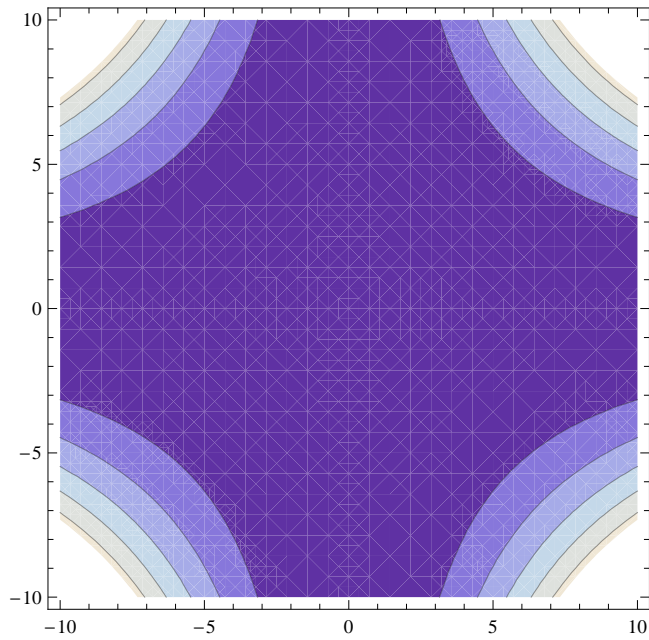
```
Out[4]=
```



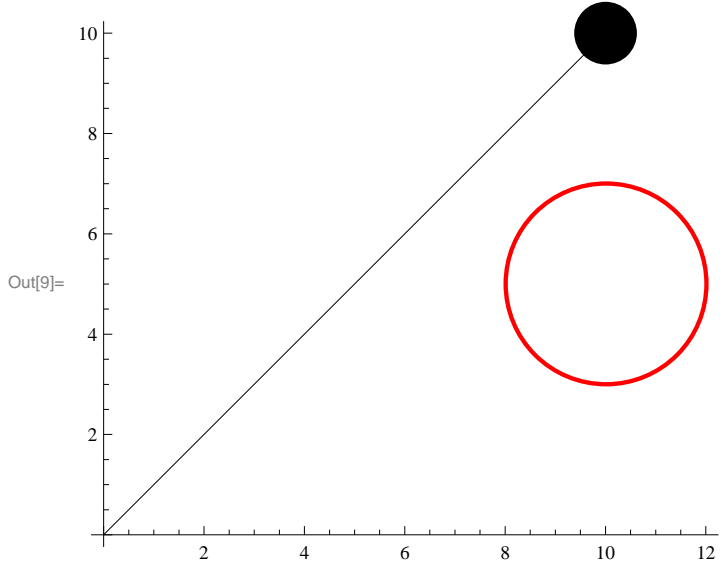

```
Plot3D[x2 y2, {x, -10, 10}, {y, -10, 10}, PlotRange -> All]
```



```
ContourPlot[x2 y2, {x, -10, 10}, {y, -10, 10}]
```



```
In[9]:= g = Graphics[{  
  Line[{{0, 0}, {10, 10}}],  
  PointSize[0.1],  
  Point[{10, 10}],  
  Red,  
  Thick,  
  Circle[{10, 5}, 2]  
}, Axes → True]
```



```
Show[g,  
  Axes → False,  
  Frame → True,  
  FrameTicks → False,  
  PlotRange → {{-20, 20}, {-20, 20}}  
]
```

