

# U-Shaped Pattern of Employees' Job Satisfaction: Polynomial Model Approach

Md. Rafiqul Islam<sup>1,\*</sup>, Md. Sabbir Hossain<sup>2</sup>, Omar Faroque<sup>3</sup>

<sup>1</sup>Department of Population Science and Human Resource Development, University of Rajshahi, Rajshahi-6205, Bangladesh

<sup>2</sup>Department of Business Administration, Bangladesh Islami University, Dhaka-1203, Bangladesh

<sup>3</sup>Department of Management, Bangabandhu Sheikh Mujibur Rahman Science & Technology University, Gopalganj-8100, Bangladesh

---

**Abstract** Employee productivity, organizational citizenship, employee loyalty, efficiency etc. totally depend on job satisfaction. Job satisfaction is an important indicator of how employees adjust about their jobs. The purpose of this study is to fit some mathematical models to percentages of employees' job satisfaction (PEJS) for men, women and both sexes. For this, the secondary data are used. Quasi Newton Method is employed to fit these mathematical models using the software STATISTICA. Moreover, t-test, F-test and cross validity prediction power (CVPP) are used to check the accuracy as well as validation of the model. In this study, it is seen that these PEJS for men, women and both sexes are showing U-shaped pattern in accordance with age. It is also found that PEJS is increasing with age after age 30 years. And it is seen that the PEJS for women is comparatively higher than that of men at every age group. Furthermore, it is found that PEJS for men, women and both sexes follow second degree polynomial models. These models are well fitted in accordance with t-test, F-test and CVPP. The stabilities of these models are more than 96.9%.

**Keywords** Percentage of Employees' Job Satisfaction (PEJS), Polynomial Model, t-test, F-test, Cross Validity Prediction Power (CVPP)

---

## 1. Introduction

Employee productivity, organizational citizenship, employee loyalty, efficiency etc. depend on job satisfaction. Job satisfaction is an important indicator of how employees feel about their jobs and a predictor of work behaviors such as organizational citizenship (Organ & Ryan, 1995); and withdrawn behaviors such as absenteeism (Wegge et al., 2007) and turnover (Saari & Judge, 2004). Job satisfaction made optimistic contributions to the organizational effectiveness and continuous performance (Sinha, 2013) and it increases employee job involvement, organizational commitment and effective job performance (Davis & Newstrom, 2006). Job satisfaction plays an important role to reduce negative behaviors at the organization such as frequent absence, indiscipline in performance and high turnover (Anitha, 2011; Rego & Cunha; 2008; Davis & Newstrom, 2006; Spector, 1997). Job satisfaction among the employees shapes genial and supportive working environment in the organizational level. Satisfied employees work more hours with better efficiency compared to unsatisfied employees (Sohail & Delin, 2013) and unsatisfied employees always try to switch their organization

or profession (Smith, 2007). Job satisfaction is used to measure the intentions of employees towards their work (Sweeney et al., 2002). Actually, job satisfaction is a factor which induces employees to work in the term (Mudor & Tooksoon, 2011).

Job satisfaction is a set of favorable or unfavorable feelings and emotions with which employees view their work and an effective attitude as a feeling of relative like or dislike toward something (Davis & Newstrom, 2006); an effective or emotional response by an employee concerning his or her particular job (Cranny et al., 1992); individual's cognitive, affective and evaluative reactions towards job (Greenberg & Baron, 1997); and a collection of feelings that an individual holds toward his or her jobs (Robbins, 2005). In fact, it is 'the extent to which people like their jobs' (Ellickson & Logsdon, 2002; Spector, 2000); a pleasurable or positive emotional state resulting from the evaluation of one's job experience (Locke, 1976); how an employee pleased is with his or her job (Victoria, 2010). Job satisfaction is the combination of 'positive or negative' feelings of workers about their job (Brikend, 2011) and 'cognitive and affective reactions to the differential perceptions of what an employee wants to receive compared to what he or she actually receives (Weiss, 2002).

