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INDEX

Sr. No.	Title	Author	Subject	Page No.
1	Current Issues In Indian Capital Market	Bhavin S. Shah	Accountancy	1-3
2	Accounting Standard (AS) 30 Accounting for Financial Instruments	Kalola Rimaben A, Chauhan Lalit R.	Accountancy	4-6
3	A Study on Lithology and Petrography of the Tipam Sandstones Exposed along the Tipong Pani River Section of Upper Assam Basin	Dr. Pradip Borgohain	Applied Geology	7-11
4	Study of Fluvial Geomorphic Features of the Lower Subansiri Basin, North-East India using Remote Sensing and GIS.	Dr. Uttam Goswami	Applied Geology	12-14
5	Sheared volcanics in the north of Pugging, East Siang District, Arunachal Pradesh	T. K. Goswami, P. Bhattacharyya, D. Bezbaruah	Applied Geology	15-18
6	Heavy Metal Biosorption Using A Biopolymer Chitin	D. Saravanan, P. N. Sudha	Chemistry	19-23
7	Impact of peripheral cues on rural consumer buying decision for FMCG products with special reference to Palitana (Gujarat)	Dr K.S. Vataliya, Bhavik .P. Parmar	Commerce	24-26
8	A Growth of Rural Postal Life Insurance in India [A Study with special Reference to Dharmapuri District]	Dr. A. Vinayagamoorthy K. Senthilkumar	Commerce	27-28
9	Promotional Strategies for International Markets with respect to Agricultural Products	Dr. B. B. Bhosale	Commerce	29-30
29	Business Risk And Financial Risk - Indian Corporate Sector	Dr. M. Dhanabhakyam, P. Balasubramanian	Commerce	31-33
10	"Customer Relationship Management"- In Banking Industry	G.V. Kori, Sri. Basavaraj Huggi	Commerce	34-36
11	Role of Investment Banks and Institutions in Economic Development	Jitendra Dhirajlal Karia, Dr. (Prof.) Vijay Kumar Soni	Commerce	37-38
12	Nature Of Information Shared And Communication Methods Used In Small Manufacturing Firms	Vipul Chalotra	Commerce	39-41
13	China's WTO Accession: An Empirical Assessment of Merchandise Trade with India	Anjali Tandon	Economics	42-45
14	Regional Disparities - Social Sector Expenditure in Rural-Urban India	Dr. Shankar B. Ambhore, Dr. Ashok S. Pawar	Economics	46-47
15	(Presenting Thought About Industry, Trade And Co-operation Of Rajarshri Shahu Maharaj)	Dr. Ashok Shankarrao Pawar, Dr.Sunita J. Rathod	Economics	48-49
16	An Assessment On Poverty Alliviation Programmes In Rural India-A Case Study	Dr. Parvathamma G. L.	Economics	50-55
17	Liveability in Guwahati: A Factor Analytic Approach	Dr. Daisy Das, Dr. Ratul Mahanta	Economics	56-58
18	Backward Class Disparities in higher Education in India	Dr. Shankar B. Ambhore, Dr. Pawar Ashok S.	Economics	59-60
19	Revenue and Expenditure Pattern of Municipal Corporations of Punjab	Naresh Kumar	Economics	61-66

