September 5, 2012 Physics 121 Prof. E. F. Redish

- **<u>Theme Music:</u> Art Tatum**
  Where or When?
- **<u>Cartoon:</u> Jim Davis**
  Garfield

9/5/12 Physics 131 1

Reading questions

- I am still a little confused about the first convention which was listed, the concept of the "suppressed zero" versus the origin which is used in the context of the spatial coordinate system. As mentioned in the reading, a curve is sometimes magnified in non-spatial systems and as a result the origin is no longer represented. I am unclear as to why this is not possible in the spatial coordinate system and why the origin must always be presented. Also, what is meant by saying that not representing the origin can mislead "the viewer into thinking an effect is more important than it is?"
- Is the second convention also important because most physical units cannot be negative? For example, it is impossible to have a negative distance.

9/5/12 Physics 131 3

Suppressed zero

Suppressed zero graphs: the BBC should know better

Here is a graph that appeared on the BBC Ten O'clock news on Friday 10th September 2010:

Looks like a dramatic drop that is coming up. But check for a moment, and look at the vertical axis. Those bars don't start at zero, as one might expect. They start at about 80,000. Nice dramatic graphic - shame it distorts the truth that the BBC is charged with communicating. (The source is perhaps relevant: the Police Federation, who might be called an "interested party" when it comes to the number of Police Officers as it is their representative body. Of course this is the way they would want to show the numbers: the question is whether the BBC should go along with it).

Let's take that data and show it with a proper zero:

Not quite so dramatic now, is it?

When such a graphic appears fleetingly on television, the viewer has no chance to reflect on what they have seen, or to check the presentation - the graph has gone and the story has moved on.

So it is vital that you are careful to make sure that the average (non-statistician) viewer takes away a fair understanding from the graphic that you show.

Black Mark BBC.

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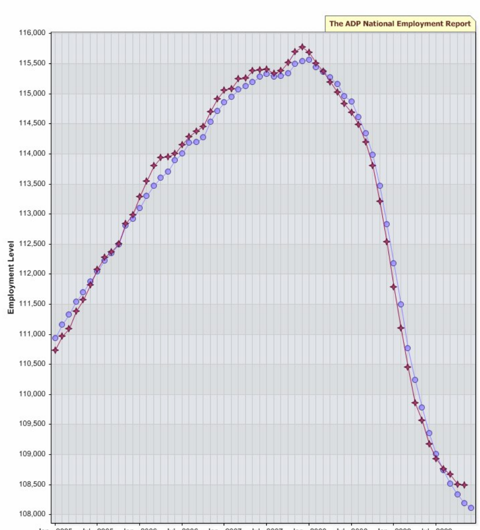
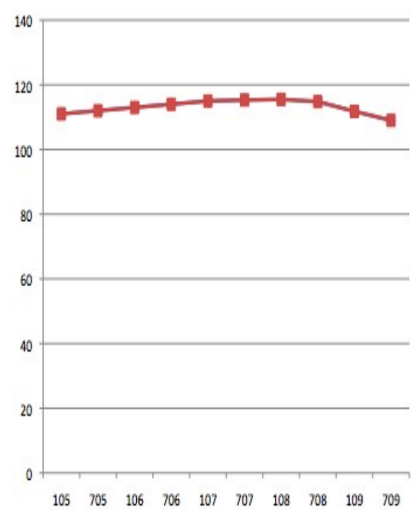
An example from current events





9/5/12 Physics 131 5

Useful numbers (people)

Numbers	
Number of people on the earth	~7 billion (7 x 10^9)
Number of people in the USA	~ 300 million (3 x 10^8)
Number of people in the state of Maryland	~ 5 million (5 x 10^6)
Number of students in a large state university	~30-40 thousand (3 x 10^4)

Physics 131

Useful numbers (distances)

Macro Distances	
Circumference of the earth	~24,000 miles (1000 miles/ time zone at the equator)
Radius of the earth*	$2/\pi \times 10^7$ m
Distance across the USA	~3000 miles
Distance across DC	~10 miles

9/5/12 Physics 131 7

Useful numbers (bio)

Bio Scales	
Size of a typical animal cell	~10-20 microns (10^{-5} m)
Size of a bacterium, chloroplast, or mitochondrion	~1 micron (10^{-6} m)
Size of a medium-sized virus	~0.1 micron (10^{-7} m)
Thickness of a cell membrane	~5-10 nm (10^{-8} m)

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The Main Question

(for this term, at least)

- Start by choosing a big question and then refining it:

How do things move?

Why choose this?

- –concepts of measurement, rate of change, and force are basic – set frame for what are appropriate terms to use to think about motion.
- –ties to everyday experience so can use and learn to build/refine intuition

9/5/12 Physics 131 10

Foothold ideas: Measuring "where"

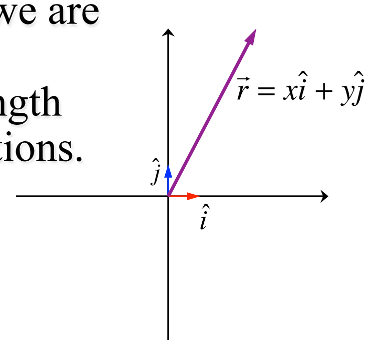
- In order to specify where something is we need a coordinate system. This includes:
  - Picking an origin
  - Picking perpendicular directions
  - Choosing a measurement scale
- Each point in space is specified by three numbers: (x, y, z), and a position vector– an arrow showing the displacement from the origin to that position.
- Vectors add like successive displacements or algebraically by $\vec{A} = A_x\hat{i} + A_y\hat{j}$ $\vec{B} = B_x\hat{i} + B_y\hat{j}$

$$\vec{A} + \vec{B} = (A_x + B_x)\hat{i} + (A_y + B_y)\hat{j}$$

9/5/12 Physics 131 12

Notation

- We specify the directions we are talking about by drawing two little arrows of unit length in two perpendicular directions.
- "x" and "y" are called the coordinates and can be positive or negative.



- Note that if x is negative, it means $x\hat{i}$ is a vector pointing in the direction opposite to $\hat{i}$

9/5/12 Physics 131 13

Foothold ideas: Measuring "when"

- Time is a coordinate just like position
  - We need an origin (when we choose $t = 0$)
  - a direction (usually times later than 0 are +)
  - a scale (seconds, years, millennia)
- Note the difference between
  - clock reading, t
  - a time interval, Δt

This is like the difference between position and length!

9/5/12 Physics 131 14

Graphing Position

- Graphs for the eye vs. graphs for the mind.
- Describe where something is in terms of its coordinate at a given time.

  - Choose origin
  - Choose axes
  - Choose scale
  - Set scales on graph
  - Take data from video
  - Construct different graphs
  - Fit the graphs with math functions

9/5/12 Physics 131 15