

**DIRECTORATE OF GOVERNEMENT EXAMINATIONS, CHENNAI-6**  
**HIGHER SECONDARY EXAMINATIONS (SECONDYEAR) MARCH-2024**  
**BUSINESS MATHEMATICS AND STATISTICS - ANSWER KEY**

**Maximum Marks - 90**

**GENERAL INSTRUCTIONS :-**

1. Answers written only in **BLACK** or **BLUE** should be evaluated.
2. For objective type questions, award 1 mark for "writing the correct option's code and the corresponding option's answer".
3. Award "0 marks" for one who wrote both "option's code" and "option's answer" with one of them is not correct.
4. Marks should be awarded for suitable alternative method also.
5. Mark(s) should not be reduced for the correct answer / stage, if it is written without formula / properties also, 2\* means award one mark for the formula.
6. Award full mark directly, if the solution is arrived with no mistakes without giving weightage for the stages.
7. The stage mark is essential, only if the part of the solution is incorrect.
8. Award marks, if the answer is in decimal value and also approximately equal to the key answer
9. **Important Note for Part II, Part III and Part IV**

For a particular stage in which the stage mark is greater than 1 and one who begins with correct step but reaches with incorrect solution, for such suitable credits should be given by breaking the stage marks.

## PART – I

i. Answer all the questions			
ii. Choose the most appropriate from the given <u>Four</u> alternatives and write the option code and the corresponding answer			
Q.No	Option	Answer	20×1=20
1	(a)	2 sq. units	1
2	(c)	(e-1) sq. units	1
3	(a)	0.0613	1
4	(c)	0.0547	1
5	(c)	$2x + 3$	1
6	(d)	1	1
7	(b)	1 or 0	1
8	(b)	Equal to $m+n-1$	1
9	(a)	A has atleast one minor of order r which does not vanish	1
10	(b)	$\left(\frac{-\Delta_1}{\Delta_2}, -\frac{\Delta_1}{\Delta_3}\right)$	1
11	(a)	Harper	1
12	(d)	Sufficient	1
13	(d)	$-\cos x + c$	1
14	(c)	$\frac{\sqrt{\pi}}{2}$	1
15	(b)	7	1
16	(a)	One	1
17	(a)	2 and 1	1
18	(d)	$Y = \sin x + c$ , c is an arbitrary constant	1
19	(a)	four	1
20	(a)	$\bar{x}$ -chart	1

## PART - II

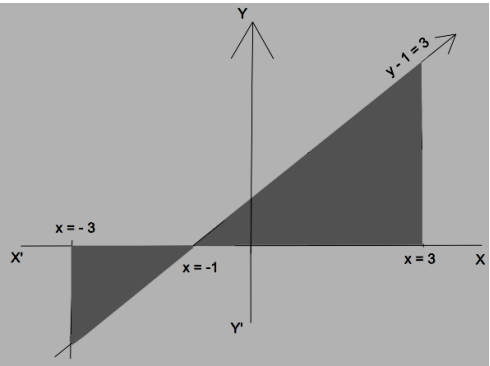
Q. No.	Answer any <u>Seven</u> Questions. Question No. 30 is compulsory.	7×2=14	
21	$(A, B) \sim \begin{pmatrix} 3 & -2 & 6 \\ 0 & 0 & -2 \end{pmatrix}$ ,	1	2
	$\rho(A) \neq \rho(A \ B)$		
	The given system is inconsistent and has no solution.	1	
22	$\int \frac{1}{2}(1 - \cos 2x) dx$	1	2
	$= \frac{1}{2} \left( x - \frac{\sin 2x}{2} \right) + C$	1	
23	$p = 122 - 5x - 2x^2$ $p_0 = 122 - 5(20) - 2(20)^2$		2
24	$\frac{dy}{dx} = e^{ax+by}$ , $e^{-by} dy = e^{ax} dx$	1	2
	$\frac{e^{-by}}{-b} = \frac{e^{ax}}{a} + C$ (or) $\frac{e^{ax}}{a} = \frac{-e^{-by}}{b} + C$	1	
25	$\Delta^2 e^x$ $= \Delta(e^{x+h} - e^x)$ $= \Delta e^x (e^h - 1)$	1	2
	$= (e^h - 1)^2 e^x$	1	
26	$p = \frac{1}{5}, q = \frac{4}{5}, n = 25$	1	2
	$P(X = x) = {}_{25}C_x \left(\frac{1}{5}\right)^x \left(\frac{4}{5}\right)^{25-x}$	1	
27	$n = 50, s = 6.3, \sigma = 6$	1	2
	$S.E. = \sqrt{\frac{\sigma^2}{2n}} = 0.6$	1	
28	It is a general tendency of time series to increase or decrease or stagnates during a long period of time.		2