20	Livelihood Security of Traditional Fishermen of Kerala: Analysing and Identifying the Roles of Self Help Groups	(Dr.) D. Rajasenan, Rajeev B.	Economics	67-70
21	Levels and Types of Questions Raised by EFL Teachers In Southern Al-Mazar Directorate of Education	Dr. Jihad Al-Turki	Education	71-74
22	Issues And Recommendations Of National Knowledge Commission In Higher Education System	Vidhi Bhalla	Education	75-77
23	Multiple Sequence Alignment of Different Species	Perna, Pankaj Bhambri, Dr. O.P. Gupta	Engineering	78-82
24	Analyzing the Phylogenetic Trees with Tree- building Methods	Jasmine, Pankaj Bhambri, Dr. O.P. Gupta	Engineering	83-85
25	Low Power High Speed with Improved Noise Margin for Domino CMOS Inverter.	Pushpa Raikwal, Dr.Vaibhav Neema, Dr.Sumant Katiyal	Engineering	86-88
26	Analysis of Drag for an Aircraft Wing Model with and without Winglet	Mitul Patel, Sharvil Shah, Dharmendra Dubey	Engineering	89-91
27	Cognitive Radio	Chauhan Jayesh R.	Engineering	92-95
28	Problems In Teaching English As A Compulsory Subject	Prof. Madhvi R. Acharya	English	96-97
30	Financial Banking Is The Science Of Managing Money: Indian Financial System	Dr. Shailesh N. Ransariya, Dr. Shailesh N. Ransariya	Finance	98-100
31	Carbon Trading a Step towards Green Environment	Ashok R. Bantwa	Finance	101-102
32	Effect of Supplementation of A Multinutrient Chocolate Bar on Nutritional Status and Athletic Performance	P. Muhtulakshmi, Dr. M. Sylvia Subapriya	Home Science	103-104
33	Imperatives of Inclusive Growth for Sustainable Development of Indian Economy Post Globalization	Dr Mahalaxmi Krishnan	Indian Economy	105-107
34	RIGHT TO INFORMATION ACT AND THE ROLE OF PRESS, MEDIA & NGO'S	Dr. Krushna Chandra Dalai	Law	108-109
35	``Thesis: A Powerful Source Of Information``	Arvind M Bhadrashetty	Library Science	110-111
36	Present Day English and Inflections	Dr Syed Mohammed Haseebuddin Quadri	Literature	112-113
37	Jigsaw II: An Effective Strategy To Develop Reading Comprehension Of High School Students	Dr. P. Nagaraj, Sindhu Thamba	Literature	114-115
38	CAPITAL STRUCTURE ANALYSIS (An Empirical Study of Paper Mills in India)	Ashok Mundhra	Management	116-118
39	Emerging Trends In Indian Rural Market	Dr. N. Ramanjaneyalu	Management	119-121
40	Credit Card Usage in Coimbatore	G. Murali Manokari, Dr. R. Ganapathi	Management	122-126
41	Micro Credit – Two Sides of the Same Coin	R. Durga Rani, J. Gnanadevan, Dr. R. Ganapathi	Management	127-130
42	Work Place Stress and Yoga Therapy	K. Revathi, Dr. R. Ganapathi	Management	131-132
43	Customer's Satisfaction Towards Modernized Petrol Stations With Reference to Coimbatore City	Dr. R. Ganapathi	Management	133-137

