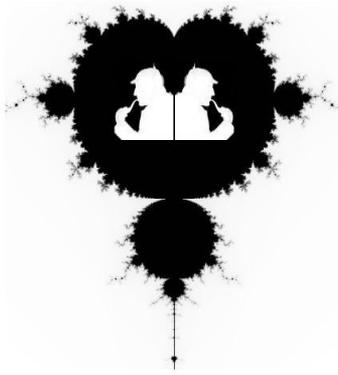


EQUALITY

Issue 01

**A Monthly Newsletter
Accompanying
=EQUALS=**

**A Math / Science /
Programming / Critical
Thinking Club**



=EQUALS=

A Club of Investigation and Discovery

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Center for
***auto* SOCRATIC EXCELLENCE**



EQUALITY

Issue 01

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THINKING OUT LOUD: A *Thinking Process*

“Something on the Table”

Three simple problems. Can you get them right – all of them – with complete confidence?

$$(x^9)^{12} = \frac{x^{72}y^9}{x^6y^3} = 14^0 =$$

Many people wrestle with problems like these, where the fundamental question is: should I do *this* or *that*? *Multiply or Add? Divide or Subtract? 1 or 0?* Not sure, we guess. This is low-hanging fruit. Let’s pick it.

IN SEARCH OF A GOOD METHOD

Let’s come up with a simple method, working with the middle problem above. Think of a simpler example that includes both exponents and division – where we know the answer – to help us find out how to solve these problems. For example:

$$\frac{4^3}{4^1} = \frac{4 \times 4 \times \cancel{4}}{\cancel{4}} = 4^2$$

This example shows: when dividing numbers with exponents, subtract the exponents. Easy enough. But let’s do more than scribble this on our paper. Let’s organize this. But how?

Let’s call this new entity our “something on the table” box. This is where all of our examples will go – our reasoning – our guessing – everything. It’s all evidence. Let’s keep track of it.

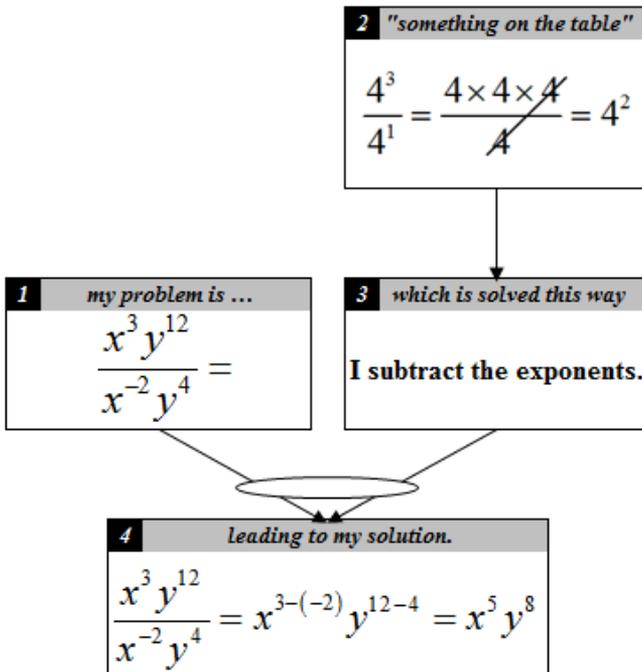


THE METHOD

“Something on the Table”

1. Write the problem;
2. Since you don't know how to solve the problem, you need to get *“Something on the Table”*, a simple example, a picture, etc.
3. From this simple example, you should be able to figure out – *generally* – what you did to solve the problem.
4. Now that you've got the general method, apply it to your particular problem!

$\frac{x^3 y^{12}}{x^{-2} y^4} =$ I can't remember if I should divide – or subtract the exponents. Here's my “something on the table” example, helping me to get to the answer:



SOME PROBLEMS

“Something on the Table”

Here are 20 problems. I use this simple thinking process – **GET SOMETHING ON THE TABLE** – on *all* these problems. *Even now!* Give it a try. And note: the game becomes not “how do I solve *this* problem”, but instead “can I think of anything related *to* this problem”?

