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

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

**Lesson Plan 10: The Chain Rule, Gradients and Directional Derivatives**

**John Tipton, 2020**

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| **Units** | **Lesson Plan 10** | **Readings** |
| **Unit 4**  **Multivariable Functions, The Chain Rule, and Partial Derivatives** | **Essential Questions**   * What is the chain rule? How is the chain rule used to evaluate derivatives in multiple dimensions? * What are directional derivatives and how are they different from normal partial derivatives? | Chapter 15 in Briggs et. al. |
| **Day 1**   * Define and apply the chain rule with one independent variable * Define and apply the chain rule with multiple independent variable * Use the chain rule for implicit differentiation |
| **Day 2**   * Understand and apply directional derivatives and the gradient * Define and apply the definition of a directional derivative as a limit * Compute directional derivatives * Understand and apply the gradient |
| **Day 3**   * Use the gradient to determine direction of change (2 dimensions) * Use and understand the properties of the gradient (2 dimensions) * Understand and interpret the gradient (2 dimensions) * Understand and apply the gradient and level curves (2 dimensions) |
| **Day 4**   * Use the gradient to determine direction of change (3+ dimensions) * Use and understand the properties of the gradient (3+ dimensions) * Understand and interpret the gradient (3+ dimensions) * Understand and apply the gradient and level curves (3+ dimensions) |
| **Day 5**   * Define and find the tangent plane of a surface * Find and solve for the linear approximation to the tangent plane of a surface at a point * Understand differentials as rates of change |