1. Matrices

1.1. **Example 1.**

$$\begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{pmatrix}$$

1.2. **Example 2.**

$$\begin{aligned} \begin{vmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \end{vmatrix} &= 1 \cdot \begin{vmatrix} 1 & 1 \\ 0 & 1 \end{vmatrix} - 0 \cdot \begin{vmatrix} 1 & 0 \\ 0 & 1 \end{vmatrix} + 1 \cdot \begin{vmatrix} 1 & 0 \\ 1 & 1 \end{vmatrix} \\ &= 1 \cdot 1 + 1 \cdot 1 \\ &= 2. \end{aligned}$$

1.3. **Example 3.** Consider the matrix $\alpha = \left(\begin{smallmatrix} 1 & 1 \\ 0 & 1 \end{smallmatrix}\right)$. Observe that for any integer n we have

$$\alpha^n = \begin{pmatrix} 1 & n \\ 0 & 1 \end{pmatrix}.$$

2. Aligning Equations

Play with the following examples and create your own.

2.1. **Example 1.**

$$\begin{aligned} \sum_{m=1}^{\infty} \frac{c_m}{m^\nu} \sqrt{\left(\frac{2}{m\pi x}\right)} \Bigg\{ & \cos(mx - \tfrac{1}{2}\nu\pi - \tfrac{1}{4}\pi - \eta_m) \\ & - \frac{4\nu^2 - 1}{8mx} \sin(mx - \tfrac{1}{2}\nu\pi - \tfrac{1}{4}\pi - \eta_m) \Bigg\} + \frac{b_m}{m^\nu} \frac{(\frac{1}{2}mx)^{\nu-1}}{\Gamma(\nu + \frac{1}{2})\Gamma(\frac{1}{2})} \end{aligned} \tag{1}$$

2.2. **Example 2.**

$$\begin{aligned} \sum_{m,n=0}^{\infty} e^{-a^n b^m x} = {} & \frac{\log^2 x}{2 \log a \log b} + \log x \left(\frac{\gamma}{\log a \log b} - \frac{1}{2 \log a} - \frac{1}{2 \log b} \right) \\ & + \frac{1}{12} \left(\frac{\log a}{\log b} + \frac{\log a}{\log b} + \frac{\pi^2 + 6\gamma^2}{\log a \log b} \right) - \frac{\gamma}{2} \left(\frac{1}{\log a} + \frac{1}{\log b} \right) + \frac{1}{4} \\ & + \sum_{n=1}^{\infty} \frac{(-1)^n}{n!(a^n - 1)(b^n - 1)} + \frac{1}{\log a} \sum_{\substack{n=-\infty \\ n \neq 0}}^{\infty} \frac{\Gamma\left(-\frac{2n\pi i}{\log a}\right) x^{2n\pi i / \log a}}{1 - b^{2n\pi i / \log a}} \\ & + \frac{1}{\log b} \sum_{\substack{n=-\infty \\ n \neq 0}}^{\infty} \frac{\Gamma\left(-\frac{2n\pi i}{\log b}\right) x^{2n\pi i / \log b}}{1 - a^{2n\pi i / \log b}}. \end{aligned} \tag{2}$$