DASC 2594\_Multivariable Math for Data Scientists\_Unit #4\_Multivariable Functions, The Chain Rule, and Partial Derivatives

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| **Stage 1 Desired Results** | | |
| ESTABLISHED GOALS  **Timeframe:** (maximum) 14 days  **Lesson Plans Referenced**:   * DASC 2594\_Unit 4\_Lesson Plan 9\_Multivariable Functions and Partial Derivatives * DASC 2594\_Unit 4\_Lesson Plan 10\_The Chain Rule, Gradients and Directional Derivatives * DASC 2594\_Unit 4\_Lesson Plan 11\_Optimization and Lagrange Multipliers | ***Acquisition*** | |
| *Students completing Unit 4 of DASC 2594 should be able to:*   * Visualize a function of two variables * Apply partial derivatives to solve optimization problems * Apply the chain rule to multivariable functions * Compute the gradient and use the gradient to determine direction of change * Find and solve linear approximations to the tangent plane of a surface * Solve optimization problems using Lagrange multipliers | *Students will be skilled at…*   * Manipulating functions of multiple variables * Using partial derivatives to solve optimization problems * Calculating derivatives using the multivariable chain rule * Solving partial derivatives for vector-valued functions |
| ***Meaning*** | |
| UNDERSTANDINGS  *Students will understand …*   * How partial derivatives are applied to multivariable functions * How differentiability of a function influences the smoothness of a function * What a gradient tells us about optimization problems * What directional derivative are and how they are used | ESSENTIAL QUESTIONS   1. How do you define the limit of a function of two variables? 2. What are boundary points? What effect does the boundary have on optimization problems? 3. What are partial derivatives? How are partial derivatives used to solve optimization problems? 4. What is the chain rule? How is the chain rule used to evaluate derivatives in multiple dimensions? 5. What are directional derivatives and how are they different from normal partial derivatives? 6. What is the chain rule? How is the chain rule used to evaluate derivatives in multiple dimensions? 7. What are directional derivatives and how are they different from normal partial derivatives? 8. What is the gradient? Why is the gradient important in data science? 9. How do you solve for minima/maxima of multivariable functions? 10. What are Lagrange multipliers? How are Lagrange multipliers used to solve constrained optimization problems? |
| ***Transfer*** | |
| *Students will be able to independently use their learning to…*   * Apply two variable functions to probability density functions to solve and plot level curves * Apply partial derivatives and boundary conditions to solve multivariable optimization problems * Determine the relative smoothness of a function based on the number of derivatives * Understand how auto-differentiation software works to evaluate partial derivatives | |
| **Stage 2 - Evidence** | | |
| **Evaluative Criteria** | **Assessment Evidence** | |
| Rubric Names: | PERFORMANCE TASK(S)    *Pre-Test:*  *Formative Assessment :*   * *HW 10: Multivariable Functions* * *HW 11: Partial Derivatives* * *HW 12: Gradients* * *HW 13: Optimization and Lagrange multipliers*   *Summative Assessment:*   * Exam (In class and take home) | |
|  | OTHER EVIDENCE:   * In class questions using learning software (google forms, etc.) * Student feedback and questions | |
| **Stage 3 – Learning Plan** | | |
| *Summary of Key Learning Events and Instruction*  *Unit #4 (maximum) 14 days*  Textbook: To be determined (likely will be primarily based on class lecture notes)  Technology: RStudio /RStudio Server / RStudio Connect;  Prerequisite Knowledge/Course(s): Fundamental understanding of Calculus at the level of Calculus II and ability to program in R  **Activity 1 (5 days):** List Topic Refer to DASC 2594\_Unit 3\_Lesson Plan 9\_Multivariable Functions and Partial Derivatives  **Activity 2 (5 days):**  List Topic Refer to DASC 2594\_Unit 3\_Lesson Plan 10\_The Chain Rule, Gradients and Directional Derivatives  **Activity 3 (4 days):**  List Topic Refer to DASC 2594\_Unit 3\_Lesson Plan 11\_Optimization and Lagrange Multipliers | | |

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| **Learning Accommodations** | |
| **Student Accommodations** | **Accelerated Students** |
| Compliance/ADA/504 | Challenge Students who want/need more |