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Interval Regression Model for Family Income and Saving

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Abstract: Income and saving are important variables in the theory of economic growth. In this research paper interval regression is used to model the monthly family saving which depends upon income and various socio-economic factors. Results were compared with the ordinary least squares estimates. It is found that the interval regression model is more appropriate to deal with economic indicators that founds in intervals. The interval regression model pointed out that region of residence, family heads education, house owner status, family size, total dependency ratio, spouse participation in economic activities, having a conveyance, value of landholding, total household income, educational expenditures, medical expenditures and other liabilities have significant role for savings.

Key words: Bayesian Information Criterion · Coefficient of Determination · Dummy Variable · Household Savings · Interval regression · Variance Inflation Factor

INTRODUCTION

Interval regression is used to model outcomes that have interval censoring. In other words, you know the ordered category into which each observation falls, but you do not know the exact value of the observation. Interval regression is a generalization of censored regression. This method is appropriate when you know into what interval each observation of the outcome variable falls. You could analyze these data using OLS regression on the midpoints of the intervals. However, that analysis would not reflect our uncertainty concerning the nature of the exact values within each interval, nor would it deal adequately with the left- and right-censoring issues in the tails [1]. It is a common practice to use linear regression models to study the impact of difference co-factors on some dependent variable. Especially, in econometric the method of OLS is used to estimate such model. In the OLS method, observations of the dependent variable are strictly point-observations. Usually the mean values given specified values of the covariates [2]. In economics theory, the behavior of income, expenditure and saving have always been remained a hot issue. The economy of a country is mainly based on the individual's income and saving. Several studies have been done to check the effects of demographic and socio-economic factors on household savings. In most of the researches, the saving is taken as dependent variable and in form of point-observation data. The OLS method is employed to develop and analyze the relationship between savings and various demographic and socio-economic variables. No doubt, these studies have their own worth and significance but in-depth view there exists a dilemma of uncertainty. This uncertainty creeps in due to the fact that it is common practice that the obtained data about income or saving may not be point-observation data. i.e., the dependent variable has observations in interval, in this situation; the application of the OLS is bound to only one way to use average of the lower and upper limit values of each interval that may not reflect the uncertainty concerning the nature of the interval. Economics theory says that saving is that amount which we obtain by calculating the difference among the household's income and household's expenditure [3]. If this difference will be small there will less saving and as the difference get more

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and more the savings get increased. Saving may in form of agricultural land, real state, bank balance, jewelry, stock exchange shares and livestock or in any other shape or form. Income is obtained from various sources including earnings from farm production, crops, business profit, job, interest on savings etc. Consumption may be considered as aggregate of the amount that is consumed by household income and saving behavior remained evergreen topic for both economist and for statisticians. Economists try to investigate those socio-economic and demographic factors that affect the income and savings behavior while statisticians try to capture these factors in shape of model. With day by day changing climate of economic conditions the modeling techniques are becoming more and more complicated but sturdy. The present study is sequence of those studies that have done in order to check the behavior of savings of households by considering various demographic and socio-economic factors. As pointed out by [5], economics variables especially income, expenditure and savings are much fluctuating and are unpredictable in a sense that after a period of time the behavior of these variables got changed. So the worth of this study could not be ignored by saying that it based on an old idea with repeatedly considered variables. In this study the current income and savings observations are used by collecting primary data. The other attractive and new dimension of this study is that the savings observations are taken in interval format. By considering the fact that variable savings is not usually exhibiting the point-observation data, it's taken in real intervals in order to avoid uncertainty and imprecise information. After considering the dependent variables savings as interval based variable the OLS technique fails to tackle such situation so a new technique 'Interval Regression" is employed for modeling and estimation. In this study latest observations collected through primary data source and changed modeling technique Interval Regression (IR) is used. Interval regression (IR) deals with the situations where uncertain data exists and our dependent variable found in form of intervals. The IR analysis, firstly introduced and used by [6, 7] for real life situations where assessment usually have to make on the basis of partially available and/or imprecise existing data for which human estimation is dominant. The main objectives are to develop a model for monthly family saving depending on income and various socio-economic factors, using interval regression and to make comparison of the results of interval regression estimates with the OLS estimates.