Thus, it is investigated that a number of research on job satisfaction has been done but mathematical modeling is nonexistent in this area. For that, in this paper, an attention is concentrated to observe the pattern of the percentages of

---

\* Corresponding author:

rafique\_pops@yahoo.com (Md. Rafiqul Islam)

Published online at <http://journal.sapub.org/ije>

Copyright © 2014 Scientific & Academic Publishing. All Rights Reserved

employees' job satisfaction (PEJS) using some mathematical models. To do so, a polynomial model is considered to study the pattern of PEJS for men, women and both sexes. It is mentioned that polynomial model was used in several studies (Islam and Ali, 2004; Islam, 2004a; 2004b; 2005a; 2005b; 2007a and 2011; Islam et al., 2004; Islam and Sabbir, 2014a and 2014b).

Thus, the fundamental objectives of this study are addressed below:

- i) to study the pattern of the PEJS for men, women and both sexes,
- ii) to fit some mathematical models to PEJS for men, women and both sexes, and
- iii) to employ t-test, F-test and cross validity prediction power (CVPP) to check the accuracy as well as validation of the model.

## 2. Data and Data Source

The data are used in this paper taken from the paper of Clark et al. (1996) which are drawn from the British Household Panel Study funded by the Economic and Social Research Council. Information was obtained through interviews from the 5192 employees from a respondent's home covering household composition, finances, personal and family backgrounds, employment characteristics, history and attitudes, and feelings of happiness and general mental health. The percentages of employees' job satisfaction (PEJS) for men, women and both sexes by ages are presented in Table 1.

**Table 1.** Percentage of Employees' Job Satisfaction by Age in Years for Men, Women and Both Sexes

Age in years (X)	Age in years for model fitting (X)	Men (Y)	Women (Y)	Total (both sexes) (Y)
16-19	1	58.59	59.63	59.06
20-29	2	49.61	58.41	53.88
30-39	3	48.56	64.47	55.94
40-49	4	51.31	65.43	58.59
50-59	5	58.68	73.88	65.94
60+	6	70.47	81.99	75.52

