Application of the Univariate Logistic Model for Studying the Effect of the Previous Knowledge about the Studied Courses in the Success of the Student - Case Study of Faculty of Sciences and Humanities (Thadiq) - Shaqraa University-KSA

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Abstract: This paper aims at studying the effect of the Previous knowledge about the studied Courses in the success of the student in Faculty of Sciences and Humanities (Thadiq) -Shaqraa University-KSA. The Logistic Regression (LR) was used to analyze the data. The important result was, there is significant relationship between the success of the student in the studied courses and the previous knowledge about these courses. Nearly 95 % of the success of the students returned to the previous knowledge about the studied courses. In consequence of the above mentioned results, there are two discussions: The first is to conduct similar studies to other courses in the other faculties, and the second is to take the advantages of this study in the planning and improvement of success proportion.
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1- Introduction:

This paper deals with the probability of success in forty courses that teaches in faculty of science and humanity in Shaqraa University (KSA). Logistic function was used in this paper because; the sample size is too large and the number of courses (levels) is more than three.

Some students mentioned that the ease of the studied course due to the previous knowledge about these courses, so that they have good marks. The researchers inquired those students about the ease in the forty courses that configured in Appendix (1). The courses arranged according to the proportion of the students that have previous knowledge about the studied course, and denoted by the variable "X". The variable "X" takes values from 1 to 40 in ascending order, depending upon the proportion of the students who have previous background about the course.

In this paper we will test the hypothesis:

$$H_0 : \beta_i = 0 \quad against \quad H_1 : \beta_i \neq 0$$

$$where \quad : \quad i = 0,1$$

The importance of this paper is that, it addresses an important method that may contribute in improvement of students' success.

This paper aims at testing the effect of the previous knowledge about the studied courses in the success of the students.

There are many studies that have used the analysis of the Logistic Model (Lo.M). The first one who used the logistic function in 1838 was Verhulst, and named it growth function. The term logistic function was used by (Pearl and Read, 1920). (Berkson; 1944) made comparison between the Logistic Model (LO.M.) and Normal Distribution Model (NDM) and reached to the result that the LO.M. was better than the NDM. Also the LO.M. and NDM were used by (Cox; 1970) for data consisted of three dose levels of drug, and found that, the LO.M. has better fit than the NDM. According to (Berkson; 1951), if the data has binomial distribution, LO.M. is better than NDM in fitting of the data, and the estimates of LO.M. are better than the estimates of NDM because, Lo. M estimates are sufficient and efficient. In 1972 Ashton wrote a book explained in how to transform LO.M. to Linear Model (Li. M.). In 1983 Mc Cullagh and Nelder; were used Chi-Square (CST) and Deviance (D) tests for fitting Lo. M. and found that the two tests approached to CST. Mc Cullagh and Nelder were used the Weighted Least Square Method (WLSM), because there was heterogeneity of variance. In 1987 Richard and Little introduced some results appeared that Lo. M for binary data is the best (Richard and Little; 1987). In 1989 Lemeston and Hosmer were used equation (1) to test the suitable partial group of Lo. M.

$$C(q)=\frac{SSE(q)}{SSE(p)/(n-p\_1)}+2(q+1)-n\rightarrow(1)$$

SSE(q) = Sum of Squares due to Error of the suitable model that contains "q" variables.

SSE(p) = Sum of Squares due to Error that belongs to the Linear Regression of the model which contains "p" variables.

If C(q) is small enough that means the model of "q" variables is the best.

