

Chapter 9 (Donald & Erickson) x (1) WhatsApp x Meet - sxe-nkim-ebv x assignment - Online LaTeX Editor x Assignment 2 x

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```
1 \documentclass[xcolor=dvipsnames]{beamer}
2 \usepackage[utf8]{inputenc}
3 \usepackage{xcolor}
4 \title{\textcolor{blue}{Assignment 2}}
5 \author{Anita\\
6 College Rollno. MAT/20/55\ University Roll no. 20044563008}
7 \institute{\large Mata Sundri College for Women\ University of Delhi}
8 \date{}
9 \usepackage{graphicx}
10 \usetheme{Madrid}
11 \definecolor{UBCblue}{rgb}{1,2}
12 \setbeamercolor{frametitle}{bg=green!40!black}
13 \usecolortheme[named=UBCblue]{structure}
14 \begin{document}
15 \frame{\titlepage}
16 \begin{frame}[copy point 1 on page number 69]
17 \begin{block}{part-1}
18 \begin{itemize}
19 \item Let  $\mathbf{x} = (x_1, \dots, x_n)$ ,
20 where the  $x_i$  are non-negative real numbers.
21 Set
22 \[
23 M_r(\mathbf{x}) = \left( \frac{x_1^r + x_2^r + \dots + x_n^r}{n} \right)^{1/r},
24 \quad ; \quad r \in \mathbf{R} \setminus \{0\},
25 \]
26 and
27 \[
28 M_0(\mathbf{x}) = \lim_{r \rightarrow 0} M_r(\mathbf{x})^{1/r} = M_0(\mathbf{x}).
29 \]
30 We call  $M_r(\mathbf{x})$  the  $r$ th power mean
31 of  $\mathbf{x}$ .
32
33 Claim:
34 \[
35 \lim_{r \rightarrow 0} M_r(\mathbf{x}) = M_0(\mathbf{x}).
36 \]
37
38 \end{itemize}
39 \end{block}
40 \end{frame}
```

File outline

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```
41 \begin{frame}{copy point 2 on page 69}
42 \begin{block}{part-2}
43 \begin{itemize}
44 \item
        Define
        \[
        V_n =
        \left[ \begin{array}{cccc}
        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{array} \right]
        We call  $V_n$  the Vandermonde matrix of order  $n$ .
      \end{itemize}
    \end{block}
  \end{frame}
  \begin{frame}{Claim:}
    \[
    \det V_n = \prod_{1 \leq i < j \leq n} (x_j - x_i).
    \]
  \end{frame}
\end{frame}
\begin{frame}{Questions 4}
\begin{block}{4.1}
 $3^3 + 4^3 + 5^3 = 6^3$ 
\end{block}
\begin{block}{4.2}
 $\sqrt{100} = 10$ 
\end{block}
\begin{block}{4.3}
 $(a+b)^3 = a^3 + b^3 + 3ab^2 + 3ba^2$ 
\end{block}
\end{frame}
\begin{frame}{remaining parts of question 4}
```

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```
81 \begin{block}{4.4}
82 $ \sum_{k=1}^n \frac{n(n+1)}{2} \\
83 \label{sum} \\
84 \end{block}
85 \begin{block}{4.5}
86 $ \frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \frac{1}{11} + \dots \\
87 \end{block}
88 \begin{block}{4.6}
89 $ \cos(\theta) = \sin(90^\circ - \theta) \\
90 \end{block}
91 \begin{block}{4.7}
92 $ e^{i\theta} = \cos(\theta) + i \sin(\theta) \\
93 \end{block}
94 \end{frame}
95 \begin{frame}{remaining parts of question 4}
96 \begin{block}{4.8}
97 $ \lim_{\theta \rightarrow 0} \frac{\sin(\theta)}{\theta} = 1 \\
98 \end{block}
99 \begin{block}{4.9}
100 $ \lim_{x \rightarrow \infty} \frac{\pi \mathbf{x}}{x \log x} = 1 \\
101 \end{block}
102 \begin{block}{4.10}
103 $ \int_{-\infty}^{\infty} e^{-x^2} dx = \sqrt{\pi} \\
104 \end{block}
105 \end{frame}
106 \end{frame}
107
108 \begin{frame}{Question 5}
109 \begin{block}{5.1}
110 Positive numbers  $a, b$  and  $c$  are the side lengths of triangle if and only if  $a+b > c, b+c > a, c+a > b$ . \\
111 \end{block}
112 \begin{block}{5.2}
113 The area of triangle with side length  $a, b, c$  is given by Heoren's formula: \\
114 \begin{eqnarray*}
115 A &=& \sqrt{s(s-a)(s-b)(s-c)}, \\
116 \end{eqnarray*} where  $s$  is the semiperemeter  $\frac{a+b+c}{2}$ . \\
117 \end{block}
118 \end{frame}
119 \begin{frame}{remaining parts of question 5}
120 \begin{block}{5.3}

```

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```
120 \begin{block}{5.3}
121 The volume of a rectangular tetrahedron of edge length 1 is $\frac{\sqrt{2}}{12}$.
122 \end{block}
123 The quadratic equation $ax^2+bx+c=0$ has roots \\
124 \begin{eqnarray*}
125 r_1, r_2 = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.
126 \end{eqnarray*}
127 \end{block}
128 \end{frame}
129 \begin{frame}{remaining parts of question 5}
130 \begin{block}{5.5}
131 The derivative of a function  $f$ , denoted  $f'$ , is defined by
132 \begin{eqnarray*}
133 f'(x) &= \lim_{h \rightarrow 0} \frac{f(x+h)-f(x)}{h}
134 \end{eqnarray*}
135 \end{block}
136 \begin{block}{5.6}
137 A real-valued function  $f$  is convex on an interval  $I$  if \\
138  $f(\lambda x + (1-\lambda)y) \leq \lambda f(x) + (1-\lambda)f(y)$ ,
139 \\
140 for all  $x, y \in I$  and  $0 \leq \lambda \leq 1$ .
141 \end{block}
142 \end{frame}
143 \begin{frame}{remaining parts of question 5}
144 \begin{block}{5.7}
145 The general solution to the differential equation \\
146  $y''-3y'+2y=0$ 
147 \\
148 is
149 \\
150  $y = C_1 e^{2x} + C_2 e^{(2x)}$ .
151 \\
152 \end{block}
153 \begin{block}{5.8}
154 The Fermat number  $F_n$  is defined as
155 \\
156  $F_n = 2^{2^n}$ ,  $n \geq 0$ .
157 \\
158 \end{block}
159 \end{frame}
160 \begin{frame}{Question 6}
```

