

Math 1C: Supplementary Videos Multivariable Differentiation Playlists

Below is a list of YouTube playlists that I created as supplementary materials for my Math 1C course. You can find these, and many other additional resources, that I provide to my students on my Math 1C course homepage:

<http://www.appliedlinearalgebra.com/blog/for-students/welcome-to-math-1c>

Lesson 0: Introduction to Multivariable Differentiation	(61 min, 41 sec)
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URL: https://www.youtube.com/playlist?list=PLSt7rwoPGTy3CS1h2kxWCgJgQ_WabE7Dp

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| □ M1C, Lesson 0.1: Review of Single Variable Calculus | (6 min, 10 sec) |
| □ M1C, Lesson 0.2: Introduction to Multivariable Calculus | (10 min, 24sec) |
| □ M1C, Lesson 0.3: Applied Math Modeling | (10 min, 39 sec) |
| □ M1C, Lesson 0.4: Intro to Least Squares | (18 min, 56 sec) |
| □ M1C, Lesson 0.5: Total-Squared Error Function | (15 min, 32 sec) |

Lesson 1: Vectors in \mathbb{R}^2	(71 min, 8 sec)
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URL: <https://www.youtube.com/playlist?list=PLSt7rwoPGTy16cnsPChMJwZVdYwhTnqx>

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| □ M1C, Lesson 1.1: Intro to Multivariable Functions | (6 min, 18 sec) |
| □ M1C, Lesson 1.2: Points in \mathbb{R}^2 | (10 min, 24sec) |
| □ M1C, Lesson 1.3: Vectors in \mathbb{R}^2 | (12 min, 8 sec) |
| □ M1C, Lesson 1.4: Two-norm in \mathbb{R}^2 | (11 min, 03 sec) |
| □ M1C, Lesson 1.5: Vector addition in \mathbb{R}^2 | (14 min, 47 sec) |
| □ M1C, Lesson 1.6: Scalar-Vector Multiplication in \mathbb{R}^2 | (16 min, 28 sec) |

Lesson 2: Vectors in \mathbb{R}^3	(129 min, 38 sec)
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URL: <https://www.youtube.com/playlist?list=PLSt7rwoPGTy1Sp8AFeCoV-rYWKiPTtGl>

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| □ M1C, Lesson 2.0: Intro to Mma Notebooks | (7 min, 30 sec) |
| □ M1C, Lesson 2.1: Intro to Mma Notebooks | (7 min, 12 sec) |
| □ M1C, Lesson 2.2: Definition of \mathbb{R}^3 | (9 min, 37sec) |
| □ M1C, Lesson 2.3: The xy-plane | (7 min, 30 sec) |
| □ M1C, Lesson 2.4: Graphing in 3D Using Mma | (20 min, 02 sec) |
| □ M1C, Lesson 2.5: Vectors of \mathbb{R}^3 | (19 min, 38 sec) |
| □ M1C, Lesson 2.6: Two norm in \mathbb{R}^3 | (16 min, 42 sec) |
| □ M1C, Lesson 2.7: Vector add and scalar mult in \mathbb{R}^3 | (15 min, 54 sec) |
| □ M1C, Lesson 2.8: Spheres and Cylinders in \mathbb{R}^3 | (25 min, 33 sec) |

Lesson 3: The Dot Product in \mathbb{R}^2 and \mathbb{R}^3

(151 min, 51 sec)

URL: <https://www.youtube.com/playlist?list=PLSt7rwoPGTy1z8NcRqRicDApkHxhYvx9W>

- M1C, Lesson 3.1: Introduction to Inner Product (10 min, 01 sec)
- M1C, Lesson 3.2: Component Definition of Dot Product (19 min, 50sec)
- M1C, Lesson 3.3: Example of Inner Products (9 min, 35 sec)
- M1C, Lesson 3.4: Algebraic Properties of Dot Product (Part 1) (13 min, 54 sec)
- M1C, Lesson 3.5: Algebraic Properties of Dot Product (Part 2) (14 min, 08 sec)
- M1C, Lesson 3.6: Proof of Pythagorean Theorem (11 min, 00 sec)
- M1C, Lesson 3.7: Proof of Law of Cosines (13 min, 53 sec)
- M1C, Lesson 3.8: Cosine Formula for Dot Product (15 min, 20 sec)
- M1C, Lesson 3.9: Dot Product and Orthogonality (6 min, 44 sec)
- M1C, Lesson 3.10: Example Cosine Formula for Dot Product (12 min, 08 sec)
- M1C, Lesson 3.11: Projections via the Dot Product (16 min, 56 sec)
- M1C, Lesson 3.12: Projection Example (8 min, 22 sec)

Lesson 4: The Cross Product \mathbb{R}^3

(139 min, 32 sec)

URL: <https://www.youtube.com/playlist?list=PLSt7rwoPGTy0Awe8EJJAUhWPK9x5p2X47>

- M1C, Lesson 4.1: Intro to Cross Products (20 min, 37 sec)
- M1C, Lesson 4.2: Intro to Component Form (11 min, 32 sec)
- M1C, Lesson 4.3: Area of Parallelogram (20 min, 16 sec)
- M1C, Lesson 4.4: Cross Products of $\mathbf{i}, \mathbf{j}, \mathbf{k}$ (15 min, 14 sec)
- M1C, Lesson 4.5: The Component Form of Cross Product (12 min, 03 sec)
- M1C, Lesson 4.6: Calculate Cross Product Examples (15 min, 53 sec)
- M1C, Lesson 4.7: Algebraic Properties of Cross Product (14 min, 53 sec)
- M1C, Lesson 4.8: Geometric Properties of Cross Product (9 min, 49 sec)
- M1C, Lesson 4.9: Sine Formula for the Cross Product (19 min, 15 sec)

