Math 291: Lecture 10

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April 5, 2018

Outline

1. The pst-func package
   - Using psplot and psaxes
   - Using psgrid
   - Using psclip
2. Another Example
3. Other function types
   - Parametric Curves
   - Solid of revolution
4. Three Dimensions
5. Resources

Graphing functions

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- Start a document and load the packages pst-func, pst-3dplot, and graphicx.
- Note: Including pst-func will also load the packages pst-plot, pstricks, pstricks-add, pst-math, and pst-xkey.

The basic commands

As with almost any command that starts with 'ps', these commands are used within a pspicture environment. Remember that the syntax for the pspicture environment is:

```
\begin{pspicture}(xmin,ymin)(xmax,ymax)
...commands...
\end{pspicture}
```

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  - Note that there are sometimes issues with certain functions. If that happens, the "plot a lot of points" option still works.
  - Note that you need to carefully enter your function, and the syntax sometimes isn't what you expect.

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- `\psset{options}`
  allows you to set values of certain commands until another psset command is entered. To set the length of 1 unit in the x- and y-directions, we could use:

  `\psset{xunit=1cm,yunit=0.2cm}`

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  gives axes centered at (x0,y0) with the minimums and maximums as described.

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- `\psaxes[options](x0,y0)(xmin,ymin)(xmax,ymax)`
  gives axes centered at (x0,y0) with the minimums and maximums as described.
  - The option [Dx=2,Dy=5] changes the increment for each axis. The default values are 1.

Let's Try Some Examples

Let's begin by graphing a few functions. Try graphing $\sin(x)$ and $\cos(x)$ on the same coordinate axes (from -2π to 2π):

```
\begin{pspicture}(-7,-2)(7,2)
\psplot[algebraic]{-6.283}{6.283}{sin(x)}
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Now add some axes of appropriate length using

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\psaxes(0,0)(-7,-2)(7,2)
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Now add the options to change the increments using Dx=3.14 and Dy=0.5.

Grids

- Create another graph:

```
\psset{xunit=0.5cm,yunit=0.5cm}
\begin{pspicture}(-10,-10)(10,10)
\psplot[algebraic]{-6.325}{6.325}{1/4*x^2}
\psaxes[Dx=2,Dy=2](0,0)(-10,-10)(10,10)
\end{pspicture}
```

and build.

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  and build.
- Now change the psaxes to psgrid.

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- Add the following options to the command
  subgriddiv=1,griddots=10,gridlabels=0
  subgriddiv=# determines the number of subdivisions of the grid. The default is 5.
  griddots=# determines the number of dots to use between ticks. The default is 0, which gives a solid line.
  gridlabels=# determines the size of the labels. 0 gets rid of them altogether.

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  gridlabels=# determines the size of the labels. 0 gets rid of them altogether.
  Try modifying your previous command to change how the grid on your example looks.

Clipping

- Note that in the parabola example, we plotted from -6.325 to 6.325.
- These were chosen so that the graph didn't go off the grid.
- We can also use the psclip command.

```
\begin{psclip}{control object}
object to be clipped
\end{psclip}
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Clipping

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- We can also use the psclip command.

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\begin{psclip}{control object}
object to be clipped
\end{psclip}
```

- This command allows you to clip an object so that all that you see of the object is the portion inside of the control object.

Clipping

- Change your parabola commands to:

```
\psset{xunit=0.5cm,yunit=0.5cm}
\begin{pspicture}(-10,-10)(10,10)
\psplot[algebraic]{-10}{10}{1/4*x^2}
\psaxes[Dx=2,Dy=2](0,0)(-10,-10)(10,10)
\psgrid[gridlabels=0,griddots=5,
subgriddiv=1](0,0)(-10,-10)(10,10)
\end{pspicture}
```

Clipping

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\psaxes[Dx=2,Dy=2](0,0)(-10,-10)(10,10)
\psgrid[gridlabels=0,griddots=5,
subgriddiv=1](0,0)(-10,-10)(10,10)
\end{pspicture}
```

- Build it and see what happens.
- Note that LaTeX is perfectly happy to graph beyond the space set aside for the pspicture.

Clipping

- Now clip your graph using a rectangle:
  - Just before the psplot command add `\begin{psclip}{\pspolygon[linestyle=none](-10,-10)(10,-10)(10,10)(-10,10)}`
  - And just after the psplot command add the end command for the psclip environment.
  - Now build again

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- See what happens if you delete the last point of the polygon...

