Assignment 2

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Exercise 9.5

• Let $x = (x_1, ..., x_n)$, where the x_i are nonnegative real numbers. Set

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

and

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

We cal $M_r(x)$ the *r*th power mean of x Claim:

$$\lim_{r\to 0}M_r(\mathsf{x})=M_0(\mathsf{x}).$$

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Exercise 9.5

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:

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

Question 4

Make the following equations

$$3^{3} + 4^{3} + 5^{3} = 6^{3}$$

$$\sqrt{100} = 10$$

$$(a + b)^{3} = a^{3} + 3a^{2}b + 3ab^{2} + b^{3}$$

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

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۲ $\frac{\pi}{4} = \frac{1}{1} - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \frac{1}{11}$ ۲ $\cos\theta = \sin(90 - \theta)$ ۲ $e^{i\theta} = \cos\theta + i\sin\theta$ ۲ $\lim_{\theta \to 0} \frac{\sin\theta}{\theta} = 1$ ۲ $\lim_{x\to\infty}\frac{\pi(x)}{x/\log x}=1$ ۲ $\int_{-\infty}^{\infty} e^{x^2}, dx = \sqrt{\pi}$

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Question 5

Typeset the following Sentence

- Positive numbers a, b, and c are the side lengths of a triangle if and only of a + b ≥ c , b + c ≥ a and c + a ≥ b
- The area of a triangle with side length 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

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- 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 the functions f, is defined by

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

• A real - valued functions f is *convex* on a 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 $0 \leq 1$

• The general solution to the differential equation

$$y^{''} - 3y^{'} + 2y = 0$$

is

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

The Fermat Number Fn is defined as

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

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Question 6

Make the following equations. Notice the large delimiters.

۲ $\frac{d}{dx}\left(\frac{x}{x+1}\right) = \frac{1}{(x+1)^2}$ ۲ $\lim_{n \to \infty} \left(1 + \frac{1}{n} \right)^n = e$ $\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$ ۲ $R_{\theta} = \begin{bmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{bmatrix}$

$$\begin{vmatrix} i & j & k \\ a_1 & b_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix} = \begin{vmatrix} a_2 & a_3 \\ b_2 & b_3 \end{vmatrix} \mathbf{i} - \begin{vmatrix} a_1 & a_2 \\ b_1 & b_2 \end{vmatrix} \mathbf{j} - \begin{vmatrix} a_1 & b_2 \\ b_1 & b_2 \end{vmatrix} \mathbf{k}$$

$$\begin{bmatrix} a_{11} & a_{12} \\ b_{21} & b_{22} \end{bmatrix} \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix} = \begin{bmatrix} a_{11}b_{11} + a_{12}b_{21} & a_{11}b_{12} + a_{12}b_{22} \\ a_{21}b_{11} + a_{22}b_{21} & a_{21}b_{12} + a_{22}b_{22} \end{bmatrix}$$

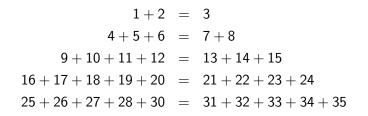
$$f(x) = \begin{cases} -x^2 & x < 0 \\ x^2 & 0 \le x \le 2 \\ 4 & x > 2 \end{cases}$$

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Question 7 Make the following multi-line equations

Part 1



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Part 2

$$(a+b)^{2} = (a+b)(a+b)$$

= $(a+b)a + (a+b)b$
= $a(a+b) + b(a+b)$
= $a^{2} + ab + ba + b^{2}$
= $a^{2} + ab + ab + b^{2}$

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Part 3

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

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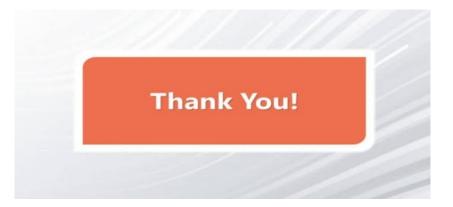
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Part 4

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

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Thankyou



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