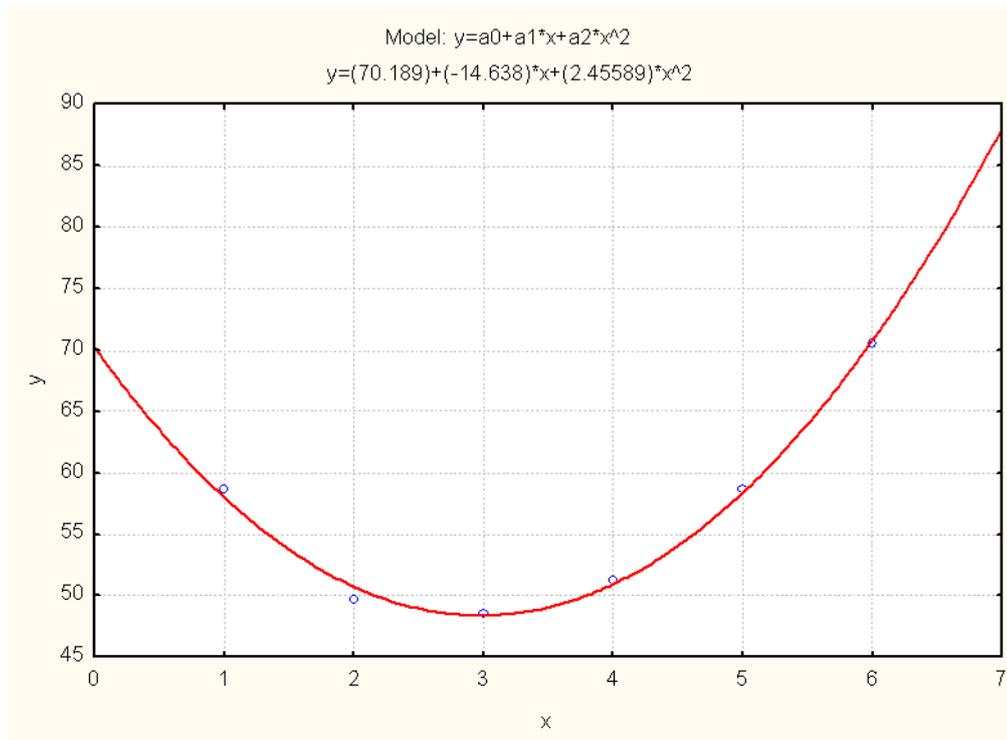
## 3. Methods and Methodological Issues

### 3.1. Model Fitting

Using the scattered plots (Fig.1-Fig.3) of PEJS by age, these seem that the data can be fitted by polynomial models with respect to different ages in years. Therefore, an nth degree polynomial model is considered and the form of the model is

$$y = a_0 + \sum_{i=1}^n a_i x^i + u$$

where, x indicates age group; y is PEJS;  $a_0$  is the constant;  $a_i$  is the coefficient of  $x^i$  ( $i = 1, 2, 3, \dots, n$ ) and u is the disturbance term of the model. Here, a suitable n is found for which the error sum of square is minimum.