In 1995 Minard authored a book entitled "Applied Logistic Regression Analysis", which contains important applications in social sciences. In 1999 Sequeiria and Taylor transformed the binary Lo.M to study treatment effect by using binary variable "I" for the treatment, with "γ" factor and continuous variable X; such that:

$$Ln\ (\frac{P}{q})\ =\ \alpha\ +\ BX^{(2)}\ +\ \gamma I\ \rightarrow\ (2)$$

Where: $\alpha,\beta,\gamma, and\ \lambda$ are parameters, p is the probability of success, "q" is equal to one minus "p" which is the probability of failure. Finally $Ln(\frac{P}{q})$ is the linear transformation of the proportion of the response in the Lo.M. In 2000 the 2nd ed. of the book "Applied Logistic Regression"; that written by David and Stanley appeared. This book contains applications of Lo.M in the field of biostatistics, social science, education, and health. In 2002 Pingchao, Kuklida and Gray authored a research entitled "An Introduction to Logistic Regression Analysis and Reporting", which dialed with educational data. This research is available in the internet website. Also in the internet website in 2006 Sansh and Gozde spread research entitled "Logistic Regression Analysis to Determine the Factors that Affect (Green Card) Usage for Health Services".

The the Lo.M is used to represent the relationship between explanatory proportional variable with binomial distribution and dummy dependent variable. The dependent variable takes the values 1 if there is response and 0 otherwise, (Seber and Wild; 1989).

Arabi, and Husain introduced a paper entitle "Trends of Secondary Schools Students in Forming Their Choice of Future Specialization whether, the Academic in Two Branches Art and Science", they have used logistic regression, and reached to students marks, actual looking, parents, fathers job, population looking, and future job affected the choice of the future specialization.

2- Material and Methods

If X_i represents the explanatory (independent) variable, n_i is the sample size of stratum "i", r_i is the sample size of the positive response of stratum "i", and $(n_i - r_i)$ is the sample size of the negative response of stratum "i", then the probability of success is given by equation (3) as follow:

$$p_i = pr(y=1/x)=\frac{r_i}{n_i}\rightarrow(3)$$

and the probability of failure is given by equation (4) as follow:

$$q=1-p_i = pr(y=0/x)=\frac{n_i-r_i}{n_i}\rightarrow(4)$$

Since "p" and "1-p" are functions in "X" we can write them according to the Lo. M as in equations (5) and (6).

$$p=\frac{\exp(\beta_0+\beta_1X_i)}{1+\exp(\beta_0+\beta_1X_i)}\rightarrow(5)$$

$$1-p=\frac{1}{1+\exp(\beta_0+\beta_1X_i)}\rightarrow(6)$$

The Lo. M is intrinsically linear model, so it can be transformed to L.M and obtain BLUE estimators (Draper and Smith; 1981) and (Rat and David; 1983). In 1944 Berkson transformed the Lo. M to L.M. according to equation (7) by dividing equation (5) by equation (6) and taking logarithm (Berkson; 1944).

$$Ln(\frac{p}{1-p})=Z_i=\beta_0+\beta_1X_i\rightarrow(7)$$

From equation (7), "p" is a function of "Z" and "Z" is a function of X, therefore:

$$\frac{\partial p}{\partial X}=\beta_1 p(p-1)\rightarrow(8)$$

$$\frac{\partial Z}{\partial X}=\beta_1\rightarrow(9)$$

The mean and variance of "Z" are given by equations (10) and (11) as follow:

$$E(Z)=\beta_0+\beta_1X_i\rightarrow(10)$$

$$V(Z)=\frac{1}{n_ip_i(1-p_i)}=\delta_i^2\rightarrow(11)$$

The Weighted Least Square Method (WLSM) should be used because the mean of "Z" is a function of $\beta_1\ and\ X_i$, and its variance is a function of its mean, therefore the variance of "Z" is heteroscedasticity, i.e. $V(e_i/X_i)\neq\delta_i^2$.

