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OPTIMIZATION OF MILK DAIRY PRODUCTS BY GAME THEORY

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Abstract:

Dairy products are generally perishable and so that the products be eatable, the cold chain must be maintained from patron to consumer. Consumption of dairy products has grown extensively worldwide since the early 1950s, and continues to expand, where traditionally these products were not present. Dairy products or milk products are simple or reused milk or food attained from milk. Among the type of milk used, the star is by far the cow milk (generally called "milk"), but the milk of goat, angel, camel, yak, buffalo milk is also used. This has created an occasion for the dairy husbandry and dairy product suckers to venture into this request and serve this demand. Consumers profit from the dairy products from a wide range of nutrients analogous as calcium, potassium, vitamin D, and protein. In this paper we are considering the dairy products optimizing in two dairy forms which are located in Andhra Pradesh like Tirumala and Visakha dairy products by using Game proposition.

Key words: Dairy products, Milk, Consumption, Game theory, saddle point.

Introduction:

Milk will be one of the leading suppliers of low- fat milk products. The request in which the brand will serve is filled with analogous or indispensable products. To face the challengers, Milk will diversify its product portfolio in its marketing blend as a strategy to increase its request outreach. The products will include toned milk and pasteurized milk from the Buffaloes, double toned and pasteurized milk from the dairy cows, supplied from original growers and drovers. Milky processing will lead to a wide range of products for different uses, and therefore full cream milk, which will be supplied to sweets, curd, and spices making companies will also be produced.

Milk is the buried fluid of the mammary glands of womanish mammals. Since the foremost times, humanity has used the milk of scapegoats, lamb and cows as food. Moment the term “milk” is synonymous with cow’s milk. The milk of other creatures is spelled out,e.g., lamb milk or scapegoat milk, when supplied commercially.

Milk is an extensively consumed libation that's essential to the diet of several millions of people worldwide because it provides important macro-and micronutrients. Milk is honored as being useful during nonage and nonage because of its composition; still, it’s fairly high impregnated fat proportion raises issues of implicit mischievous goods, videlicet on the cardiovascular system. This review evaluates the most recent literature on dairy and mortal health, framed within epidemiologic, experimental, and biochemical substantiation. As an illustration, the goods of milk on body weight appear to be well proved, and the conclusions of the vast maturity of published studies indicate that dairy consumption doesn't increase cardiovascular threat or the prevalence of some cancers. Indeed, though the available substantiation isn't conclusive, Milk is an essential element of the diet of6 billion people The world product of milk reaches 730 million tons/ y (). Indeed, though mammals produce milk to feed their seed, in numerous areas of the world humans continue to consume milk throughout their life. Still, it must be emphasized that lactose dogmatism is wide throughout the world and that a large proportion of the world’s population would not profit from the apparent benefits of milk. In addition to milk, several dairy products similar as cream, adulation, yogurt, kefir, and rubbish have been produced and consumed worldwide for glories. Thus, the impact of milk and dairy products on mortal health is quantitatively applicable and has been the subject of several examinations, on both whole products and their insulated factors. In particular, the fat portion of milk (largely composed of SFAs) and some of its minor factors, especially calcium and oligosaccharides, are being laboriously delved for their implicit health places. This review summarizes the most recent studies on milk and mortal health and critically discusses the apparent conduct of milk and top dairy ingredients. some studies suggest that milk and its derivations might actually be salutary to some population parts.

The multi cellular organisms organize the cells into napkins and further into specific organs with specific functions. Accordingly, the concealment of these cells will have specific composition with the arrangement of these factors in a specific manner giving unique physical structure to it. Depending up on the conditions, the structure of milk is either maintained or being disturbed in order to prepare certain products. As such a knowledge of these rudiments will give better understanding of the structure of the milk.

Structure of Milk:

Milk being a caching of the epithelial cells of the mammary gland has specific interactive forces working between its factors which help in maintaining the integrity of the whole system. The physical structure i.e., the arrangement of the factors in space must also be known. The interactive forces between the factors are important; they determine the integrity of the whole system under various conditions. The main structural rudiments are shown schematically. They are bitty orsub-bitsy in scale. The structure of milk is truly simple and extensive studies are being conducted on this aspect. Since milk constituents live in different physical state impacting milk parcels in addition to the chemical nature of the constituents.