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    `\begin{psclip}{\pspolygon[linestyle=none](-10,-10)`
    `(10,-10)(10,10)(-10,10)}`
  - And just after the psplot command add the end command for the psclip environment.
  - Now build again
- See what happens if you delete the last point of the polygon...
- If you remove the linestyle command you will see what is going on.

Outline

I always feel like somebody's watching me

Here is a cool example using psclip:

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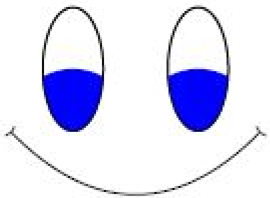

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Here is the code for this example:

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```
\psset{xunit=1cm,yunit=1cm}
\begin{pspicture}(0,0)(4,4)
\begin{psclip}{\psellipse(1,2)(.5,1)}
\pscircle*[linecolor=blue](1,1){1}
\end{psclip}
\psellipse(1,2)(.5,1)
\begin{psclip}{\psellipse(3,2)(.5,1)}
\pscircle*[linecolor=blue](3,1){1}
\end{psclip}
\psellipse(3,2)(.5,1)
\parabola{)-(}(0,1)(2,0)
\end{pspicture}
```

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Parametric Curves

- To graph a parametrized curve the notation changes slightly.

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- Suppose we want to use sine and cosine to graph a parametrized circle.
- To your code for the sine and cosine graphs add the line:

```
\parametricplot[algebraic,linecolor=green]
{-3.14}{3.14}{2*cos(t)|2*sin(t)}
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Parametric Curves

- To graph a parametrized curve the notation changes slightly.
- Suppose we want to use sine and cosine to graph a parametrized circle.
- To your code for the sine and cosine graphs add the line:

```
\parametricplot[algebraic,linecolor=green]
{-3.14}{3.14}{2*cos(t)|2*sin(t)}
```

- There should now be a green circle of radius 2 on your grid.

A Graphic to Depict the Area Under a Curve

- Suppose you want to shade the area under a curve for integrating.

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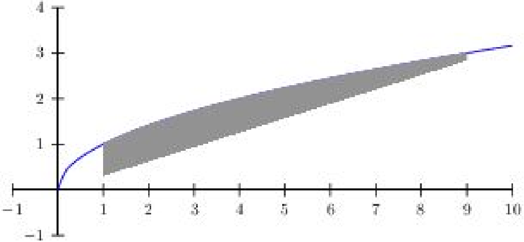
- Suppose you want to shade the area under a curve for integrating.
- We can use psclip, but note that our curve is what will need to do the clipping.
- Let's use the curve $\sqrt{x}$ from 1 to 9. Graph this with a set of coordinate axes. Make your picture from (-1,-1) to (10,4).
- Use the psclip option to shade it:

```
\begin{psclip}{
\psplot[algebraic]{0}{10}{sqrt(x)}}
\pspolygon*[linecolor=gray](1,0)(9,0)(9,4)(1,4)
\end{psclip}
```

A Graphic to Depict the Area Under a Curve

- You should get



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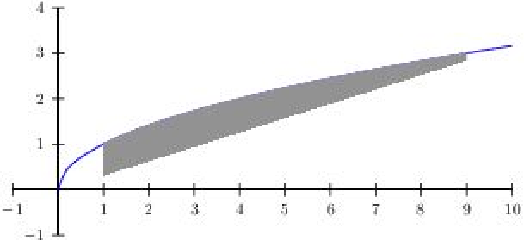

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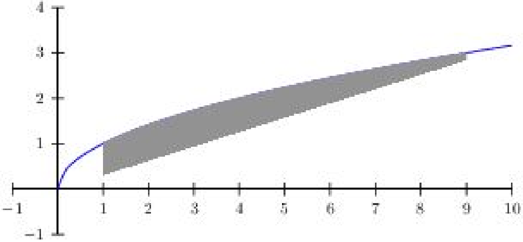
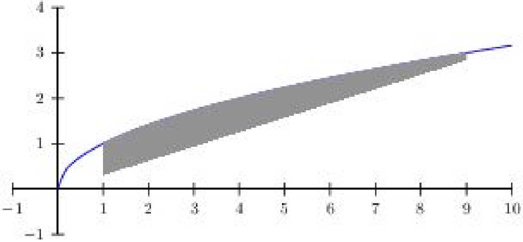


- This isn't what we wanted.
- What happened?