According to (Kendall and Stuart; 1968) the weight "w_i" which in equation (12) was used to have homogeneity of variance.

$$w_i = \frac{1}{\delta_i^2} = n_i p_i (1 - p_i) \rightarrow (12)$$

To estimate ß$_0$ and ß$_1$ the WLSM and partial derivative of ß$_0$ and ß$_1$ were used to equation (13)

$$SSe = \sum_{j=1}^{n_i} w_i (Z_i - \hat{Z}_i)^2 = \sum_{j=1}^{n_i} w_i (Z_i - \beta_0 - \beta_1 X_i)^2 \rightarrow (13)$$

At 1st by differentiating equation (13) with respect to ß$_0$ and equate the result by zero, at 2nd by differentiating the same equation with respect to ß$_1$ and equate the result by zero. Finally by solving the two previous equations that obtained by the differentiation we have:

$$\hat{\underset{\sim}{\beta}} = (X'WX)^{-1} X'WZ \rightarrow (14)$$

where:

$$\hat{\underset{\sim}{\beta}} = \begin{bmatrix} \hat{\beta}_0 \\ \hat{\beta}_1 \end{bmatrix}, \quad X = \begin{bmatrix} 1 & X_{11} \\ 1 & X_{21} \\ 1 & X_{31} \\ . & . \\ . & . \\ 1 & X_{n1} \end{bmatrix}, \quad Z = \begin{bmatrix} \ln(\frac{p_1}{q_1}) \\ \ln(\frac{p_2}{q_2}) \\ . \\ . \\ \ln(\frac{p_n}{q_n}) \end{bmatrix}$$

$$W = \begin{bmatrix} W_1 & 0 & ..... & 0 \\ 0 & W_2 & ..... & 0 \\ . & . & . & ... \\ . & . & . & \\ 0 & 0 & .... & W_n \end{bmatrix}, \quad X'WZ = \begin{bmatrix} \sum W_i Z_i \\ \sum W_i X_i Z_i \end{bmatrix} \quad X'WX = \begin{bmatrix} \sum W_i & \sum W_i X_i \\ \sum W_i X_i & \sum W_i X_i^2 \end{bmatrix}$$

From the previous equations the vector β can be written as in equation (15):

$$\hat{\underset{\sim}{\beta}} = \begin{bmatrix} \hat{\beta}_0 \\ \hat{\beta}_1 \end{bmatrix} = \begin{bmatrix} \frac{\operatorname{cov}(X,Z)}{v(X)} \\ \bar{Z} - \hat{\beta}_1 \bar{X} \end{bmatrix} \rightarrow (15)$$

The estimated value of "Z" can be written as in equation (16):

$$\hat{Z}_i = \hat{\beta}_0 + \hat{\beta}_1 X_i \rightarrow (16)$$

The Sum of Squares due to Regression (SSR) can be written as in equation (17):

$$SSR = S_{\hat{Z}\hat{Z}} = \hat{\beta}_1 \operatorname{cov}(X,Z) = \hat{\beta}_1^2 S_{XX} \rightarrow (17)$$

The Sum of Squares due to Error term (SSE) can be written as in equation (18):

$$SSE = S_{ZZ} - S_{\hat{Z}\hat{Z}} = S_{ZZ} - \hat{\beta}_1^2 S_{XX} \rightarrow (18)$$

$$SST_0 = S_{ZZ} = \sum W_i Z_i^2 - \frac{(\sum W_i Z_i)^2}{\sum W_i} \rightarrow (19)$$

The means of $\hat{\beta}_0$ and $\hat{\beta}_1$ are given by $E(\hat{\beta}_0) = \beta_0$ and $E(\hat{\beta}_1) = \beta_1$, and their variances are given by $S_{\hat{\beta}_0}^2 = MSE(C_{00})$ and $S_{\hat{\beta}_1}^2 = MSE(C_{11})$ .where C$_{00}$ and C$_{11}$ are the diagonal elements of the matrix $\begin{bmatrix} \sum W_i & \sum W_i X_i \\ \sum W_i X_i & \sum W_i X_i^2 \end{bmatrix}^{-1}$.

Since $MSE = \hat{\delta}^2 = 1$, therefore

$$S_{\hat{\beta}_0}^2 = C_{00} = \frac{1}{\sum W_i} + \bar{X}^2 S_{\hat{\beta}_1}^2$$

and $S_{\hat{\beta}_1}^2 = C_{11} = \frac{1}{S_{XX}}$.

