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STATISTICAL ANALYSIS OF THE TIME SERIES DATA FOR THE PRICES OF MILK, OIL, DESI GHEE AND VEGETABLE GHEE IN BALOCHISTAN.

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Abstract

The Prices of Oil, Desi Ghee and Vegetable Ghee are compared with the Price of Milk, using Ratios, Growth Rates, Index Numbers, Regression and Correlation Analysis, from1973 to 1994. Econometric models are also fitted for forecasting their Prices.

It has been observed that the Prices of Milk, Oil, D. Ghee and V. Ghee have increased by 510%, 540%, 450% and 370%, respectively. The change is maximum for Oil and minimum for V. Ghee.

Poly-3 is the best curve for predicting the Prices of all items, while Exponential curve is the 2nd for Milk and D.Ghee. The maximum increase in the Prices occurred in 1974 and the minimum in 1976 (the effect of devaluation of currency).

Changes in Prices of all the items are explained more by their previous rates than with time (not as for Wheat Floor, Beef, Mutton, etc) [3]. The Prices of D. Ghee and V. Ghee are strongly correlated with those of Milk and Oil, respectively.

Key words: Econometric Models, Forecasting

Introduction

Different Statisticians have compared the Prices of various food items for Balochistan [3], [4] and [5]. This study has been undertaken for the following purpose:

To find the association of Prices of Milk, Oil, D.Ghee and V. Ghee with time and previous rates, using regression and correlation.

To find the dependence (if any) of Prices of Oil, D.Ghee, V.Ghee on Milk.

To find the suitable curve for predicting the Prices of each item and to check/compare the results with those obtained in [3],[4]and [5].

Data is obtained from the office of Deputy Director, Bureau of Statistics, Quetta and is presented in Table-1. Methods for comparison are the same as discussed in [3, 4, 5].

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Results and Discussion

Ratios

Table-2.1

	Average	Max (Year)	Min (Year)	Range	C.V.
Oil/Milk	2.5	2.94 (78)	2.03 (88)	0.91	0.10
D.ghee/Milk	8.4	10.23 (76)	7.30 (88)	2.93	0.09
V.ghee/Milk	2.68	3.78 (76)	1.98 (88)	1.80	0.20
D.ghee/V.ghee	3.22	3.80 (86)	2.66 (85)	1.13	0.12
Oil/V.ghee	0.96	1.17 (92)	0.70 (76)	0.46	0.13

We expect to buy 2.5 kgs, 8.4 kgs and 2.7 kgs of Milk, respectively, in exchange of 1 kg of Oil, D.Ghee and V.ghee.

C.V. for ratios of Prices with Milk price is minimum for D.Ghee and maximum for V.Ghee.

The ratios of Prices of Oil and D.Ghee with Milk follow the pattern of the ratios of Beef and Fish Prices with Wheat Flour [3] and of Sugar with Gur [5].

Growth Rates

Table – 2.2

Food Item	Average	Max (Year)	Min (Year)	C.V.
Milk	9.24	20.69 (74)	5.19 (76)	0.71
Oil	9.57	25.18 (74)	- 2.16 (76)	0.87
D.ghee	8.64	29.42 (74)	1.70 (76)	0.77
V.ghee	8.04	28.21 (74)	- 0.28 (85)	1.12

The variations in the G.R's of Prices are largest for V.Ghee and smallest for Milk.

The average rise in the Prices is largest for Oil and smallest for V.Ghee.

Maximum change in the Prices for all the items occurred in 1974 and minimum change occurred in 1776 (except for V.Ghee); being the effect of devaluation of currency.

Regression

(a) Regression with time (Table 2.3 (A) Econometric models)

Poly-3 is the best curve on the basis of Adj-R^2 and No. of significant coefficients. Adj-R^2 is largest for Milk and smallest for Oil.

About 94.8%, 82.4%, 91.4% and 89% of the variation in the Prices of Milk, Oil, D.Ghee and V.Ghee are explained by time.

All the error terms are not auto-correlated (Durban-Watson test).

