LARSON—MATH 255–CLASSROOM WORKSHEET 07
Lists and Calculus.

1. (a) Start the Chrome browser.
   (b) Go to `http://cocalc.com`
   (c) Login using **your VCU email address** .
   (d) Click on our class Project.
   (e) Click "New", then "Worksheets", then call it **c07**.
   (f) For each problem number, label it in the Sage cell where the work is. So for Problem 2, the first line of the cell should be `#Problem 2`.

   Lists in Sage

   A *list* is a basic *data structure* in Python and Sage. They are represented by square brackets with comma separated numbers, strings, etc., between them (like $[2, 5, 9]$ or `["red", "blue"]`). We have already seen lists in our use of both the `solve()` and `line()` commands which used, respectively, a list of equations and a list of points.

2. Lists can be given names. Evaluate `L=[2,3,5,9]`. Then evaluate `L`.
3. Lists are indexed starting with 0. Evaluate each of `L[0]`, `L[1]`, `L[2]`, and `L[3]`.
4. Lists can be combined with "+". Evaluate `[2,3,5,9]+[3,4,5]`. (Note: any common elements are repeated.)
5. Let `M=[3,4,5]`. Evaluate `L+M`.
6. If you want all the integers from x to y you can use the shorthand notation $[x..y]$. Evaluate `[3..7]`.
7. If you want a list with m n's you can use the shorthand notation $[n] * m$. Evaluate `[0]*7`.
8. You can have a list of lists. Evaluate `L=[[0,1],[2,3],[4,5]]`. Now evaluate `L[1]`. Then evaluate `L[1][0]`. What do you think the value of `L[0][1]` is?
9. You can use *list comprehension* to get a list of the values of any function applied to an initial list. Evaluate `[x**2 for x in [2,5,9]]`.
10. Use list comprehension to produce a list of the cubes of all the integers from 2 to 17.
11. List comprehension can also be used to *filter* the numbers in a list. Evaluate `[x for x in [2,5,9] if x%2==0]`. What did this do?
12. Evaluate `[x for x in [2,5,9] if x%2==1]`. What did this do?

    Calculus in Sage

13. Find the derivatives for x^2, $2x^4$, $log(x)$, $sin(x)$, e^{2x}, and x^x using the command `diff(f(x),x)` (put each function in for f(x)).

14. Find the 2^{nd} derivatives for x^2, $2x^4$, $log(x)$, $sin(x)$, e^{2x}, and x^x using the command diff(f(x),x,2) (put your function in for f(x)).

15. Let $g(x) = x^x$. Sketch the graph of $g(x)$. Let `gprime(x)=diff(g(x),x)`. Evaluate `gprime(1)` and `gprime(0)`. Explain.

16. Sketch the graph of $gprime(x)$. Solve when $gprime(x) = 0$.

17. Evaluate `derivative(g(x))`. (`diff()` is just shorthand for `derivative()`.

18. Find `g(x).derivative()`.

19. Let h(x,y)=xy. Find $\frac{\partial h}{\partial x}$ the partial derivative of h(x) with respect to x by hand. Then evaluate `h(x,y)=xy`, and `diff(h(x,y),x)`.

20. Let h(x,y)=xy. Find `diff(h(x,y),x)`.

21. Find $\frac{\partial h^2}{\partial x \partial y}$. Now try diff(h(x,y),x,y)

22. Find $\frac{\partial h^2}{\partial x \partial x}$.

23. Try `h.derivative()`. Explain what you get.

24. Find $\int 3x\,dx$ by hand. Check with `integral(3*x,x)`.

25. Let f(x)=3x. Let fint=integral(3*x,x). Check that diff(fint,x)=f(x).

26. Find $\int_1^2 f(x)\,dx$ by hand. Check using `integral(f(x),x,1,2)`.

27. Sketch $g(t) = t^{20}e^t$ on $(0, 3)$.

28. Find $\int t^{20}e^t\,dt$.

29. Find $\int_2^3 t^{20}e^t\,dt$.

30. Find a numerical approximation for $\int_2^3 t^{20}e^t\,dt$.

31. Try `numerical_integral(`$t^{20}e^t$`, 2, 3)`.

32. Find out what the second number of your answer means.

Getting your classwork recorded

When you are done, before you leave class...

(a) Click the "Make pdf" (Adobe symbol) icon and make a pdf of this worksheet. (If Cocalc hangs, click the printer icon, then "Open", then print or make a pdf using your browser).

(b) Send me an email with an informative header like "Math 255 - c07 worksheet attached" (so that it will be properly recorded).

(c) Remember to attach today's classroom worksheet!