MATERIALS AND METHOD

Tehsil Rawalpindi of Pakistan which was selected as study area, consists of 82 union councils including 36 rural and 46 urban. Two-stage sampling plan [8] was used to collect the data. At the first stage, union councils had been selected by using Stratified Random Sampling technique [9]. The two strata were rural and urban areas of tehsil Rawalpindi. 9 union councils are randomly selected from the rural and 11 from the urban areas. At the second stage, 1000 families were randomly selected from the 10 already selected union councils from the rural areas and 1000 families were randomly selected from the 10 already selected union councils from urban areas.

Source of Data: Keeping in view the objectives of the study a comprehensive questionnaire was developed. The questionnaire was pre-tested in the study area through pilot survey from 30 households in rural and 30 household in urban area. The questionnaire got amended in the light of shortcomings found and feedback received through this pilot study. In order to cover maximum aspects of demographic and socio-economic characteristics, a single questionnaire was used to collect required information. It was especially instructed in questionnaire to give savings in real interval form.

Parameters of Interest: Following [10] with some modifications, our study is based on the Life Cycle Hypothesis postulated by [11]. To model the Household Savings (Y) in the form of intervals, 19 parameters were observed and their significance were also quantified. These parameters are defined as:

X_1: Type of Residence (dummy variable)
=1; if household reside in Urban Area
=0; if household reside in Rural Area
X_2: Age of household head (continuous variable)
X_3: Square of Age in Completed years of age.
X_4: Completed years of education of household head (continuous variable).
X_5: Marital status of household head (dummy variable)
=1; if household head is married.
=0; if household head is un-married.
X_6: Type of employment (dummy variable)
=1; Self-employed or own business
=0; If salaried or daily waged person
X_7: Status of household residence (dummy variable)
=1; if the household owns a house.

=0; if the household does not own a house.

X_8: Family Size (discrete variable for total family members)

X_9: Ratio of total female members in household to total males.

X_{10}: It is Ratio of Total Dependents to Total Household Size.

X_{11}: A dummy variable about conveyance (other than bi-cycle); motorbike or car etc.

=1; if Yes

=0; if No

X_{12}: Amount/value of land that household own (if any) other than own house (continuous variable).

X_{13}: Amount/value of livestock (if any) in household (continuous variable).

X_{14}: Spouse participating in economic activity (discrete variable).

=1; if actively taking part in economic activity

=0; if actively not taking part in economic activity

X_{15}: Total Income of household from all sources (continuous variable)

X_{16}: Number of permanent diseased persons in household (discrete variable).

X_{17}: Monthly medical expenditures (continuous variable)

X_{18}: Monthly Education expenditures borne by household head (continuous variable).

X_{19}: Liabilities that a household head have to pay (continuous variable).

Interval Linear Regression Model: The general saving function is explained as below:

$$S = f(X) + \varepsilon, \tag{1}$$

Where S is monthly saving, X represents all the explanatory variables as defined above and ε is the random error.

[6] and [12] proposed an interval linear regression model which can be written as:

$$Y(x) = A_0 + A_1x_1 + A_2x_2 + ...A_nx_n = Ax \tag{2}$$

Where $x = (1, x_1, \ldots, x_n)^t$ is a real input vector, $A = (A_0, A_1, \ldots, A_n)$ is an interval coefficient vector and $Y(x)$ is the corresponding estimated interval. An interval coefficient A_i is denoted as $A_i = (a_i, c_i)$ where a_i is a center and c_i is a radius. Thus, an interval coefficient A_i can also be expressed as in (3)

$$A_i = \{u \mid a_i - c_i \le u \le a_i + c_i\} = [a_i - c_i, a_i + c_i] \tag{3}$$

$$Y(X_j) = (a_0, c_0) + (a_1, c_0)x_j + ...(a_n, c_n)x_{jn} = (a_0 + a_1x_{j1} + ...a_nx_{jn}, c_0 + c_1\left|x_{j1}\right| + ...c_n\left|x_{jn}\right|) = (a^{/}x_j, c^{/}\left|x_j\right|) \tag{4}$$