29	The transportation problem is to determine the amount to be transported from each origin to each destinations such that the total transportation cost is minimized		2
30	$V(X) = E(X^2) - [E(X)]^2$	1	2
	$V(X) = E(X^2)$	1	

## PART – III

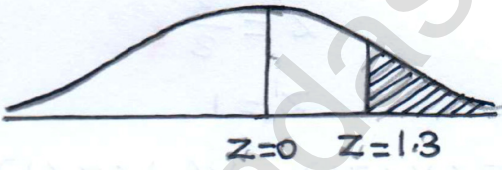
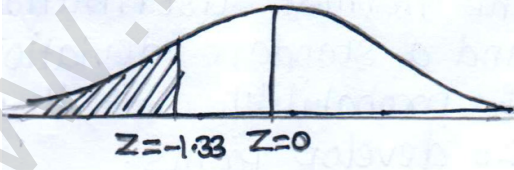
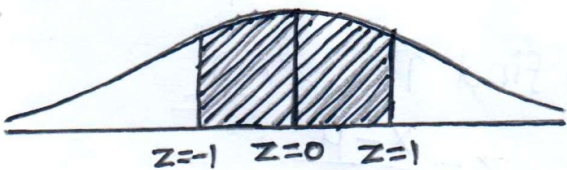
<b>Q. No.</b>	<b>Answer any seven questions. Question number 40 is compulsory.</b>	<b>7×3=21</b>
31	$(A \ B) \begin{pmatrix} 0.9 & 0.1 \\ 0.3 & 0.7 \end{pmatrix} = (A \ B)$	1
	$0.9A + 0.3B = A$	1
	$A = 75\%$ $B = 25\%$	1
32	$\int \frac{1}{\sqrt{x+1} + \sqrt{x-1}} X \frac{\sqrt{x+1} - \sqrt{x-1}}{\sqrt{x+1} - \sqrt{x-1}} dx$	1
	$\int \frac{\sqrt{x+1} - \sqrt{x-1}}{(x+1) - (x-1)} dx$	
	$\int \frac{\sqrt{x+1} - \sqrt{x-1}}{2} dx$	1
	$\frac{1}{3} [(x+1)^{3/2} - (x-1)^{3/2}] + c$	1
33	$P = \tan x \quad Q = \cos^3 x$ $I.F = e^{\int p dx} = e^{\log \sec x} = \sec x$	1
	$y(I.F) = \int Q(I.F) dx + c$ $= \int \cos^2 x dx + c$ $= \int \frac{1 + \cos 2x}{2} dx + c$ $= \frac{1}{2} \left( x + \frac{\sin 2x}{2} \right) + c$	2*

