PROBABILITY DENSITY FUNCTION – AN INNOVATIVE INDICATOR OF ORGANIZATIONAL COMMITMENT OF SALES EXECUTIVES

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Abstract

Long term plans and successful implementation of marketing strategy depends on Organisational commitment of employees. If employee attrition is high, long term plans will suffer. The Organisation Commitment of 50 employees of Marketing and sales department in a South India based National FMCG company was calculated using Allen and Meyer Organisational commitment scale. The Affective, Normative and Continuance commitment sores were calculated. The scores are not mutually exclusive, since a person who has high Affective score may also be in organization for some Normative or Continuance reason. The scores of the three constructs overlap. This gives a distorted picture of the true organizational commitment. To overcome the defect , this paper demonstrates innovative use of probability distribution and Mixed distribution to get the probability score of Organisation commitment. The management can thus know the probability of various scores of commitment and take appropriate steps to improve the organization commitment. It is found that the Affective Commitment score follows a Weibull Distribution with $\alpha = 30.25$, $\beta = 4.12$, $\gamma = 0$. The Normative construct follows Triangular distribution with parameters m =3, a = 2.63, b= 3.53. The Continuance Commitment has Wakeby distribution with distribution parameter $\alpha = 0.53078$, $\beta = 3.1003$, $\gamma = 0.14264$, $\delta = -0.05068$, $\xi = 3.2123$. The probability of Affective commitment between 4 and 5 is 0.67 or 67%. $P(X1 < X < X2) = 0.67413$, probability of employees having a Normative commitment of between 3 and 3.5 is 0.59 or 59%. $P(X1 < X < X2) = 0.59081$.The probability of Continuance commitment between 3.3 and 4 is 0.84 or 84% $P(X1 < X < X2) = 0.84815$. The Mixed distribution shows that the

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probability of high organization commitment is 22.79 % [P(4 < X< 5) = 0.227867] . Probability of medium organization commitment score is 77.2 %. [P(3 < X<4) = 0.77207]. The management has to take steps to improve the Organisation commitment.

Keywords: *Organisation Commitment, Probability Distribution, Cumulative Distribution Function, Mixed Distribution.*

I . Introduction:

Every company has long term plans – be it expansion in new geographical area, new markets, new product introduction, starting new product line or mergers and acquisition. The plans can be implemented properly only when the teams of employee in-charge of the plan continue to be with the company. Hence organization commitment is vital aspect of success of any organization. Organisation commitment can be defined as "a psychological state that characterizes an employee's relationship with an organisation and has implications for the decision to continue membership of the organisation" (Meyer and Allen 1991). The top management needs to know how much are the employees committed to the organization. Knowing the commitment level of employees will also help the Human Resource department to plan appropriate incentives, plan management succession, develop recruitment strategy to appoint higher committed personnel and design intervention plans to improve existing commitment. A comprehensive measure of employee commitment can be obtained by Allen and Meyer's Organizational Commitment Scale. This paper shows an innovative way of measuring Organizational commitment by combing the Organizational Commitment scale values with Probability Density Function.

The study was carried out among South India based FMCG Company's Marketing and Sales employees.

Meyer and Allen organizational commitment scale:

Meyer and Allen developed the 3 component model of organizational commitment. It consists of 1) Affective 2) Normative and 3) Continuous scales. **Affective Commitment** measures commitment based on emotional ties that the employee develops with the organization . **Normative Commitment** reflects commitment based on perceived obligation towards the organization. **Continuance Commitment** is based on economic and social cost of leaving the

current organization. The questionnaire used to measure the commitment has 28 questions (Eight for each of the three components) and the answers are scored on a 7 or 5 point Likert scale.

Cumulative Distribution Function (CDF):

The function is used to calculate the cumulative proportion of a continuous probability distribution. It describes the probability that a real random variable X with a given probability distribution will be found at a value which is less than or equal to the variable X. In the case of this paper CDF refers to the cumulative probability of organizational commitment score.