The hypothesis should be tested is:

$H_0 : \beta_i = 0$ against $H_1 : \beta_i \neq 0 \ \forall i = 0,1$

To test the above hypothesis the statistic "t" that in equation (20) was used.

$$t_c = \frac{\hat{\beta}_i - \beta_i}{s_{\hat{\beta}_i}} = \frac{\hat{\beta}_i}{s_{\hat{\beta}_i}} \rightarrow (21)$$

where under H$_0$ we have $\beta_i = 0$.

Since the sample size which used in the research was very large, calculated value "t" is approach to Z, therefore it will be compared with the tabulated value "1.96", (because 95% confidence limits was used). If the absolute value of the calculated value in equation (21) is greater than 1.96, H$_0$ is rejected, otherwise it accepted.

The coefficient of determination which given by equation (22) was used to determine the dependency percentage of the dependent variable "Z" upon the independent variable "X" in the linear regression.

$$R^2 = \frac{S_{\hat{Z}\hat{Z}}}{S_{ZZ}} \rightarrow (22)$$

According to the LSM theorem, the residuals should be normally distributed with mean zero and variance equal to σ^2, and there is no relationship between errors and the variable "X" in one hand, and there is no relationship between the errors and the variable "Z" in the other hand. The existence of the relationship between the two variables can be tested by the Analysis of Variance (ANOVA) of the regression between them.

To obtain sample size for proportional allocation a population of size "N" is divided into "L" strata of sizes $N_1, N_2, \ldots, N_L$, and select samples of sizes $n_1, n_2, \ldots, n_L$, respectively, from the "L" strata, the allocation is proportional if $n_i = (\frac{N_i}{N})n$ for all i=1,2,3,..,L, (Walpole: 1982).

The stratified random sample was used to select the data. The number of the strata was equal to the number of the studied courses. According to the equation (23) the proportional allocation was used for determination of the stratum sample.

$$n_{prop} = \frac{N\sum_{i=1}^{L} N_i S_i^2}{ND^2 + \sum_{i=1}^{L} N_i S_i^2} \rightarrow (23)$$

Where S_i^2 is the stratum variance of marks of students in course "i", N_i is stratum size, N is the population size, and D is specified error term.

The data collected from faculty of science and humanities, Shaqraa University (KSA), years 1433-1436 A.H. The total number of the students who studied the courses under research was N=4000, divided proportionally into 40 strata (courses). To determine the sample size 99% confidence limits was used, with marginal error equal to 0.01. The total size of the grand sample was equal to 1850. With respect to the strata, the number of successful was denoted by "r_i", and the number of unsuccessful was denoted by "n_i-r_i" as in Appendices (1) and (2).

According to Appendices (1) and (2), the total number of successful was 1678, and the total number of unsuccessful was 188.

In appendix (1), p was calculated according to equation (3), q according to equation (4), Z according to equation (7), w_i according to equation (12), $\hat{Z}$ according to equation (16), and $\hat{p}_i$ according to equation (24).

$$\hat{p}_i = \frac{e^{\hat{Z}_i}}{1 + e^{\hat{Z}_i}} \rightarrow (24)$$

Estimation of equation (14) is:

$$\begin{bmatrix} \hat{\beta}_0 \\ \hat{\beta}_1 \end{bmatrix} = \begin{bmatrix} 152.83806 & 2842.448270 \\ 2842.44827 & 69784.50704 \end{bmatrix}^{-1} \begin{bmatrix} 287.08362 \\ 6745.72265 \end{bmatrix}$$

$$\begin{bmatrix} \hat{\beta}_0 \\ \hat{\beta}_1 \end{bmatrix} = \begin{bmatrix} 0.026983242 & -0.001099076 \\ -0.001099076 & 0.0000590972 \end{bmatrix} \begin{bmatrix} 287.08362 \\ 6745.72265 \end{bmatrix}$$

$$\begin{bmatrix} \hat{\beta}_0 \\ \hat{\beta}_1 \end{bmatrix} = \begin{bmatrix} 0.332385 \\ 0.0831263 \end{bmatrix}$$