A Graphic to Depict the Area Under a Curve

- You should get



- This isn't what we wanted.
- What happened? LaTeX wants the clip to be a closed shape, so is graphing the curve, but then connecting the first and last points, in this case the points (0,0) and $(10, \sqrt{10})$.

A Graphic to Depict the Area Under a Curve

- So lets fix it by adding the missing bit after the clip ends:
  `\pspolygon*[linecolor=gray](1,0)(9,0)(9,3)(1,1)`

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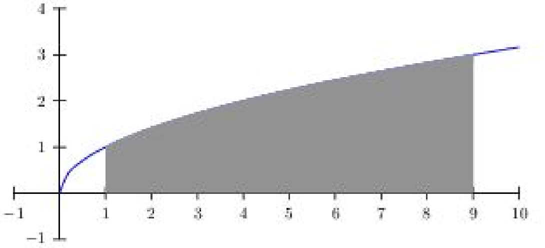

Solid of Revolution

- What if we want to draw a picture of the washer method for finding the volume of the solid formed by revolving the function $f(x) = \sqrt{x}$ around the x-axis.
- It would look as follows:

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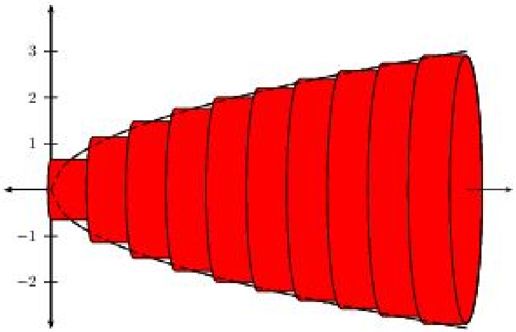

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```
\begin{pspicture}(-1,-1)(10,4)
\psaxes[arrows=<->](0,0)(-1,-1)(9,4)
\psVolume[fillstyle=solid,fillcolor=red]
(0,9){10}{x sqrt}
\psline[arrows=->](9,0)(10,0)
\end{pspicture}
```

Outline

A Sphere

- The pst-3dplot allows us to graph in 3 dimensions.

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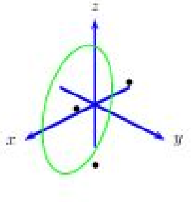
- Try the following code.

```
\begin{pspicture}(-4,-4)(4,4)
\pstThreeDCoor
\pstThreeDSphere(0,0,0){3}
\end{pspicture}
```

3D

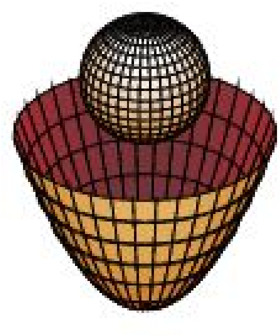
- Here is a fun 3D graphic:



The Code:

```
\begin{pspicture}(-2,-1)(1,2)
\psset{unit=1cm}
\pstThreeDCoor[linewidth=1.5pt,linecolor=blue,
xMin=-1,xMax=2,yMin=-1,yMax=2,zMin=-1,zMax=2]
\pstThreeDEllipse[linecolor=green]
(1,0.5,0.5)(-0.5,0.5,0.5)(0.5,0.5,-1)
\pstThreeDDot(1,.5,.5)
\pstThreeDDot(-.5,.5,.5)
\pstThreeDDot(.5,.5,-1)
\end{pspicture}
```

More 3D



The Code:

```
\begin{pspicture}(-3,0)(3,6)
\pstParaboloid[showInside=false]{3}{2}
\pstThreeDSphere(0,0,4){1}
\end{pspicture}
```

A Helix

- We can also do parametric plots in 3D.

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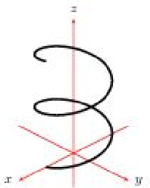

The Code

```
\begin{pspicture}(-4,-4)(4,4)
\pstThreeDCoor[xMin=-2,xMax=2,yMin=-2,yMax=2,
zMin=-1,zMax=4]
\parametricplotThreeD[xPlotpoints=200,plotstyle=curve,
algebraic,linewidth=1.5pt](0,12.564){cos(t)|sin(t)|t/4}
\end{pspicture}
```

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Some Resources

Here is a list of links to websites that have useful information about using pst-plot.

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(The file names are long, so follow the links embedded in the posted .pdf file for this week)

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- General PSTricks
- Pst-Plot with the algebraic option
- pst-3dplot