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

**Unit 5: Multiple Integration**

**Lesson Plan 12: Multiple Integration**

**John Tipton, 2020**

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| **Units** | **Lesson Plan 12** | **Readings** |
| **Unit 5**  **Multiple Integration** | **Essential Questions**   * What are multiple integrals? * How can you apply iterated integrals? Under what conditions can the order of integration change? * How do multiple integrals give a measure of volume? * What are Jacobians? Why are Jacobians important? | Chapter 16 in Briggs et. al. |
| **Day 1**   * Use and apply double integrals over rectangular regions * Solve double integrals using iterated integrals * Define and apply Fubini's theorem to change order of integration |
| **Day 2**   * Solve for double integrals over general regions * Use iterated integrals to evaluate double integrals over general regions * Apply double integrals over nonrectangular regions * Choose and change the order of integration for nonrectangular regions * Apply double integrals to solve problems (area of region, volume between two surfaces, etc.) |
| **Day 3**   * Evaluate double integrals using polar coordinates * Change of variables for double integrals over polar rectangular regions * Change of variables over general polar regions * Solve for areas of polar regions using double integrals |
| **Day 4**   * Define and evaluate triple integrals over rectangular coordinates * Use triple integrals to find mass and volume * Apply Fubini's theorem to change the order of integration for triple integrals * Use triple integrals to find the average value of a function of three variables |
| **Day 5**   * Triple integrals in spherical coordinates * Apply and use transformations between rectangular and spherical coordinates * Find the limits of integration in spherical coordinates * Perform change of variable for triple integrals in spherical coordinates * Use integrals to solve for center of mass in one dimension, two dimensions, and three dimensions |
| **Day 6**   * Apply change of variables for multiple integrals * Identify one-to-one transformations * Use and apply Jacobian determinant of a transformation of two variables * Apply change of variables for double integrals using Jacobian * Use and apply Jacobian determinant of a transformation of three variables * Apply change of variables for triple integrals using Jacobian |