Main Structure of Milk

Name	Type of dispersion	Percentage	Number (l^{-1})	Diameter (mm)	Surface (m^2/l milk)	Specific density[a] (g/ml)
Fat globules	Emulsion	3.8	10^{13}	100–10,000	70	0.92
Casein micelles	Suspension	2.8	10^{17}	10–300	4000	1.11
Globular proteins (whey proteins)	Colloidal solution	0.6	10^{20}	3–6	5000	1.34
Lipoprotein particles	Colloidal suspension	0.01	10^{17}	10	10	1.10

[a] 20 °C.

Milk fat:

In milk, fat exists in the form of fat droplets. The unique point of these fat droplets is that these fat droplets are girdled with a membrane which is deduced from the apical membrane of the mammary clerk cell. Milk minus fat droplets is called “Milk tube”.

Proteins:

Casein is the major protein of bovine milk and exists mainly as micellar form, where as in mortal milk major proteins are whey proteins. The Casein micelle consists of water, casein, hearties and some minor factors including lipase and proteinase. Casein micelles are erected of lower patches calledsub-units orsub-micelles. Milk tube free from casein micelles is known as milk serum. The liquid that is attained on clotting of milk either with rennet or by acidification to pH4.6 (so electric point of casein) is known as whey. This whey differs in its composition from that of serum in having some of the polypeptides stuck from casein by the action of rennet. The proteins present in whey are nominated as whey proteins of milk. The whey proteins are mainly globular proteins. Lipoprotein patches sometimes called macrodomes vary in their volume, composition, and shape.

Somatic cells:

The somatic cells consist of mainly leukocytes of various types is considered as extraneous particles although they are always present. They are about 10 μ m in diameter; number is about 100,000 per milliliter and accounts for about 0.005% of the volume of milk. They contain all cytoplasm components notable nucleic acids and enzymes. They are rich in catalase. In mastitis milk the cell counts are much higher.

Physical structure of milk:

Still, still, it cannot be homogeneous since it's cloudy in nature, if we try to see a drop of milk with only 5 times exaggeration it appears as invariant liquid. With an increase in the exaggeration by another 100 times one can observes globular driblets of fat floating in tube. A farther increase of exaggeration by another 100 times the proteinaceous patches (casein micelles) come visible. Fat, casein micelles and other proteins form the major structural rudiments for milk, and these rudiments are bitsy or submicroscopic in their size. Although fat is considered to be present in the form of a conflation but it isn't just a simple conflation, because of the fact that the fat droplets are being covered with the fat drop membrane which is deduced during its biosynthesis. In addition to the fat globules some of the fat in the milk is plant outside the droplets while the membrane material includes several enzymes and proteins and polar lipids. As similar fat and fat droplets aren't identical.

Milk plasma:

Milk gets its structure with the structural rudiments. The main structural element being the fat, all that portion of milk which is free from the fat is considered as milk tube. It's frequently a practice to use cream partitions for getting the skim milk, but all the fat present in milk won't be separated as similar we cannot consider milk tube to be synonymous to skim milk. Then we consider fat free-milk to be tube but not skim milk. Although the words serum and tube are used for separation of blood then in milk these words are denoting the physical fragments of milk.

Milk serum:

All that portion of milk banning the casein micelles is appertained as milk serum. By using either rennet or dilute acids the casein micelles could be separated from the tube to gain milk serum. The spherical proteins consist substantially the whey proteins. Lipoprotein patches present in milk are also appertained as the milk microsomes.

Casein micelles:

Water, casein and mariners along with some minor factors similar as lipases and proteinases constitute this structural element of milk. Casein micelles don't fully regard for the casein content since some of the casein is also present in a result form. As casein binds captions especially the Ca--and Mg ions at the normal pH of milk i.e., 66, it's appertained as casein ate. Unformed calcium phosphate and small quantities of citrates are the ingredients associated with the casein micelle. Calcium casein ate phosphate complex is the term applicable to describe the casein micelles. Phosphate being a part of the colloidal patches, the term colloidal phosphate is also used.

Whey proteins:

The non-micellar proteins constitute the whey proteins, but it is often the globular proteins present as such are considered to be the whey proteins

TIRUMALA DAIRY FARM:

Thirumala Milk Products Private Limited is a leading dairy company in South India established in the time 1996. Since also, Thirumala has been maintaining its position as a fastest growing brand with presence in major countries of India similar as Tamil Nadu, Karnataka, Andhra Pradesh, Telangana, Kerala, Madhya Pradesh, Uttar Pradesh, and West Bengal. Moment, Thirumala produces dairy products across nine state-of-the- art manufacturing shops spread across southern countries of India.

