05 Power and Periodic Functions

Expressions, Functions, and Equations

$\ln(x^2 + x)$	is an expression--algebraic operations with a variable
$f(x) = \ln(x^2 + x)$	is a function definition--given an input, what output will be produced? (= defines)
$\ln(x^2 + x) = 0$	is an equation--what values of x satisfy this? (== signifies two numbers are the same)

Let $f(x) = \ln(x^2 + x)$. What is $f(3.1)$?

Does $x = 3.1$ satisfy the equation?

Make graphs of $f(x)$ and $g(x) = x^2 + x$ on a suitable domain. (You might use WolframAlpha).

First, estimate the horizontal intercepts of $f(x)$. Then use $g(x)$together with your knowledge about the ln(...) function to estimate the same quantities.

How is the graph of $f(x + a)$ different from $f(x)$?

Power Functions

Body Size

The DuBois formula states that for a 70 kg person the fourth power of her or his surface area s is proportional to the cube of her or his height h. Find a formula for surface area as a function of height.

How can this relationship be described in more colloquial terms?

If a 70 kg person is 180 cm tall and has a surface area of 1.42 m^2, what is the proportionality constant?

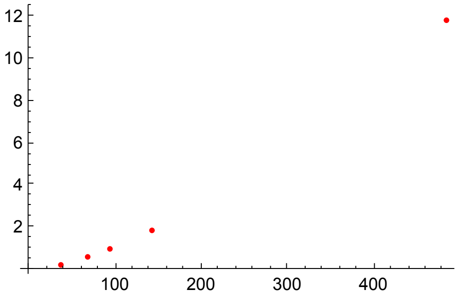
Planets

Find a function that relates for the first four planets in our solar system the period, T, of revolution about the sun (in Earth years) to the mean distance, D from the sun (in millions of miles). (Use the data on Mercury and Jupiter to do this “by hand”)

Planet	Mercury	Venus	Earth	Mars	Jupiter
Distance, D	36.0	67.1	92.9	141.7	483.4
Period, T	0.24	0.62	1	1.88	11.87

In[12]:=
```
ddata = {36.0, 67.1, 92.9, 141.7, 483.4};
pdata = {0.24, 0.62, 1, 1.88, 11.87};
data = Transpose[{ddata, pdata}];
plotdata = ListPlot[data, PlotStyle → Red]
```

Out[15]=



Periodic Functions

The definition of cosine and sine: Given a number *t*, travel that distance counterclockwise around the unit circle starting from the point (1,0). Call the resulting point (x, y). Then $\cos(t) = x$ and $\sin(t) = y$. The amplitude of these functions is 1 and the period of these functions is 2π.

Goshen Temperature

Consider for Goshen, Indiana, the mean daily temperature (in °C) as a function of days after January 1, 2012. Find a function that models the trend of this data.

Do this by estimating the amplitude, midline, and the horizontal shift, and figuring out what the period ought to be.

In[33]:=
```
station = WeatherData[{"Goshen", "Indiana", "UnitedStates"}];
xdata = Range[0, 365];
ydata =
  Values[WeatherData["KGSH", "MeanTemperature", {{2012, 1, 1}, {2012, 12, 31}, "Day"}]];
data = Transpose[{xdata, ydata}];
plotdata = ListPlot[data, PlotStyle → Red]
```

Out[37]=