MATHEMATICAL BACKGROUND

The three main areas where prior knowledge is expected is

- Probability & statistics
- Linear algebra
- (Multivariate) calculus

More detailed topics in each of these areas is listed below. If you have not seen this material before or it has been some time since you have seen it – it is recommended you go over some of these topics. We include three course notes which approximately cover the required material. The course notes contain additional material (particularly for calculus. In the breakdown below, we list which chapters are relevant. Finally, we include three freely available online resources which may be helpful.

- Linear Algebra: `http://vmls-book.stanford.edu/`
- Calculus/Linear Algebra: `http://people.reed.edu/~wieting/essays/DPMath211.pdf` (Chapters 1,2,3, 4.1.4.4-4.8,5).
- Calculus (concise): `http://dsp.ucsd.edu/~kreutz/General%20Lecture%20Notes/Lecture_Notes_on_Real_Vector_Derivatives.pdf` (Chapter 1)

A brief summary of the topics more in detail are as follows:

- Probability & statistics: Much of this will be reviewed in Probability and Statistics for Data Analytics, but it will be helpful to review it. The provided course notes are helpful.
    - Definition of probability and random variables,
    - Expectations and variance of random variable,
    - Maximum likelihood estimation,
    - Bayes rule/theorem.
- Linear algebra: One should known how to perform the following computations and be familiar with **matrix notation**. The provided lecture notes cover the required material (with some additional topics).
    - Inner products
    - Matrix-vector multiplications,
    - Matrix-matrix multiplications,
    - Eigenvalues & eigenvectors.
- (Multivariate) calculus: This is the topic which often has the most questions. Calculus is a large subject with many topics. There are many standard textbooks available such as Calculus by Thomas. The provided course notes cover the required material and much more. The main topics you will need for Data Analytics involve computing derivatives (and occasionally an integral). The majority of the material for the following topics is in Chapters 2 and the beginning of Chapter 3.
    - Derivatives of a function,
    - Partial derivatives of multivariate functions,
    - Gradients,
    - Hessians and Jacobians,
    - Integrals.