Probability Density Function (PDF):

All data follow a pattern of distribution. PDF is a mathematical function that provides a model for the probability that a value of a variable lies within a particular interval in the data distribution. In the case of this paper PDF refers to the organizational commitment score laying in a particular interval.

Mixed Distribution:

Combination of two or more distribution with different parameters forming a new combined distribution is called Mixed Distribution. In this paper, the distribution of 3 constructs of Organisation Commitment is combined.

II. Literature Review:

Meyer, John P.; Allen, Natalie J.; Smith, Catherine A.(1993), "Commitment to organizations and occupations: Extension and test of a three-component conceptualization", Journal of Applied Psychology, Vol 78(4),pp. 538-551.

Meyer and N. J. Allen's tested the generality of three -component model of organizational commitment. The analyses were consistent with predictions made on the basis of the 3-component model. It proved that the occupational and organizational commitment contribute independently to the prediction of professional activity and work behaviour..

Sanjeev Agarwal; Thomas E. DeCarlo; Shyam B. Vyas; (1999). "Leadership Behavior and Organizational Commitment: A Comparative Study of American and Indian Salespersons", Journal of International Business Studies, Vol. 30, No. 4 pp. 727-743.

The study is about the impact of leadership behaviors on salespersons' organizational commitment in India and USA. The study presents a framework for understanding the role of culture on relationships between leadership behaviors and organizational commitment..

Jai Prakash Sharma; Naval Bajpai (2010), "Organizational Commitment and its Impact on Job Satisfaction of Employees: A Comparative Study in Public and Private Sector in India", International Bulletin of Business Administration, ISSN: 1451-243X, Issue 9

The papers compares organistional commitment of Public and Private sector employees. Significant difference is noticed between public sector and private sector organization in this study. Public sector employees exhibited higher degree of organizational commitment as compared to private sector employees. Most importantly, organizational commitment was proved to be the catalyst for enhancing job satisfaction level of employees.

Madden, David ;(2007) , "An analysis of mental stress in Ireland, 1994- 2000", Working paper series ,UCD Centre for Economic Research, No. 2007/10

The paper examined the Stress levels of respondents in Ireland. It describes the use of General Health Questionnaire (GHQ) and Cumulative Distribution Frequency in measuring Stress level scored on a Likert scale.

III. Objectives:

1. Gather and Analyze the Affective, Normative and Continuance commitment scores.
2. Derive the type of distribution of three components of the organizational commitment scores
3. Construct Probability Density function and Cumulative Density function from the derived distribution.
4. Find the organization commitment probability scores of employees and risk of employees leaving the organization.
5. Using Mixed Distribution , establish the risk of attrition.

IV. Data and Methodology:

Data:

50 employees out of a total set of 82 Sales and Marketing department employees in Tamilandu from a South India based national FMCG Company were chosen using random sampling method. Since the base sample was small for female employees and distribution based on experience was small, separate analysis based on experience, age, gender was not carried out.

Table1: Data Set

Total Data set of TN Sales Employees	Sample chosen
82	50

Methodology:

1. Structured self administered questionnaire was used to get the Organisation commitment scores. Allen & Meyer 8-item, 3 component versions of the commitment scale was used. There are 24 questions. The questions were scored on a 5 point Likert scale. The questionnaires were given during the monthly (July 2012) sales meeting of the organization.
2. Reliability of scale was determined using Cronbach's Alpha value.
3. To determine the best fit of data to a probability distribution, Kolmogrov Smirnov goodness of fit statistics was used.
4. Probability Density Function and Cumulative Distribution Function was determined by integration between two points. The Cumulative Distribution Function , Probability Density Curve and Mixed distribution calculations were done using Wolfram Mathematica 8 software

V. Analysis and Result

Reliability analysis:

The reliability of Allen & Meyer 8-item, 3 component organizational commitment scale was determined using Cronbach Alpha Statistics. Table 1 shows the reliability score.

