A Geometric Representation of Trigonometric Functions Using TI-92

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Using similar triangles, a relationship is established between the 6 trigonometric functions of an angle and simple line segments. These relationships are then confirmed using line segment measurement capabilities of TI-92.

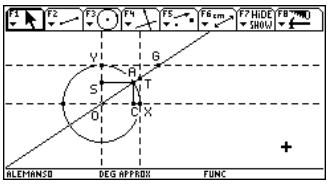

Figure 1:

Relationship (1) - (6) are developed using this diagram.

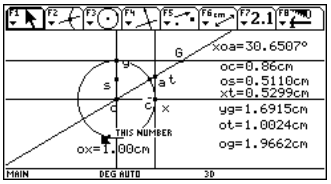

Figure 2:

TI-92's measurement of the 6 line segments.

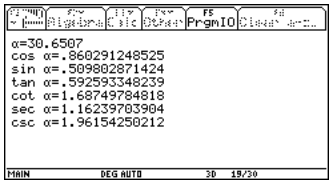

Figure 3:

TI-92's calculation of the 6 trig functions. See Figure 2.

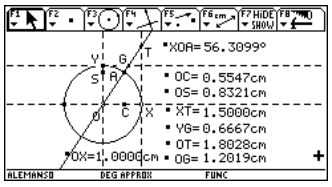

Figure 4:

As point A is "dragged", measurements are updated.

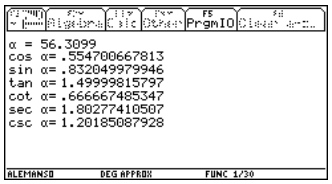

Figure 5:

New calculations based on measurements of Figure 4.

1. Construct a unit circle centered at the origin **(OA= 1)**.

2. At points **X** and **Y**, draw tangents to the circle parallel to x and y axes. $\angle XOA = \alpha$ is an angle in standard position with $AC \perp OX$ and $AS \perp OY$, see Figure 1. Using similar triangles, we have:

$$\frac{AC}{OA} = \frac{OS}{1} = \sin(\alpha)$$

$$\frac{OC}{OA} = OC = \cos(\alpha)$$

$$\frac{XT}{OX} = \frac{AC}{OC} \Rightarrow XT = \frac{\sin(\alpha)}{\cos(\alpha)} = \tan(\alpha)$$

$$\frac{OT}{OA} = \frac{XT}{AC} \Rightarrow OT = \frac{\tan(\alpha)}{\sin(\alpha)} = \frac{1}{\cos(\alpha)} = \sec(\alpha)$$

$$\frac{YG}{OY} = \frac{AS}{OS} \Rightarrow YG = \frac{\cos(\alpha)}{\sin(\alpha)} = \cot(\alpha)$$

$$\frac{OG}{OA} = \frac{YG}{SA} \Rightarrow OG = \frac{\cot(\alpha)}{\cos(\alpha)} = \frac{1}{\sin(\alpha)} = \csc(\alpha)$$

3. In the geometry environment of TI-92 construct the diagram of Figure 1 and measure the length of the 6 line segments obtained in (1) through (6) as well as the measure of angle α. These measurements can be to any desired degree of accuracy as shown in Figure 2.

4. Next, using a simple program we calculate the 6 trigonometric functions of angle α as it was measured in Figure 2. Figure 3 shows the result of these calculations.

5. Complete agreement between measurements of Figure 2 and calculations of Figure 3 as it was predicted by the relationships (1) through (6).

6. Now as we "drag" point A on the circumference of the circle, TI-92 continuously measures the new α as well as the 6 line segments. See Figure 4.

7. Figure 5 shows once again the result of the calculations of the trigonometric functions of new α and they are in complete agreement with the measurements of Figure 4.

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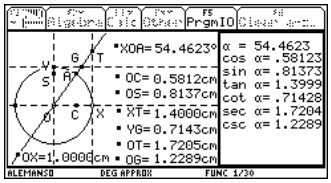

Figure 6:
Split screen allows for simultaneous viewing.

8. Using split screen feature of TI-92, we can combine Figures 2 and 3 into a single screen for simultaneous viewing, See Figure 6.

9. If model of Figure 1 is superimposed on a Cartesian coordinate system, it is easy to see that line segments **OC**,**OS**, **XT**, and **YG** will take on negative quantities as points **C**, **S**, **T**, and **G** oscillate between the 4 quadrants. ◆

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