

**Directions:** You will turn in a typed report detailing your strategy and work to complete the following problem. Working with others in the class is encouraged, but be careful to avoid cheating and/or plagiarism. When you use an idea or approach from anyone outside your group on an assignment, you must acknowledge their contribution to your work.

### Integral Averages

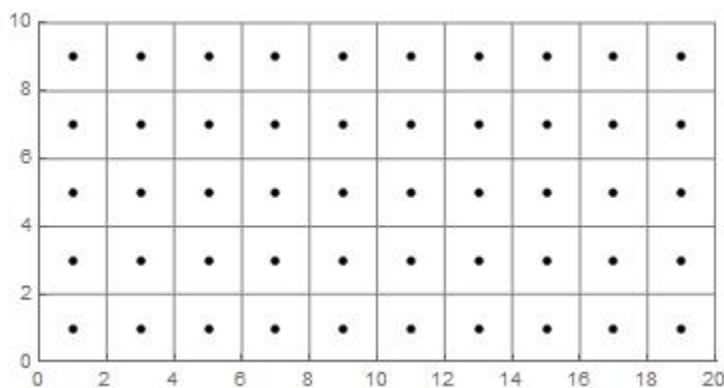
As you have seen in Calculus, the average value of a function over a set is found by integrating the function over that set and then dividing by the size of that set. In one dimension, that looks like:

$$f_{ave} = \frac{1}{b-a} \int_a^b f(x) dx.$$

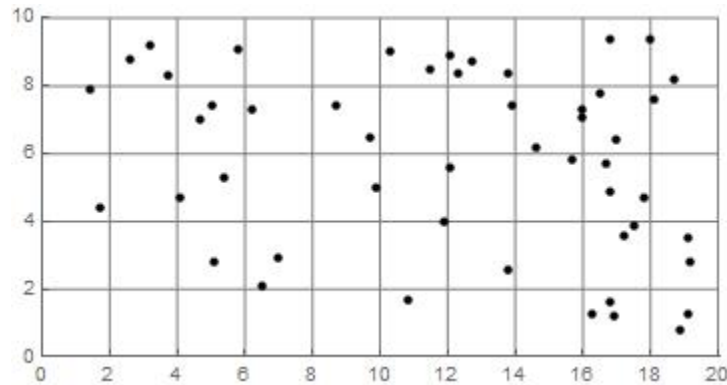
In two dimensions, the average value of a function over a region  $R$  is given by:

$$f_{ave} = \frac{1}{Area(R)} \int \int_R f(x, y) dx dy.$$

In real-world situations, you often collect data instead of having the formula for a function. Preferably, the data would be from evenly spaced locations throughout the region. Then a simple average would be the same as the Riemann sum approximation of the integral average. For example, if you were calculating the average temperature on a surface that was 10 feet by 20 feet, you might sample data from the 50 locations shown below. Each reading is treated as the average of the region it represents.



Sometimes you don't have control over the sample data. You have to do the best with the data you have. Suppose you have temperature readings from the 50 locations pictured below. The grid is there for comparison to the previous figure.



Explain why a simple arithmetic average of the data is not appropriate for this data set. Then develop a strategy for calculating the average temperature of this surface. Implement your strategy for this problem using the data in the given Excel file. You'll find the  $x$  and  $y$  coordinates of each sample point and their corresponding temperature.

Looking ahead, your next data challenge will be a similar problem with more data and one other twist. It is to your advantage to start thinking about a strategy that can be automated. Fifty data points is small enough that you can work with each point individually if you want. For a larger set, you'll want a well-defined algorithm so you can let the computer do most of the work.

Make sure you explain your ideas and your work really well. You are free to use any of the usual software that you feel comfortable with. Let me know if you have any questions.