34	$\Delta^4 U_0 = (E - 1)^4 U_0$ $= (E^4 - 4E^3 + 6E^2 - 4E + 1)U_0$ (or) $= U_4 - 4U_3 + 6U_2 - 4U_1 + U_0$	1	3																						
	$\Delta^4 U_0 = 0$ (Any other Alternate method award full marks)	1																							
35	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th rowspan="2">Stra tegy</th> <th colspan="2">States of Nature</th> <th rowspan="2">Minimum</th> <th rowspan="2">Maximum</th> </tr> <tr> <th>E<sub>1</sub></th> <th>E<sub>2</sub></th> </tr> </thead> <tbody> <tr> <td>S<sub>1</sub></td> <td>40</td> <td>60</td> <td>40</td> <td>60</td> </tr> <tr> <td>S<sub>2</sub></td> <td>10</td> <td>-20</td> <td>-20</td> <td>10</td> </tr> <tr> <td>S<sub>3</sub></td> <td>-40</td> <td>150</td> <td>-40</td> <td>150</td> </tr> </tbody> </table> Maximin (40, -20, -40) = 40 S <sub>1</sub> is the best Strategy Minimax (60, 10, 150) = 10 S <sub>2</sub> is the best Strategy	Stra tegy	States of Nature		Minimum	Maximum	E <sub>1</sub>	E <sub>2</sub>	S <sub>1</sub>	40	60	40	60	S <sub>2</sub>	10	-20	-20	10	S <sub>3</sub>	-40	150	-40	150	1	3
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S <sub>2</sub>	10	-20	-20	10																					
S <sub>3</sub>	-40	150	-40	150																					
		1																							
36	$p = 0.4$ $q = 1 - 0.4 = 0.6$ , $n = 5$ i. $P(X = 1) = 0.2592$ ii. $P(X \geq 1) = 1 - P(X = 0) = 0.9222$	1 1 1	3																						
37	$n=100$ , $\bar{x} = 7.4$ , $s=1.2$ $S.E = \frac{\sigma}{\sqrt{n}} = \frac{1.2}{\sqrt{100}} = 0.12$	1	3																						
	$\bar{x} - z_{\alpha/2} \frac{\sigma}{\sqrt{n}} \leq \mu \leq \bar{x} + z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$	1																							
	<b>(7.165 ≤ μ ≤ 7.635)</b>	1																							
38	$UCL = \bar{x} + 3 \frac{\sigma}{\sqrt{n}}$ $UCL = 0.534$	1	3																						
	$CL = \bar{x} = 0.532$	1																							
	$LCL = \bar{x} - 3 \frac{\sigma}{\sqrt{n}}$ $= 0.5293$	1																							

39	$f(x) = F'(x) = \begin{cases} 4k(x-1)^3 & 1 \leq x \leq 3 \\ 0 & \text{otherwise} \end{cases}$	1	
	$k = \frac{1}{16}$	1	3
	$f(x) = \frac{1}{4}(x-1)^3, 1 \leq x \leq 3$	1	
40		1	3
	$A = - \int_{-3}^{-1} (x+1) dx + \int_{-1}^3 (x+1) dx$	1	
	<b>= 10 sq. units</b>	1	

## PART – IV

Q. No.	Answer all the questions.	7×5=35																																													
41 (a)	$x + y + z = 8500, 2x + 3y + 6z = 38000, x + y - z = 0$	1																																													
	$\Delta = -2 \neq 0,$ $\Delta_x = -500, \Delta_y = -8000, \Delta_z = -8000$	1																																													
	$x = ₹ 250, y = ₹ 4000, z = ₹ 4250$ (OR)	3																																													
(b)	<table border="1"> <thead> <tr> <th>x</th> <th>Y</th> <th>X = x - 1998</th> <th>X<sup>2</sup></th> <th>XY</th> </tr> </thead> <tbody> <tr> <td>1995</td> <td>155</td> <td>-3</td> <td>9</td> <td>-465</td> </tr> <tr> <td>1996</td> <td>162</td> <td>-2</td> <td>4</td> <td>-324</td> </tr> <tr> <td>1997</td> <td>171</td> <td>-1</td> <td>1</td> <td>-171</td> </tr> <tr> <td><b>1998</b></td> <td>182</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>1999</td> <td>158</td> <td>1</td> <td>1</td> <td>158</td> </tr> <tr> <td>2000</td> <td>180</td> <td>2</td> <td>4</td> <td>360</td> </tr> <tr> <td>2001</td> <td>178</td> <td>3</td> <td>9</td> <td>534</td> </tr> <tr> <td><b>N=7</b></td> <td><b>1186</b></td> <td><b>0</b></td> <td><b>28</b></td> <td><b>92</b></td> </tr> </tbody> </table>	x	Y	X = x - 1998	X <sup>2</sup>	XY	1995	155	-3	9	-465	1996	162	-2	4	-324	1997	171	-1	1	-171	<b>1998</b>	182	0	0	0	1999	158	1	1	158	2000	180	2	4	360	2001	178	3	9	534	<b>N=7</b>	<b>1186</b>	<b>0</b>	<b>28</b>	<b>92</b>	5
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$a = \frac{\sum Y}{n} = \frac{1186}{7} = 169.428$	1																																														
$b = \frac{\sum XY}{\sum X^2} = \frac{92}{28} = 3.2857$	1																																														
$y = a + bX, y = 169.428 + 3.2857 X$	1																																														