Sri Vijaya Visakha Milk Dairy farm:

Sri Vijaya Visakha Milk Producers Company Ltd ((Visakha Dairy)) in the Indian state of Andhra Pradesh. It sells Milk & Milk Products in the name of Visakha Dairy. It works on collaborative principles. Nearly every North Coastal quarter in the state has milk producingco-operatives. The milk is collected from member growers, reused and vended in the request under the brand of Visakha Dairy.

In 1977 this factory reached LPD running capacity. In 1999 it registered as"Sri Vijaya Visakha District Milk Directors Mutually Backed Cooperative UnionLtd. “In 2006 it converted to Sri Vijaya Visakha Milk Producers Company Limited.

LINEAR PROGRAMMING:

Linear programming is also called direct optimization is a system to achieve the stylish outgrowth in a fine model whose conditions are represented by direct connections. Linear programming is a special case of fine programming.

Further formally, direct programming is a fashion for the optimization of a direct ideal function, subject to direct equivalency and direct equivalency constraints. Its doable region is a convex polytope, which is a set defined as the crossroad of finitely numerous half spaces, each of which is defined by a direct inequality. Its objective function is a real- valued affine (direct) function defined on this polyhedron. A direct programming algorithm finds a point in the polytope where this function has the lowest (or largest) value if such a point exists.

Linear programs are problems that can be expressed in canonical form as

$$\begin{array}{ll} \text{Find a vector} & \mathbf{x} \\ \text{that maximizes} & \mathbf{c}^T\mathbf{x} \\ \text{subject to} & A\mathbf{x} \leq \mathbf{b} \\ \text{and} & \mathbf{x} \geq \mathbf{0}. \end{array}$$

Linear programming (LP) is a fine optimization fashion. By “Optimization” fashion we mean a system which attempts to maximize or minimize some ideal,e.g., maximize gains or minimize costs. In numerous problems in business and assiduity we're making opinions that will maximize or minimize some volume. For illustration, a factory director may want to determine the most provident way of shipping goods from the plant to the requests, a sanitarium may want to design a diet satisfying certain nutritive conditions at a minimal cost, an investor may want to elect investments that will maximize gains, or a manufacturer may wish to blend constituents, subject to given specifications, to maximize profit.

Linear Programming Under this content we give; i) Several exemplifications of LP problems and show how fine models can be formulated for them. ii) Geometric results of above LP problems.

GAME THEORY:

The conception of game proposition provides a common language to formulate structure dissect and ultimately understand different strategical scripts. A game in the sense of game proposition is given by a number of players, who interact according to given rules. Those players might be individualities, groups, companies, associations and so … on. Their commerce will have an impact on each of the players and on the whole group of players i.e., they're independent. Game proposition was developed considerably in the 1950s by numerous scholars. It was explicitly applied to elaboration in the 1970s, although analogous development go back as least as far as the 1930s game proposition has been extensively honored as an important tool in numerous fields. As of 2014 with the Noble honorary prize in profitable Noble prize. John Maynard smith was awarded the Crawford prize for his operation of evolutionary game proposition. Game proposition has come to play an decreasingly important part in sense and in computer wisdom. Several logical propositions have a base in game semantics. In addition, computer scientists have used game to model interactive calculations Also, game proposition provides a theoretical base to the field ofmulti-agent systems.

The emergence of the Internet has motivated the development of algorithms for chancing equilibrium in games, request, computational deals, peer-to- peer system, and security and information requests Algorithmic game proposition and within it algorithmic medium design combine computational algorithm design and analysis of complex systems with profitable proposition.

SADDLE POINT:

Saddle point or mini maximum point is a point on the face of the graph of a function where the pitches in orthogonal directions are all zero. Saddle point if the outgrowth is a minimum in its row and outside in column.

The Prisoner's Dilemma:

Game Proposition is the model frame for understanding strategic decision timber among individualities, or players. Internee's dilemma is an illustration ofnon-cooperative game proposition that demonstrates why two rational individualities would refuse to work together indeed if it might be in their better interest to do so.

Illustration of the internee's dilemma "when two challengers are battling it out in the business. Internee's dilemma presents a situation where 2 parties, separated and unfit to communicate, must each choose betweenco-operating with the other or not.

saddle point Steps (Rule)	
Step-1:	1. Select the minimum element from each row and write them in Row Minimum column. 2. Select the maximum element from Row Minimum column and enclose it in [ ]. It is called Row MaxiMin.
Step-2:	1. Select the maximum element from each column and write them in Column Maximum row. 2. Select the minimum element from Column Maximum row and enclose it in ( ). It is called Column MiniMax.
Step-3:	1. Find out the elements that is same in rectangle [ ] and circle ( ). 2. If Column MiniMax = Row MaxiMin then the game has saddle point and it is the value of the game.