Testing of the hypotheses:

$$S_{\hat{\beta}_0} = \sqrt{S^2_{\hat{\beta}_0}} = C_{00} = \sqrt{0.026983242} = 0.164266$$

$$S_{\hat{\beta}_1} = \sqrt{S^2_{\hat{\beta}_1}} = C_{11} = \sqrt{0.0000590972} = 0.007687$$

For testing $H_0: \beta_0 = 0$ against $H_1: \beta_0 \neq 0$ we have:

$$|t| = |Z| = \frac{0.332385}{0.164266} = 2.023$$

Since $|Z| = 2.023 > 1.96 = Z_{0.025}$, H_0 is rejected.

For testing $H_0: \beta_1 = 0$ against $H_1: \beta_1 \neq 0$

$$|Z| = \frac{0.0831263}{0.007687} = 10.813$$

Since $|Z| = 10.813 > 2.575 = Z_{0.005}$, H_0 is rejected.

Computation of coefficient of determination:

By using equations (17), (19) and (22):

$$S_{ZZ} = 661.28116 - \frac{(287.08362)^2}{152.83806} = 661.28116 -$$

$$539.24399 = 122.037173$$

$$S_{XX} = \sum WX^2 - \frac{(\sum WX)^2}{\sum W} = 69740.50704 -$$

$$\frac{(2842.44827)^2}{152.83806} = 69740.50704 - 52863.22116$$

$$= 16877.28588$$

$$S_{\hat{Z}\hat{Z}} = (0.0831263)^2(16877.28588) = 116.62174$$

$$SSR = (0.08344)^2(71610.40564) = 498.5684$$

$$R^2 = \frac{116.62174}{122.037173} = 0.956$$

Explaining of R^2 means that nearly 95% of the success of the students returned to the previous knowledge about the studied courses.

To check whether, there is relationship between $\sqrt{W_i}.e_i$ and $\sqrt{W_i}.\hat{Z}_i$, the correlation and coefficient of determination between the two variables are shown in table (1), and the Analysis of Variance (ANOVA) between the two variables is given in table (2), the result in the two variables is that there is no correlation between the two variables.

Table (1): Correlation and Coefficient of Determination between $\sqrt{W_i}.e_i$ and $\sqrt{W_i}.\hat{Z}_i$.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.002[a]	.000	-.026-	.36674754
a. Predictors: (Constant), $\sqrt{W_i}.\hat{Z}_i$				

Table (2): Analysis of Variance Between $\sqrt{W_i}.e_i$ and $\sqrt{W_i}.\hat{Z}_i$.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.000	1	.000	.00	.993[b]
	Residual	5.111	38	.135		
	Total	5.111	39			
a. Dependent Variable: $\sqrt{W_i}.e_i$						
b. Predictors: (Constant), $\sqrt{W_i}.\hat{Z}_i$						

To check whether, there is relationship between $\sqrt{W_i}.e_i$ and $\sqrt{W_i}.X_i$, the correlation and coefficient of determination between the two variables are shown in table (3), and the Analysis of Variance (ANOVA) between the two variables is given in table (4), the result in the two variables is that there is no correlation between the two variables. From the previous, the estimated model has no problem of linear regression.

Table (3): Correlation and Coefficient Determination Between $\sqrt{W_i}.e_i$ and $\sqrt{W_i}.X_i$.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.001[a]	.000	-.026-	.36674762
a. Predictors: (Constant), $\sqrt{W_i}.X_i$				

Table (4): Analysis of Variance Between $\sqrt{W_i}.e_i$ and $\sqrt{W_i}.X_i$.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.000	1	.000	.000	.993[b]
	Residual	5.111	38	.135		
	Total	5.111	39			
a. Dependent Variable: $\sqrt{W_i}.e_i$						
b. Predictors: (Constant), $\sqrt{W_i}.X_i$						

3- Results:

There is strong relationship exists between the success of the student in the studied courses and the previous knowledge about these courses.