42 (a)	$\frac{4x^2+2x+6}{(x+1)^2(x-3)} = \frac{A}{x+1} + \frac{B}{(x+1)^2} + \frac{C}{x-3}$ $\frac{4x^2+2x+6}{(x+1)^2(x-3)} = \frac{1}{x+1} - \frac{2}{(x+1)^2} + \frac{3}{x-3}$ $\int \frac{4x^2+2x+6}{(x+1)^2(x-3)} dx = \int \frac{dx}{x+1} - 2 \int \frac{dx}{(x+1)^2} + \int \frac{3dx}{x-3}$ $\int \frac{4x^2+2x+6}{(x+1)^2(x-3)} dx = \log  x+1  + 3 \log  x-3  + \frac{2}{x+1} + c$ <p>(OR)</p>	1  2  1  1	5
(b)	$\mu = 68, \quad \sigma = 3$ $z = \frac{x - \mu}{\sigma}$ $P(x > 72) = \frac{72 - 68}{3} = 1.33$ $P(Z > 1.33) = 0.5 - 0.4082 = 0.0918$  <p>z=0   z=1.3</p> <p><b>Out of 500 students = 0.0918 × 500 = 45.9 ≈ 46</b></p> $P(X < 64) = P(Z < -1.33) = 0.5 - 0.4082 = 0.0918$  <p>z=-1.33   z=0</p> <p><b>Out of 500 students = 0.0918 × 500 = 45.9 ≈ 46</b></p> $P(65 < X < 71) = P(-1 < Z < 1) = 2P(0 < Z < 1) = 0.6826$  <p>z=-1   z=0   z=1</p> <p><b>Out of 500 students = 0.6826 × 500 = 341.37 ≈ 342</b></p>	1 1      1	



43 (a)	$C(X) = 50x + \frac{x^2}{100} + 200$	1	5																												
	$R(X) = 60x$	1																													
	$P = R - C$	1																													
	$P = 10x - \frac{x^2}{100} - 200$																														
	$\frac{dP}{dx} = 0$ then $x = 500$ and $\frac{d^2P}{dx^2} = \frac{-1}{50} < 0$	1																													
	Max. profit $P = 10(500) - \frac{(500)^2}{100} - 200$ $= ₹ 2300$	1																													
<b>(OR)</b>																															
43 (b)	<b>Total Demand = Total supply = 17</b> <b>Final Distribution:</b>	1	5																												
	<table style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th><math>D_1</math></th> <th><math>D_2</math></th> <th><math>D_3</math></th> <th><math>D_4</math></th> <th>Su.</th> </tr> </thead> <tbody> <tr> <td><math>O_1</math></td> <td>(1) 2</td> <td>(5) 3</td> <td>11</td> <td>7</td> <td>6</td> </tr> <tr> <td><math>O_2</math></td> <td>1</td> <td>0</td> <td>6</td> <td>(1) 1</td> <td>1</td> </tr> <tr> <td><math>O_3</math></td> <td>(6) 5</td> <td>8</td> <td>(3) 15</td> <td>(1) 9</td> <td>10</td> </tr> <tr> <td>De.</td> <td>7</td> <td>5</td> <td>3</td> <td>2</td> <td></td> </tr> </tbody> </table>			$D_1$	$D_2$	$D_3$	$D_4$	Su.	$O_1$	(1) 2	(5) 3	11	7	6	$O_2$	1	0	6	(1) 1	1	$O_3$	(6) 5	8	(3) 15	(1) 9	10	De.	7	5	3	2
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Total transportation cost is $= 2 + 15 + 1 + 30 + 45 + 9 = ₹ 102$		1																													
44 (a)	$\frac{dy}{dx} = \frac{y^2 - 2xy}{x^2 - 2xy}$	1	5																												
	$y = vx$	1																													
	$\frac{dy}{dx} = v + x \frac{dv}{dx}$	1																													
	$x \frac{dv}{dx} = \frac{3v^2 - 3v}{1 - 2v}$	1																													
	$\int \frac{(2v - 1)dv}{v^2 - v} = -3 \int \frac{dx}{x}$ $(y^2 - xy)x = c$	1																													
<b>(OR)</b>																															