TABLE 1: RELIABILITY OF ORGANIZATIONAL COMMITMENT SCALE

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.812	0.813	24

TABLE 2: **RELIABILITY OF ORGANIZATIONAL COMMITMENT SCALE IF ITEM IS DELETED**

Questions	Scale Mean if Item Deleted	Cronbach's Alpha if Item Deleted
ocq_1	71.18	.803
ocq_2	70.10	.809
ocq_3	70.06	.801
ocq_5	73.08	.805
ocq_7	70.04	.804
ocq_10	72.10	.811
ocq_11	71.10	.808
ocq_13	72.18	.806
ocq_14	71.02	.805
ocq_15	71.22	.801
ocq_16	71.20	.803
ocq_17	70.36	.803
ocq_20	71.10	.808
ocq_21	72.24	.802
ocq_22	70.26	.805
ocq_4	73.24	.806
ocq_6	73.16	.811
ocq_8	73.24	.805
ocq_9	71.24	.810
ocq_12	71.28	.804
ocq_18	73.36	.806

ocq_19	72.14	.804
ocq_23	70.20	.808
ocq_24	72.08	.809

Inference: The Cronbach Alpha score is 0.812. Table 2 shows that even if any of the 24 questions are deleted, the reliability score will not improve. Since the score is above 0.70, it can be concluded that the scale is reliable.

Affective Commitment:

The commitment based on emotional ties to the organization is calculated by 8 questions in the Affective construct of the Organization commitment scale. The score of Questions 4, 6 and 8 were recoded. Table 2 shows the Affective Commitment statistics.

TABLE 3 AFFECTIVE COMMITMENT STATISTICS

Statistic	**Value**
Sample Size	50
Range	0.75
Mean	4.0625
Variance	0.02567
Std. Deviation	0.16022
Coef. of Variation	0.03944
Std. Error	0.02266
Skewness	0.18172
Excess Kurtosis	-0.07216

Inference: The mean score is 4.06 of a possible 5 so the Affective commitment is high which is good for the organization. The important statistics is excess kurtosis. The kurtosis is negative hence it can be deduced that the score distribution is platykurtic and is not a normal distribution.

Goodness of Fit for Affective Commitment

To determine what distribution the data follows, Kolmogorov Smirnov test is carried out. Table 4 shows the values of various distributions.

TABLE 4: AFFECTIVE COMMITMENT DISTRIBUTION STATISTICS

Distribution	Kolmogorov Smirnov	
	Statistic	Rank
Weibull	0.17226	1
Gen. Pareto	0.18135	2
Uniform	0.18739	3
Wakeby	0.18786	4
Cauchy	0.18927	5

Inference: Weibull distribution has the lowest calculated value of 0.17. It can be concluded that the best fit for Affective commitment score is Weibull distribution.

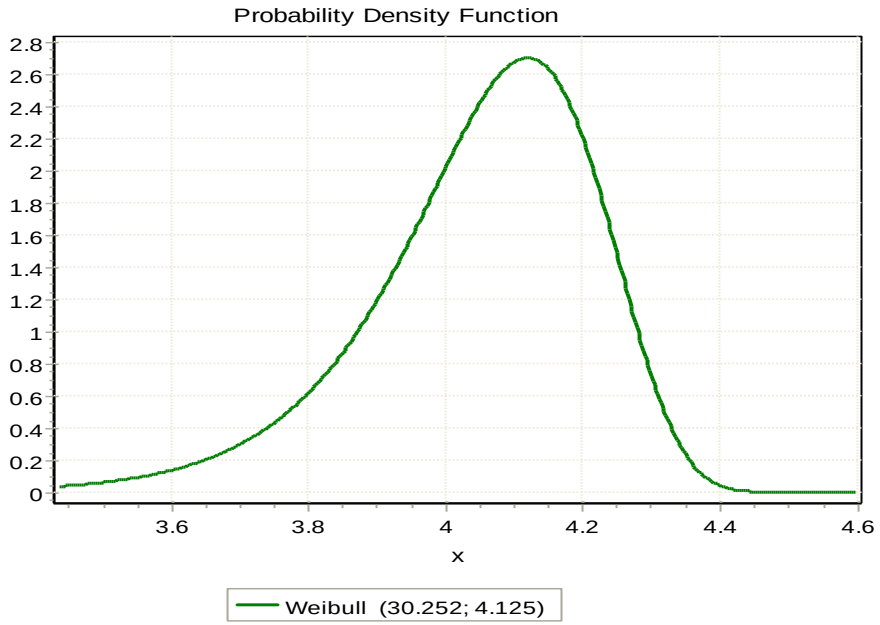
Distribution Parameter

The Weibull distribution parameters are shown in Table 5. Based on these values, the Probability Density Curve can be constructed (Figure 1)

