
Assignment 2

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1. Let $\mathrm{x} = (x_1, \ldots, x_n)$,where the x_i are non negative real numbers. Set

$$M_r(\mathrm{x}) = \left(\frac{x_1^r + x_2^r + \cdots + x_n^r}{n} \right)^{1/r}, \quad r \in \mathrm{R} \setminus \{0\},$$

and

$$M_0(\mathrm{x}) = (x_1 x_2 \ldots x_n)^{1/n}$$

We call $M_r(\mathrm{x})$ the *rth power mean* of x Claim:

$$\lim_{r \to 0} M_r(\mathrm{x}) = M_O(\mathrm{x})$$

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2 Define

$$V_n = \begin{bmatrix} 1 & 1 & 1 & \dots & 1 \\ x_1 & x_2 & x_3 & \dots & x_n \\ x_1^2 & x_2^2 & x_3^2 & \dots & x_n^2 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ x_1^{n-1} & x_2^{n-1} & x_3^{n-1} & \dots & x_n^{n-1} \end{bmatrix}$$

We call V_n the *Vandermonde matrix* of order n Claim:

$$\det V_n = \prod_{1 \leq i < j \leq n} (x_j - x_i)$$

Equations

- $$3^3 + 4^3 + 5^3 = 6^3$$

- $$\sqrt{100} = 10$$

- $$(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$$

- $$\sum_{k=1}^{n} k = \frac{n(n+1)}{2}$$

- $$\frac{\pi}{4} = \frac{1}{1} - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \frac{1}{11} + \cdots$$

Equations

- $$\cos\theta = \sin(90^\circ - \theta)$$

- $$e^{i\theta} = \cos\theta + i\sin\theta$$

- $$\lim_{\theta \to 0} \frac{\sin\theta}{\theta} = 1$$

- $$\lim_{x \to \infty} \frac{\pi(x)}{x/\log x} = 1$$

- $$\int_{-\infty}^{\infty} e^{-x^2} dx = \sqrt{\pi}$$

Typeset

- Positive numbers a, b, and c are the side lengths of a triangle if and only if $a+b>c$, $b+c>a$, and $c+a>b$
- The area of a triangle with side lengths a, b, c is given by $Heron's$ *formula*:
  $$A=\sqrt{s(s-a)(s-b)(s-c)}$$
  where s is the semiperimeter (a+b+c)/2.

Typeset

- The volume of a regular tetrahedron of edge length 1 is $\sqrt{2}/12$.
- The quadratic equation $ax^2 + bx + c = 0$ has roots

$$r_1, r_2 = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

- The derivative of a function f, denoted by f', is defined by

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

Typeset

- A real-valued function f is *convex* on an interval I if

  $$f(\lambda x + (1-\lambda)y) \leq \lambda f(x) + (1-\lambda)f(y)$$

  for all $x, y \in I$ and $0 \leq \lambda \leq 1$
- The general solution to the differential equation

  $$y^n - 3y' + 2y = 0$$

  is

  $$y = C_1 e^x + C_2 e^{2x}$$

Typeset

- The *Fermatnumber* F_n is defined as

$$F_n = 2^{2^n}, n \geq 0$$

Make the following equation. Notice the large delimiters

- $$\frac{d}{dx}(\frac{x}{x+1}) = \frac{1}{(x+1)^2}$$

- $$\lim_{n\to\infty}(1+\frac{1}{n})^n = e$$

- $$\left|\begin{array}{cc} a & b \\ c & d \end{array}\right| = ad - bc$$

- $$R_\theta = \left[\begin{array}{cc} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{array}\right]$$

- $$\left|\begin{array}{ccc} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{array}\right| = \left|\begin{array}{cc} a_2 & a_3 \\ b_2 & b_3 \end{array}\right|\mathbf{i} - \left|\begin{array}{cc} a_1 & a_3 \\ b_1 & b_3 \end{array}\right|\mathbf{j} + \left|\begin{array}{cc} a_1 & a_2 \\ b_1 & b_2 \end{array}\right|\mathbf{k}$$

Make the following equation. Notice the large delimiters

- $$\left[\begin{array}{cc} a_{11} & a_{12} \\ a_{21} & a_{22} \end{array}\right]\left[\begin{array}{cc} b_{11} & b_{12} \\ b_{21} & b_{22} \end{array}\right]=\left[\begin{array}{cc} a_{11}b_{11}+a_{12}b_{21} & a_{11}b_{12}+a_{12}b_{22} \\ a_{21}b_{11}+a_{22}b_{21} & a_{21}b_{12}+a_{22}b_{22} \end{array}\right]$$

- $$f(x)=\begin{cases} -x^2 & x<0 \\ x^2, & 0\leq x\leq 2 \\ 4, & x>2 \end{cases}$$

Multi-line equation

$$
\begin{aligned}
1+2 &= 3 \\
4+5+6 &= 7+8 \\
9+10+11+12 &= 13+14+15 \\
16+17+18+19+20 &= 21+22+23+24 \\
25+26+27+28+29+30 &= 31+32+33+34+35
\end{aligned}
$$

Multi-line equation

$$
\begin{aligned}
(a+b)^2 &= (a+b)(a+b) \\
&= (a+b)a + (a+b)b \\
&= a(a+b) + b(a+b) \\
&= a^2 + ab + ba + b^2 \\
&= a^2 + ab + ab + b^2 \\
&= a^2 + 2ab + b^2
\end{aligned}
$$

Multi-line equation

$$\begin{aligned}
\tan(\alpha+\beta+\gamma) &= \frac{\tan(\alpha+\beta)+\tan\gamma}{1-\tan(\alpha+\beta)\tan\gamma} \\
&= \frac{\frac{\tan\alpha+\tan\beta}{1-\tan\alpha\tan\beta}+\tan\gamma}{1-\frac{\tan\alpha+\tan\beta}{1-\tan\alpha\tan\beta}\tan\gamma} \\
&= \frac{\tan\alpha+\tan\beta+(1-\tan\alpha\tan\beta)\tan\gamma}{1-\tan\alpha\tan\beta-(\tan\alpha\ +\tan\beta)\tan\gamma} \\
&= \frac{\tan\alpha+\tan\beta+\tan\gamma-\tan\alpha\tan\beta\ tan\gamma}{1-\tan\alpha\tan\beta-\tan\alpha\tan\gamma-\tan\beta\tan\gamma}
\end{aligned}$$

Multi-line equation

$$
\begin{aligned}
\prod_p \left(1 - \frac{1}{p^2}\right) &= \prod_p \frac{1}{1 + \frac{1}{p^2} + \frac{1}{p^4} + \cdots} \\
&= \left(\prod_p \left(1 + \frac{1}{p^2} + \frac{1}{p^4} + \cdots\right)\right)^{-1} \\
&= \left(1 + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} \cdots\right)^{-1} \\
&= \frac{6}{\pi^2}
\end{aligned}
$$


Thank You