Example:

Find Solution of game theory problem using saddle point

Player A\Player B	B1	B2	B3	B4
A1	20	15	12	35
A2	25	14	8	10
A3	40	2	10	5
A4	-5	4	11	0

Solution:

1. Saddle point testing
Players

		Player *B*			
		*B*1	*B*2	*B*3	*B*4
Player *A*	*A*1	20	15	12	35
	*A*2	25	14	8	10
	*A*3	40	2	10	5
	*A*4	-5	4	11	0

We apply the maximin (minimax) principle to analyze the game.

		Player *B*				
		B_1	B_2	B_3	B_4	Row Minimum
Player *A*	A_1	20	15	[(12)]	35	[12]
	A_2	25	14	8	10	8
	A_3	40	2	10	5	2
	A_4	-5	4	11	0	-5
	Column Maximum	40	15	(12)	35	

Select minimum from the maximum of columns Column MiniMax = (12)

Select maximum from the minimum of rows Row MaxiMin = [12]

Here, Column MiniMax = Row MaxiMin = 12

∴ This game has a saddle point and value of the game is 12

The optimal strategies for both players are
The player A will always adopt strategy 1
The player B will always adopt strategy 3

The **Pure Strategy game**, Maximizing player arrives at optimal strategy on the basis of maximin criterion and minimizing player's strategy is based on minimax criterion. The game is solved when maximin values equals minimax value. This value is the **Value of game**.

Problem:

The Thirumala diary milk products operating revenues range is over INR 500 cores for the financial year ending on 31 march 2020. Now taking two branches of Thirumala diary Eluru and Vijayawada, both sale the products- Milk, Curd, Ghee. The averages are as follows:

ELURU	VIJAYAWADA		
	MILK	CURD	GHEE
MILK	9	7	6
CURD	7	4	3
GHEE	6	3	2

Find the Pure Strategy game between the two branches Eluru and Vijayawada.

PROBLEMS:

Min $Z=3500\ X_1+4000X_2$

Stc: - $10X_1+11X_2 \geq 110$

$17X_1+18Y_2 \geq 112$

$13X_1+8X_2 \geq 72$

The given objective function is of minimization type so converting it into maximization type

$\therefore \max Z = -3500X_1 - 4000X_2$

The problem is converted to canonical form by adding slack, surplus and artificial variables as appropriate

Max $Z= -3500X_1 - 4000X_2 + 0.S_1 + 0.S_2 + 0.S_3 - MA1 - MA2 - MA3$

Stc: - $10X_2 + 11X_2 - S_1 + A_1 = 110$

$17X_1 + 18X_2 - S_2 + A_2 = 112$

$13X_1 + 8X_2 - S_3 + A_3 = 72$

Where $x_1, x_2, S_1, S_2, S_3, A_1, A_2, A_3 \geq 0$

Iteration-1:

Iteration-1		C_j	-3500	-4000	0	0	0	-M	-M	-M	
B	C_B	X_B	X_1	X_2	S_1	S_2	S_3	A_1	A_2	A_3	Min ratio X_B/X_1
A_1	-M	110	10	11	-1	0	0	1	0	0	110/10=11
A_2	-M	112	17	18	0	-1	0	0	1	0	112/17=6.5882
A_3	-M	72	(13)	8	0	0	-1	0	0	1	72/13=5.5385 →
		Zj	-40M	-37M	M	M	M	-M	-M	-M	10/13=0.7692
		Zj-Cj	-40M+3500↑	-37M+4000	M	M	M	0	0	0	

Iteration-2:

Iteration-2		Cj	-3500	-4000	0	0	0	-M	-M	-M	
B	C_B	X_B	X_1	X_2	S_1	S_2	S_3	A_1	A_2	A_3	Min ratio X_B/X_2
A_1	-M	710/13	0	63/13	-1	0	10/13	1	0	-10/13	710/13/63/13 =710/63 =11.2698
A_2	-M	232/13	0	(98/13)	0	-1	17/13	0	1	-17/13	232/13/98/13 =116/49 =2.3673→
X_1	-3500	92/13	1	8/13	0	0	-1/13	0	0	1/13	72/13/8/13=9
		Z_j	-3500	-161M/13-28000/13	M	M	-27M/13+3500/13	-M	-M	27M/13-3500/13	63/13/98/13=0.6
		Zj-Cj	0	-161M/13+24000/13↑	M	M	-27M/13+3500/13	0	0	40M/13-3500/13	