Whereas $a = (a_0,\ldots,a_n)^t$, $c = (c_0,\ldots,c_n)^t$ and $|x_j| = (1, |x_{j1}|,\ldots,|x_{jn}|)^t$. Here $a^t x_j$ and $c^t x_j$ represent a center and radius of the estimated interval $Y(x_j)$, respectively. In general by introducing the expert knowledge suggesting that the interval coefficient $A_i = (a_i, c_i)$ should be included in some interval $B_i = (b_i, d_i)$, the interval A_i can be estimated within the limit of that knowledge B_i. Then, the inclusion relation between these two intervals can be defined by the following inequalities:

$$A_i \subseteq B_i \leftrightarrow \begin{matrix} a_i - c_i \ge b_i - d_i \\ a_i + c_i \le b_i + d_i \end{matrix} \tag{5}$$

Since A_i is constrained by the expert knowledge B_i, the obtained interval linear regression model would be acceptable

RESULTS AND DISCUSSION

The data compiled, analyzed and the results are interpreted by using both interval regression model and simple linear regression model.

Interval Regression Model: Interval Regression model is given as:

$$s_{\text{int}} = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 .....\beta_{19}X_{19} + \varepsilon \tag{6}$$

Where S_{int} is continuous variable measured in interval form. The explanatory variables for different demographic and socio-economic factors used in above model have been defined earlier. Every respondent was asked to tell savings in real interval form that best represents his/her average monthly savings. On the basis of the survey results following model as given (7) is obtain for household saving in interval form.

$$\begin{aligned} S_{\text{int}} = {} & -2628.04 - 1164.58X_1 + 36.76X_2 - 0.24074X_3 - \\ & 40.12X_4 + 37.86X_5 + 76.35X_5 + 753.93X_7 - 410.28X_8 - \\ & 47.33X_9 - 1815.64X_{10} + 426.15X_{11} + 668.89X_{12} - \\ & 0.00017X_{13} - 0.00050X_{14} + 0.36190X_{15} - 0.35321X_{16} \\ & +113.89X_{17} - 0.28097X_{18} - 0.26730X_{19} \end{aligned} \tag{7}$$

Along with the coefficient of variables standard error, z-statistic, p-values and interval of confidence, which emphasis relative importance of the variables included the model [13, 14] are given in Table 1.

Table 1: Interval regression model's coefficients and their test of significance

Variables	Coefficient	Std. Err.	Z	P>|z|	95% Coefficient Interval	
X_1	-1164.58	112.43	-10.36	0.000	-1384.74	-944.00
X_2	36.76	46.49	0.79	0.429	-54.36	127.89
X_3	-.24074	.51522	-0.47	0.640	-1.25	.76907
X_4	-40.12	274.41	-0.15	0.884	-677.96	497.72
X_5	37.86	15.83	2.39	0.017	6.83	68.88
X_6	76.35	104.51	0.73	0.465	-128.48	281.18
X_7	753.93	119.52	6.31	0.000	519.68	988.18
X_8	-410.28	49.48	-8.29	0.000	-507.25	-313.31
X_9	-47.33	328.28	-0.14	0.885	-690.74	596.09
X_{10}	-1815.64	757.32	-2.40	0.017	-3299.96	-331.33
X_{11}	426.15	210.32	2.03	0.043	13.93	838.38
X_{12}	668.89	98.12	6.82	0.000	476.58	861.19
X_{13}	-.00017	.00004	-3.97	0.000	-.00025	-.00008
X_{14}	-.00050	.00029	-1.73	0.084	-.00107	.00007
X_{15}	.36190	.00852	42.48	0.000	.34520	.37859
X_{16}	-.35321	.02326	-15.18	0.000	-.39881	-30761
X_{17}	113.89	173.10	0.66	0.5111	-225.38	453.16
X_{18}	-.28097	.03758	-7.48	0.000	-.35462	-.20732
X_{19}	-.26730	.02591	-10.32	0.000	-.31808	-.21653
A	-2628.04	915.91	-2.87	0.004	-4423.19	-832.90

