Math Refresher

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1 Calculus

1.1 Derivatives

$$u(x,y) = x^\alpha y^\beta, \tag{1}$$
$$u(x,y) = 2x + 3y, \tag{2}$$
$$f(t) = \frac{1}{e^t + e^{-t}}, \tag{3}$$
$$f(t) = e^{t/2} + e^{-t/2}, \tag{4}$$
$$g(x) = x^3(\ln x)^2, \tag{5}$$
$$g(x) = (\ln x + 3x)^2, \tag{6}$$
$$u(x,y) = (x-2)^3(y-1), \tag{7}$$
$$u(c) = \frac{1}{1-\theta}(c^{1-\theta} - 1), \tag{8}$$
$$\pi(q) = (\bar{q} - q)q - \gamma q, \tag{9}$$
$$c(q) = b + aq - 0.5q^2 + q^3, \tag{10}$$
$$f(x) = \frac{\sqrt{x} - 2}{\sqrt{x} + 1}, \tag{11}$$
$$f(x) = \frac{x^2 - 1}{x^2 + 1}, \tag{12}$$
$$f(x) = \frac{x^2 + x + 1}{x^2 - x + 1} \tag{13}$$

1.2 Integration

$$\int (3x^4 + 5x^2 + 2)dx, \tag{14}$$
$$\int \frac{(y-2)^2}{\sqrt{y}} dy, \tag{15}$$
$$\int_2^5 e^{2x} dx, \tag{16}$$
$$\int_{-2}^2 (x - x^3 - x^5)dx \tag{17}$$

by parts

$$\int xe^x dx, \tag{18}$$

$$\int (1/x) \ln x dx, \tag{19}$$

$$\int x^3 e^{2x} dx, \tag{20}$$

$$\int xe^{-x} dx, \tag{21}$$

$$\int 3xe^{4x} dx \tag{22}$$

2 Matrix Algebra

2.1 Multiplication

$$\mathbf{A} = \begin{pmatrix} 0 & -2 \\ 3 & 1 \end{pmatrix} \qquad \mathbf{B} = \begin{pmatrix} -1 & 4 \\ 1 & 5 \end{pmatrix}$$

$$\mathbf{C} = \begin{pmatrix} 8 & 3 & -2 \\ 1 & 0 & 4 \end{pmatrix} \qquad \mathbf{D} = \begin{pmatrix} 2 & -2 \\ 4 & 3 \\ 1 & -5 \end{pmatrix}$$

$$\mathbf{E} = \begin{pmatrix} 0 & 1 & 2 \\ 2 & 3 & 1 \\ 4 & -1 & 6 \end{pmatrix}, \qquad \mathbf{F} = \begin{pmatrix} 3 & 2 \\ 1 & 0 \\ -1 & 1 \end{pmatrix},$$

$$\mathbf{G} = \begin{pmatrix} 1 & 2 & -3 \\ 5 & 0 & 2 \\ 1 & -1 & 1 \end{pmatrix}, \qquad \mathbf{H} = \begin{pmatrix} 3 & -1 & 2 \\ 4 & 2 & 5 \\ 2 & 0 & 3 \end{pmatrix}$$

Multiply $\mathbf{A} \times \mathbf{B}$, $\mathbf{C} \times \mathbf{D}$, $\mathbf{E} \times \mathbf{F}$, $\mathbf{G} \times \mathbf{H}$.

2.2 Determinants

Find the determinants of

$$\mathbf{A} = \begin{pmatrix} 1 & 4 \\ 2 & 8 \end{pmatrix}, \tag{23}$$

$$\mathbf{B} = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}, \tag{24}$$

$$\mathbf{C} = \begin{pmatrix} 8 & 1 & 3 \\ 4 & 0 & 1 \\ 6 & 0 & 3 \end{pmatrix}, \tag{25}$$

$$\mathbf{D} = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 7 & 5 \\ 3 & 6 & 9 \end{pmatrix}, \tag{26}$$

$$\mathbf{E} = \begin{pmatrix} 1 & 2 & 3 \\ 8 & 9 & 4 \\ 7 & 6 & 5 \end{pmatrix} \tag{27}$$

3 Simple Optimization

Find the critical point by setting $f'(x) = 0$. If $f''(x) > 0$, it's a min, if $f''(x) < 0$, it's a max.

$$\max y(x) = \ln x - 5x, \tag{28}$$

$$\min f(x) = e^x + e^{-2x} \tag{29}$$