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```
160 \begin{frame}{Question 6}
161 \begin{block}{6.1}
162   ${\frac{d}{dx}}(\frac{x}{x+1}) = \frac{1}{(x+1)^2} \\
163   \end{block}
164 \begin{block}{6.2}
165   \lim_{x \rightarrow \infty}(1+\frac{1}{n})^n = e \\
166 \end{block}
167 \end{frame}
168 \begin{frame}{remaining parts of question 6}
169 \begin{block}{6.3}
170 \[
171 \begin{vmatrix}
172   a & b \\
173   c & d
174 \end{vmatrix}
175 =
176 ad - bc
177 \]
178 \end{block}
179 \begin{block}{6.4}
180 \[
181 R_\theta =
182 \left[ \begin{array}{cc}
183   \cos\theta & -\sin\theta \\
184   \sin\theta & \cos\theta
185 \end{array} \right]
186 \right]
187 \]
188 \end{block}
189 \end{block}
190 \end{frame}
191 \begin{frame}{ remaining parts of question 6}
192 \begin{block}{6.5}
193 \[
194 \begin{vmatrix}
195   i & j & k \\
196   a_1 & a_2 & a_3 \\
197   b_1 & b_2 & b_3
198 \end{vmatrix}
199 \right]
200 \end{block}

```

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```
200 i\begin{vmatrix}
201 a_2 & a_3\\
202 b_2 & b_3
203 \end{vmatrix}
-
205 \begin{vmatrix}
206 a_1 & a_3\\
207 b_1 & b_3
208 \end{vmatrix}j
-
210 \begin{vmatrix}
211 a_1 & a_2\\
212 b_1 & b_2
213 \end{vmatrix}k
-
215 \end{block}
216 \begin{block}{6.6}
\left[
\begin{array}{cc}
| a_{11} & a_{12} \\
| a_{21} & a_{22}
\end{array}
\right]
\begin{array}{cc}
| b_{11} & b_{12} \\
| b_{21} & b_{22}
\end{array}
\right]
=
231 \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]
\end{block}
\end{frame}
```

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Assignment 2

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Copy point 1 on page number 69

part-1

- Let $x = (x_1, \dots, x_n)$, where the x_i are non-negative real numbers. Set

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

and

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

We call $M_r(x)$ the *rth power mean* of x .

Claim:

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

copy point 2 on page 69

part-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:

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

Questions 4

4.1

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

4.2

$$\sqrt{100} = 10$$

4.3

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

remaining parts of question 4

4.4

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

4.5

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

4.6

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

4.7

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

remaining parts of question 4

4.8

$$\lim_{\theta \rightarrow 0} \frac{\sin(\theta)}{\theta} = 1$$

4.9

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

4.10

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

Question 5.

5.1

Positive numbers a, b and c are the side lengths of triangle if and only if $a+b>c$, $b+c >a$, $c+a >b$.

5.2

The area of triangle with side length a , b , c is given by *Heoren's formula*:

$$A = \sqrt{(s)(s-a)(s-b)(s-c)},$$

where s is the semiperimeter $\frac{a+b+c}{2}$.

remaining parts of question 5

5.3

The volume of a rectangular tetrahedron of edge length 1 is $\frac{\sqrt{2}}{12}$

5.4

The quadratic equation $ax^2 + bx + c = 0$ has roots

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

remaining parts of question 5

5.5

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

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

5.6

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 $0 \leq \lambda \leq 1$.

remaining parts of question 5

5.7

The general solution to the differential equation

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

is

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

5.8

The *Fermatnumber* F_n is defined as

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

Question 6

6.1

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

6.2

$$\lim_{n \rightarrow \infty} \left(1 + \frac{1}{n}\right)^n = e$$

remaining parts of question 6

6.3

$$\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$$

6.4

$$R_\theta = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$$

remaining parts of question 6

6.5

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

6.6

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

remaining parts of question 6

6.7

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

question 7

7.1

$$1 + 2 = 3$$

$$4 + 5 + 6 = 7 + 8$$

$$9 + 10 + 11 + 12 = 13 + 14 + 15$$

$$16 + 17 + 18 + 19 + 20 = 21 + 22 + 23 + 24$$

$$25 + 26 + 27 + 28 + 29 + 30 = 31 + 32 + 33 + 34 + 35$$

remaining parts of question 7

7.2

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

remaining parts of question 7

7.3

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

remaining parts of question 7

7.4

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