Graphs of Regression curves for each food item are available with the main author

(b) Linear Regression with Milk, and with V.Ghee.

Table 2.3 (B) Linear Regression

Regression Equation	Adj-R^2	*F*	*r*	Average Ratio
Oil = -0.339 + 2.551 Milk	0.938	305.52	0.97	2.50
D.ghee = 3.219 + 7.696 Milk	0.986	1448.48	0.99	8.41
V.ghee = 2.822 + 2.024 Milk	0.935	288.87	0.96	2.68
Oil = 3.165 + 0.789 V. ghee	0.980	1188.23	0.99	0.96
D. ghee = - 4.997 + 3.636 V.ghee	0.960	489.05	0.98	3.22

Adj-R^2 for regression with Milk is largest for D.Ghee and smallest for V.Ghee, i.e. Price of D.Ghee is highly dependent on Milk Price.

All slopes are positive as for other items considered in [4][5]. Both coefficients are significant at 95% level of significance. The slopes are approximately equal to the average ratios of the Prices, except for V. Ghee with Milk and also with Oil.

(c) Lagged Linear Regression

Table-2.3 (C) Lagged Linear Regression

Item	Regression Equation	Adj-R^2 (Lag-1)	Adj-R^2 with time
Milk	$Y_t = 0.06 + 1.08\ Y_{t-1}$	0.99	0.94
Oil	$Y_t = -0.88 + 1.17\ Y_{t-1}$	0.97	0.82
D. Ghee	$Y_t = 0.41 + 1.07\ Y_{t-1}$	0.98	0.91
V. Ghee	$Y_t = -1.12 + 1.16\ Y_{t-1}$	0.96	0.80

All slopes are significant, but intercepts are insignificant (as for other items in [3] [4] [5].

Adj-R^2 is largest for Milk and smallest for V. Ghee (for lag-1).

Largest change (per year) takes place in the Price of Oil and smallest for D. Ghee (by estimated slope).

Changes in the Price of each item are explained more by previous rates than by time (contrary to the changes in the Prices of W. Flour, Mutton, Beef,.. ..., except for Onion) [3] [4] [5].

By Correlation

Table-2.4 Correlation Coefficients

Item	Lagged-1	Food item	With Time
Milk	0.99	0.97 (Milk)	0.975
Oil	0.98	0.99 (V.Ghee)	0.912
D. Ghee	0.99	0.99 (Milk)	0.958
V. Ghee	0.98	0.98 (D.Ghee)	0.904

The Prices of D. Ghee are highly correlated with those of Milk.

The Prices of V. Ghee are more correlated with Oil than with D. Ghee.

The Prices of all items are more correlated with their previous values than with time.

The Prices of all items are highly correlated with each other.

Forecasting

Table-3.1 (Forecasting)

	Poly-2	Poly-3	Exp.	Gomp.	Mod. Exp.	Lagged-1
Milk (22)	13.12	13.59	13.73	14.42	14.62	13.56
(23)	14.07	14.80	14.98	15.58	15.87	14.71
Oil (22)	35.22	41.25	32.04	37.15	39.05	41.28
(23)	38.29	47.60	34.71	41.08	43.31	47.47
D. ghee (22)	113.90	107.13	103.97	123.66	122.07	108.197
(23)	125.12	115.27	112.29	137.11	134.25	117.02
V. ghee (22)	31.49	36.29	27.16	41.47	39.00	36.24
(23)	34.06	41.47	28.86	49.27	44.49	41.19

Table-3.2 (Forecasting)

	Poly-2	Poly-3	Exp.	Gomp.	Mod. Exp.	Lagged-1
Milk (24)	15.05	16.09	16.33	16.83	17.22	15.95
(25)	16.08	17.49	17.82	18.16	18.68	17.29
Oil (24)	41.51	54.83	37.60	45.52	48.09	54.72
(25)	44.90	63.00	40.73	50.55	53.45	63.22
D. ghee (24)	138.73	123.78	121.29	152.42	147.77	126.54
(25)	152.99	132.68	131.00	169.90	162.78	136.80
V. ghee (24)	36.77	47.37	30.67	59.53	50.95	46.97
(25)	39.62	54.02	32.59	73.28	58.56	53.72

The Prices forecasted by higher order polynomials are better than by other curves, as in case of earlier studies for other food items in Balochistan [3] [4] [5]. Gompertz curve and modified exponential curves failed to produce unbiased results for prediction.