1. $\log_2 8 = y$

2. $(x^9)^{12} =$

3. $\frac{7}{8} \times \frac{2}{7} =$

4. My odds of winning are 5:1. What is the probability I win?

5. $\frac{x^{72}y^9}{x^6y^3} =$

6. $LCM(72,14) =$

7. $\frac{1}{4} + \frac{2}{3} =$

8. Find the midpoint of $(-5, 11)$ and $(7, -1)$.

9. 30% of what is 16?

10. $14^0 =$

11. $(2x-3)(y+4) =$

12. Put 126.4×10^{-4} in scientific notation.

13. $\sqrt[3]{8} =$

14. How many ways can I arrange the letters a, b, c, d, e, f ?

15. $(9.2 \times 10^{-5})(6.1 \times 10^5) =$

16. With a coin and a die, what is the probability of getting “tails” and “1 or 2”?

17. How many numbers are there in this series: 14, 15, 16, ..., 94, 95, 96?

18. What is a line perpendicular to $y = 4x - 3$?

19. $i^{22} =$

20. A polyhedron has 20 faces and 12 vertices. How many edges does it have?

MORE INFORMATION / MORE WORKED EXAMPLES

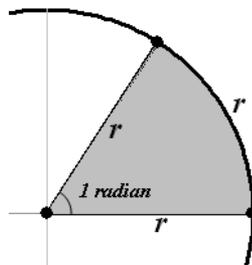
For more information on this process, worked problems on these above, and many more problems, visit:

www.rationalsys.com/autosocraticmath.html

DEGREES TO RADIANS

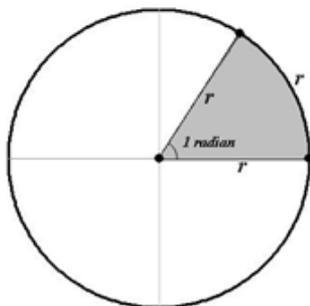
AND MOVING ABOUT THE GRID

Look at my semi-circle with radius r . I've actually got *three* distances labeled r here: two *are* the radius, and the other is the same distance, but this time measured as we move *around* the circle.



My question is: how many degrees have I "carved out" when I move the distance r around the circle? Answer: **1 radian**.

"Radian" is a degree measure. It's between 45° and 90° ... you can tell that just by looking. But *how* far exactly? Let's see:



One radian takes me a distance r around the circle.

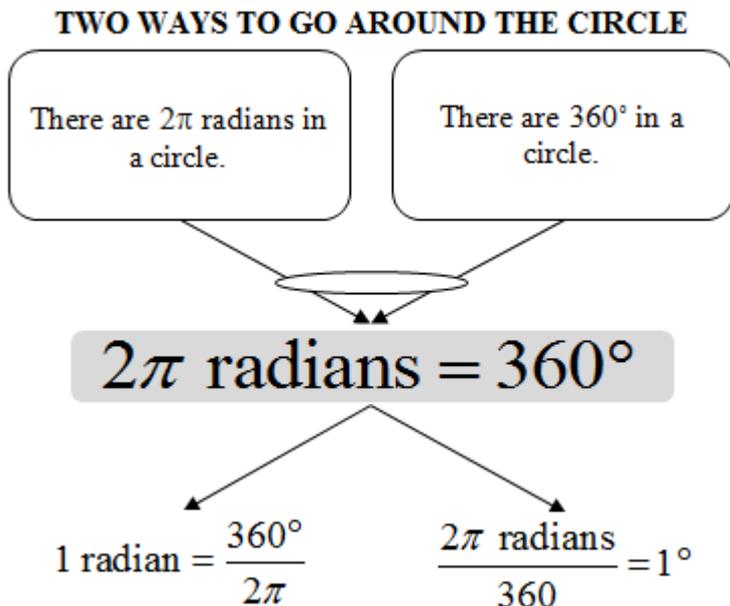
The circumference of a circle is $C = 2\pi r$.

There are 2π radians in a circle.

If I move 2π radians around the circle, then I'm back where I started: 360° . π radians and I'm only *halfway* around the circle: 180° .