It is clear from the table marital status, profession of household head, livestock value, number of permanently diseased person in household and female ratio to male in household have no significant effects on savings. However, the region of residence, age of household head, education of household, ownership of house, family size, spouse participation in economic activities, personal convince, income of household, educational expenditures, medical expenditures, total dependent ratio in household and liabilities to be paid by the household head have significant role in savings of household.

Table 1 show that the type of residence (X_1) to be significant factor and contains negative sign that reflects decrease in saving level when people move from rural to urban areas. Their saving decrease because there is low consumption, in rural areas while in posh or urban areas there is more consumption. The above mentioned statement is true to the city like Rawalpindi/Islamabad because here living standard and expenses are more as compared to the other cities of Pakistan.

The study also discloses that there is positive but non-significant relationship among the completed year of age of household (X_2) and household savings. Similarly, the square of completed year of age of household (X_3) has non-significant relationship with household saving but the sign relationship is negative here. The positive sign for completed years of age of household shows linear relationship with saving while negative sign for squared of age showing its non linear relationship with savings. As ageo of the household (X_2) increases by one year, his saving increases by 36.76 rupees on the average per month. However at some stage this increase in saving along with increase in age starts declining as the square of age (X_3) behavior shows. As the household head become old, he gets more and more experienced and his earning increases. As in case of government employee its fact that along with increase in age, the employee get more salary due to avail of annual increment and other allowances. But normally at the age of 60 years when he gets retired his earning gets reduced. So decrease in earning also reduces the savings. In countries like Pakistan, where, there is joint children get married and they start living separately so the earning and savings of household decreases.

In this study marital status (X_4) has negative sign but insignificant effect. This confirms that married people less likely to be able to save more than unmarried people. Married people save approximately 40 rupees less per month on the average then unmarried people. This is insignificant value so can be ignored.

There exist a positive relationship between education of household head (X_5) and his savings. The relationship is statistically significant and positive sign demonstrate that there is linear relationship between these two factors. As the education of household head increases his saving also increases. Increase in one step of education increase 37.86 rupees of savings. Educated people become more conscious and aware of about the economic

crises that griping the whole world rapidly. They make proper monthly budget and spend with great care. So the saving in educated people is increasing.

Type of employment (X_6) shows positive but non-significant relationship with household savings. People those who are self-employed or running own business save more than salaried or daily waged people but this difference is not a big difference and is ignorable. Peoples running their own business save 76.35 rupees more than salaried or daily waged people. The main reason of this difference is due to limited income of salaried or daily waged persons. As the businessman or self-employed person usually earn more and increase in prices not directly hit these people as they also increase the rate of their commodities while the rise in prices directly hit the salaried people and their purchasing power gets trim down. House owner status (X_7) is an important factor that has a significant relationship with household savings and the relationship is positive. It's clear from the results that if household head have own house he will save 753.93 rupees more than those who have not their own house and residing in rented house. The study reveals that mostly people who living in rural areas has their own house while in urban area 46% of residence don't have their own houses. A large amount of income spent on house rent reduces the household savings.