**Figure 1.** Observed and Fitted PEJS for Men. X: Age in Years and Y: PEJS

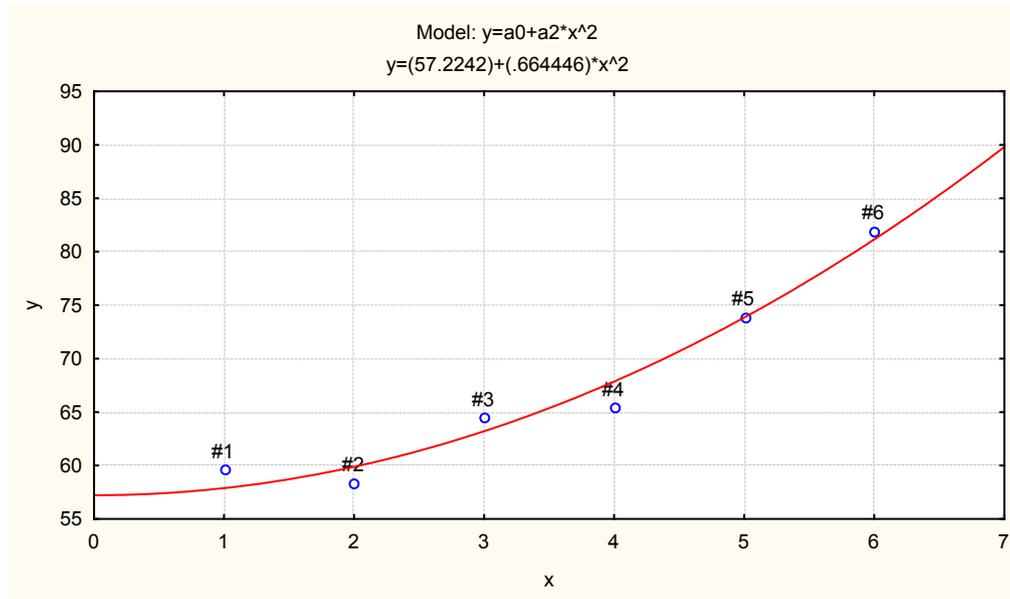


Figure 2. Observed and Fitted PEJS for Women. X: Age in Years and Y: PEJS

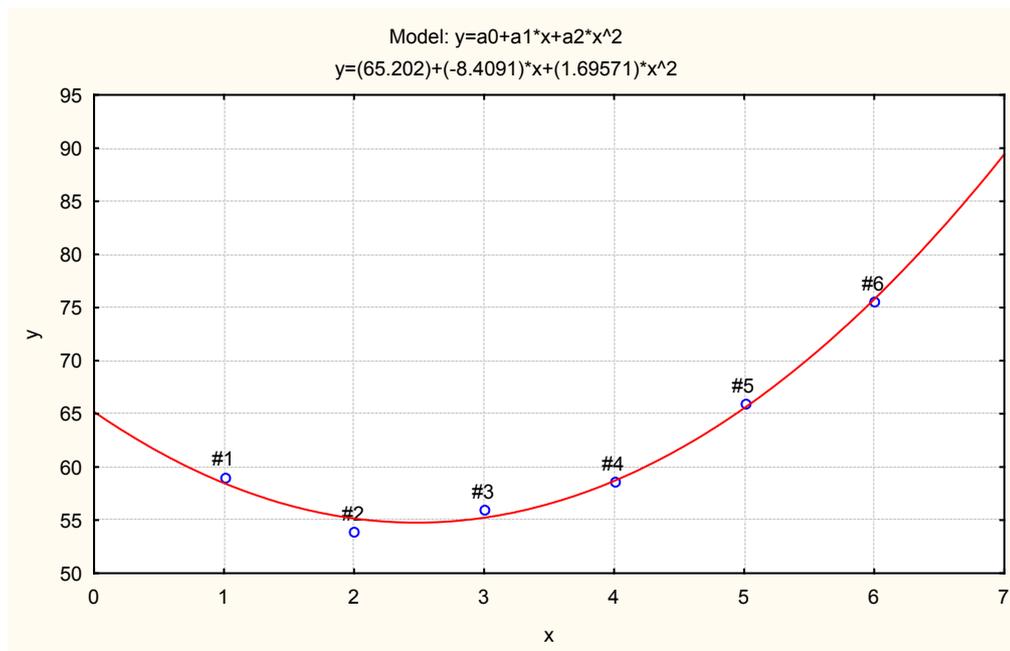


Figure 3. Observed and Fitted PEJS for Both Sexes. X: Age in Years and Y: PEJS

The software STATISTICA was used to fit these mathematical models to PEJS.

### 3.2. Model Validation Technique

To check how much these models are stable over population, the cross validity prediction power (CVPP),  $\rho_{cv}^2$ , is applied. Here

$$\rho_{cv}^2 = 1 - \frac{(n-1)(n-2)(n+1)}{n(n-k-1)(n-k-2)} (1 - R^2)$$

(Stevens, 1996)

where, n is the number of cases, k is the number of predictors in the model and the cross validated R is the correlation

between observed and predicted values of the dependent variable. The shrinkage coefficient of the model is the positive value of  $(\rho_{cv}^2 - R^2)$ ; where  $\rho_{cv}^2$  is CVPP and  $R^2$  is the coefficient of determination of the model. 1-shrinkage is the stability of  $R^2$  of the model. The information on model fittings and estimated CVPP have been demonstrated in Table 2. This technique is also used as model validation technique (Islam, 2007b; 2008; 2012a; 2012b; 2013; Islam & Hossain, 2013a; 2013b; Hossain & Islam, 2013; Islam *et al.*, 2013).

### 3.3. F-test

To verify the measure of overall significance of the model as well as the significance of  $R^2$ , the F-test is employed here.

The formula for F-test is given below:

$$F = \frac{R^2 / (k - 1)}{(1 - R^2) / (n - k)}$$

where k = the number of parameters is to be estimated, n = the number of cases and R<sup>2</sup> is the coefficient of determination of the model (Gujarati, 1998). These estimates are shown in Table 3.

### 4. Results and Discussion

Employee satisfaction is typically measured using an employee satisfaction survey. These surveys address topics such as compensation, workload, perceptions of management, flexibility, teamwork, resources, etc. The PEJS by age and sex is presented in Table 1. It is observed that job satisfaction is very high for the people age above 60 years. And it is investigated that the PEJS for women is comparatively higher than that of men at each cases. The modeling approaches for the percentages of employees' job satisfaction (PEJS) for men, women and both sexes are discussed below.

