

# Using Beamer and TikZ

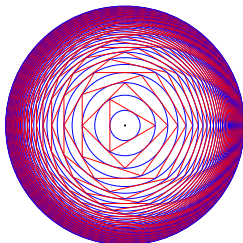
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# Introduction

TikZ is a package that allows you to draw pictures within the  $\text{\LaTeX}$  environment.



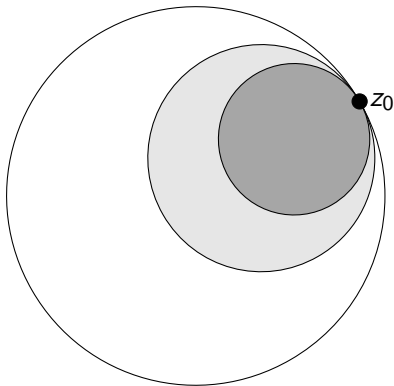
The radius of the innermost circle is 1. It is circumscribed by an equilateral triangle, which is circumscribed by a circle, and so forth. The radius of the circle as the number of figures approaches  $\infty$  is

$$\prod_{n=3}^{\infty} \sec\left(\frac{\pi}{n}\right) \approx 8.7$$

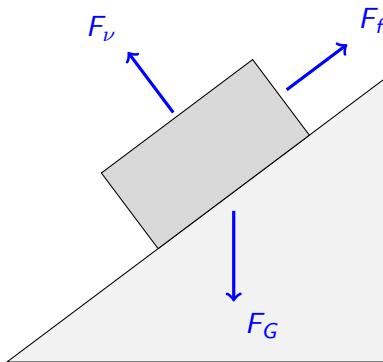
**Figure:** Created by Brian S. Marks

# Wolff's Theorem

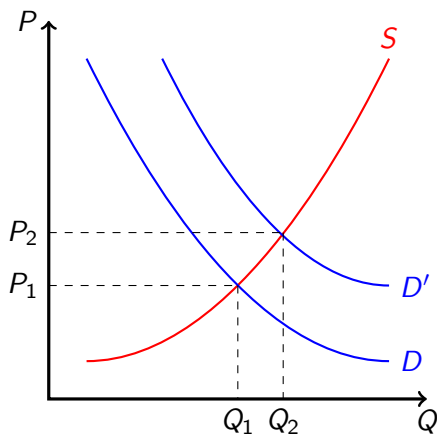
This is a theorem from complex analysis.



# Force Diagram



# Supply & Demand



# Many More Examples

You can find many more examples of TikZ at the following website:

<http://www.texample.net/tikz/examples/>

# TikZ Tutorial

To use TikZ, you need to include the command `\usepackage{tikz}` at the beginning of your  $\text{\LaTeX}$  document.

Each TikZ picture is defined within the TikZ environment.

```
\begin{tikzpicture}  
  ...  
  ...  
\end{tikzpicture}
```

# TikZ Tutorial

Try the following example:

```
\begin{tikzpicture}  
  \draw[color=blue,fill=red] (0,0) circle (1);  
\end{tikzpicture}
```

All TikZ commands should end with a semi-colon! This is very important.



# TikZ Tutorial

Here are some other TikZ commands to try.

- A line:  
`\draw [options] (-5,0) -- (5,2);`
- A sequence of line segments:  
`\draw [options] (-1,0) -- (1,0) -- (0,1) -- (0,-1);`
- A rectangle:  
`\draw [options] (0,0) rectangle (2,2);`
- An arrow: `\draw [very thick, ->] (0,0) -- (2,3);`

Notice that one `\draw` command can draw more than one object.

# TikZ Tutorial

Any time you enter a coordinate in a TikZ picture, you may add  $\text{\LaTeX}$  text next to that coordinate with the `node` command.

```
\begin{tikzpicture}
  \draw[semithick, color=blue] (0,0) circle (1);
  \draw[semithick, <->](-2,0) -- (2,0) node[below] {$x$};
  \draw[semithick, <->](0,-2) -- (0,2) node[left] {$y$};
  \draw (1,1) node[above right] {$x^2+y^2= 1$};
\end{tikzpicture}
```

Copy this TikZ picture into  $\text{\LaTeX}$ , then try adding position markers for  $x = -1$ ,  $x = 1$ ,  $y = -1$ , and  $y = 1$ .

# TikZ Tutorial

You can also write for-loops with TikZ, which can really save time. For example, try the following command.

```
\begin{tikzpicture}
  \draw[semithick,<->] (-2.5,0) -- (5.5,0);
  \foreach \n in {-2,-1,0,1,2,3,4,5}
  {
    \fill (\n,0) circle (1.6pt) node [below=2pt] {$\n$};
  }
\end{tikzpicture}
```

## Source Code for Examples

On the next three slides you can find the  $\text{\LaTeX}$  source code for the three TikZ examples I showed at the beginning.

# Wolff's Theorem TikZ Source

```
\begin{center}
\begin{tikzpicture}
\filldraw[fill=gray!0!white, draw=black]
  (1.5cm,2cm) arc (30:360:2.5cm) arc(0:30:2.5cm);
\filldraw[fill=gray!20!white, draw=black]
  (1.5cm,2cm) arc (30:360:1.5cm) arc(0:30:1.5cm);
\filldraw[fill=gray!70!white, draw=black]
  (1.5cm,2cm) arc (30:360:1cm) arc(0:30:1cm);
\filldraw (1.5cm, 2cm) circle (0.1cm) node[right] {$z_0$};
\end{tikzpicture}
\end{center}
```

## Force Diagram Example Source

```
\begin{center}
\begin{tikzpicture}
  \filldraw[fill=gray!10!white, draw=black]
    (0,0) -- (5,0) -- (5,3.75) -- (0,0);
  \filldraw[fill=gray!30!white, draw=black]
    (2,1.5) -- (4,3) -- (3.25,4) -- (1.25,2.5) -- (2,1.5);
  \draw[very thick, color=blue, ->]
    (3,2) -- (3,0.8) node[below right] {$F_G$};
  \draw[very thick, color=blue, ->]
    (3.7,3.6) -- (4.5,4.2) node[above right] {$F_{\text{f}}$};
  \draw[very thick, color=blue, ->]
    (2.2,3.3) -- (1.6,4.1) node[above left] {$F_{\nu}$};
\end{tikzpicture}
\end{center}
```

## Supply & Demand Example Source

```
\begin{center}
\begin{tikzpicture}
\draw[very thick, <->] (5,0) node[below] {$Q$}
  -| (0,5) node[left] {$P$};
\draw[red, thick] (0.5,0.5) parabola (4.5,4.5)
  node[above] {$S$};
\draw[blue, thick] (0.5,4.5) parabola[bend at end]
  (4.5,0.5) node[right] {$D$};
\draw[blue, thick] (1.5,4.5) parabola[bend at end]
  (4.5,1.5) node[right] {$D'$};
\draw[dashed] (0,1.5) node[left] {$P_1$} --
  (2.5,1.5) (2.5,1.5) -- (2.5,0) node[below] {$Q_1$};
\draw[dashed] (0,2.2) node[left] {$P_2$} --
  (3.1,2.2) (3.1,2.2) -- (3.1,0) node[below] {$Q_2$};
\end{tikzpicture}
\end{center}
```