Family size (X_8) and household savings are highly associated with each other and the nature of this association is negative. As the family size increase the savings of household decreases. From results as given in Table 1 it can be seen that increase of one family member reduces the household savings about 410.28 rupees on the average. Survey shows that about 79.2% households have only one earning person. So it's evident that large family size will put huge financial burden on household head as a result the financial budget of household will collapse and the savings will be diminished.

The female to male ratio (X_9) have negative but insignificant relationship with household savings. As in our country the female not much contribute in earning especially in most of the families the household not allow the female members to work so they not actively participate in earning as a result they become inactive family member and the household having more family members show less savings. One point rise in female to male ratio reduces the savings about 47.33 rupees on the average.

Total dependency rate (X_{10}) is negatively associated with household savings. The relationship is significant in nature. Most of the families have less earning members and more dependents so a lot of income get spend on dependents educational, marriages and monthly expenses. From table 10, it is clear that increase in one point in total dependency ratio decrease the savings to 1815.64 rupees.

Spouse participation in economic activity (X_{14}) is also positively associated with household saving and has significant association. The p-value is not very high it means the relationship is significant but not highly significant in this case. The results can be interpreted as if spouse actively participate in economic activity then the saving will be increased by 426.15 rupees per month on the average. In past if was not think better to allow wife or female member of family to work to participate in any economic or earning activity. The female was assumed to stay at home and look after the child and kitchen matter. But now as the inflation rises it become difficult for household head to individually run the household economy smoothly so now there is change in attitude and thinking. Now spouses (especially wives) also started active participation in earning by doing job or some kind of own work like clinic, boutique, etc. Now even in marriage, the grooms parents prefer bride that is working woman or have own business.

Conveyance (X_{12}) and household savings also has positive and significant association with each other. The household having conveyance saves 668.89 rupees more than those who don't have such facility. Now a day's increase in fuel charges enhances the transport rents and eventually a lot of earnings spent on travelling. So own conveyance reduces the expenditures and increases the savings of household.

In this study it is found that value of landholding (X_{12}) is significant but negatively related with household savings. Increase in value of land owned by the household head decrease the saving. In depth study shows that the value is significant in case of rural area as given in table 10 but not significant in case of urban area. The reason is as in rural areas the people involved in agriculture and have agricultural land. Rawalpindi is a barani area and the agriculture in this area depends much on rain fall. A farmer having reasonable piece of land spend much on that land in cultivation, sowing and pre-sowing season but if rain not fall according to expectation then he goes in loss and even can't earn that

amount which he spent on the fertilizer, seed, sowing etc. So the relationship among value of land and savings is negative here.

Value of livestock (X_{13}) and household savings are also negatively related and the relationship is insignificant in nature. The coefficient value is small i.e., -0.00050. This showing increase in 10 thousand in value of livestock decreases the saving to 5 rupees on the average.

There is positive and statistically significant relationship between total income (X_{15}) and savings of households. Keynesian theory of consumption [15] also supports this statement according to which there is positive relationship between income and savings. The results as given in Table 10 also matches with Keynesian theory of income and savings. According to these results increase in 1 unit of income increases the saving by 0.3 units. As the income of household increases the saving also gets increased. Similar positive results are found by [10, 16, 17, 18, 12, 19, 20, 21] with varying Marginal Propensity to Save (MPS) values 0.63, 0.94, 0.886, 0.803, 0.22, 0.0572, 0.0078 etc. respectively.

Educational expenditures (X_{18}) of household reduce saving level of household. The relationship between these two factors is negative and statistically significant. Results depicting that increase in monthly children's educational expenditures of one rupee are associated with a decrease of saving by 0.35 rupees. In present age, the household head have to spend much on children education like books, tuition fees, monthly stationary etc. from their income. These expenditures reduce the household savings.