Note: Above tables indicate the Prices forecasted for each item, separately. Value for (22), (23), (24), (25) denote predictions for Prices during years 1995, 1996, 1997 and 1998, respectively.

Summary

The rise in the Prices is maximum for Oil and minimum for V. Ghee.

C.V. and Range of G. R's is maximum for V. Ghee and Minimum for Milk.

The Price of Milk is highly associated with time and of D. Ghee is strongly related with Milk. V. Ghee and Oil Prices are also highly correlated.

Poly-3 is the best curve for regression of Prices of all the food items.

The rates of food items depend more on their previous rates than on time and more on rates one year ago than two years ago.

The Prices forecasted by higher order polynomials are better than by other curves. Gompertz curve and Modified exponential curves failed to produce unbiased results for prediction, as in [3] [4] [5].

References:

1. Madnani, G.M.K, Introduction to Econometrics, Principles and Applications, 4th edition, Oxford, IBM Publishers, New Delhi (1988).
2. Sher Muhammed Chaudhry, Introduction to Statistical Theory, Part-I and Part-II, Ilmi Kitab Khana, Urdu Bazar, Lahore (1992).
3. M.Naim Sajjad and N.M. Shaikh, "Econometrics Models for the Prices of Wheat Flour, Fish, Mutton and Beef in Baluchistan from 1973-1992; Commerce and Economic Review, S.A.L., University, Khairpur (1995).
4. M.Naim Sajjad and N.M. Shaikh, "Comparison of Statistics of the Prices of Rice, Mongs, and Grams with Wheat Flour in Bauchistan from 1973-1992; Journal of Pure and Applied Sciences, Bahawelpur. Vol. 15, No. 2, Dec. (1996), pp 49-61.
5. N.M Shaikh, Siraj M. Pandhiani and Lal Chand, "Fitting Econom tric Models on the Prices of Sugar, Gur, Potato, Onion, Chilies and Salt in Balochistan", Arts Series Research Journal, University of Sindh, Jamshoro (2000).
6. Damondar N. Gujarati - Basic Econometrics, third Edition, New York; Macmillan Publishing Co. Inc. (1999).
7. "A Comparative Study of Mathematical Trend Curves for Forecasting Jowar Production in Pakistan from 1970 to 1995", accepted for publication. Commerce and Economic Review, S.A.L. University, Khairpur (1998).
8. Mrs Shahnaz and Miss. Nusrat Fatima Kazi "The Analysis of Production of Chillies in Pakistan during the period from 1983-84 to 1992-93", Commerce & Economic Rewiew, S.A.L University Khairpur. (1995).
9. A.H. Labano, N.A Chaudhary, N.M Shaikh, Niaz A.Khaskheli, "Path coefficient analysis of yield components of Wheat (variety Sindh-81)", Sindh University Research Journal (Science Series) Volume 31, No.2 (pp 23). (1999).