44 (b)	<table border="1"> <thead> <tr> <th><math>p_0</math></th> <th><math>q_0</math></th> <th><math>p_1</math></th> <th><math>q_1</math></th> <th><math>p_0q_0</math></th> <th><math>p_0q_1</math></th> <th><math>p_1q_0</math></th> <th><math>p_1q_1</math></th> </tr> </thead> <tbody> <tr> <td>40</td> <td>5</td> <td>48</td> <td>4</td> <td>200</td> <td>160</td> <td>240</td> <td>192</td> </tr> <tr> <td>45</td> <td>2</td> <td>42</td> <td>3</td> <td>90</td> <td>135</td> <td>84</td> <td>126</td> </tr> <tr> <td>90</td> <td>4</td> <td>95</td> <td>6</td> <td>360</td> <td>540</td> <td>380</td> <td>570</td> </tr> <tr> <td>85</td> <td>3</td> <td>80</td> <td>2</td> <td>255</td> <td>170</td> <td>240</td> <td>160</td> </tr> <tr> <td>50</td> <td>5</td> <td>65</td> <td>8</td> <td>250</td> <td>400</td> <td>325</td> <td>520</td> </tr> <tr> <td>65</td> <td>1</td> <td>72</td> <td>3</td> <td>65</td> <td>195</td> <td>72</td> <td>216</td> </tr> <tr> <td colspan="4" style="text-align: center;"><b>Total</b></td> <td><b>1220</b></td> <td><b>1600</b></td> <td><b>1341</b></td> <td><b>1784</b></td> </tr> </tbody> </table>	$p_0$	$q_0$	$p_1$	$q_1$	$p_0q_0$	$p_0q_1$	$p_1q_0$	$p_1q_1$	40	5	48	4	200	160	240	192	45	2	42	3	90	135	84	126	90	4	95	6	360	540	380	570	85	3	80	2	255	170	240	160	50	5	65	8	250	400	325	520	65	1	72	3	65	195	72	216	<b>Total</b>				<b>1220</b>	<b>1600</b>	<b>1341</b>	<b>1784</b>	2	
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$P_{01}^F = \left( \sqrt{\frac{\sum p_1q_0}{\sum p_0q_0} \times \frac{\sum p_1q_1}{\sum p_0q_1}} \right) \times 100 = \mathbf{110.706}$	1																																																																		
<b>Time Reversal Test:</b> $P_{01} \times P_{10} = \mathbf{1}$	1																																																																		
<b>Factor Reversal Test:</b> $P_{01} \times Q_{10} = \frac{1784}{1220} = \frac{\sum p_1q_1}{\sum p_0q_0}$ <p style="text-align: center;">∴ It's satisfies both tests.</p>	1																																																																		
45 (a)	$I = \int_0^{\frac{\pi}{2}} \frac{\sin x}{\sin x + \cos x} dx$ $I = \int_0^{\frac{\pi}{2}} \frac{\cos x}{\sin x + \cos x} dx$ $2I = \int_0^{\frac{\pi}{2}} dx$ $2I = \frac{\pi}{2}$ $I = \frac{\pi}{4}$	1	5																																																																
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45 (b)	<table border="1"> <thead> <tr> <th>x</th> <th>y</th> <th><math>\nabla y</math></th> <th><math>\nabla^2 y</math></th> <th><math>\nabla^3 y</math></th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td>1</td> <td></td> <td></td> </tr> <tr> <td>1</td> <td>2</td> <td></td> <td>1</td> <td></td> </tr> <tr> <td></td> <td></td> <td>2</td> <td></td> <td>0</td> </tr> <tr> <td>2</td> <td>4</td> <td></td> <td>1</td> <td></td> </tr> <tr> <td></td> <td></td> <td>3</td> <td></td> <td>0</td> </tr> <tr> <td>3</td> <td>7</td> <td></td> <td>1</td> <td></td> </tr> <tr> <td></td> <td></td> <td>4</td> <td></td> <td>0</td> </tr> <tr> <td>4</td> <td>11</td> <td></td> <td>1</td> <td></td> </tr> <tr> <td></td> <td></td> <td>5</td> <td></td> <td>0</td> </tr> <tr> <td>5</td> <td>16</td> <td></td> <td>1</td> <td></td> </tr> <tr> <td></td> <td></td> <td>6</td> <td></td> <td>0</td> </tr> <tr> <td>6</td> <td>22</td> <td></td> <td>1</td> <td></td> </tr> <tr> <td></td> <td></td> <td>7</td> <td></td> <td>0</td> </tr> <tr> <td>7</td> <td>29</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	x	y	$\nabla y$	$\nabla^2 y$	$\nabla^3 y$	0	1						1			1	2		1				2		0	2	4		1				3		0	3	7		1				4		0	4	11		1				5		0	5	16		1				6		0	6	22		1				7		0	7	29				2	
	x	y	$\nabla y$	$\nabla^2 y$	$\nabla^3 y$																																																																														
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			2		0																																																																														
	2	4		1																																																																															
			3		0																																																																														
	3	7		1																																																																															
			4		0																																																																														
4	11		1																																																																																
		5		0																																																																															
5	16		1																																																																																
		6		0																																																																															
6	22		1																																																																																
		7		0																																																																															
7	29																																																																																		
	$y = y_n + \frac{n}{1!} \nabla y_n + \frac{n(n+1)}{2!} \nabla^2 y_n + \frac{n(n+1)(n+2)}{3!} \nabla^3 y_n + \dots$	1																																																																																	
	$x_n = 7, h = 1 \text{ \& } n = x - 7$	1																																																																																	
	$y = \frac{1}{2}(x^2 + x + 2)$	1																																																																																	
46 (a)	$k = \frac{1}{10}$	1	5																																																																																
	$P(X < 6) = \frac{81}{100}$	1																																																																																	
	$P(X \geq 6) = \frac{19}{100}$	1																																																																																	
	$P(0 < X < 5) = \frac{4}{5}$	1																																																																																	
	The minimum value of $x$ for which $P(X \leq x) > \frac{1}{2}$ is 4 (OR)	1																																																																																	

