**DASC 2594 – Multivariable Math for Data Scientists**

**Unit 4: Multivariable Functions, The Chain Rule, and Partial Derivatives**

**Lesson Plan 9: Multivariable Functions and Partial Derivatives**

**John Tipton, 2020**

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| **Units** | **Lesson Plan 9** | **Readings** |
| **Unit 4**  **Multivariable Functions, The Chain Rule, and Partial Derivatives** | **Essential Questions**   * What is a function of two variables? How do you visualize a function over two variables? * How do you define the limit of a function of two variables? * What are boundary points? What effect does the boundary have on optimization problems? * What are partial derivatives? How are partial derivatives used to solve optimization problems? * What is the effect of differentiability on the smoothness of a function? | Chapter 15 in Briggs et. al. |
| **Day 1**   * Define and graph functions of two variables * Identify and solve for level curves * Use a probability function of two variables and calculate level curves * Use level curves to characterize electric potential * Graph functions of more than two variables |
| **Day 2**   * Define the function, domain, and range from n independent variables * Define the limit of a function of two variables * Define and apply limits of constant and linear functions * Apply and understand limit laws for functions of two variables |
| **Day 3**   * Define and understand interior and boundary points * Define and identify open and closed sets * Define and apply continuity for functions of two variables * Define and use the properties of continuity for composite functions |
| **Day 4**   * Define and apply partial derivatives in two dimensions * Calculate and apply higher order partial derivatives for functions in two dimensions * Extend the understanding of partial derivatives to three or more variables * Apply partial derivatives to physical systems |
| **Day 5**   * Identify and apply differentiability conditions for multivariable functions * Understand differentiability implies continuity * Demonstrate how differentiability determines smoothness of model fits in data science (graphical demonstration of GPs with exponential, Matern, Gaussian covariance functions) |