The polynomial model is constructed for PEJS for men and the fitted equation is as follows:

$$y = 70.189 - 14.638x + 2.4558x^2 \tag{1}$$

t-stat (48.5668) (-15.4820) (18.5739)  
 P-value (0.00001) (0.00058) (0.00034)

And, another polynomial model is constructed for PEJS

for women and the fitted equation is

$$y = 57.2242 + 0.664446x^2 \tag{2}$$

t-stat (48.02869) (10.85914)  
 P-value (0.0000) (0.0004)

In which the term containing x is excluded from the model because of the insignificant of the parameter.

Moreover, another polynomial model is fitted for PEJS for both sexes and the fitted equation is given below:

$$y = 65.202 - 8.4091x + 1.69571x^2 \tag{3}$$

t-stat (38.3069) (-7.5516) (10.8891)  
 P-value (0.0000) (0.0048) (0.0016)

The estimated CVPP,  $\rho_{cv}^2$  corresponding to their R<sup>2</sup> are shown in Table 2. The observed and fitted values are depicted in Figure 1 to Figure 3. In this table, all fitted models from equation (1) to equation (3) are highly cross validated and their shrinkage's are very small. Moreover, it is observed that all the parameters of the fitted models are statistically significant in terms of t-test with large proportion of variation explained and their proportion of variation are more than 99%, 96% and 99% respectively. And the stabilities of these models are more than 97%, 93% and 96% respectively. The stabilities of R<sup>2</sup> of these models are also more than 96.9%. The calculated values of F-statistic of the models (1) to (3) and their corresponding tabulated values at 1% level of significance are shown in Table 3. Therefore, from these statistics it is concluded that all these constructed models are highly statistically significant. Hence, the fits of all these models are well.

**Table 2.** Information on Model Fittings and Estimated CVPP of the Predicted Equations of PEJS

Models	n	k	R <sup>2</sup>	$\rho_{cv}^2$	Shrinkage	Variance explained (%)
Equation 1	6	2	0.99426128	0.977683	0.01657852	99.42
Equation 2	6	1	0.96719184	0.936206	0.03098548	96.71
Equation 3	6	2	0.99150365	0.966959	0.02454501	99.15

**Table 3.** Information on Model Fittings and Calculated Tab. F of the Predicted Equations of PEJS

Models	n	k	Cal. F	Tab.F (at 1% level)
Equation 1	6	3	9852.573	30.82 with (2,3) d.f.
Equation 2	6	2	4115.001	21.20 with (1,4) d.f.
Equation 3	6	3	8468.855	30.82 with (2,3) d.f.

### 5. Conclusions

In this study, it is found that job satisfaction is U-shaped for men, women and both sexes. It is also observed that job satisfaction is increasing after age 30 years. And it is seen that the PEJS for women is comparatively upper than that of men at every age group. Also it is investigated that PEJS for men, women and both sexes follow quadratic polynomial models with explaining large proportion of variance. The stabilities of these models are more than 93%. Moreover, the stabilities of R<sup>2</sup> of these models are more than 96.9%. It is found that the overall significance of these models is very high due to F-statistics.

