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The Binary Logistic Regression for Index Numbers of Monthly Stock Price

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Abstract. This paper explores the definitions of index number, price index number and the formula of the price index number calculation. In this paper, the price index numbers take the montly Microsoft stock price. The calculation is done for case of the empirical data of the monthly Microsoft stock price in 1986-2017 year. The calculation use the Simple Aggregative with a base year and a given year method. This paper also link the results of the price index number calculation into the binary logistic regression and analyzed them by using SPSS application. Method to explore the definitions of index number, price index number and the formula of the price index number use the literatures study. Method of analysis in binary logistic regression use the SPSS application. Results of this research are the calculation of the price index numbers of the monthly Microsoft stock by using the Simple Aggregative with a base year have the values greater than a given year and the binary logistic regression model is not fit for the empirical data of the price index numbers of the monthly Microsoft stock by calculating in both methods.

Key Words: Price, index, data, stock, empirical, monthly, microsoft, aggregative, regression.

INTRODUCTION

An index number is a statistical measure, designed to measure changes in a variable or a group of related variables with respect to time, geographical location or other characterisrics such as [6]. It also can be defined that index number is a number that expresses the relative change in the variable of price, quantity, or value compared to base period.

There are three type of index numbers i.e price, quantity, and value index [5] . A price index number is a measure reflecting the average of the proportionate changes in the prices of the specified set of goods and services between two period of time. Usually the index is assigned a value of 100 in some selected base period and the values of the index for other periods are intended to indicate the average percentage change in price compared with the base period. A price index number also reflects the percentage change in the price of a commodity or a group of commodity in a given period of time over the price paid for that commodity or a group of commodity at a particular point of time in the past.

Calculating method of index number can be classified into great groups i.e Simple and Weighted method. Both methods are divided into two groups, namely Aggregative and Average of relative. While the method of Weighted Aggregative include Laspeyres, Paasche, Marshall-Edgeworth, and Fisher [1].

Price index number are produced for a number of individual commodities. This price index number then can be calculated by using a Simple Aggregative method. This calculation method of price index number expressed a formula as the total of commodity price in a given year as percentage of total commodity in the base year. In this paper then called A Simple Aggregative Price Index Number with a base year (I_{BY}). A Simple Aggregative method also can be formulated as the total of commodity price under the old base in the new base year and called a Simple Aggregative Price Index Number with a given year (I_{GY}).

A certain stock can be reasoned as a commodity such that the stock price index number can be determined by using the Simple Aggregative method. This paper take a Microsoft stock for case. The calculation of the index are done for monthly Microsoft stock price data that use the Simple Aggregative with a base year and a given year. The calculation results of the price index numbers then are compared.

The calculation of the monthly Microsoft stock price data always result the price index numbers i.e down and up between the new year and the old year. Based on this condition so this paper link to construct a binary logistic regression model by using categories of the dependent variable 0 to be down and 1 to be up. The construction of binary logistic regression model use the analysis result of SPSS application.

THE SIMPLE AGGREGATIVE ON THE DATA CASE

This section effort to explore some formulas of calculating of index numbers, especially study the Simple Aggregative method and its application on case of the empirical data. As in the introduction it has been mentioned that there are several ways to calculate the number index. If P_n denote the commodity price in the current year, P_0 is the commodity price in the base year, Q_n is the quantity in the current year, and Q_0 is the quantity in the base year so formulas to calculate the number index as in the introduction is defined [1,3].

$$Laspeyres\ \text{Index} = \frac{\sum P_n Q_0}{\sum P_0 Q_0} \tag{1}$$

$$Paasche\ \text{Index} = \frac{\sum P_n Q_n}{\sum P_0 Q_n} \tag{2}$$

$$Marshall-Edgeworth\ \text{Index} = \sqrt{\frac{\sum P_n (Q_0 + Q_n)}{\sum P_0 (Q_0 + Q_n)}} \tag{3}$$

$$Fisher\ \text{Index} = \sqrt{\frac{\sum P_n Q_0}{\sum P_0 Q_0} \text{ x } \frac{\sum P_n Q_n}{\sum P_0 Q_n}} \tag{4}$$

The Simple Aggregative method has been proposed in the literature to calculate the price index number. It included the Simple Aggregative Price Index Number with a base year (I_{BY}) and a given year (I_{GY}). Equation (5) and equation (6) define the Simple Aggregative method of the price index numbers.

$$I_{BY} = \frac{\sum P_n}{\sum P_0} \text{ x } 100 \tag{5}$$

where

I_{BY} = Price Index Number with a base year

$\sum P_n$ = Sum of price for year n

$\sum P_0$ = Sum of price for the base year

$$I_{GY} = \frac{\sum P_n}{\sum P_{n-1}} \text{ x } 100 \tag{6}$$

where

I_{BY} = Price Index Number with a given year

$\sum P_n$ = Sum of price for year n

$\sum P_{n-1}$ = Sum of price for year n-1

In this section then presents the case of monthly Microsoft stock price data from 1986 until 2017 year. Those are taken from www.finance.yahoo.com. Table 1 presents the stock price and the calculation results of the price index number by using the Simple Aggregative with a base year and a given year.