Table 2.3 (A) Econometric Models for Milk, Oil D.Ghee and V. Ghee

Model	Regression Equation of Milk	Adj.R^2	F	$r/\sqrt{R^2}$	Sig.	Insig.	Neg.	d (Comments)
Poly-1 (1.721)	$y = 0.615 + 0.493\ x$ (1.90) (19.15)	0.948	366.99	0.975	2	0	0	0.240
Poly-2 (1.725)	$y = 2.273 + 0.061\ x + 0.019\ x^2$ (13.10) (1.67)* (12.26)	0.994	1700.6	0.997	2	1	0	
Poly-3 (1.729)	$y = 1.803 + 0.291\ x - 0.005\ x^2 + 0.00007\ x^3$ (8.64) (3.62) (–0.70)* (3.09)	0.996	1675.3	0.998	3	1	1	
Exp	$y = 2.034\ e^{0.086x}$ (50.31) (54.82)	0.996	3005.8	0.998	2	0	0	(Best)
Model	Regression Equation of Oil	Adj.R^2	F	$r/\sqrt{R^2}$	Sig.	Insig.	Neg.	d (Comments)
Poly-1 (1.721)	$y = 1.717 + 1.214\ x$ (1.09) (9.74)	0.824	95.04	0.912	1	1	0	0.253
Poly-2 (1.725)	$y = 8.508 - 0.557\ x + 0.080\ x^2$ (5.53) (–1.73) (5.60)	0.933	141.36	0.969	3	0	1	
Poly-3 (1.729)	$y = 2.478 + 2.394\ x - 0.247\ x^2 + 0.0097x^3$ (2.15) (5.47) (–5.36) (7.20)	0.982	377.91	0.992	4	0	1	(Best)
Exp	$y = 5.512\ e^{0.080x}$ (21.68) (21.78)	0.922	474.68	0.962	2	0	0	
Model	Regression Equation of D.Ghee	Adj.R^2	F	$r/\sqrt{R^2}$	Sig.	Insig.	Neg.	d (Comments)
Poly-1 (1.721)	$y = 8.421 + 3.757\ x$ (2.62) (14.68)	0.914	215.50	0.958	2	0	0	0.188
Poly-2 (1.725)	$y = 24.472 - 0.429\ x + 0.190\ x^2$ (11.90) (–0.99)* (10.01)	0.986	721.31	0.993	2	1	1	
Poly-3 (1.729)	$y = 17.706 + 2.881\ x - 0.177\ x^2 + 0.011x^3$ (8.36) (3.54) (–2.08) (4.38)	0.993	973.90	0.997	4	0	1	(Best)
Exp	$y = 19.088\ e^{0.077x}$ (34.87) (33.74)	0.984	1138.4	0.992	2	0	0	
Model	Regression Equation of V.Ghee	Adj.R^2	F	$r/\sqrt{R^2}$	Sig.	Insig.	Neg.	d (Comments)
Poly-1 (1.721)	$y = 4.539 + 0.956\ x$ (3.48) (9.21)	0.890	84.97	0.904	2	0	0	0.277
Poly-2 (1.725)	$y = 10.461 - 0.589\ x + 0.070\ x^2$ (8.99) (–2.41) (6.53)	0.989	156.91	0.972	3	0	1	
Poly-3 (1.729)	$y = 5.665 + 1.758\ x - 0.190\ x^2 + 0.0079x^3$	0.993	617.60	0.995	4	0	1	(Best)
Exp	$y = 7.138\ e^{0.060x}$	0.917	210.65	0.946	2	0	0	

Table-1 Balochistan Price (Data, Ratios, Growth Rates, Index Numbers)