46 (b)	$\left. \begin{aligned} n &= 400, \quad \bar{x} = 67.47 \\ \mu &= 67.39 \quad \sigma = 1.30 \end{aligned} \right\}$ <p>Null Hypothesis : <math>H_0: \mu = 67.39</math>  Alternate Hypothesis : <math>H_1: \mu \neq 67.39</math></p> $ z  = 1.2308$ $ z  = 1.2308 < 1.96$ $H_0$ is accepted	1	
47 (a)	<b><math>3m^2 + m - 14 = 0</math></b>	1	5
	<b>C. F = <math>Ae^{-\frac{7}{3}x} + Be^{2x}</math></b>	1	
	$P.I_1 = \frac{-4}{14} = \frac{-2}{7}$	1	
	$P.I_2 = xe^{-\frac{7}{3}x}$	1	
	General solution $y = C.F. + P.I_1 + P.I_2$ $y = Ae^{-\frac{7}{3}x} + Be^{2x} + \frac{-2}{7} + xe^{-\frac{7}{3}x}$	1	
	<b>(OR)</b>		
47 (b)	<b><math>n = 4, \quad p = 0.18, \quad q = 0.82</math></b>	1	
	$P(X = x) = nC_x p^x q^{n-x}$		
	(i) $P(X = 1) = \mathbf{0.3969}$	2*	
	(ii) $P(X = 0) = \mathbf{0.45212}$	1	
	(iii) $P(X \leq 2) = 0.45212 + 0.3969 + 0.1307 = \mathbf{0.9797}$	1	