Nearly 95 % of the success of the students returned to the previous knowledge about the studied courses.

4- Discussions

In consequence of the above mentioned results, the following points discussed:

To conduct similar studies to other courses in the other faculties.

To take the advantages of this study in the planning and improvement of education success.

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Appendix (1): Variables of the Study

ourse	Code	X	ni	ri	ni-ri
English	NGL111	1	5	2	3
English	Eng112	2	11	7	4
English	Eng120	3	42	29	13
English	Eng113	4	14	10	4
English	Eng114	5	14	10	4
English	Eng320	6	7	5	2
Business	BUS372	7	14	10	4
Accounting	ACC231	8	21	15	6
English	Eng111	9	40	29	11
Q.Methods	Q.M101	10	25	19	6
Economics	ECO101	11	50	38	12
English	Eng116	12	9	7	2
English	Eng182	13	14	11	3
English	Eng115	14	5	4	1
Accounting	ACC102	15	35	28	7
Q.Methods	Q.M102	16	113	92	21
law	Law 211	17	34	29	5
Psychology	S.B217	18	21	18	3
English	NGL114	19	22	19	3
English	NGM105	20	20	18	2
law	Law 101	21	79	72	7
Accounting	ACC101	22	115	105	10
Islamic Culture	IC101	23	128	117	11
Q.Methods	Q.M121	24	12	11	1
Arabic Language	ARAB102	25	13	12	1
Business	BUS111	26	83	77	6
Q.Methods	Q.M211	27	14	13	1
Business	BUS101	28	70	66	4
Psychology	PSY141	29	36	34	2
Business	BUS351	30	19	18	1
Business	BUS371	31	19	18	1
Business	BUS341	32	20	19	1
Economics	ECO201	33	21	20	1
English	NGL118	34	23	22	1
Psychology	PSY105	35	37	36	1
Islamic Culture	IC103	36	174	167	7
Islamic Culture	IC102	37	261	252	9
Psychology	PSY140	38	15	14	1
Arabic Language	ARAB103	39	70	68	2
Arabic Language	ARAB101	40	125	123	2

X	Z	q	p
1	-.40547	.60000	.40000
2	.55962	.36364	.63636
3	.80235	.30952	.69048
4	.91629	.28571	.71429
5	.91629	.28571	.71429
6	.91629	.28571	.71429
7	.91629	.28571	.71429
8	.91629	.28571	.71429
9	.96940	.27500	.72500
10	1.15268	.24000	.76000
11	1.15268	.24000	.76000
12	1.25276	.22222	.77778
13	1.29928	.21429	.78571
14	1.38629	.20000	.80000
15	1.38629	.20000	.80000
16	1.47727	.18584	.81416
17	1.75786	.14706	.85294
18	1.79176	.14286	.85714
19	1.84583	.13636	.86364