Table 1. Stock Price and Price Index Number

Year	Stock Price	Price Index Number (a base year)	Price Index Number (a given year)
1986	1,21	100	100
1987	4,21	347,9339	347,9339
1988	4,6	380,1653	109,2637
1989	5,39	445,4545	117,1739
1990	10,57	873,5537	196,1039
1991	20,06	1657,851	189,7824
1992	30,03	2481,818	149,7009
1993	31,27	2584,298	104,1292
1994	39,42	3257,851	126,0633
1995	62,43	5159,504	158,3714
1996	92,39	7635,537	147,9897
1997	183,72	15183,47	198,8527
1998	303,66	25095,87	165,2841
1999	536,83	44366,12	176,7865
2000	437,72	36175,21	81,53792
2001	373,85	30896,69	85,40848
2002	321,94	26606,61	86,11475
2003	307,41	25405,79	95,48674
2004	324,97	26857,02	105,7122
2005	309,8	25603,31	95,33188
2006	317,37	26228,93	102,4435
2007	370,19	30594,21	116,643
2008	314,22	25968,6	84,88074
2009	278,05	22979,34	88,48896
2010	319,1	26371,9	114,7635
2011	313,69	25924,79	98,30461
2012	357,25	29524,79	113,8863
2013	395,87	32716,53	110,8104
2014	516,34	42672,73	130,4317
2015	561,51	46405,79	108,7481
2016	669,3	55314,05	119,1965
2017	876,57	72443,8	130,9682

ANALYSIS OF BINARY LOGISTIC REGRESSION

The Binary Logistic Regression model are generally written as follows:

$$\pi(x) = \frac{e^{\beta_0 + \beta_1 X}}{1 + e^{\beta_0 + \beta_1 X}} \quad (7)$$

with $\pi(x) = E(Y|x)$, i.e Y's expectation of x.

A logit transformation in the form $\pi(x)$ is defined

$$g(x) = \ln\left(\frac{\pi(x)}{1-\pi(x)}\right) = \beta_0 + \beta_1 X \quad (8)$$

Based on equation (8) refer that g (x) has properties of a linear regression [2]

In this section then analyzed to obtain equation in (7) or in (8) by using SPSS application for the price index number of monthly Microsoft stock price data. Table 2 refer the stock price data and its shifting is down or up.

Table 2. Stock Price and Shifting Down or Up

Year	Stock Price	Shifting Down or Up (a base year)	Shifting Down or Up (a given year)
1986	1,21		
1987	4,21	1	1
1988	4,6	1	0
1989	5,39	1	1
1990	10,57	1	1
1991	20,06	1	0
1992	30,03	1	0
1993	31,27	1	0
1994	39,42	1	1
1995	62,43	1	1
1996	92,39	1	0
1997	183,72	1	1
1998	303,66	1	0
1999	536,83	1	1
2000	437,72	0	0
2001	373,85	0	1
2002	321,94	0	1
2003	307,41	0	1
2004	324,97	1	1
2005	309,8	0	0
2006	317,37	1	1
2007	370,19	1	1
2008	314,22	0	0
2009	278,05	0	1
2010	319,1	1	1
2011	313,69	0	0
2012	357,25	1	1
2013	395,87	1	0
2014	516,34	1	1
2015	561,51	1	0
2016	669,3	1	1
2017	876,57	1	1

Based on data in table 2 is obtained the analysis results that the price index number of monthly Microsoft stock price calculated with a base year result P-value (significance) = 0,433 > 0,05. Other result of analysis is the

price index number of monthly Microsoft stock price calculated with a given year result P-value (significance) = 0,351 > 0,05.

CONCLUSION

The calculation of price index numbers for the monthly Microsoft stock price data result the values of a Simple Aggregative method with a base year greater than with a given year. This means that the year choosing as the base will determine the values of the price index numbers. The analysis of Binary Logistic Regression result that they are not fit for the data of the monthly Microsoft stock price index numbers. This means that the price index number of the monthly Microsoft stock price can not be used to measure the price's changes.

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