Number of permanently diseased person in household (X_{16}) depicts positive but insignificant relation with household savings. The result is very interesting as it is expected that more patient will reduce the savings of household but result is against the expectations. The reason may that there are 89.7% families in which there is no permanently diseased patient while only 10.3% families in which there is 1 or 2 permanently diseased patients. In Pakistan many departments provides free medical facility to their employees and their families so it is possible that these permanently diseased people are getting benefit of this facility due to which they exert no negative impact on household savings. There are many public supporting departments like Bait ul Maal, NGOs, Government Hospitals that provide free medical facilities of specific diseased persons so due to their support the family get rid of huge expenses. The relationship between number of permanently diseased person and savings is statistically insignificant so can be ignored.

There exists an inverse but significant relationship among household monthly medical expenditures (X_{17}) and savings. Increase in medical expenditure reduces the household saving. Prices of medicines are increasing day by day. Consultancy fee of medical specialist has been increased so the household head have to spend a reasonable amount on his family monthly medical expenditures. Increase of 1 rupee reduces the monthly savings about 0.28 rupees (28 paisa) on the average.

Results show that there is significant inverse relationship between liabilities (X_{19}) and household above the savings will be -2628.04. The negative sign show that in actual it is not savings but its consumption. In more depth, we can say that by keep all other variables constant, if a household earn nothing even then said household will spent an amount of rupees 2628.04 as minimum monthly expenditure.

Simple Linear Regression Model: The simple linear regression model is given as:

$$s_{OLS} = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 ..... \beta_{19} X_{19} + \varepsilon \quad (8)$$

where S_{OLS} is saving measured by taking average of maximum and minimum limit of saving, which can by estimated by above ordinary least squares regression model. The explanatory variables for different demographic and socio-economic factors used in above model have been explained earlier.

On the basis of the survey results following model (9) is obtained for the household savings

$$\begin{aligned} S_{OLS} = & -2883.55 - 1169 X_1 + 47.69 X_2 - 0.35805 X_3 - \\ & 62.49 X_4 + 39.63 X_5 + 81.02 X_6 + 773.01 X_7 - 405.47 X_8 \\ & + 49.90 X_9 - 1934.70 X_{10} + 402.39 X_{11} + 656.46 X_{12} - \\ & 0.00017 X_{13} - 0.00054 X_{14} + 0.36451 X_{15} - 0.34936 X_{16} \\ & + 108.26 X_{17} - 0.28775 X_{18} - 0.26683 X_{19} \end{aligned} \quad (9)$$

The coefficients along with standard error, t-statistic, p-values and confidence intervals are given in Table 2.

The comparison of IR and OLS regression model is Given in the Table 3.

And the Table 4 present results of regression diagnostic results.

Table 2: Determinants of OLS model along with t and probability values

Variables	Coef.	Std.Err	T	P>|t|	[95% Conf. Interval]	
X_1	-1169.13	117.46	-9.95	0.000	-1399.50	-938.77
X_2	47.19	48.54	0.97	0.331	-48.00	142.39
X_3	-0.35805	0.53784	-0.67	0.506	-1.41	0.69675
X_4	-62.49	287.12	-0.22	0.828	-625.58	500.60
X_5	39.63	16.55	2.39	0.017	7.17	72.09
X_6	81.02	109.23	0.74	0.458	-133.20	295.25
X_7	773.01	124.98	6.19	0.000	527.90	1018.12
X_8	-405.47	51.63	-7.85	0.000	-506.72	-304.21
X_9	49.90	343.23	0.15	0.884	-623.23	723.04
X_{10}	-1934.70	786.86	-2.46	0.014	-3477.86	-391.53
X_{11}	402.39	218.37	1.84	0.066	-25.86	830.65
X_{12}	656.46	102.57	6.40	0.000	455.30	857.63
X_{13}	-0.00017	0.00004	-3.83	0.000	-0.00026	-0.00008
X_{14}	-0.00054	0.00030	-1.77	0.077	-0.00113	0.00006
X_{15}	.36451	.00880	41.42	0.000	.34725	0.38177
X_{16}	-0.34936	.02416	-14.46	0.000	-0.39675	-0.30197
X_{17}	108.26	180.82	0.60	0.549	-246.35	462.87
X_{18}	-0.28775	0.03917	-7.35	0.000	-0.36458	-0.21093
X_{19}	-0.26683	0.02686	-9.93	0.000	-0.31950	-0.21415
A	-2883.55	955.96	-3.02	0.003	-4758.35	-1008.76