44	Evaluation Tactics: A tool to evaluate success of corporate training programme	Dr. Shobha Dedhia	Management	138-140
45	A Preliminary Study On Issues And Challenges Faced In Measurement Of Social Media Return On Investment	Khushbu Pandya	Management	141-142
46	Profitability Analysis (A Case Study of Selected Public and Private Sector Companies)	Manish Manglik	Management	143-144
47	Performance Management System	S.Jayakrishna, N.Sainath, M.V.Subbareddy, N.Raji Reddy	Management	145-147
48	A Study On Organizational Culture In Bharath Heavy Eletrical Limited, Ranipet	S.Sridhar, D.Yuvaraj, V. Kandasamy	Management	148-150
49	Cost Effective Transportation	Sarada Prasanna Patra Dr. Manjusmita Dash	Management	151-154
50	A Study On Efficiency Of Outbound Training With Reference to Titan Industries, Hosur	V. Kandasamy, D. Yuvaraj, S. Ragothaman	Management	155-157
51	Performance Improvement Enhance The Efficiency	Vidya L. Hulkund	Management	158-159
52	Packaging- The Salient Seller	Vidya L. Hulkund	Management	160-161
53	An Empirical Study Of Student Satisfaction With Reference To Gujarat Technological University (Gtu)	Dr. Vijay K. Patel	Management	162-163
54	Maximizing Customer Profitability in Retailing Industry (Durable Goods) - Role of Analytical CRM -A Case Analysis	Dr.A.R.Krishnan, R.Selvamani	Management	164-165
55	Financial Inclusion - Role Of Banking Industry	Dr. K. Marutha Muthu, Ms.T. A.Tamilselvi	Management	166-167
56	The Growth of Self Help Groups in India: A Study	S.Ravi, Dr. P. Vikkraman	Management	168-170
57	Role of E-Banking	K. K. Devi	Marketing	171-172
58	Reasons after the war of going Green –Green Marketing	Kavita A. Trivedi	Marketing	173-175
59	Strongly Minimal Generalized Boundary	K. Chandrasekhara Rao, P . Padma	Mathematics	176-177
60	ACCESSORY RENAL ARTERY: A CASE REPORT	Archana U Shekokar, Vandana A Tendolkardolkar	Medical Science	178-179
61	Fibrinous Pericarditis: A Case Report	Vandana A Tendolkar, Archana U Shekokar	Medical Science	180-181
62	Social life, Addictions and Subjective Wellbeing of the Transsexuals	Seemanthini.T.S, Manjula. M. Y	Psychology	182-184
63	Using E-Content In Science Class: The Effect Of Treatment, Gender, And Their Interaction On Science Achievement	Suman Rani	Psychology	185-188
64	Bullying - Societal Curse- A Serious Issue	Latha Janaki. R, Dr.Kalyani Kenneth	Social Science	189-191
65	Factor Influencing Foetal Wastage	Dr. Dipti Bhavsar, Dr. C. D. Bhavsar	Environment	192-195
66	Approach Of Universilization Educational And Women Empowerment Of Rajarshri Shahu Maharaj	Dr. Ashok Shankarrao Pawar, Dr. Sunita J. Rathod	Economics	196-199



Strongly Minimal Generalized Boundary

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ABSTRACT

In this paper properties of smg - boundary are investigated.

Keywords : smg - interior , smg - closure , smg - boundary

Introduction :

In [2] , Pushpalatha and Sudha discussed properties of strongly minimal generalized (Smg) closed sets . Ravi , Je-yashri , Vijayalakshmi and Antony Rex Rodrigs in their paper [3] dealt with smg - interior and smg - closure . The present paper is devoted to smg - boundary .

Smg - Boundary

Definition :

Let A be a subset of a topological space X . Then smg - boundary of A is defined as

$\text{smg} - \text{bd} A = [(\text{smg} - \text{int} A) \cup (\text{smg} - \text{int} A^c)]^c$, where A^c denotes the complement $X - A$ of the set A .

Theorem 1 :

$\text{Smg} - \text{bd} A = \text{smg} - \text{cl} A - \text{smg} - \text{int} A$.

Proof :

$\text{Smg} - \text{bd} A = \{ (\text{smg} - \text{int} A) \cup (\text{smg} - \text{int} A^c) \}^c$ (by definition) .

$$= (\text{smg} - \text{int} A)^c \cap (\text{smg} - \text{int} A^c)^c$$

$$= (\text{smg} - \text{cl} A^c) \cap (\text{smg} - \text{cl} A)$$

$$= (\text{smg} - \text{cl} A) \cap (\text{smg} - \text{cl} A^c)^c$$

$$= \text{smg} - \text{cl} A - \text{smg} - \text{int} A .$$

Theorem 2 :

$(\text{smg} - \text{bd} A) = (\text{smg} - \text{int} A) \cup (\text{smg} - \text{int} A^c)$.

Proof :

By definition ,

$$\text{Smg} - \text{bd} A = \{ (\text{smg} - \text{int} A) \cup (\text{smg} - \text{int} A^c) \}^c$$

$$\Rightarrow (\text{Smg} - \text{bd} A)^c = (\text{smg} - \text{int} A) \cup (\text{smg} - \text{int} A^c) .$$

Theorem 3 :

$\text{Smg} - \text{cl} (A) = A \cup (\text{smg} - \text{bd} A)$.