---

## REFERENCES

- [1] Anitha, R. (2011). A study on job satisfaction of paper mill employees with special reference to Udumalpet and Palani Taluk. *Journal of Management and Science*, 1(1), 36-47.
- [2] Brikend, A. (2011). Job Satisfaction. *Management Research and Practice*, 3(4), 77-86.
- [3] Clark, A. E. (1997). Job satisfaction and gender: Why are women so happy at work? *Labor Economics*, 4(4), 341-472.
- [4] Clark, A., Oswald, A. & Warr, P. (1996). Is job satisfaction U-shaped in age? *Journal of Occupational and Organizational Psychology*, 69(1), 57-81.
- [5] Cranny, C. J., Smith, P. C. & Stone, E. F. (1992). Job satisfaction: How people feel about their jobs and how it affects their performance. Lexington, New York.
- [6] Davis, K. & Newstrom, J. W. (2006). (eds). *Organizational Behavior*. Tata McGraw Hill, New Delhi. pp. 208-226.
- [7] Ellickson, M. C. & Logsdon, K. (2002). Determinants of job satisfaction of municipal government employees. *Public Personnel Management*, 31(3), 343-358.
- [8] Gujarati, D. N. (1998) Basic Econometrics. Third Edition, McGraw Hill, Inc., New York.
- [9] Greenberg, J. & Baron, R. A. (1997). (eds) *Behavior in Organizations*. Prentice Hall, Upper Saddle River, NJ.
- [10] Hossain, M. S. & Islam, M. R. (2013) Age Specific Participation Rates of Curacao in 2011: Modeling Approach. *American Open Computational and Applied Mathematics Journal*, Vol. 1, No. 2, pp: 08 - 21.
- [11] Islam, M. R. and Ali, M. K. (2004). Mathematical Modeling of Age Specific Fertility Rates and Study the Reproductivity in the Rural Area of Bangladesh During 1980-1998, *Pakistan Journal of Statistics*, Vol. 20(3), Page 379-392.
- [12] Islam, M. R. (2004a). Mathematical Modeling of Age Specific Fertility Rates in the Rural Area of Bangladesh, *J. of Science, Rajshahi University Studies, Part-B*, Vol. 32, pp. 211-227.
- [13] Islam, M. R. (2004b). Mathematical Modeling of Age Specific Fertility Rates in Urban Area of Bangladesh, *J. of Science, Rajshahi University Studies, Part-B*, Vol. 32, pp. 229-240.
- [14] Islam, M. R., Islam, M. N. and Rahman, M.M. (2004). Trends and Patterns of Reproductivity Decline in Bangladesh: 1956-1998, *Man in India*, Vol. 84, No. 1 & 2, pp. 85-97.
- [15] Islam, M. R. (2005a) Construction of Abridged Life Tables and Indirect Estimation of Some Mortality Measures of Bangladesh in 2005. *Journal of Population, Indonesia*, Vol. 11, No. 2, pp: 117-130.
- [16] Islam, M. R. (2005b) Mathematical Modeling of Age Specific Marital Fertility Rates in Urban Area of Bangladesh. *Pakistan J. of Statistics*, Vol. 21, No. 3, pp. 289-295.
- [17] Islam, M. R. (2007a) Construction of Abridged Life Tables and Indirect Estimation of Some Mortality Measures of Bangladesh in 2005. *Journal of Population, Indonesia*, Vol. 11, No. 2, pp: 117-130.
- [18] Islam, M. R. (2007b) Predicting Population for Male of Rural Area in Bangladesh. *J. of Statistical Research of Iran*, Vol. 4, No. 2, pp: 227-238.
- [19] Islam, M. R. (2008) Modeling Age Structure for Female Population in Rural Area of Bangladesh. *J. of Interdisciplinary Mathematics*, Vol. 11, No. 1, pp: 29-37.
- [20] Islam, M. R. (2011) Modeling of Diabetic Patients Associated with Age: Polynomial Model Approach. *International Journal of Statistics and Applications*, Vol. 1, No. 1, pp: 1-5.
- [21] Islam, M. R. (2012a) Mathematical Modeling of Age and of Income Distribution Associated with Female Marriage Migration in Rajshahi, Bangladesh. *Research Journal of Applied Sciences, Engineering and Technology*, Vol. 4, No. 17, pp: 3125-3129.
- [22] Islam, M. R. (2012b) Modeling and Projecting Population for Muslim of Urban Area in Bangladesh. *International Journal of Probability and Statistics*, Vol. 1, No. 1, pp: 4-10.
- [23] Islam, M. R. & Hossain, M. S. (2013a) Mathematical Modeling of Age Specific Adult Literacy Rates of Rural Area in Bangladesh. *American Open Demography Journal*, Vol. 1, No. 1, pp: 01-12.
- [24] Islam, M. R. and Hossain, M. S. (2013b) Mathematical Modeling of Age Specific Participation Rates in Bangladesh. *International Journal of Scientific and Innovative Mathematical Research (IJSIMR)*, Vol. 1, No. 2, pp: 150-159.
- [25] Islam, M. R. (2013) Modeling Age Structure and ASDRs for Human Population of Both Sexes in Bangladesh. *International Journal of Anthropology*, Vol. 28, No. 1, pp: 47-53.
- [26] Islam, M. R., Ali, M. K. & Islam, M. N. (2013) Construction of Life Table and Some Mathematical Models for Male Population of Bangladesh. *American Journal of Computational and Applied Mathematics*, Vol. 3, No. 6, pp: 269-276.
- [27] Islam, M. R. and Hossain, M. S. (2014a). Some Models Associated with Age Specific Adult Literacy Rates of Urban Area in Bangladesh, *International Journal of Ecosystem*, Vol. 4(2), pp. 66-74.
- [28] Islam, M. R. and Hossain, M. S. (2014b). Mathematical Modeling of Age Specific Adult Literacy Rates in Bangladesh, *Advances in Life Sciences*, Vol. 4(3): 106-113.
- [29] Locke, E. A. (1976). The nature and causes of job satisfaction. In Dunnette, M. (eds) *Handbook of Industrial and Organizational Behavior*. Rand McNally, Chicago. pp. 1297-1349.
- [30] Mudor, H. & Tooksoon, P. (2011). Conceptual framework on the relationship between human resource management practices, job satisfaction and turnover. *Journal of Economics and Behavioral Studies*, 2(2), 41-49.
- [31] Rego, A. & Cunha, M. P. (2008). Authentic climates and employee happiness: Pathways to individual performance? *Journal of Business Research*, 61(7), 739-752.
- [32] Robbins, S. P. (2005). *Organizational Behavior*. (eds) Prentice Hall of India, New Delhi. pp.10-155.