Lesson 5: Lines and Curves in \mathbb{R}^2 and \mathbb{R}^3

(108 min, 57 sec)

URL: <https://www.youtube.com/playlist?list=PLSt7rwoPGTy2x76mmKvua7U66sMvoyEUL>

- M1C, Lesson 5.1: Intro to Vector-Valued Functions (8 min, 55 sec)
- M1C, Lesson 5.2: Intro to Lines as Vector-Valued Functions in \mathbb{R}^2 (14 min, 59 sec)
- M1C, Lesson 5.3: Vector Equation for Lines in \mathbb{R}^2 (10 min, 38 sec)
- M1C, Lesson 5.4: Vector Equation for Circle in 2D (17 min, 26 sec)
- M1C, Lesson 5.5: Intro to Scalar Equation for Ellipse (23 min, 19 sec)
- M1C, Lesson 5.6: Vector Equation for Ellipse (7 min, 39 sec)
- M1C, Lesson 5.7: Vector Equation for Line in \mathbb{R}^3 (19 min, 23 sec)
- M1C, Lesson 5.8: Vector Equation for Line Segment in \mathbb{R}^3 (6 min, 38 sec)

Lesson 6: Planes and Surfaces in \mathbb{R}^3

(160 min, 48 sec)

URL: <https://www.youtube.com/playlist?list=PLSt7rwoPGTy1mx5VayGiKVymkDsdPqAc->

- M1C, Lesson 6.1: Intro to Equation Types (11 min, 14 sec)
- M1C, Lesson 6.2: Implicit Equation for a Line (16 min, 28 sec)
- M1C, Lesson 6.3: General Equations for a Plane (12 min, 19 sec)
- M1C, Lesson 6.4: Example 1 of Equation for Plane (20 min, 56 sec)
- M1C, Lesson 6.5: Example 2 of Parallel and Orthogonal Planes (12 min, 46 sec)
- M1C, Lesson 6.6: Example 3 of Intersection of Planes (18 min, 55 sec)
- M1C, Lesson 6.7: Intro to Quadratic Surfaces (12 min, 35 sec)
- M1C, Lesson 6.8: Ellipsoids (33 min, 31 sec)
- M1C, Lesson 6.9: Elliptic Paraboloid (22 min, 04 sec)

Lesson 7: Graphs and Level Curves

(104 min, 29 sec)

URL: <https://www.youtube.com/playlist?list=PLSt7rwoPGTy0090FZ0SADehweWiTOFYX0>

- M1C, Lesson 7.1: Intro to Level Curves in 2D (5 min, 43 sec)
- M1C, Lesson 7.2: Implicit Equation for a Line (12 min, 56 sec)
- M1C, Lesson 7.3: General Equations for a Plane (18 min, 12 sec)
- M1C, Lesson 7.4: Example 1 of Equation for Plane (15 min, 36 sec)
- M1C, Lesson 7.5: Example 2 of Parallel and Orthogonal Planes (16 min, 21 sec)
- M1C, Lesson 7.6: Tangent Lines to Level Curves (18 min, 50 sec)
- M1C, Lesson 7.7: Tangent Lines to Level Curves in Mma (16 min, 51 sec)

Lesson 8: Limits & Continuity

(62 min, 04 sec)

URL: https://www.youtube.com/playlist?list=PLSt7rwoPGTy27YSbaKRhas_s0WPMT9Plc

- M1C, Lesson 8.1: Intro to Multivariable Limits (13 min, 36 sec)
- M1C, Lesson 8.2: Review of Limits (11 min, 15 sec)
- M1C, Lesson 8.3: Imprecise Definition of Multivariable Limits (13 min, 43 sec)
- M1C, Lesson 8.4: Example via Limit Laws (6 min, 57 sec)
- M1C, Lesson 8.5: The Two Path Test (9 min, 30 sec)
- M1C, Lesson 8.6: Example 2 of the Two Path Test (7 min, 03 sec)

Lesson 11: Directional Derivatives

(89 min, 7 sec)

URL: <https://www.youtube.com/playlist?list=PLSt7rwoPGTy3gmCHuOPHGSLkpUpV8XcL3>

- M1C, Lesson 11.1: Intro to Directional Derivatives (14 min, 38 sec)
- M1C, Lesson 11.2: Limit Definition of the Directional Derivative (24 min, 19 sec)
- M1C, Lesson 11.3: Visualizing Directional Derivatives with Mma (17 min, 49 sec)
- M1C, Lesson 11.4: Dot Product Formula for Directional Derivatives (10 min, 52 sec)
- M1C, Lesson 11.5: Example 1 of Directional Derivatives (21 min, 26 sec)

- M1C, Lesson 11.6: Example 2 of Directional Derivatives (MM min, SS sec)
- M1C, Lesson 11.7: The Gradient and Steepest Ascent (MM min, SS sec)
- M1C, Lesson 11.8: Example 3 Steepest Ascent (MM min, SS sec)
- M1C, Lesson 11.8: Visualizing Steepest Ascent with Mma (MM min, SS sec)

Lesson 12: Tangent Planes

(66 min, 48 sec)

URL: https://www.youtube.com/playlist?list=PLSt7rwoPGTy00Su6pXq_WXMQj4MU89-Bu

- M1C, Lesson 12.1: Intro to Tangent Planes (9 min, 13 sec)
- M1C, Lesson 12.2: Derivatives of Vector-Valued Functions (16 min, 25 sec)
- M1C, Lesson 12.3: Derivation of Tangent Plane Equation (19 min, 14 sec)
- M1C, Lesson 12.4: Example 1 of Tangent Planes (21 min, 56 sec)