20	2.19722	.10000	.90000
21	2.33076	.08861	.91139
22	2.35138	.08696	.91304
23	2.36428	.08594	.91406
24	2.39790	.08333	.91667
25	2.48491	.07692	.92308
26	2.55205	.07229	.92771
27	2.56495	.07143	.92857
28	2.80336	.05714	.94286
29	2.83321	.05556	.94444
30	2.89037	.05263	.94737
31	2.89037	.05263	.94737
32	2.94444	.05000	.95000
33	2.99573	.04762	.95238
34	3.09104	.04348	.95652
35	3.13549	.04167	.95833
36	3.17208	.04023	.95977
37	3.33220	.03448	.96552
38	3.46574	.03030	.96970
39	3.52636	.02857	.97143
40	4.11904	.01600	.98400
Total	81.07428	6	34
WZ	Z^2	WZ^2	P^8
-.48656	.16440	.19728	.60185
1.42448	.31317	.79716	.62166
7.20201	.64376	5.77851	.64108
2.61797	.83959	2.39882	.66005
2.61797	.83959	2.39882	.67851
1.30899	.83959	1.19941	.69644
2.61797	.83959	2.39882	.71378
3.92696	.83959	3.59824	.73052
7.73097	.93974	7.49441	.74663
5.25622	1.32867	6.05874	.76208
10.51244	1.32867	12.11747	.77688
1.94874	1.56942	2.44131	.79101
3.06260	1.68814	3.97918	.80447
1.10904	1.92181	1.53745	.81726
7.76325	1.92181	10.76215	.82939
25.25733	2.18232	37.31180	.84088
7.49675	3.09006	13.17822	.85173
4.60738	3.21040	8.25532	.86196
4.78237	3.40708	8.82742	.87159
3.95500	4.82780	8.69003	.88064
14.86963	5.43242	34.65749	.88914
21.46908	5.52897	50.48186	.89710
23.77208	5.58981	56.20383	.90455
2.19807	5.74990	5.27074	.91152
2.29376	6.17476	5.69978	.91802
14.20536	6.51294	36.25274	.92408
2.38174	6.57897	6.10904	.92973
10.57267	7.85883	29.63901	.93499
5.35163	8.02710	15.16230	.93989
2.73825	8.35425	7.91455	.94443
2.73825	8.35425	7.91455	.94865
2.79722	8.66972	8.23623	.95257
2.85308	8.97441	8.54706	.95620
2.95665	9.55454	9.13913	.95956
9.01455	9.83132	28.26506	.96268
21.31130	10.06211	67.60122	.96556
28.95571	11.10359	96.48634	.96823
3.36071	12.01133	11.64735	.97070
6.85121	12.43522	24.15985	.97298
8.10627	16.96647	33.39001	.97509

X^2	W	WX	$W.X^2$
1	1.20000	1.20000	1.20000
4	2.54545	5.09091	10.18182
9	8.97619	26.92857	80.78571
16	2.85714	11.42857	45.71429
25	2.85714	14.28571	71.42857
36	1.42857	8.57143	51.42857
49	2.85714	20.00000	140.00000
64	4.28571	34.28571	274.28571
81	7.97500	71.77500	645.97500
100	4.56000	45.60000	456.00000
121	9.12000	100.32000	1103.52000
144	1.55556	18.66667	224.00000
169	2.35714	30.64286	398.35714
196	.80000	11.20000	156.80000
225	5.60000	84.00000	1260.00000
256	17.09735	273.55752	4376.92035
289	4.26471	72.50000	1232.50000
324	2.57143	46.28571	833.14286
361	2.59091	49.22727	935.31818
400	1.80000	36.00000	720.00000
441	6.37975	133.97468	2813.46835
484	9.13043	200.86957	4419.13043
529	10.05469	231.25781	5318.92969
576	.91667	22.00000	528.00000
625	.92308	23.07692	576.92308
676	5.56627	144.72289	3762.79518
702	.92857	25.07143	676.92857
784	3.77143	105.60000	2956.80000
841	1.88889	54.77778	1588.55556
900	.94737	28.42105	852.63158
961	.94737	29.36842	910.42105
1024	.95000	30.40000	972.80000
1089	.95238	31.42857	1037.14286
1156	.95652	32.52174	1105.73913
1225	2.87500	100.62500	3521.87500
1296	6.71839	241.86207	8707.03448
1369	8.68966	321.51724	11896.13793
1444	.96970	36.84848	1400.24242
1521	1.94286	75.77143	2955.08571
1600	1.96800	78.72000	3148.80000
22140	**152.83806**	**2842.44827**	**69784.50704**

Z^8	e	WXZ	$\sqrt{W}$
.41318	-.81865	-.48656	1.09545
.49662	.06299	2.84895	1.59545
.58006	.22229	21.60604	2.99603
.66350	.25279	10.47189	1.69031
.74694	.16935	13.08987	1.69031
.83038	.08591	7.85392	1.19523
.91382	.00247	18.32581	1.69031
.99726	-.08097	31.41568	2.07020
1.08070	-.11130	69.57872	2.82400
1.16414	-.01146	52.56219	2.13542
1.24758	-.09490	115.63681	3.01993
1.33102	-.07826	23.38491	1.24722
1.41446	-.11518	39.81374	1.53530
1.49790	-.11161	15.52650	.89443
1.58134	-.19505	116.44873	2.36643
1.66478	-.18751	404.11726	4.13489
1.74822	.00964	127.44470	2.06512