Table 3: Comparison IR and OLS regression model

	Coefficients for interval regression mode		Coefficients for OLS regression model	
Variables	Coef.	P>|z|	Coef.	P>|t|
X_1	-1164.58	0.000	-1169.13	0.000
X_2	36.76	0.429	47.19	0.331
X_3	-.24074	0.640	-.35805	0.506
X_4	-40.12	0.884	-62.49	0.828
X_5	37.86	0.017	39.63	0.017
X_6	76.35	0.465	81.02	0.458
X_7	753.93	0.000	773.01	0.000
X_8	-410.28	0.000	-405.47	0.000
X_9	-47.33	0.885	49.90	0.884
X_{10}	-1815.64	0.017	-1934.70	0.014
X_{11}	426.15	0.043	402.39	0.066
X_{12}	668.89	0.000	656.46	0.000
X_{13}	-.00017	0.000	-.00017	0.000
X_{14}	-.00050	0.084	-.00054	0.077
X_{15}	.36190	0.000	.36451	0.000
X_{16}	-.35321	0.000	-.34936	0.000
X_{17}	113.89	0.5111	108.26	0.549
X_{18}	-.28097	0.000	-.28775	0.000
X_{19}	-.26730	0.000	-.26683	0.000
A	-2628.04	0.004	-2883.55	0.003

Table 4: Regression diagnostics (information criteria IC)

Model	Log Likelihood ratio with constant	Log Likelihood ratio without constant	Akaike Information Criterion	Bayesian Information Criterion
OLS	-19164.91	-18013.96	36067.93	36179.95
Interval regression	-10439.86	-9255.696	18553.39	18671.01

CONCLUSION

Household savings play a leading role in the economic growth and stability of any country. Economic growth requires investment and it can be financed through domestic savings or from abroad through foreign capital inflows. However, in the long run a nation has to rely on household savings. Usually household savings is estimated by using OLS model but in many situations savings data is exists in hiatus form so it become difficult to deal such data. Taking data of savings in interval form, Interval regression model was fitted for this study and it was found that:

- Interval regression model is an appropriate alternate of OLS model specifically in those conditions where dependent variable exists in interval form.
- Interval regression model for savings disclosed that region of residence is an important factor in household savings. In model it contains negative sign showing decrease in saving level when people move from rural to urban area.
- Age of household had positive but insignificant role. Similarly, amount of livestock and number of permanent diseased person in household had positive but insignificant role in IR model for savings.
- Education of household head had positive and significant role. Similarly, Income, conveyance, ownership of home and asset had positive and highly significant role in model.
- Family size, total dependent ratio, educational expenditure of children, medical expenditure and liabilities had significant but negative role in IR model for savings.

Policy makers and financial experts may utilize the IR model with full confidence and self-assurance in situations where data is available in interval form. Interval regression is technique through which reliable results can be determined without converting the interval data in average form. IR model is indispensible for those situations where people avoid providing information in point data likewise income, savings, age etc. Research scholars can employ IR modeling for estimation and forecasting where data is available in hiatus format and no other modeling technique is applicable for such situations.

