

MOL 410/510 Introduction to Biological Dynamics

What you should know before class

We expect college-level calculus, high-school trigonometry, and some knowledge of complex numbers. We don't expect you to have programmed before (although it is useful if you have!).

The list below is *not* exhaustive.

1. Exponentials

$$y = e^x \implies x = \ln y \quad (1)$$

$$e^{x+y} = e^x \cdot e^y \quad (2)$$

2. Basic differentiation

$$\frac{dx^n}{dx} = nx^{n-1} \quad (3)$$

$$\text{Chain rule : } \frac{df(g(x))}{dx} = \frac{df}{dg} \frac{dg}{dx} \quad (4)$$

$$\text{Product rule : } \frac{d(f(x)g(x))}{dx} = \frac{df}{dx}g(x) + f(x)\frac{dg}{dx} = f'g + fg' \quad (5)$$

$$\frac{de^x}{dx} = e^x \quad (6)$$

3. Basic integration

$$\int_x^y x^n dx = \frac{1}{n+1} [x^{n+1}]_x^y \quad (7)$$

$$\text{Integration by parts : } \int_x^y f(x)g'(x)dx = [fg]_x^y - \int_x^y f'(x)g(x)dx \quad (8)$$

4. Partial derivatives

Definition and practice of a partial derivative.

5. Taylor series

$$f(x) \approx f(x_0) + (x - x_0) \frac{df}{dx} \Big|_{x_0} + \frac{1}{2} (x - x_0)^2 \frac{d^2 f}{dx^2} \Big|_{x_0} + \dots \quad (9)$$

$$= \sum_{n=0}^{n=\infty} \frac{1}{n!} (x - x_0)^n \frac{d^n f}{dx^n} \Big|_{x_0} \quad (10)$$

6. Basic trigonometry

The definition of cos, sin, tan, etc.

7. Complex numbers

$$i^2 = -1 \quad (11)$$

$$c = a + ib \implies c^* = a - ib \quad (12)$$

$$|c|^2 = c \cdot c^* \quad (13)$$

8. DeMoivre's theorem

$$e^{i\theta} = \cos \theta + i \sin \theta \quad (14)$$