CONVERTING BETWEEN RADIANS AND DEGREES A GENERAL METHOD

You really don't have to remember *any* formulas. Instead, think of this: *there are two ways of going all the way around the circle:*



A FINAL NOTE

When I convert from radians to degrees or vice versa, I do not reduce the fractions above. The formulas above remind me I'm going about the circle. It's the geometric process I keep in my head! *I don't need to remember any formulas!* Just the image of going around the circle!

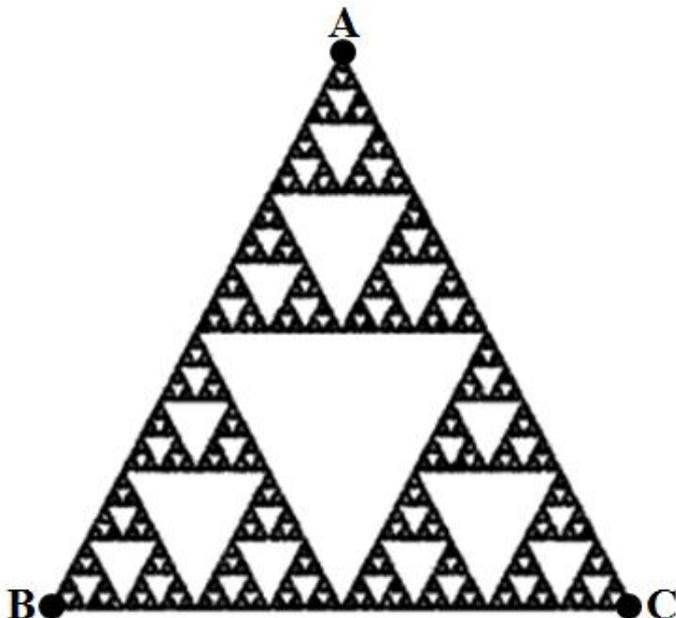
The Amazing Flexibility of the
SCATTER PLOT
A FEW EXAMPLES

PLAYING AROUND WITH FRACTALS

The Chaos Game

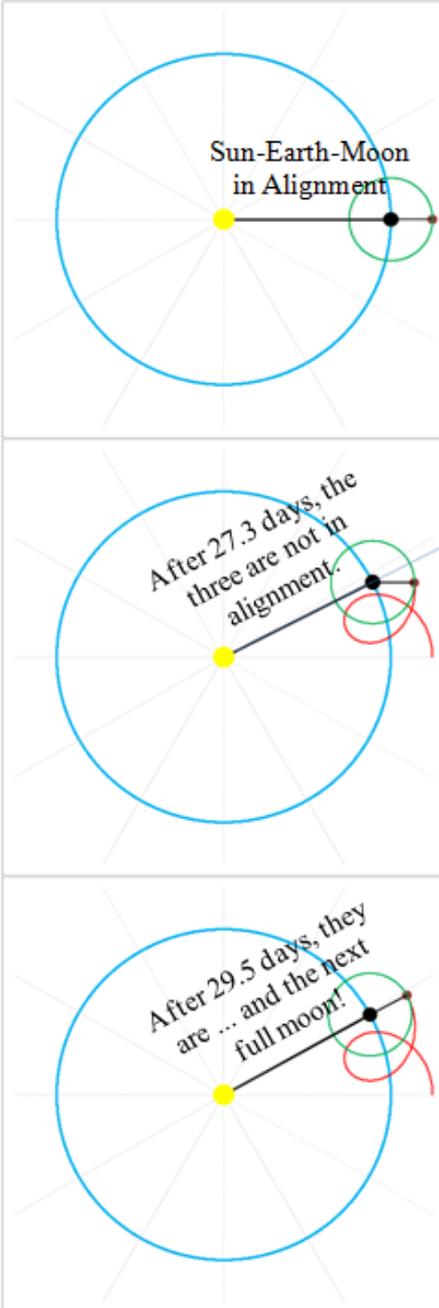
Plot three points on a piece of paper. Label them A, B, and C. Now put your pencil anywhere on the paper, and then randomly select one of our three points. Make a point halfway between your pencil and your chosen point.

Do it again. And again. And again. Thousands of times! OK – don't do it thousands of time – on paper. Do it in the spreadsheet.



THE LUNAR ORBIT

Revolutions about the Solar System



The earth orbits the sun, and the moon orbits the earth. The time for the earth to make one complete rotation about the sun? About 365 days. One year. How about the moon about the earth? A little research shows it's 27.3 days.