1.83166	-.03990	82.93287	1.60357
1.91510	-.06927	90.86501	1.60963
1.99854	.19868	79.10008	1.34164
2.08198	.24877	312.26229	2.52582
2.16542	.18595	472.31973	3.02166
2.24886	.11542	546.75791	3.17091
2.33230	.06559	52.75370	.95743
2.41574	.06917	57.34400	.96077
2.49918	.05286	369.33947	2.35929
2.58262	-.01767	64.30694	.96362
2.66606	.13730	296.03486	1.94202
2.74950	.08371	155.19713	1.37437
2.83294	.05743	82.14741	.97333
2.91638	-.02601	84.88565	.97333
2.99982	-.05538	89.51094	.97468
3.08326	-.08753	94.15159	.97590
3.16670	-.07566	100.52608	.97802
3.25014	-.11465	315.50911	1.69558
3.33358	-.16150	767.20672	2.59199
3.41702	-.08482	1071.36120	2.94782
3.50046	-.03473	127.70712	.98473
3.58390	-.05754	267.19737	1.39386
3.66734	.45170	324.25061	1.40285

$\sqrt{W}$ e	$Z^{8} \sqrt{W}$	X $\sqrt{W}$
-.89678	.45262	1.09545
.10050	.79233	3.19090
.66597	1.73788	8.98809
.42729	1.12152	6.76123
.28625	1.26256	8.45154
.10268	.99250	7.17137
.00417	1.54464	11.83216
-.16762	2.06453	16.56157
-.31431	3.05190	25.41604
-.02448	2.48592	21.35416
-.28660	3.76761	33.21927
-.09760	1.66007	14.96663
-.17683	2.17162	19.95889
-.09982	1.33976	12.52198
-.46156	3.74214	35.49648
-.77535	6.88369	66.15830
.01990	3.61028	35.10698
-.06398	2.93719	28.86421
-.11151	3.08260	30.58297
.26656	2.68132	26.83282
.62836	5.25870	53.04214
.56189	6.54317	66.47654
.36598	7.13094	72.93099
.06280	2.23301	22.97825
.06645	2.32097	24.01922
.12472	5.89630	61.34163

-.01703	2.48868	26.01785
.26664	5.17753	54.37647
.11505	3.77883	39.85669
.05590	2.75738	29.19986
-.02532	2.83860	30.17318
-.05398	2.92386	31.18974
-.08542	3.00895	32.20470
-.07400	3.09709	33.25266
-.19439	5.51088	59.34539
-.41860	8.64059	93.31149
-.25002	10.07277	109.06942
-.03419	3.44702	37.41981
-.08020	4.99547	54.36070
.63366	5.14474	56.11417

Appendix (2): Sum of the Variables of the Study

Variable	N	Sum
e^2	40	2.26462
x	40	820
n	40	1850
r	40	1664
n-r	40	186
p	40	33.85713
q	40	6.14287
Z	40	81.07428
X^2	40	22140
W	40	152.83806
W.X	40	2842.44827
$W.X^2$	40	69784.50704
W.Z	40	287.08362
W.X.Z	40	6745.72265
$W.Z^2$	40	661.28116
$\sqrt{W}$	40	71.24101
X $\sqrt{W}$	40	1375.68200
Z^ $\sqrt{W}$	40	138.03480
$\sqrt{W}$ .e	40	.01361
Z^2	40	204.46967
Z $\sqrt{W}$	40	138.04841
e	40	-.38469-
Z^	40	81.45897
P^	40	33.99658
q^	40	6.00342
Valid N (listwise)	40	

1/23/2015