		DATA				RATIOS					GROWTH RATES (CHAIN BASE)				Index Numbers			
S.No.	Year	Milk	Oil	D. Ghee	V. Ghee	O/MK	DG/MK	VG/MK	DG/VG	O/VG	MK	OIL	DG	VG	MILK	OIL	DG	VG
1	73-74	2.03	5.60	18.22	6.77	2.76	8.98	3.33	2.70	0.80	0.0	0.0	0.0	0.0	100.0	100.0	100.0	100.0
2	74-75	2.45	7.01	23.58	8.68	2.86	9.62	3.54	2.70	0.80	20.7	25.2	29.4	28.2	120.7	125.2	129.4	128.2
3	75-76	2.89	7.42	27.57	10.35	2.57	9.54	3.58	2.70	0.70	18.0	5.8	16.9	19.2	142.4	132.5	151.3	152.9
4	76-77	2.74	7.26	28.04	10.35	2.65	10.23	3.78	2.70	0.70	-5.2	-2.2	1.7	0.0	135.0	129.6	153.9	152.9
5	77-78	3.20	7.92	29.10	10.35	2.48	9.09	3.23	2.80	0.80	16.8	9.1	3.8	0.0	157.6	141.4	159.7	152.9
6	78-79	3.20	9.42	30.08	10.45	2.94	9.40	3.27	2.90	0.90	0.0	18.9	3.4	1.0	157.6	168.2	165.1	154.4
7	79-80	3.83	11.13	32.46	11.41	2.91	8.48	2.98	2.80	1.00	19.7	18.2	7.9	9.2	188.7	198.8	178.2	168.5
8	80-81	4.13	11.27	34.63	11.41	2.73	8.38	2.76	3.00	1.00	7.8	1.3	6.7	0.0	203.4	201.3	190.1	168.5
9	81-82	4.54	11.58	36.83	11.41	2.55	8.11	2.51	3.20	1.00	9.9	2.8	6.4	0.0	223.6	206.8	202.1	168.5
10	82-83	5.00	12.13	38.96	11.42	2.43	7.79	2.28	3.40	1.10	10.1	4.7	5.8	0.1	246.3	216.6	213.8	168.7
11	83-84	5.63	12.96	41.83	13.05	2.30	7.43	2.32	3.20	1.00	12.6	6.8	7.4	14.3	277.3	231.4	229.6	192.8
12	84-85	6.00	13.86	48.77	14.22	2.31	8.13	2.37	3.40	1.00	6.6	6.9	16.6	9.0	295.6	247.5	267.7	210.0
13	85-86	6.08	14.29	51.21	14.18	2.35	8.42	2.33	3.60	1.00	1.3	3.1	5.0	-0.3	299.5	255.2	281.1	209.5
14	86-87	6.56	15.00	53.95	14.19	2.29	8.22	2.16	3.80	1.10	7.9	5.0	5.4	0.1	323.2	267.9	296.1	209.6
15	87-88	7.42	16.53	57.86	16.08	2.23	7.80	2.17	3.60	1.00	13.1	10.2	7.2	13.3	365.5	295.2	317.6	237.5
16	88-89	8.22	16.69	60.00	16.31	2.03	7.30	1.98	3.70	1.00	10.8	1.0	3.7	1.4	404.9	298.0	329.3	240.9
17	89-90	9.05	20.00	70.00	20.41	2.21	7.73	2.26	3.40	1.00	10.1	19.8	16.7	25.1	445.8	357.1	384.2	301.5
18	90-91	9.54	21.35	79.09	20.87	2.24	8.29	2.19	3.80	1.00	5.4	6.8	13.0	2.3	470.0	381.3	434.1	308.3
19	91-92	10.23	26.42	85.96	24.19	2.58	8.40	2.36	3.60	1.10	7.2	23.7	8.7	15.9	503.9	471.8	471.8	357.3
20	92-93	11.67	32.75	96.67	28.06	2.81	8.28	2.40	3.40	1.20	14.1	24.0	12.5	16.0	574.9	584.8	530.6	414.5
21	93-94	12.50	36.00	100.00	32.00	2.88	8.00	2.56	3.10	1.10	7.1	9.9	3.4	14.0	615.8	642.9	548.8	472.7
	Mean	6.04	15.08	49.75	15.06	2.53	8.46	2.68	3.22	0.96	9.24	9.57	8.64	8.04	297.70	269.21	273.07	222.38
	S.D	3.06	8.05	23.73	6.40	0.26	0.74	0.54	0.38	0.13	6.56	8.34	6.66	9.00	150.94	143.84	130.26	94.58
	C.V	0.51	0.53	0.48	0.43	0.10	0.09	0.20	0.12	0.13	0.71	0.87	0.77	1.12	0.51	0.53	0.48	0.43
	Max.	12.50	36.00	100.00	32.00	2.94	10.23	3.78	3.80	1.17	20.69	25.18	29.42	28.21	615.76	642.86	548.85	472.67
	Min.	2.45	7.01	23.58	8.68	2.03	7.30	1.98	2.66	0.70	-5.19	-2.16	1.70	-0.28	120.69	125.18	129.42	128.21