**Name:   
Advanced Programming in Java**

**Lab Exercise 9/9/2021**

**Using Numeric Variables**

1. Read Lesson 4 in Blue Pelican Java
2. Do the following exercises printing out your documented source code and attach to this handout:

**Exercise 1 --- Average Rain Fall**

Write a program that averages the rain fall for three months, April, May, and June. Declare and initialize a variable to the rain fall for each month. Compute the average, and write out the results, something like:

Rainfall for April: 12

Rainfall for May : 14

Rainfall for June: 8

Average rainfall: 11.333333

To get the numerical values to line up use the tabulation character '\t' as part of the character string in the output statements. Check that your program prints the correct results. There is a beginner's error lurking in this program too! Did you fall victim to it?

**Exercise 2 --- Trigonometry**

To compute the sine of a double precision value use this method:

Math.sin( value )

The value is in radians (not degrees.) The cosine is computed using

Math.cos( value )

Again, value is in radians. Write a program that:

1. Computes the sine of 0.5236 radians and saves it in a variable.
2. Computes the cosine of 0.5236 radians and saves it in another variable.
3. Computes the square of each those two values (use the variables), adds the two squares, and saves the result (in a third variable.)
4. Writes out the three variables.

The output statement should be something like:

System.out.println("sine: " + sinx + " cosine: " + cosx + " sum: " + sum );

Try a few other values besides 0.5236.

**Exercise 3 --- Degrees to Radians**

It is sometimes hard to think in terms of radians; we would rather use degrees. Remember (from those dark days of trigonometry class) that there are PI radians per 180 degrees. So to convert an angle given in degrees to radians do this:

rad = degrees \* Math.PI/180

Math.PI gives you an accurate value of PI.

Edit the previous program so that it does the same things, but the angle is 30 degrees (which you will convert into radians.)

**Exercise 4 --- Trigonometry Identity**

Write a program that uses Math.sin() and Math.cos() to check that the value of sin2θ + cos2θ is approximately 1 for any θ. Just print the value. Why are the values not always exactly 1?

**Exercise 5 --- Polar Coordinates**

**Polar coordinates.** Write a program CartesianToPolar.java that converts from Cartesian to polar coordinates. Your program should take two real numbers x and y and print the polar coordinates r and θ. Use the Java method Math.atan2(y, x), which computes the arctangent value of y/x that is in the range from -π to π.

**Exercise 6 --- Gaussian Random Numbers**

**Gaussian random numbers.** One way to generate a random number taken from the Gaussian distribution is to use the *Box-Muller* formula

Z = sin(2 π v) (-2 ln u)1/2

where u and v and real numbers between 0 and 1 generated by the  Math.random()  method. Write a program StdGaussian.java that prints out a standard Gaussian random variable.

**When you have completed the exercises, submit your documented source code.**