TABLE 5: WEIBULL PARAMETERS

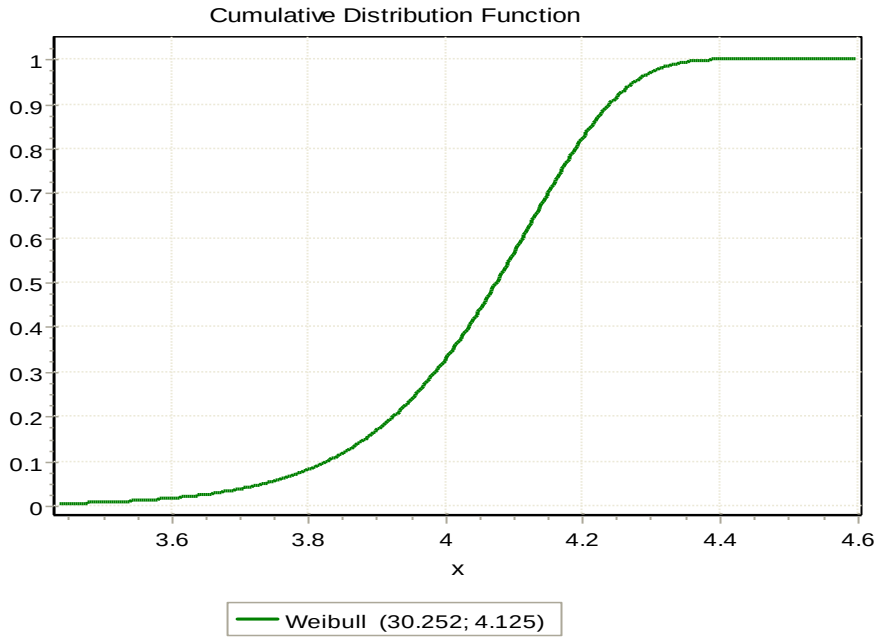
Distribution	Parameters
Weibull	$\alpha = 30.25$, $\beta = 4.12$, $\gamma = 0$

Figure 1: PDF of Affective Commitment - Weibull Distribution



Based on the parameter values, the Cumulative Distribution Function can be constructed (Figure 2)

Figure 2: CDF of Affective Commitment - Weibull Distribution



The CDF shows the probability of Affective commitment scores. (Table 6)

TABLE 6: AFFECTIVE COMMITMENT PROBABILITY

P(X< X1) = 0.32587	P(X>X1) =0.67413	P(X1 < X< X2) =0.67413

X 1=4, X 2=5

Inference: The probability of Affective commitment below 4 is 0.325 or 33%. It can be seen that the probability of employees having an Affective commitment of between 4 and 5 is 0.67 or 67%.

Normative Commitment:

The commitment based on perceived obligation towards the organization is calculated by 8 questions in the Normative construct of the Organization commitment scale. The score of Questions 9 and 12 were recoded. Table 7 shows the Normative Commitment statistics.

TABLE 7 NORMATIVE COMMITMENT STATISTICS

Statistic	Value
Sample Size	50
Range	0.75
Mean	3.0425
Variance	0.03738
Std. Deviation	0.19334
Coef. of Variation	0.06355
Std. Error	0.02734
Skewness	0.12336
Excess Kurtosis	-0.58154

Inference: The mean score is 3.04 of a possible 5 so the Normative commitment is low and needs to be improved. The important statistics is Excess kurtosis. The kurtosis is negative hence it can be deduced that the score distribution is platykurtic and is not a normal distribution.