Proof :

From result 1 ,

$$A \cup (\text{smg} - \text{bd} A) = A \cup (\text{smg} - \text{cl} A \cap \text{smg} - \text{cl} A^c)$$

$$= (A \cup \text{smg} - \text{cl} A) \cap (A \cup \text{smg} - \text{cl} A^c)$$

$$= (\text{smg} - \text{cl} A) \cup X$$

$$= \text{smg} - \text{cl} (A) .$$

Theorem 4 :

$\text{Smg} - \text{int} A = A - (\text{smg} - \text{bd} A)$.

Proof :

$$A - (\text{smg} - \text{bd} A) = A \cap (\text{smg} - \text{bd} A)^c$$

$$= A \cap (\text{smg} - \text{int} A \cup \text{smg} - \text{int} A^c)$$

$$= (A \cap \text{smg} - \text{int} A) \cup (A \cap \text{smg} - \text{int} A^c)$$

$$= (\text{smg} - \text{int} A) \cup f .$$

$$= \text{smg} - \text{int} A .$$

Theorem 5 :

A is smg - closed $\Leftrightarrow A$ contains its smg - boundary .

Proof :

A is smg - closed .

$$\Leftrightarrow A = \text{smg} - \text{cl} A , \text{ by theorem 4.3 of [3]}$$

$$\Leftrightarrow A = A \cup \text{smg} - \text{bd} A .$$

$$\Leftrightarrow (\text{smg} - \text{bd} A) \subset A .$$

Theorem 6 :

A is smg - open $\Leftrightarrow A \cap (\text{smg} - \text{bd} A) = f$.

Proof :

A is smg - open .

$$\Leftrightarrow A = \text{smg} - \text{int} A \text{ (by theorem 3.5 of [3])} .$$

$$\Leftrightarrow A = A - (\text{smg} - \text{bd} A)$$

$$\Leftrightarrow A = A \cap (\text{smg} - \text{bd} A)^c$$

$$\Leftrightarrow A \subset (\text{smg} - \text{bd} A)^c$$

$$\Leftrightarrow A \cap (\text{smg} - \text{bd} A) = f .$$

Theorem 7 :

$\text{smg} - \text{bd} A^c = \text{smg} - \text{bd} A$.

Proof :

$$\text{smg} - \text{bd} A^c = (\text{smg} - \text{cl} A^c) \cap \text{smg} - \text{cl} (A^c)^c .$$

$$= (\text{smg} - \text{cl } A^c) \cap (\text{smg} - \text{cl } A)$$

$$= \text{smg} - \text{bd } A.$$

Theorem 8 :

$$X = (\text{smg} - \text{int } A) \cup (\text{smg} - \text{int } A^c) \cup (\text{smg} - \text{bd } A).$$

Proof :

Note $\text{smg} - \text{bd } A = (\text{smg} - \text{cl } A) \cap (\text{smg} - \text{cl } A^c)$

$$= (\text{smg} - \text{int } A)^c \cap (\text{smg} - \text{int } A^c)^c.$$

$$\Rightarrow (\text{smg} - \text{int } A) \cap (\text{smg} - \text{bd } A) = (\text{smg} - \text{int } A) \cap (\text{smg} - \text{int } A)^c \cap$$

$$(\text{smg} - \text{int } A^c)^c$$

$$= f \cap (\text{smg} - \text{int } A)^c$$

$$= f \dots (1)$$

Always

$$(\text{smg} - \text{int } A) \cap (\text{smg} - \text{int } A^c) = f \dots (2)$$

From (1) and (2), it follows that

$$X = (\text{smg} - \text{int } A) \cup (\text{smg} - \text{int } A^c) \cup (\text{smg} - \text{bd } A).$$

Theorem 9 :

If A is the smg - closure of an smg - open set G, then $A = \text{smg} - \text{cl} (\text{smg} - \text{int } A)$.

Proof :

We have

$$A = \text{smg} - \text{cl } G$$

$$\Rightarrow G \subset A.$$

$$\Rightarrow G \text{ is an smg - open subset of } A.$$

But $\text{smg} - \text{int } A$ is the largest open subset of A.

