Last name ______________________

First name ______________________

LARSON—MATH 511—CLASSROOM WORKSHEET 01
Getting Started with Sage/CoCalc.

1. Create a Sage/CoCalc account.
   (a) Start the Chrome browser.
   (b) Go to `http://cocalc.com`
   (c) "Create new account" using **your VCU *EID* email address** .
   (d) You should see an existing Project for our class. Click on that.
   (e) Click "New", then "Sage Worksheet", then call it **c01**.

2. Evaluate `900*(1+.06*(90/365)` to find $900(1+.06(90/365))$. Click "Run" or SHIFT-ENTER to evaluate.

3. Evaluate `2**25` to find 25^2.

4. Find $550\frac{[1+(1.05)^{-30}]}{0.05}$.

5. Evaluate `sqrt(8)` to get an *exact* expression for $\sqrt{8}$.

6. Evaluate `numerical_approx(sqrt(8))`, or simply `n(sqrt(8))` to get an *approximate* expression for $\sqrt{8}$.

7. Evaluate "pi". Find a decimal approximation for π. Find a decimal approximation for 2π. Remember to type `2*pi`.

8. Evaluate "e". Then use `n(e,digits=7)` to find a 7-digit approximation for e.

9. Find a 6-digit approximation for e^3.

10. Find $\log 10$. What did Sage compute? Did Sage compute the base-10 log?

11. Evaluate `plot(x**3,-2,2)` to sketch the graph of x^3 on the interval $(-2,2)$.

12. Use Sage to sketch $\cos x$ on the interval $(-2\pi, 2\pi)$.

13. For any variable other than "x" you must tell Sage that you will use it as a variable. Evaluate `var("y")` to define "y" as a variable. Now evaluate `plot3d(x**2+y**2-2, (-1,1),(-1,1))` to sketch $g(x) = x^2 + y^2 - 2$ for $-1 \leq x \leq 1$ and $-1 \leq y \leq 1$.

14. Sage is written in Python. Type in the following program and evaluate.

```
def write_string(string_name):
    print string_name
```

Now type `write_string("hello world!")` and evaluate.

In order to do sophisticated calculations, or to allow for multiple inputs, you will need to define *procedures* (also called *functions*). Our "hello world!" program was the first example. It included a `print` statement. Other program features, in almost any language, include *conditional statements* (if..then..) and *loops*.

15. Type in the following procedure definition and evaluate.

```
# This function returns the absolute value of a number x
def absolute(x):
    if x>=0:
        return x
    else:
        return -x
```

16. Now test it. Evaluate `absolute(4)`, `absolute(-4)`. "#" is the *comment* symbol. Everything after "#" is ignored—and not evaluated.

```
def abs_plus_five(x):
    return absolute(x)+5
```

17. You don't have to add five, you can add *any* number by adding a *parameter*.

```
def abs_plus(x,y):
    return absolute(x)+y
```

18. Now test it. Evaluate `abs_plus(4,5)`, `abs_plus(-4,5)`, `abs_plus(-4,23)`, etc.

19. We can represent the system of linear equations $\begin{cases} 2x + y = 5 \\ x + 3y = 7 \end{cases}$

with the matrix $A = \begin{bmatrix} 2 & 1 & 5 \\ 1 & 3 & 7 \end{bmatrix}$

Enter this in Sage by evaluating: `A=matrix(2,3,[2, 1, 5, 1, 3, 7])`

20. Evaluate `A` to see your matrix.

21. Evaluate `A.rref()` to find a matrix that represents an equivalent system in *row-reduced echelon form*. What do you get?

22. Consider the system: $\begin{cases} x + 3y = 5 \\ x + 3y = 7 \end{cases}$

    Find a matrix that represents this system, and enter it in Sage. Then use Sage to find the row-reduced echelon form of this matrix. Then rewrite (on your own, without Sage) this as an equivalent system of linear equations and interpret.

23. Consider the system: $\begin{cases} x + y = 5 \\ 2x + 2y = 10 \end{cases}$

    Find a matrix that represents this system, and enter it in Sage. Then use Sage to find the row-reduced echelon form of this matrix. Then rewrite (on your own, without Sage) this as an equivalent system of linear equations and interpret.

24. Consider the system: $\begin{cases} 9a + 3b + 1c = 32 \\ 4a + 2b + 1c = 15 \\ 1a + 1b + 1c = 6 \end{cases}$

    Find a matrix that represents this system, and enter it in Sage. Then use Sage to find the row-reduced echelon form of this matrix. Then rewrite (on your own, without Sage) this as an equivalent system of linear equations and interpret.

25. Evaluate: `A=matrix(2,2,[1,2,3,4])`, and `b=vector([5,6])`. Solve the matrix equation $A\hat{x} = \hat{b}$ by evaluating `A.solve_right(b)`. What do you get?