Goodness of Fit for Affective Commitment

To determine what distribution the data follows, Kolmogorov Smirnov test is carried out. Table 8 shows the values of various distributions.

TABLE 8: NORMATIVE COMMITMENT DISTRIBUTION STATISTICS

Distribution	Kolmogorov Smirnov	
	Statistic	Rank
Triangular	0.13064	1
Error	0.13466	2
Weibull	0.13615	3
Johnson SB	0.13843	4
Rice	0.14041	5

Inference: Triangular distribution has the lowest calculated value of 0.130. It can be concluded that the best fit for Normative commitment score is Triangular distribution.

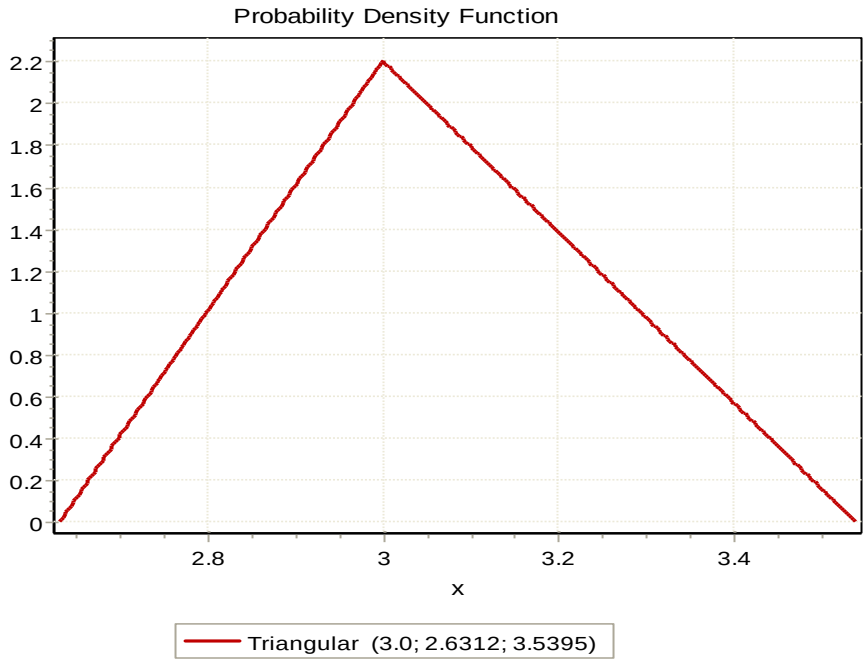
Distribution Parameter

The Triangular distribution parameters are shown in Table 9. Based on these values, the Probability Density Curve can be constructed (Figure 3)

TABLE 9: TRIANGULAR DISTRIBUTION PARAMETERS

Distribution	Parameters
Triangular	m =3, a = 2.63, b= 3.53

Figure 3: PDF of Normative Commitment - Triangular Distribution



Based on the parameter values, the Cumulative Distribution Function can be constructed (Figure 4)

