

Geol 300 Matlab review exercises
Due April 11

1. Symbolic toolbox

Take the derivative

- A) x^2
- B) $x^3 + x^4 + x^7 + \text{atan}(x)$

Simplify

- A) $\exp(x \cdot \log(\sqrt{\alpha + \beta}))$

Calculate

- A) $(x+1)^7$

2. Variables

- A) Write the matlab code to assign the value 4.5 to a variable name y
- B) Show the code to assign the following values (all at once to create a vector) to a single variable named FredAstaire
[1, 7, 8, 10, -2, 0]
- C) Show the code to create a 2 by 2 matrix with values of your own choosing

3. Loops

- A) Write the matlab code to create a loop that goes from 1 to 10.
- B) Write the code to go from 1 to 10 by 2's
- C) Write the code to fill a 10 by 10 matrix with the value 1 using two nested loops.

4. Functions

A) Create a function to calculate the average of a set of numbers. The number should be in a vector with N elements. The function should work like this:

```
>> x = [1,2,3,4]
x = 1 2 3 4
>> n = 4
n = 4
>> find_average(x,n)
ans = 2.5000
```

B) Modify the function so that you don't need to provide the number of elements.

5. Scripts

A) The formula for the change in gravity above a buried sphere of differing density is:

$$\Delta g = \left(\frac{4\pi G R^3 \Delta \rho}{3} \right) \left[\frac{b}{(x^2 + b^2)^{\frac{3}{2}}} \right]$$

where R is the radius of the sphere, b is the depth of the sphere, x is the horizontal distance between the center of the sphere and the point at which the gravity is measured. G is the gravitational constant ($6.6732 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$), and $\Delta \rho$ is the difference in density. Assume that you are trying to determine the difference in density for a sphere of buried salt in sediments. The density of the salt is 2200 kg/m^3 and the density of the sediments is 2400 kg/m^3 . The depth of the center of the sphere is 6 km and R is 4.0 km.

Calculate Δg at the surface directly above the sphere ($x = 0.00$). You should get 9.9387×10^{-5} (units ?). Verify that your script works correctly.

Now turn your script into a function, so that you can type stuff like this:

```
>> gravity(0)
ans = 9.9387e-05
```

B) Now calculate and plot Δg for x from -10 to 10 km (remember to convert into m for your script).

C.) Suppose we wanted to calculate the gravity anomaly over an area centered above the sphere. Remember, the only variable is x, the horizontal distance. One way is to imagine an X and Y grid with the center of the salt at [0,0]. The formula for distance between two points on a plane is

$\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$. In this formula, x_1 and y_1 are 0, so we only need $\sqrt{(x_1)^2 + (y_1)^2}$. Make another script named distance, which calculates the distance between a point and the origin.

```
>> distance(1,1)          ans = 1.4142
```

Now, using two loops, calculate the gravity change over a 10 km by 10 km area at a spacing of 1 km. Save the results in a 2d array [for example, $g(j,k)$]. Copy your scripts and results to your lab write-up. Type `contour(g)` - this should make a contour plot. Try other plots - `mesh(g)`, `surf(g)` and `rotate3d`. Save your `area_gravity` program as another script.

D.) Modify your scripts so that the depth of the sphere of the sphere can be varied as well.

E) Extra-credit: Suppose, instead of a sphere of salt we had a hollow cave – what is the change in gravity above that cave?

For part 5, the write-up should include the script, answers, and plots of gravity above a sphere.