REFRENCES

1. Stewart, M.B., 1983. On least squares estimation when the dependent variable is grouped. Review of Economic Studies, 50: 737-753.
2. Pavelescu and F. Marius, 2004. Orienterpretare a metodologiei standard de estimare a parametrilor modelului de regresie liniara, Working Papers of Macroeconomic Moedling Seminar 040401, Institute of Economic Forecasting.
3. Beverly, S. and M. Sherraden, 1999. Institutional determinants of savings: Implications for lowincome households. Journal of Socio-Economics, 28: 457-473.
4. Lorek, S., Spangenberg and H. Joachim, 2001. Indicators for environmentally sustainable household consumption. Int. J. Sustainable Development, 4(1): 101-120.
5. Deaton, A. and C. Paxson, 1989. Saving in Developing Countries: Theory and Review. World Bank Economic Review, Proceedings of the World Bank Annual Conference on Development Economics, pp: 61-69.
6. Ishibuchi, H. and H. Tanaka, 1989. Formulation and analysis of linear programming problem with interval coefficients (in Japanese). Journal of the Japan Industrial Management Association, 40: 320-329.
7. Ishibuchi, H. and H. Tanaka, 1990. Multiobjective programming in Optimization of the interval objective function, European Journal of Operation Research, 48: 219-225.
8. Sukhatme, B.V. and R.S. Koshal, 1959. A Contribution to Double Sampling, journal of Indian Socio Agri. Stat., 11: 128-144.
9. Ghosh, S.P., 1958. A Note on Stratified Random sampling with Multiple Characteristics, Calcutta Statistical Association Bulletin, 8: 81-89.
10. Rehman, H., M.Z. Faridi and F. Bashir, 2010. Households saving behavior in Pakistan: A case of Multan district. Pakistan Journal of Social Sciences, 30(1): 17-29.
11. Ando, A. and F. Modigliani, 1963. The 'life-cycle' hypothesis of saving: aggregate implications and tests. American Economic Review, 53(1): 55-84.
12. Tanaka, H. and H. Lee, 1998. Interval regression analysis by quadratic programming approach. IEEE Transactions on Fuzzy Systems, 6(4): 473-481.

13. Schervish, M.J., 1996. P Values: What They Are and What They Are Not, The American Statistician, 50(3).
14. Gurland, J. And R.C. Tripathi, 1971. A simple approximation for unbiased estimation of the standard deviation. American Statistician American Statistical Association, 25(4): 30-32.
15. Sheffrin, S.M., D.A. Wilton and D.M. Prescott, 1988. Macroeconomics: Theory and Policy, Cincinnati, OH: South Westren Publisher Co., pp: 56-61.
16. Khalek, T.A., F. Arestoff, N.E. De-Freitas and S. Mage, 2009. A macro-econometric analysis of households saving determinants in Morocco, pp: 1-18.
17. Sajid, G.M. and M. Sarfraz, 2008. Savings and economic growth in Pakistan: An issue of casuality. Pakistan Economic and Social Review, 46(1): 17-36.
18. Fasoranti, M.M., 2007. The influence of rural savings mobilization on economic development of the rural areas: A study of Akoko region in Ondo state in Nigeria. J. International Business Mgt., 1(2): 20-23.
19. Brata, A.G., 1999. Household saving behavior: The case of rural industry in Bantul. Analysis CSIS, 28(1): 75-86.
20. Burney, N.A. and A.H. Khan, 1992. Socioeconomic characteristics and household savings: An analysis of the households' saving behavior in Pakistan. The Pakistan Development Review, 31(1): 31-48.
21. Bautista, R.M. and M.B. Lamberte, 1990. Comparative saving behavior of rural and urban households in the Philippines. J. of Philippines Development, 17(2): 149-181.
22. Dunning, T., 1993. Accurate Methods for the Statistics of Surprise and Coincidence, Computational Linguistics, 19(1): 61-74.
23. Burnharm, K.P. and D.R. Anderson, 2004. Multimodel Inference: Understanding AIC and BIC in Model Selection, 33: 261-304.
24. Hirose, K., S. Kawano, S. Konishi and M. Ichikawa, 2011. Bayesian Information Criterion and Selection of the Number of factors in Factor Analysis Models, 9: 243-259.