Figure 4: CDF of Normative Commitment - Triangular Distribution

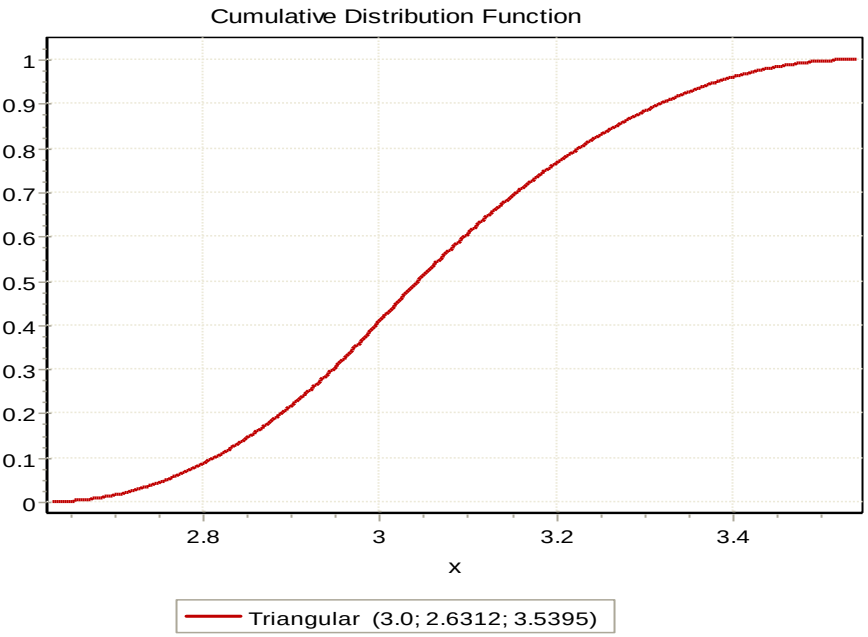


TABLE 10: NORMATIVE COMMITMENT PROBABILITY

P(X< X1) = 0.406	P(X>X1) = 0.594	P(X1 < X< X2) = 0.59081	P(X< X2) =0.99681	P(X>X2) 0.00319

X1 =3, X2=3.5

Inference: The probability of Normative commitment below 3 is 0.406 or 40.6%. It can be seen that the probability of employees having a Normative commitment of between 3 and 3.5 is 0.59 or 59%. There is only 0.003 or 0.3% probability of employees having a Normative Commitment score of above 3.5 . The personnel department has to take serious steps to improve the Normative score of the Sales and Marketing Department employees.

Continuance Commitment

The commitment based on social cost of leaving the organization is calculated by 8 questions in the Continuance construct of the Organization commitment scale. The score of Questions 18, 19,23 and 24 were recoded. Table 11 shows the Continuance Commitment statistics.

TABLE 11: CONTINUANCE COMMITMENT STATISTICS

Statistic	Value
Sample Size	50
Range	0.75
Mean	3.4775
Variance	0.02786
Std. Deviation	0.16692
Coef. of Variation	0.048
Std. Error	0.02361

Skewness	0.71842
Excess Kurtosis	0.62205

Inference: The mean score is 3.47 of a possible 5 so the Continuance commitment is low but it needs to be lower as the employees staying in organization due to lack of other opportunity or staying due to social cost may leave organization when the competitive job field is advantageous to them. In general ,Personnel department has to reduce Continuance commitment by appropriate training .The Excess Kurtosis is positive hence the distribution is leptokurtic.

Goodness of Fit for Continuance Commitment

To determine what distribution the data follows, Kolmogorov Smirnov test is carried out. Table 12 shows the values of various distributions.

TABLE 12: CONTINUANCE COMMITMENT DISTRIBUTION STATISTICS

Distribution	Kolmogorov Smirnov	
	Statistic	Rank
Wakeby	0.1571	1
Log-Pearson 3	0.16029	2
Log-Logistic	0.16082	3

Inference: Wakeby distribution has the lowest calculated value of 0.157. It can be concluded that the best fit for Continuance commitment score is Wakeby distribution.

Distribution Parameter

The calculated Wakeby distribution parameters are shown in Table 13. Based on these values, the Probability Density Curve can be constructed (Figure 5)

TABLE 13: WAKEBY DISTRIBUTION PARAMETERS

Distribution	Parameters
Wakeby	α= 0.53078, β= 3.1003, γ= 0.14264, δ= -0.05068, ξ= 3.2123