Fast forward 27.3 days. However, the moon is *not* in alignment with the sun and the earth. *This isn't a complete cycle, is it?*

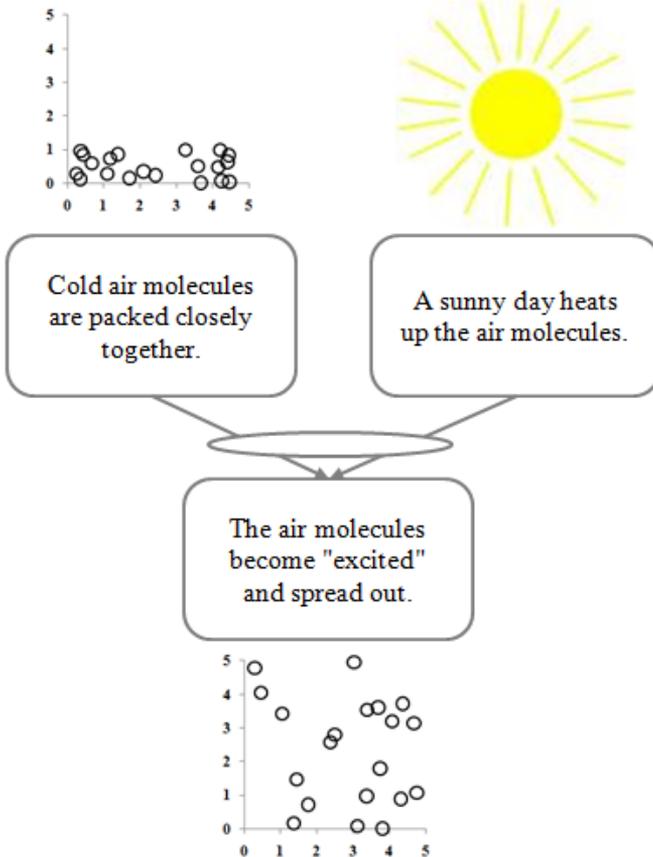
Advancing, we finally see our full moon, now in alignment with the sun and earth. Why? It takes 27.3 days for the moon to go around the earth. This is a *sidereal* month. But the earth is moving as well! The time between full moons – 29.5 days – is longer. This is a *synodic* month!

The Weather Around Us

The Air, Temperature, and Barometric Pressure

The weather report is on TV every night. The forecast is available on the internet for every location in the world. The temperature is rising. The barometric pressure is falling. Mostly just words to me. *What's barometric pressure – and why's is it falling?* What's the relationship between temperature and pressure?

Using simple random numbers and a scatter plot, we can pretty easily create a simple model of weather activity:

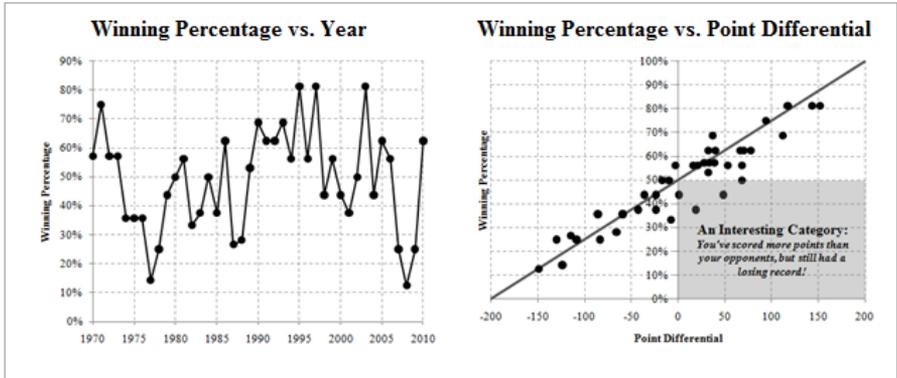


IN THE GRID

Programming Tips

THE NORMAL SCATTER PLOT

Normally, we think of a scatter plot as merely plotting two variables. Here are two, plotting data from the Kansas City Chiefs:



DESIGNS: ANOTHER USE

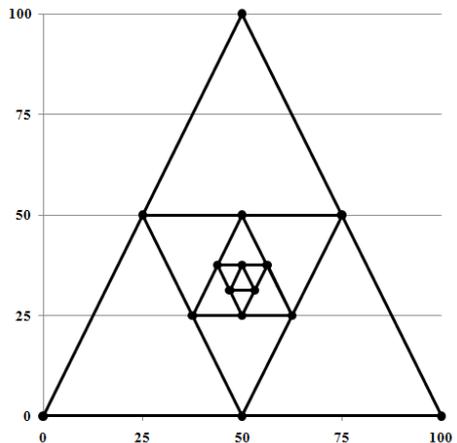
This, too, is a scatter plot!
Right click the data series, and
select:

“Format Data Series”

“Line Color”

and select a line color.

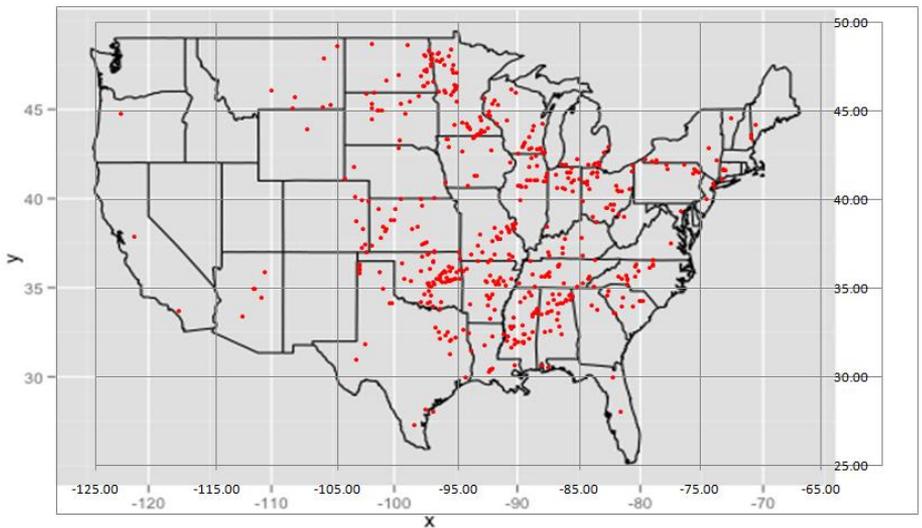
There are many other options
there for you to play with!



A GEOGRAPHIC USE

This is a scatter plot of Tornado touchdowns in 2010. Each tornado has a longitude and latitude. To overlay a scatter plot over an image (a map, here), you need to:

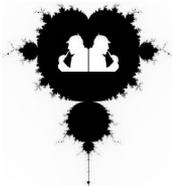
1. Highlight the inside portion of the scatter plot, right click, select “Format Plot Area”, select “Fill”, select “Solid Fill”, and finally, move the “Transparency” slider all the way to the right;
2. Highlight the outside portion of the scatter plot, right click, select “Format Chart Area”, and repeat the steps in “1” above.



SCATTER PLOTS: A SUMMARY

There really are an infinite variety of applications to the scatter plot, once you get the idea of “plotting numbers”! This was evidenced with the three earlier examples – The Chaos Game, The Lunar Orbit, and The Weather – all Scatter Plot Applications!

Announcements



=EQUALS=

A Club of Investigation and Discovery

www.rationalsys.com

=EQUALS= is a math, science, programming, and critical thinking club for Kansas City students and teachers. The club is open to persons of all ages, of all abilities, and is for those who not only enjoy math/science, but those who don't as well! The goal of =EQUALS= is to look at fractals, simulation, statistics, chaos and complexity, engineering, math, etc., from a new perspective – *and actually do the work*. Visit the site for recent news and the next meeting!

POSTER COMPETITION

There are several poster / project competitions throughout the year, in addition to many conferences with student displays. The American Statistical Association, for example, annually puts on “Statistical Poster” and “Statistical Project” competitions.

YEAR-END CELEBRATION

=EQUALS= is planning to have a year-end celebration of things done in the club. A special guest (announcement coming) will be there! It's a chance to put on display for all to see the good things you've done, and see what others have done!