- [33] Saari, L. M. & Judge, T. A. (2004). Employee attitudes and job satisfaction. *Human Resource Management*, 43, 395-407.
- [34] Sinha, E. (2013). A research work on employee satisfaction measurement with special reference to KRIBHCO, Surat. *International Journal of Modern Engineering Research*, 3(1), 523-529.
- [35] Smith, W. T. (2007). Job satisfaction in the United States. University of Chicago. <http://www.news.uchicago.edu/releases/07/pdf/070417.jobs.pdf>.
- [36] Sohail, M. T. & Delin, H. (2013). Job satisfaction surrounded by academics staff: A case study of job satisfaction of academics staff of the GCUL, Pakistan. *Interdisciplinary Journal of Contemporary Research in Business*, 4(11), 126-137.
- [37] Spector, P. E. (1997). (eds) *Job satisfaction: Application, assessment, causes and consequences*. London: Thousand Oaks, CA: Sage.
- [38] Spector, P. E. (2000). (eds) *Industrial & organizational psychology*. (New York: John Wiley & Sons.
- [39] Sweeney, A., Hohenshil, T. & Fortune, J. (2002). Job satisfaction among employee assistance professionals. *Journal of Employment Counseling*, 39, 52-60.
- [40] Stevens, J. (1996) *Applied Multivariate Statistics for the Social Sciences*. Third Edition, Lawrence Erlbaum Associates, Inc., Publishers, New Jersey.
- [41] Victoria, B. (2010). Organizational culture as a predictor of job satisfaction: The role of gender and age. *Career Development International*, 15(1), 4-19.
- [42] Wegge, J., Schmidt, K., Parkes, C. & Dick, V. K. (2007). Taking a sickle: Job satisfaction and job involvement as interactive predictors of absenteeism in a public organization. *Journal of Occupational and Organizational Psychology*, 80, 77-89.
- [43] Weiss, H. (2002). Deconstructing job satisfaction: Separating evaluations, beliefs and affective experiences. *Human Resource Management Review*, 12, 173-194.