Figure 5: PDF of Continuance Commitment - Wakeby Distribution

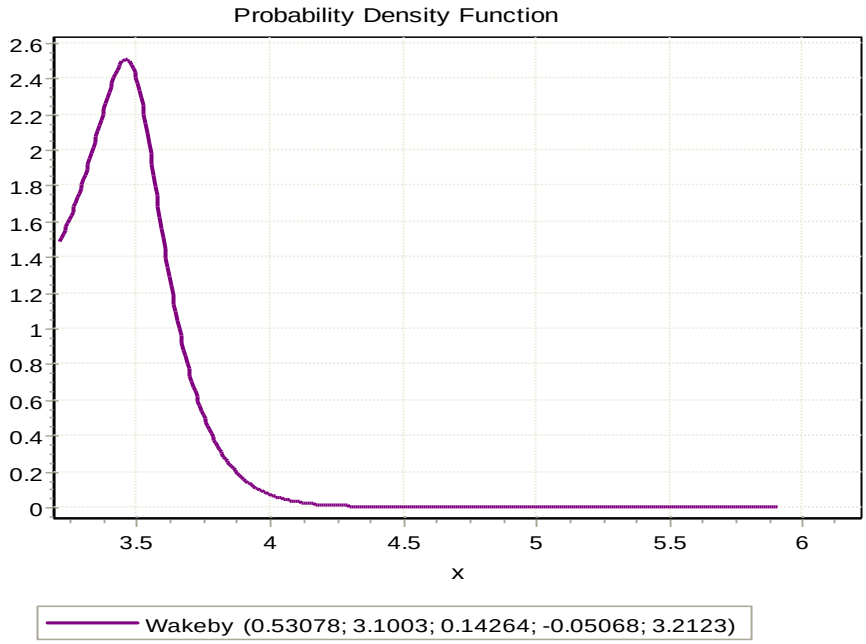


Figure 6: PDF of Continuance Commitment - Wakeby Distribution

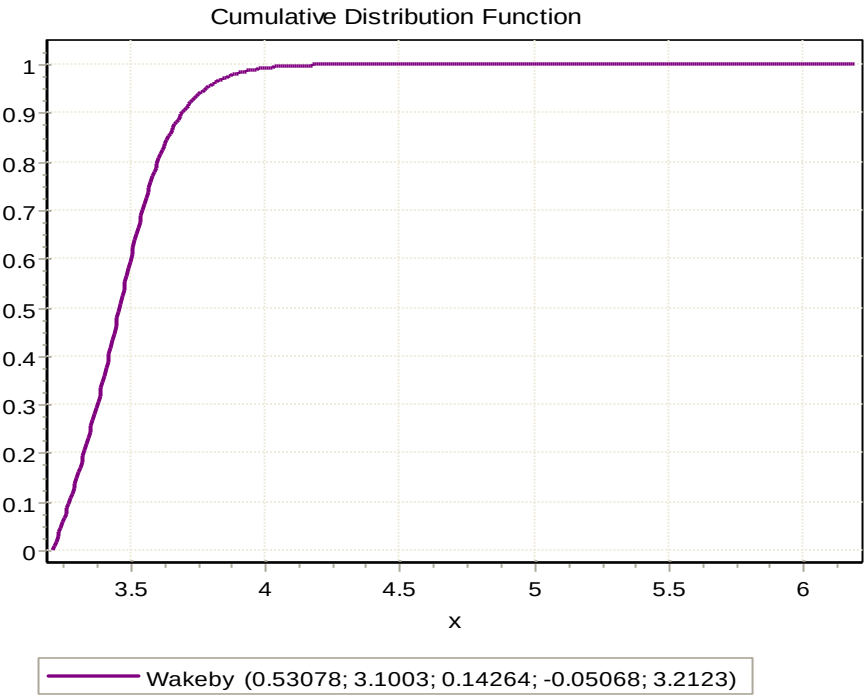


TABLE 14: CONTINUANCE COMMITMENT PROBABILITY

P(X< X1) = 0.1442	P(X>X1) =0.8557	P(X1 < X< X2) = 0.84815	P(X< X2) =0.99239	P(X>X2) =0.00761

X1 =3.3, X2=4

Inference: The probability of Continuance commitment below 3.3 is 0.144 or 14.4%. It can be seen that the probability of employees having a Continuance commitment of between 3.3 and 4 is 0.84 or 84%. There is only 0.007 or 0.7% probability of employees having a Continuance Commitment score of above 4 . As only 14% employees have low continuance commitment score, the personnel department has to take steps to reduce the Continuance score of rest of the Sales and Marketing Department employees.