Hence

$$G \subset \text{smg} - \text{int } A.$$

$$\Rightarrow \text{smg} - \text{cl } G \subset \text{smg} - \text{cl} (\text{smg} - \text{int } A).$$

$$\Rightarrow A \subset \text{smg} - \text{cl} (\text{smg} - \text{int } A) \dots (1)$$

Now $\text{smg} - \text{int } A \subset A$.

$$\Rightarrow \text{smg} - \text{cl} (\text{smg} - \text{int } A) \subset \text{smg} - \text{cl } A \dots (2)$$

But $A = \text{smg} - \text{cl} (G)$

$$\Rightarrow \text{smg} - \text{cl } A = \text{smg} - \text{cl} (\text{smg} - \text{cl } G)$$

$$\Rightarrow \text{smg} - \text{cl } A = \text{smg} - \text{cl } G = A.$$

Using this in (2), we get

$$\text{smg} - \text{cl} (\text{smg} - \text{int } A) \subset A \dots (3)$$

From (1) and (3), we get

$$\text{smg} - \text{cl} (\text{smg} - \text{int } A) = A.$$

Theorem 10

$$\text{smg} - \text{bd} (\text{smg} - \text{bd} (\text{smg} - \text{bd} (A))) = \text{smg} - \text{bd} (\text{smg} - \text{bd } A).$$

Proof :

Put $B = \text{smg} - \text{bd } A$

But

$$\text{smg} - \text{bd } A = (\text{smg} - \text{cl } A) \cap (\text{smg} - \text{cl } A^c).$$

Hence $\text{smg} - \text{bd } A$ is a closed set in X.

Consequently,

B is a closed subset of X.

Hence

$$B = \text{smg} - \text{cl } B \dots (1)$$

Now

$$\text{smg} - \text{bd } B = (\text{smg} - \text{cl } B) \cap (\text{smg} - \text{cl } B^c).$$

$$= B \cap (\text{smg} - \text{cl } B^c) \text{ [by using (1)] } \dots (2)$$

Put

$$C = \text{smg} - \text{bd } B.$$

Then by (1),

$$C = \text{smg} - \text{cl } C \dots (3)$$

We have

$$\text{smg} - \text{bd} (\text{smg} - \text{bd} (\text{smg} - \text{bd } A)) = (\text{smg} - \text{cl } C) \cap (\text{smg} - \text{cl } C^c)$$

$$C \cap (\text{smg} - \text{cl} (B \cap \text{smg} - \text{cl } B^c))^c = C \cap \text{smg} - \text{cl} (B^c \cup \text{smg} - \text{int } B)$$

$$= C \cap [\text{smg} - \text{cl } B^c \cup \text{smg} - \text{cl} (\text{smg} - \text{int } B)]$$

$$= C \cap [\text{smg} - \text{int } B]^c \cup (\text{smg} - \text{cl} (\text{smg} - \text{int } B))$$

$$= C \cap X$$

$$= C$$

$$= \text{smg} - \text{bd } B$$

$$= \text{smg} - \text{bd} (\text{smg} - \text{bd } A).$$

Theorem 11 :

Let A be an smg - closed set. Let B be any set. Then $(\text{smg} - \text{bd } A) \cap B \subset (\text{smg} - \text{bd} (A \cap B))$.

Proof :

$$(\text{smg} - \text{bd } A) = (\text{smg} - \text{cl } A) \cap (\text{smg} - \text{cl } A^c)$$

$$= A \cap (\text{smg} - \text{cl } A^c)$$

$$\Rightarrow (\text{smg} - \text{bd } A) \cap B = [A \cap (\text{smg} - \text{cl } A^c)] \cap B$$

$$= (A \cap B) \cap (\text{smg} - \text{cl } A^c)$$

$$\subset [\text{smg} - \text{cl} (A \cap B)] \cap (\text{smg} - \text{cl } A^c)$$

$$\subset [\text{smg} - \text{cl} (A \cap B)] \cap [\text{smg} - \text{cl } A^c \cup \text{smg} - \text{cl } B^c]$$

$$= [\text{smg} - \text{cl} (A \cap B)] \cap [\text{smg} - \text{cl} (A \cap B)^c]$$

$$= \text{smg} - \text{bd} (A \cap B).$$

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