Iteration-3		C_j	-3500	-4000	0	0	0	-M	-M	-M	
B	C_B	X_B	X_1	X_2	S_1	S_2	S_3	A_1	A_2	A_3	Min ratio X_B/S_2
A_1	-M	302/7	0	0	-1	9/14	1/14	1	-9/14	1/14	362/4/9/14= 604/9= 67.1111
X_2	-4000	116/49	0	1	0	-13/98	17/98	0	13/98	-17/98	-
X_1	-3500	200/49	1	0	0	(4/49)	-9/49	0	-4/49	9/49	200/49/4/49= 50→
		Z_j	-3500	-4000	M	-9M/14 + 1200/49	M/14-2500/49	-M	9M/14 - 1200 0/49	M/14 + 2500/49	9/14/4/49=
		Zj-Cj	0	0	M	-9M/14 + 12000/49 ↑	M/14-2500/49	0	234/14-1200 0/49	13M/14+ 2500/49	

Iteration-4:

Iteration-4		C_j	-3500	-4000	0	0	0	-M	-M	-M	
B	C_B	X_B	X_1	X_2	S_1	S_2	S_3	A_1	A_2	A_3	Min ratio X_B/S_3
A_1	-M	11	-63/8	0	-1	0	(11/8)	1	0	-11/8	11/11/8=8→
X_2	-4000	9	13/8	1	0	0	-1/8	0	0	1/8	-
S_2	0	50	49/4	0	0	1	-9/4	0	-1	9/4	-
		Z_j	63M/8-6500	-4000	M	0	-11M/8 + 500	-M	0	11M/8 - 500	
		Zj-C_j	63M/8-3000	0	M	0	-11M/8 + 500↑	0	M	19M/8-500	

Iteration-5:

Iteration-5		Cj	-3500	-4000	0	0	0	-M	-M	-M	
B	C_B	X_B	X_1	X_2	S_1	S_2	S_3	A_1	A_2	A_3	Min ratio X_B/X_1
S_3	0	8	-63/11	0	-8/11	0	1	8/11	0	-1	-
X_2	-4000	10	(10/11)	1	-1/11	0	0	1/11	0	0	10/10/11=11 →
S_2	0	68	-7/11	0	0-18/11	1	0	18/11	-1	0	-
Z=-40000		Z_j	-40000/11	-4000	4000/11	0	0	-4000/11	0	0	-63/11/10/11=
		Zj - Cj	-1500/11 ↑	0	4000/11	0	0	M-4000/11	M	M	

Iteration-6:

Iteration-6		C_j	-3500	-4000	0	0	0	-M	-M	-M	
B	C_B	X_B	X_1	X_2	S_1	S_2	S_3	A_1	A_2	A_3	Min ratio X_B/X_1
S_3	0	71	0	63/10	-13/10	0	1	13/10	0	-1	
X_1	-3500	11	1	11/10	-1/10	0	0	1/10	0	0	
S_2	0	75	0	7/10	-17/10	1	0	17/10	-1	0	
		Z_j	-3500	-3850	350	0	0	-350	0	0	
		Zj-Cj	0	150	350	0	0	M-350	M	M	

$$\therefore Z_j - C_j \geq 0$$

Hence optimal solution is arrived with value of variables as

$X_1 = 11$, $x_2 = 0$

Max Z = - 38500

Min Z = 38500

Solution: -

Vijayawada / Eluru	Milk	Curd	Ghee	Minimum
Milk	9	7	6	6
Curd	7	4	3	3
Ghee	6	3	2	2
Maximum	9	7	6	

To find maximum value

a) The minimum value in each row denoting minimum possible game from each strategy of Eluru branch
b) Maximum value is maximum of these minimum values which is 6

To find minimum value

a) The maximum value in each column denoting minimum possible loss from each strategy of Vijayawada branch
b) Minimum value is minimum of these maximum values which is 6

To find saddle point

The maximum value of row minimum is 6 and the minimum value of column maximum is 6

The value of the game is 6.

Conclusion:

Milk and its derivatives are proposed as being useful foods throughout all life periods, in particular during childhoodand adolescence, when their contents of calcium, protein, phosphorus, and other micronutrients might promote skeletal, muscular, and neurologic development. By using the game theory we can solve and give accurate solutions to the real world problems.

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