Mixture Distribution:

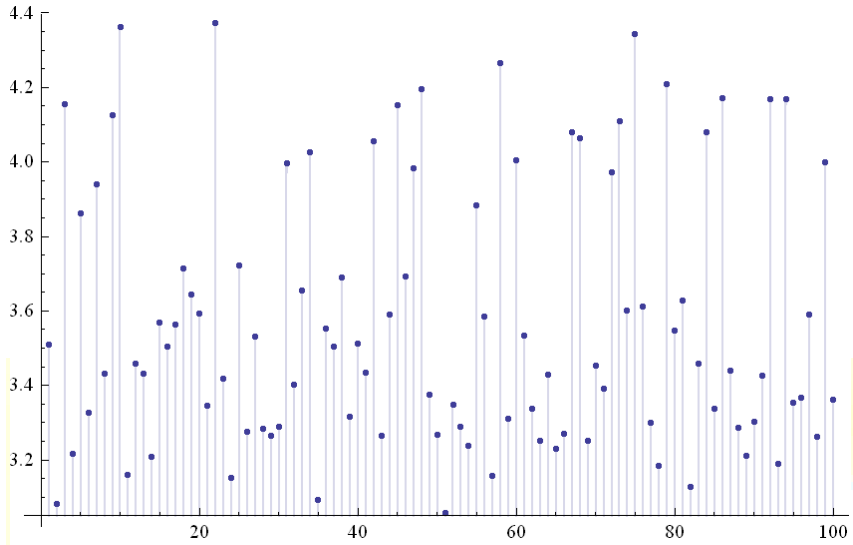
To get better estimate of Organisation Commitment, the 3 distributions are combined using Mixed Distribution (Refer Appendix 1 – Mathematca Commands). The mixture distribution consists of Weibull, Wakeby and Triangular Distribution. Each distribution is given equal weight of 1/3 and probability score is calculated

TABLE 15: MIXED DISTRIBUTION PROBABILITY

P(3< X< 4) = 0.77207	P(4 < X< 5) = 0.227867

Inference: The probability of 'High Organisation commitment' score between 3 and 4 is 0.227867 or only 22.79 % while 'Medium organization commitment' probability (score between 3 and 4) is 0.77207 or 77.2 % . Overall the organisation has a medium commitment which indicates probability of lower employee attrition, but to ensure very low attrition probability , the organisation has to improve the commitment level of 77% of employees of Marketing and Sales division.

Figure 7: Simulated Probability score for 100 respondents based on Mixed Distribution



VI. Limitations

1. The results are confined to Marketing and Sales Department. The Organisation Commitment level in other departments may vary.
2. The results cannot be extrapolated to other similar organization without industry wide study.
3. Due to limited sample size, gender and tenure based probability distribution was not carried out.

VII. Conclusion

The study establishes that Probability Distribution function can be effectively used as a Personnel research tool to deduce a more accurate Organisation Commitment score. The organization has medium commitment and has a lower risk of employee turnover . However it is prudent to improve the Commitment score to 'High' as probability of a organization commitment between 4 and 5 is only 22.7%.

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APPENDIX

'Mathematica' commands:

1. The mixture distribution consists of Weibull, Wakeby and Triangular Distribution. Each distribution is given equal weight of 1/3. The result is assigned to variable OCQ□

```
OCQ□ =MixtureDistribution[{1/3,1/3,1/3},{WeibullDistribution[30.25,4.12],WakebyDistribution
[0.53,3.10,0.142,0.05,3.21],TriangularDistribution[{3.0,3.53}]}]
```

2. The Probability of combined Organisational commitment score between 4 and 5 and 3 and 4 is determined:

```
Probability [4<=x□ 5,x□ OCQ□ ]

Probability [3 <= x ≤ 4, x□□□ ≈ OCQ𝒟]
```

3. Simulated Probability of Organisation Commitment score for 100 respondents:

```
ListPlot[RandomVariate[OCQ𝒟, 100], Filling → Axis]
```